Planning and Installation Guide
ShoreTel 14.2

March 2014

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Company Information

ShoreTel, Inc.
960 Stewart Drive
Sunnyvale, California 94085 USA
+1.408.331.3300
+1.408.331.3333 (fax)
www.shoretel.com

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Preface

This preface provides information about the objectives, organization, and conventions of the *ShoreTel Planning and Installation Guide*.

Objectives

This document provides planning and installation information for the ShoreTel system and components.

Audience

This guide is written for the person who plans, installs, administers, and maintains the ShoreTel system. This individual should be knowledgeable about data networking and telephony to use this guide effectively.

Organization

This document is generally organized into major tasks, presented in the order in which they should be completed.

Documentation Overview

The ShoreTel system is documented as described in the following sections.

System Documentation

The *ShoreTel Planning and Installation Guide* (this guide) is in the documentation folder on the ShoreTel USB flash drive. In addition, and ShoreTel Director has a link to this guide.

This guide provides information on how to plan the implementation of the ShoreTel system, as well as how to install the necessary hardware, data communications, and telecommunications elements. The *ShoreTel Planning and Installation Guide* can be used in conjunction with the ShoreCare® project management tool.

Software Documentation

The *ShoreTel System Administration Guide* provides detailed reference information (both task-based and screen-by-screen) on how to administer and maintain the ShoreTel system using ShoreTel Director.

If you are installing one or more ShoreTel Service Appliances, refer to the *Conferencing and Instant Messaging Planning and Installation Guide* for complete installation and configuration information. Both guides can be found in the documentation folder on the ShoreTel Server USB flash drive.

Hardware Documentation

The following hardware installation documents are packaged with their associated ShoreTel voice switch, Service Appliance 100 and Service Appliance 400, or ShoreTel IP phone:

- *ShoreGear Voice Switch Quick Install Guide*
- *ShoreTel Conferencing and Instant Messaging Planning and Installation Guide*
- *ShoreTel IP Phone Quick Install Guide*

User Documentation

End-user documentation is installed during the ShoreTel Communicator installation. It is available through the **Help > Contents and Index** menu within the ShoreTel Communicator or through the Telephone.

Release Notes

The release notes listed below provide information about new releases and new features as well as installation and upgrade information. They can be found in the documentation folder on the associated ShoreTel USB flash drive and can also be accessed from ShoreTel Director.

- ShoreTel Server Release Notes
- ShoreTel Client Release Notes

Online Knowledge Base

To access additional information about the current release or to resolve issues with the ShoreTel system, you can use the ShoreTel online knowledge base. This password-protected, online database is accessible to authorized contacts through the ShoreTel web site at www.ShoreTel.com.

Document Conventions

Conventions used in this guide include the following:

- Data-entry field names, hypertext links, control buttons, keywords, and other items within the system management interface are in **boldface** text.
- Information that you enter in data-entry fields is in a `data_entry` font.

CHAPTER 1

Getting Started

This chapter describes how to plan and install a ShoreTel system. It contains the following information:

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Overview

This document describes how to plan and install a ShoreTel system. Each chapter in this document begins with recommendations that help with the transition to a ShoreTel system.

For an installation outside the U.S., see Appendix A, International Planning and Installation.

Assembling the Team

To deploy a ShoreTel system, the members of the team might include some or all of the type of support sources:

- **System Designer:** The system designer determines the number of telephones, number and type of trunks, and the call flow that the customer needs in the network.
- **Project Manager:** The project manager oversees the entire project and communicates important decisions to the entire team. The project manager usually is an IT manager.
- **IT Manager:** The IT department needs to give its full support and cooperation.
- **Electrician:** An electrician might be necessary for installing new power outlets and cooling and ventilation systems. The building that has the ShoreTel system must be able to provide enough power to the system.
- **Service Providers:** An effective relationship with a telephone service provider for local and long-distance telephone service is necessary. The phone company or Internet service provider and the customer must have a clear understanding of the technical requirements and characteristics that exist on both sides of the network boundary.
- ShoreTel: A certified ShoreTel partner might be necessary for the implementation. This possibility likely depends on the complexity of the network and support package that the customer purchased.

Phase 1: Voice Communication System Analysis and Ordering

Table 1: Voice Communications System Analysis and Ordering

	Task	Date Completed
	Download and modify the Microsoft Project installation schedule included in Resources	
	Complete Call Flow Analysis	
	Inventory and determine trunk requirements	
	Order new trunk lines	
	Trunk installation date	

Table 1: Voice Communications System Analysis and Ordering (Continued)

	Task	Date Completed
	Inventory your existing telephone equipment	
	Order new phones and/or headsets	
	Review your need for a ShoreTel Server Appliance	
	Order a ShoreTel Server Appliance	
	Review the need for a ShoreTel Enterprise Contact Center Solution	
	Order a ShoreTel Enterprise Contact Center Solution	
	Order ShoreTel voice switches	
	ShoreTel shipping date	

Phase 2: Environmental and Infrastructure Analysis and Upgrade

Table 2: Environmental and Infrastructure Analysis and Upgrade

	Task	Date Completed
	Participate in the Phase 2 conference call	
	Read ShoreTel's power requirements	
	Order power upgrades (as necessary)	
	Scheduled power upgrade completion date	
	Read ShoreTel's racking requirements	
	Racking installation date (if racking is ordered)	
	Read ShoreTel's ventilation requirements	
	Ventilation system upgrade completion date (if ordered)	
	Read ShoreTel's recommendations for uninterruptable power source (UPS)	
	UPS installation date (if ordered)	
	Read ShoreTel's cabling requirements	
	Cabling installation date (if ordered)	
	Determine the overhead paging needs	
	Source your Music on Hold needs	
	Read ShoreTel's LAN requirements	
	Attach LAN topology map	
	LAN installation date (if ordered)	

Table 2: Environmental and Infrastructure Analysis and Upgrade (Continued)

	Task	Date Completed
	Read ShoreTel's WAN requirements	
	Attach WAN topology map	
	WAN upgrade installation date (if ordered)	
	Read ShoreTel's server requirements	
	Order your server for the ShoreTel System	
	Server installation date	
	Read ShoreTel's desktop requirements	
	Desktop software upgrade installation date (if required or ordered)	
	ShoreTel scheduled installation date	

Phase 3: Resource Scheduling and Tracking

Table 3: Resource Scheduling and Tracking 24

	Task	Date Completed
	Participate in the Phase 3 conference call	
	Verify Telco order is on schedule	
	Verify phone order is on schedule	
	Verify power order is on schedule	
	Verify racking order is on schedule	
	Verify ventilation order is on schedule	
	Verify uninterruptable power source (UPS) order is on schedule	
	Verify cabling order is on schedule	
	Verify LAN upgrade order is on schedule	
	Verify WAN upgrade order is on schedule	
	Verify desktop upgrade order is on schedule	
	Verify ShoreTel order is on schedule	
	Read ShoreTel's descriptions of the different ShoreTel Communicator applications	
	Schedule your System Administration training with ShoreTel	
	Order new business cards and business stationary if your phone numbers are changing	
	Verify that you have obtain all licenses and license keys for your planned installation.	

Phase 4: System Load and Configuration

Table 4: System Load and Configuration

	Task	Date Completed
	Participate in the Phase 4 conference call	
	Verify receipt of ShoreTel equipment	
	Reserve IP addresses for your network	
	Configure server with the appropriate server operating system	
	Load the ShoreTel software	
	Enter the database configuration for ShoreTel	
	Confirm your ShoreTel System installation and cut-over dates	
	Confirm installation and cut-over coverage	
	Verify racking is complete	
	Verify power is in compliance	
	Verify UPS is installed	
	Verify cabling is complete	
	Verify ventilation upgrade is complete	
	Verify new phones and headsets have been delivered	
	Verify your System Administrators have been trained	
	Schedule training for your Operators and Workgroup(s)	

Phase 5: Installation Readiness Review

Table 5: Installation Readiness Review

	Task	Date Completed
	Participate in the Phase 5 conference call	
	Upgrade desktops, if necessary, and ensure readiness for Client software installation	
	Notify users of the ShoreTel system implementation	
	Verify telephone trunk lines are installed and tested	
	Verify server appliance is installed	
	Configure on-hour and off-hour schedules for Auto-Attendant menus and Workgroups	
	Configure your Workgroups	

Table 5: Installation Readiness Review (Continued)

	Task	Date Completed
	Configure your Auto-Attendant menus	
	Script and record all Auto-Attendant and department voice mail greetings	

Phase 6: Cut-Over

Table 6: Cut-Over

	Task	Date Completed
	Participate in the Phase 6 conference call	
	Complete your Cutover Review Checklist	
	Send web-based training modules to end users	
	Send TUI guides to end users	
	Verify that operators are trained	
	Verify that workgroups are trained	
	Verify that all phones have been placed and extensions tested	
	Verify that existing trunk lines have been swapped and tested	
	Verify that end users have been sent the ShoreTel client notification	
	Cut-over to the ShoreTel system	
	Complete your Post Cut-over Survey	
	Review ShoreTel Web Center to understand the available ShoreTel support resources	

CHAPTER

2

Planning and System Design

This chapter describes the initial design of the ShoreTel system. It contains the following information:

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Overview

This chapter describes the initial design of the ShoreTel system.

Recommendations

The following recommendations will assist you in designing your new voice communications system.

- Make sure you understand all the unique routing and hunting requirements of your current system.
- Be sure to account for all devices, including conference rooms, lobby phones, fax machines, and modems.
- Make sure you consider the changes to the call flow and overall system design that may drive the need for additional trunks.

Network Assessment

As you plan your phone system, ShoreTel recommends that you have a network assessment performed. A network assessment does the following:

- Ensure necessary protocols and standards are supported
- Confirm that the infrastructure is optimally configured for IP telephony traffic
- Verify that the installed WAN technologies are compatible with IP telephony.
- Measure delay, packet loss and jitter to ensure that they meed acceptable thresholds for toll-quality voice calls

To complete your system design, the final step is to identify your network connectivity. You should identify the following for the network connections to each site:

- Bandwidth
- Latency
- Jitter
- Packet Loss

Determine System Topology

The ShoreTel system has a unique distributed call control software architecture that enables you to deploy ShoreTel voice switches and IP phones anywhere across your IP network. Even though multiple sites are supported, the ShoreTel system is a single system with an extensive set of integrated applications and a single management image. The ShoreTel system offers unmatched simplicity through this single image system, and delivers high availability, with no single point of failure, through its distributed architecture.

The first step in planning a voice network is to determine the overall network topology. Topology information includes the following:

- Sites and Users. Number of sites and number of users at each site.
- Headquarters and Distributed ShoreTel Servers. Number of servers required, plus the name or IP address of all ShoreTel servers (main and distributed).
- Teleworker Sites. Number of teleworker installations and the type of telephones supported.
- Telephone Requirements. Number of telephones at each site (by type).
- Trunk Requirements. Number of trunks required for optimal performance.
- ShoreTel Voice Switches. What models are needed and how many of each model.
- WAN Connections. The number of WAN connections (per site) and complete service-level information.

For detailed information about planning your network for the ShoreTel system, see Chapter 3, Network Requirements and Preparation on page 43.

Sites and Users

Your network topology diagram should provide an accurate inventory of the different physical sites and the number of users at each site.

Headquarters and Distributed ShoreTel Servers

The Headquarters ShoreTel server hosts the voice applications platform and the management web site, as well as the integrated voice applications. Typically, the Headquarters ShoreTel server is located at the largest location, containing the majority of users. Make special note of the main ShoreTel server on your topology diagram.

On your topology diagram, provide the following information about ShoreTel servers:

- Total number of servers (i.e. sum of servers at all sites).
- Number of servers at each site.
- The name and IP address of every server.

The ShoreTel system also supports Distributed Voice Servers (DVS) to allow distributing voicemail and other applications. Distributed servers help accomplish the following:

- Reduce bandwidth, because local users' calls to voice mail are answered by the local voice mail application and do not go across the WAN.
- Increase system scale by extending the unified messaging and desktop call control services to additional users of the applications.
- Increase reliability by providing local support for some services and applications if a site loses connectivity with the Headquarters server.

Even though there are multiple servers, the ShoreTel system provides a single image system across your entire network. The system is currently certified to support up to 21 servers, one at the headquarters site and up to 20 distributed servers. You should add a server at any site that exceeds 100 users. You must deploy a server for every 1,000 users.

The distributed voice applications platform can also provide an open applications platform for extending telephone services through TAPI-compliant third-party applications. A dedicated distributed server is required to host the third-party applications. This server is deployed like other distributed servers, except that it must not have voice mail users assigned to it.

The distributed voice application servers' Remote TAPI Service Provider relies on the call control information from the main server. To add reliability to your remote server, consider using redundant network paths to the main server.

Citrix and Windows Terminal Server

Citrix and Windows Terminal Server (WTS) technologies enable processing for multiple users to be aggregated on a single Windows computer. The single Windows computer is a process- and disk-sharing server for multiple users who have lightweight or thin graphics stations on their desktop. Citrix communicates between the server and clients using the ICA protocol, whereas Windows Terminal Server uses the RDP protocol.

For more information on configuring ShoreTel Communicator clients on Citrix and WTS, see Chapter C, Installing Communicator on Citrix and Windows Servers on page 383.

Teleworker Sites

ShoreTel IP Phones can operate away from the ShoreTel site. For example, employees (telecommuters) can have an IP phone at their home so that they can work from home. The ShoreTel topology diagram must include the number and location of off-site IP phones.

For information on configuring ShoreTel IP phones for teleworkers, see Chapter 14, IP Phone Installation on page 267.

Telephone Requirements

This section describes how to determine the telephone requirements, as follows.

1. Count the telephone users in the current environment. Include conference room telephones, lobby telephones, and telephones that multiple users share.
2. Count the number of ShoreTel BB24 button boxes that operators and receptionists need. The maximum number of BB24s on a multi-line phone is four.
3. Count the number of ports that fax machines and modems will use.
4. If you are deploying IP phones, determine the number of telephones that will be IP phones and the number that will be analog phones.
5. Some users might need specialized features. For example, an operator needs a phone with programmable buttons. Therefore, consider the type of functions that each user needs to select the appropriate phone for each user.
6. Consider the needs for additional telephone ports for third-party systems, including server appliances and overhead paging systems.

Note

See Telephone Planning and Ordering on page 163, for more information about selecting telephones.

7. Determine the number of user licenses you need.

   Each user on the system requires a user access license. The types of user licenses are listed below:

   - Extension and mailbox: Purchase of this license entitles the user to be assigned to both a physical extension and a ShoreTel voice mailbox.
   - Extension-only: This license lets the user have a physical extension through an explicit assignment or through the Extension Assignment feature.

Note

An Extension-only license is a requirement for each conference room telephone, lobby telephone, fax machine, and modem. A user access license is not necessary for trunks and anonymous telephones.

   - Mailbox-only: This license lets the user have only a ShoreTel voice mailbox.
   - Audio conference: Purchase this license for each audio port that you want to use in conferences managed by a ShoreTel Service Appliance. A license allows one audio endpoint to participate in a conference.
   - Web conference: Purchase this license for each Web port that you want to use in conferences managed by a ShoreTel Service Appliance. A license allows one data-compatible endpoint to participate in a conference

Trunk Requirements

Trunks provide connectivity between users on the ShoreTel system and the public switched telephone network (PSTN). In this next task in the system design process, you determine the number of trunks required.

The number of trunks required on your system varies, depending on the number of users and your specific application needs. It is important to size your trunking correctly because not having enough trunks can lead to blocked calls when all trunks are busy, and too many trunks can lead to wasted money on monthly access charges.

See Telephone Planning and Ordering on page 163, for more information about trunk features, ordering, and installation.

You have several options for determining the number of trunks your site requires:

- Review the number of trunks on your current system. In general, this is one of the best methods to gauge the number of trunks you need.
- You can also request a traffic analysis from your service provider, interconnect, or telecom manager to understand your current trunk utilization. This method will help you understand your current usage and allow you to maintain the current service level.
- Visit a web site, such as www.erlang.com, to use a traffic calculator for determining your trunk requirements.
- Consider the following:
  - Larger locations can typically use lower-density trunking (15%).
  - Smaller locations need higher-density trunking (50%).
  - Some applications, such as call centers, can demand higher-density trunking (50%).

Table 7: Trunk Density

Trunk Density	Trunks/Users%
Low	15%
Average	30%
High	50%

When planning trunks, consider the call volume for your workgroups or ACD groups. Since there is generally a queuing solution in place for ACD calls, the number of trunks required should be based on the full utilization of the expected number of agents and sufficient trunks for the expected number of waiting callers.

Determine Number of ShoreTel Voice Switches

The ShoreTel telephony solution is a mixture of hardware and software components that you install across your enterprise to create a single telephone system. A critical component to the solution is the ShoreTel voice switch. Voice switches are the interface that connect the telephones to the ShoreTel system. These switches provide signaling and call-setup functions for the phones and trunking to interface with service providers and other telephony networks. The ShoreTel voice-switch portfolio offers a broad range of telephony switches to meet the needs of our different customers.

For more information about ShoreTel Voice Swithces, see Appendix F, ShoreTel Voice Switches.

For information about the features that ShoreTel supports outside the U.S., see Appendix A, International Planning and Installation.

WAN Connections

To complete your system design, the final step is to identify your network connectivity. You should identify the following for the network connections to each site:

- Bandwidth
- Latency
- Jitter
- Packet Loss

Failover

To provide high availability, ShoreTel supports failover at two very important points in the system. ShoreTel supports failover for the headquarters (HQ) server and for voice switches. For the HQ server, ShoreTel supports a back-up server that monitors and can duplicate the primary server. If the primary server fails, the back-up server immediately starts operating as the HQ server with minimal interruption. After the primary server returns to operation, the system administration must perform a manual fail-back to restore the servers to their previous operation.

For voice switch backup, ShoreTel supports two approaches. The system administrator can configure extra port capacity or install a dedicated spare voice switch. A spare voice switch be on a network that is remote to the failed voice switch.

System Capacity

The ShoreTel system can scale incrementally up to 20,000 ports (users and trunks) representing 500 ShoreTel voice switches over the entire system. The system is completely nonblocking and can support 10,000 simultaneous calls at a rate of 100,000 calls per hour depending upon server configurations.

Table 8 provides a summary of the ShoreTel system capacity.

Table 8: ShoreTel System Capacity

Component	Capacity	Notes
System		
Sites	500	Exact number varies by configuration.
Switches	100/site 500/system 100/server	Exact number varies by configuration. **Note:** For Very Large deployments, systems with more than 10,000 ports, the maximum number of switches per site is 60.
Route Points	300/server	This is per server
Analog Ports	5,000	Exact number varies by configuration.
IP Phones	20,000 (max)	Exact number varies by configuration. See Server capacity table.
Simultaneous Calls	10,000	10,000 calling 10,000.
Busy Hour Call Completion	100,000	Depending upon server configurations
Users		
Users	20,000	
– Port Based Users	5,000	
– IP Phone Users	20,000	
– Virtual Users	1,000/server	
User Groups	250	
Telephony Permissions	100	
Call Permissions	100	
Voice Mail Permissions	100	
Trunks		
Trunks	10,000	
Trunk Groups	500	
Number of Trunks/TG	220	
Servers		

Table 8: ShoreTel System Capacity(Continued)

Component	Capacity	Notes
Number of servers	21	1 main, 20 distributed (for voice mail, auto-attendant, messaging, directory, configuration services, and desktop call control). Each server is certified to support up to 1,000 users.
Number of Voicemail Box Switches (VMBs)	500/system 100/server	
Number of 3rd Party SIP Servers	20	
Media streams (G.711 per server)	254	Simultaneous voice mail sessions, for example.
Media streams (G.729 per server)	40	
Media streams (total)	9,384	21 servers x 254 media streams per server + 500VMB x 9 streams per VMB.
Voice Mail		
Mailboxes (total)	20,000	These can be distributed across the servers.
Mailboxes (per server)	3,000	
Storage	Unlimited	Restricted by the size of disk available (1 hour of voice mail per 30 MB of disk storage).
Auto-Attendant		
Menus (total)	1,000	Every server has every menu.
Hunt Groups		
Hunt groups per switch	8	
Total hunt group members per switch	16	
Workgroups		
Workgroups (total)	256/system	
Members per workgroup	300	Top down, round robin, and longest idle hunt pattern.
WG Agents (total per system)	300/system	If more are required it is recommended you investigate the ShoreTel Enterprise Contact Center Solution
WG Agents	16	Simultaneous ring.
Calls in Queue per Queue	254/server	Overflow is directed to the workgroup backup extension.

Table 8: ShoreTel System Capacity(Continued)

Component	Capacity	Notes
BHCC/system without reports during business hrs	Very Large HW=100k /Large HW = 50K / Med HW =2 5K /Small HW = 5K	See Server HW specs for size & traffic considerations
BHCC/system with reports during business hrs	Very Large HW=10k /Large HW = 5K / Med HW = 1K / Small HW = not recommended	See Server HW specs for size & traffic considerations
Max # of PCM's in WG server	300	
Paging Groups		
Paging Groups (total)	300/system	
Paging Group Members	300/system	
Max # of simultaneous pages	100/server	
Account Code		
Account Code (per system)	100,000/ system)	
Call Detail Record		
Storage	1.5 GB (MySQL has a capacity of 64TB)	500,000 workgroup calls, OR 1.5 million extension-to-extension calls, OR 1.0 million combined call records Implementing a database of this size typically requires 4.0 GB of disk space, including disk space for the main database (1.5 GB), the archive database (1.5 GB), and temporary space required to generate reports (1.0 GB).
ShoreTel Communicator		
ShoreTel Communicators (total)	10,000	
ShoreTel Communicators (per server)	1,000	**Note:** For Very Large deployments, systems with more than 10,000 ports, the maximum number of Communicators for web and mobile per server is 1,000. For ShoreTel Communicator for Windows, the maximum number is 500 per server.
Personal	10,000	

Table 8: ShoreTel System Capacity(Continued)

Component	Capacity	Notes
Professional	10,000	
Workgroup Agent	300	
Workgroup Supervisor	128	
Workgroup Agent/server	300 per server, 300 per system	
Workgroup Supervisor/ server	128 per server, 128 per system	
Operator	200	250 monitored extensions/each operator maximum.
ShoreTel Communicator for Mobile	1,000	Per system.
Music on Hold (MOH)		
Music on Hold (MOH)	15	One switch can provide MOH for up to 15 calls per site.
Programmable Buttons		
IP phone buttons configured for extension monitoring (per switch)	1024	
Phones that can monitor an extension	32	
Voice Switch Capacity		
Media streams/switch (No encryption)	60	
Media streams/switch (encryption)	60	
Media streams/switch (SRTP)	40	
Media streams/switch (SRTP + authentication)	30	
G711 Limits for VMB	9	
G729 Limits for VMB	5	
BAA Simultaneous # of calls - Voice Switches	60	
Simultaneous # of calls SIP Ringing - Voice Switches -G711	60	
Simultaneous # of calls SIP Ringing - Voice Switches -G729	0	

The following tables contain information on how to select a server for your ShoreTel implementation.

Server requirements are specified in four tiers:

- Servers for small systems that support up to 500 users.
- Servers for medium sized systems that support up to 2,500 users.
- Servers for large systems that support up to 10,000 users.
- Servers for very large systems that support up to 20,000 users.

Table 9 describes the key capacity limits for each of the new server tiers and includes the following concepts:

- BHCC (Busy Hour Call Completion) per system is the total number of calls in the system during the busy hour including internal and external calls and including calls terminated to desk phones, softphones, trunks, or server applications such as voicemail.
- BHCC per server is based on the number of calls actually handled by the server during the business hour including workgroup calls in menus and queues, auto-attendant calls and calls to the voicemail service.
- The ShoreTel report generation tools that run on the server are configured by default to run at a lower priority than other, more critical services. A light demand of report generation should have little or no affect on a server with adequate minimum performance specifications. If you are a heavy report user or experience any degradation of voicemail or other server prompts on an underpowered server, you must move up to the next tier level of servers.

Table 9: System and Service Capacities

Size	Maximum users per System	Maximum users assigned per Server	Maximum System BHCC	Maximum BHCC per Server (Outside Business Hours)	Maximum BHCC per Server (During Business Hours)
Small	500	500	5,000	1,000	Not Recommended
Medium	2,500	1,000	25,000	5,000	1,000
Large	10,000	1,000	50,000	10,000	5,000
Very Large	20,000	1,000	100,000	10,000	10,000

To select a server for your new system deployment, first consult the sizing table and determine the tier of the server needed using the system and per server specifications. Then match that size (small, medium, large or very large) to the server requirements shown in Table 10.

Table 10: Server Specifications

Size	Processor	RAM	Network
Small	Intel® Core 2 Duo E8400, Single Dual Core 3.00 GHz or Intel® Core™ i3-540 Processor (4M Cache, 3.06 GHz)	4 GB	100 Base-T
Medium	Intel Xeon 5520 Single Quad Core 2.27 GHz	8 GB	100 Base-T or Gigabit Ethernet
Large	Intel Xeon 5520 Dual Quad Core 2.27 GHz	8 GB	Gigabit Ethernet
Very Large	Intel Xeon 5680 Dual Six Core 3.33 GHz	12 GB	Gigabit Ethernet

Note

Use the hardware specifications to size servers running ShoreTel Headquarters server software and ShoreTel Distributed Voice Services software. For example, consider a 2 location system with 2,000 users and 20,000 BHCC. A Headquarters server is located at the main site and a Distributed Voice Services server is located at the remote site. Each of the servers handle 2,000 BHCC. In this case, both servers should be provisioned with hardware that meets the medium tier of hardware requirements because the system capacity and both server capacities fall within this tier.

When deploying servers for medium or large systems, be aware that you must select an operating system that supports expanded memory, such as the Enterprise Editions of Microsoft Windows 2003 server or Microsoft Windows 2008 Server.

Virtual Phone and Virtual Trunk Switches

The ShoreTel system supports virtual phone switches and virtual SIP trunk switches.

The virtual phone switch supports the following features:

- All non-TDM features (no physical trunks or analog phones)
- Up to 1000 IP phones per switch
- Requires the ShoreTel Virtual Switch Phone License

Note

The virtual phone switch does not support the Nightbell or Overhead Paging features.

The virtual trunk switch supports up to 500 SIP trunks and requires the Virtual Switch SIP Trunk license.

For virtual switch capacities and requirements, see Virtual Switches and Service Appliances on page 258.

BHCC Call Volume

BHCC per system is the total number of calls in the system during the busy hour including internal and external calls and calls terminated to desk phones, softphones, trunks, or server applications such as voicemail. This includes all traffic that can occur in the server - regular voice calls, workgroup calls, voicemail etc. See Table 9 on page 37 for information about BHCC capacity for the different sizes of ShoreTel systems.

BHCA Call Volume

Busy Hour Call Attempts (BHCA) is the number of calls attempted at the busiest hour of the day (peak hour). The higher the BHCA, the higher the stress on the network processors. If a bottleneck in the network exists with a capacity lower than the estimated BHCA, then congestion will occur resulting in many failed calls and customer dissatisfaction.

ShoreTel systems support 5,000 BHCA.

Call Load Capacity for Switches

A ShoreTel system supports a maximum of 100 Voicemail Model Switches. There are no restrictions concerning the allocation of switches among the sites defined by the system.

ShoreTel Voicemail Model Switches support the following call load capacities:

- 5400 BHCC when supporting 90 MGCP IP Phones or 90 SIP Trunks.
- 3600 BHCC when supporting 90 SIP IP Phones or 90 SIP Trunks.

Extension Monitoring Limitations

That there is a limit to the number of extensions that can be monitored, whether from a ShoreTel IP Phone -BB24 device or from a ShoreTel IP Phone multiline phone. This limitation is dependent on two factors:

- Update rate (every call causes one or more monitoring phones to be updated.
- Whether the monitoring phones are spread across one or more switches.

ShoreTel Voice Switches support an update rate of 1 per second. This limit is independent of whether the monitored extensions are on the same switch or a different switch. If the monitored extensions are on a different switch, then IPDS is involved.

ShoreTel Voice Switch Feature Capacity

The ShoreTel voice switch is designed to handle the maximum load for the services it provides. Some features place a higher real-time load on the ShoreTel voice switch processor than others, and the use of these features must be carefully planned to take into account the impact on the processing power of a switch to handle call control signaling messages.

Table 11 offers some general guidelines for the number of extensions and group members for several commonly used features. Keep in mind that in addition to observing these limitations, you must stay below the real-time requirements of the switch itself.

Table 11: Feature Capacity

	Hunt Group	Bridged Call Appearance	Pickup Group	IP Phones
Extension	8	24	16	120
Members/ extensions	16	32 – phones monitoring the same extension	24	N/A
Stack size/ extensions	24	24	N/A	24
Total members on all extensions	16	N/A	80	N/A

IP phones

Ringing a single user's IP phone generates only one set of call control messages. However, as the call rate increases, the load on the processor also increases. Note that the call rate is the driving factor of load and not the length of a call. For instance, sixty calls placed over one hour, with each call lasting one minute, is a much higher load on the processor than a single call lasting one hour.

Hunt Groups

Hunt groups place a significantly heavier burden on the ShoreTel voice switch. For example, if you have a hunt group with 16 members, a single call into the hunt group will generate 16 simultaneous calls (assuming the feature is configured to simultaneously ring each hunt group member).

To extend this example, assume that the call stack size for this hunt group is set to 16, and 16 calls arrived at the same time, this would be equivalent to 256 calls (16 x 16) simultaneous calls. The number of hunt group members (as well as the call stack depth) is a multiplying factor for the signaling load that would be generated – thus, you should closely engineer hunt groups to ensure that the voice switch is not overburdened in order to ensure optimal performance.

You can have 8 hunt groups on a switch. Each hunt group can have up to 16 members and each hunt group can have a call stack of 24. The maximum number of members across all groups on the switch also has to remain below 16. For instance, you could have one hunt group of 16 members or 2 hunt groups with 8 members each.

Bridged Call Appearances

With Bridged Call Appearances (BCA), additional processor load is related to the call control signaling transmission to the buttons that have been programmed on the ShoreTel IP phones. If a single BCA with a call stack of one is configured on a phone, this represents one load. However, if that same BCA were to appear on 24 different phones, that would represent 24 times more call signaling load than if the BCA were to appear on one phone.

The switch is capable of handling 24 BCAs, with a call stack depth of 24 and up to 32 phones monitoring a single BCA. If there are no hunt groups on the switch, it is possible for the switch to support up to 160 buttons programmed to monitor BCAs.

Pickup Groups

Pickup Groups place an additional load on the processor related to tracking the extensions in the group (although the actual real-time load is rather light and is not factored into the real time equation).

The switch is capable of supporting 16 pickup groups with a maximum of 24 members in the group. The total number of members in all groups on the switch must not exceed 80.

Real Time Capacity

In addition to the overall feature capacity limit, you should calculate the real-time load on the switch using the formula below:

$$\left(\sum_{n=1}^{No.HG} HG_StackSize(n) * HG_Members(n)\right) + (.5 * No._BCA_Monitoring_Lines) \leq 80$$

For example, with the following configurations:

- A hunt group with four members and a call stack of four.
- A second hunt group with eight members and a call stack of three.
- Ten phones, each monitoring four BCA.

You would have room to spare:

HG 1	+	HG 2	+	BCAs	=	Total
4 x 4	+	8 x 3	+	(10 x 4)/2	=	60
16	+	24	+	20	=	60

CHAPTER

3

Network Requirements and Preparation

This chapter describes the network requirements and preparation needed to use the ShoreTel system. It contains the following information:

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Overview

The ShoreTel system is an IP-based voice solution deployed across your IP network. This allows the components of the system to be located anywhere on your IP network, resulting in a single system for all your voice applications at all locations. This single system approach significantly reduces the complexity associated with legacy systems that consist of multiple PBXs, multiple voice mail systems, multiple auto-attendants, and multiple automatic call distribution systems, each with their unique management interfaces.

Because the ShoreTel system becomes another application on your IP network, it is important to understand how the system integrates with your data network. As you migrate your network to include voice as another application across your wide area network, it becomes necessary for your IP LAN and WAN to provide a network that meets the requirements for toll-quality voice. The ability of your network to deliver this performance will vary based on the number of simultaneous calls between locations, the voice quality required, and the other application traffic on the network. Some of the key considerations are:

- Bandwidth
- Latency
- Jitter
- Quality of service

Understanding the Network Requirements for Toll-Quality Voice

The ShoreTel system is designed to deliver the highest possible voice quality. To ensure high quality voice transmissions, you must be sure that the entire network on which you deploy the ShoreTel telephony system is able to provide toll-quality voice communications throughout. Both LAN and WAN links must be adequately constructed to ensure the fluid transmission of time- and order-sensitive voice packets.

This section provides you with the background to understand the factors involved in engineering an IP network that is ready for voice communications.

General Network Requirements

When your voice traffic travels across your IP network, you must ensure that your network does all of the following:

- Delivers enough bandwidth
- Meets the latency and jitter requirements
- Meets the packet loss requirements for toll-quality voice

You also need to prioritize your voice traffic over your data traffic and configure the ShoreTel system's Admission Control feature.

In general, to ensure voice quality on the LAN, the ShoreTel system must be used in a switched Ethernet network. To ensure voice quality on the WAN, the ShoreTel system requires that you do the following:

- Get a service-level agreement (SLA) from your WAN service provider that guarantees prioritization of voice traffic.
- Prioritize your voice traffic ahead of your data traffic on network routers.
- Set the ShoreTel admission control feature to ensure that the voice traffic does not flood the WAN links.

With these items taken into consideration, you can simply and easily achieve toll-quality voice using the ShoreTel system.

The ShoreTel system is designed to work in multi-vendor network environments and, therefore, leverages Quality of Services (QoS) standards to ensure voice prioritization including:

- Layer 2 IP Precedence (802.1p and 802.1q) (this only applies on the LAN)
- Layer 3 Differentiated Services Code Point (DiffServ/ToS)

Impact of Long Network Outages

The ShoreTel system is a completely distributed system in which each ShoreTel voice switch provides all call control functionality for inbound and outbound calls, as well as features such as transfer, conference, pickup, and trunk selection. When there is a long network outage, the switches detect the problem and run isolated from the switches that can no longer be reached. In the ShoreTel system, switches communicate every 30 seconds and disconnect when there is no response after 60 seconds.

TCP and UDP Port Usage in the ShoreTel System

For information about the ports ShoreTel devices and applications use to communicate with other ShoreTel devices and applications, see the Port Usage appendix in the *ShoreTel Maintenance Guide*.

Bandwidth Requirements

The amount of bandwidth required for voice calls depends on these details:

- Number of simultaneous calls
- Voice encoding scheme in use
- Amount of signaling overhead

Within a site, G.722 wideband encoding is recommended because bandwidth in the LAN is inexpensive and readily available. Between sites, G.729a is recommended because it uses the least amount of bandwidth. Linear codecs provide slightly higher voice quality than G.711, but they should not be used if there are any bandwidth concerns.

If you select linear broadband or linear encoding, end points that do not support either codec negotiate for the highest quality codec for both end points, and G.711 is the only high-quality codec shared by all end points. Table 12 provides bandwidth information for different codecs.

Table 12: Supported Codecs

Codec	Sample Rate	Data Rate
L16/1600 (Linear Broadband)	16 KHz	256 Kbps
L16/8000 (Linear)	8 KHz	128 Kbps
G.711 µ-law (PCMU)	8 KHz	64 Kbps
G.711 A-law (PCMA)	8 KHz	64 Kbps
G.722	16 KHz*	32 Kbps
G.729a	8 KHz	8 Kbps
iLBC	8 KHz	13.33 Kbps
AAC_LC	32 KHz	
BV-32	16KHz	32 Kbps
BV-16	8KHz	16 Kbps
DV-14	8KHz	
T.38		

* In network traces, G.722 often appears as “G722/8000” even though it should be “G722/16000”. This is due to an historical error in notation. ShoreTel follows the Internet Engineering Task Force recommendation of maintaining the G722/8000 notation.

Latency

Latency is the amount of time it takes for one person’s voice to be sampled, digitized (or encoded), packetized, sent over the IP network, de-packetized, and replayed to another person. The ITU G.114 Recommendation recommends not more than 150 ms one-way delay, from “mouth-to-ear.” If the latency is too high, it interferes with the natural flow of the conversation, causing the two parties to confuse the latency for pauses in speech. The resulting conversation is reminiscent of international calls over satellite facilities. The maximum latency for ShoreTel phones on an ideal intranet is 130 ms. Networks can inject additional latency if not properly designed. Potential trouble spots to be aware of are routers and wide-area-network interfaces. Care should be taken to ensure that all network congestion points are designed to provide sufficient capacity to ensure low latency throughput.

Jitter for Voice Switches

Jitter is the variation of latency across the network and the variation in packet processing inside the switches. To compensate for jitter, the ShoreTel voice switches and 400-Series IP phones continuously measure the jitter in the system and dynamically change the size of the receive jitter buffers to optimize voice quality.

If the jitter buffer is too small, there can be packet loss from buffer underflows. This occurs when the jitter buffer runs out of valid voice samples. If the jitter buffer is too large, there will be unnecessary latency. Both conditions have a negative impact on voice quality.

The jitter buffer starts at the minimum size of 0 ms as packets from the network are placed into the switchboard queue for immediate processing. When jitter is detected on the network, the jitter buffer dynamically increases in increments of 5 ms to compensate for increased jitter and decreases in reaction to less jitter. The maximum value of the jitter buffer is set in ShoreTel Director and ranges from 20 to 400 ms, with a default of 300 ms.

As the jitter increases on the network and the jitter buffer needs to be increased to guarantee timely audio play, the latency of the audio also increases. The system attempts both to maintain a minimum jitter buffer size that provides good-quality voice without dropping packets and to provide minimum latency.

For third-party IP phones that are configured in the ShoreTel system, the jitter buffer is not configurable. The minimum jitter buffer is 10 ms, and the maximum is 80 ms.

Maximum jitter buffer values greater than 100 ms should rarely be necessary. If needed, this could indicate a problem in your network that should be addressed in another way. As the jitter buffer depth increases, the latency experienced by the user increases. For this reason, network jitter should be kept to a minimum.

Packet Loss

Lost packets can occur on the IP network for any number of reasons. Packet loss above 1% begins to adversely affect voice quality. To help reduce this problem, ShoreTel voice switches and 400-Series IP phones have a feature called lost packet concealment. When a packet is lost on the network, the last sample received is replayed to the receiving party at a reduced level. This is repeated until a nominal level is reached, effectively reducing the clicking and popping associated with low levels of packet loss.

Fax and modem calls demand essentially zero packet loss to avoid missing lines on fax calls and to avoid dropped modem calls. In addition, fax and modem calls, when detected, may change to a higher-rate codec.

Bandwidth Management

In addition to the network requirements discussed above, bandwidth management techniques need to be deployed to ensure that real-time voice data is not affected by bursts or high amounts of data traffic.

Local Area Network (LAN)

To manage bandwidth in the local area network (intrasite) and meet the requirements for toll-quality voice, use Ethernet switching. Ethernet switching is cost effective and simple to provision. Your LAN configuration requirements will vary depending on your infrastructure and whether your network includes IP phones.

IP phones sample the user’s voice and convert the voice signal to IP packets using the Real Time Protocol (RTP). These packets must be tagged for higher prioritization in the network. ShoreTel IP phones have embedded Ethernet switches and automatically prioritize voice traffic ahead of any data traffic coming from daisy-chained personal computers (for example, large file transfers and e-mail).

On the local area network, methods to prioritize voice packets include the following:

- IP Precedence – 5 (configurable, recommendation is 5)
- DiffServ/ToS – EF (configurable, recommendation is EF)

The Ethernet switch configuration should prioritize traffic using one of these methods. This allows the voice traffic arriving at the switch to travel ahead of the data traffic.

ShoreTel customers typically prioritize voice traffic by setting the Differentiated Service (DiffServ) field because this configuration is easy to set up on smart Ethernet switches.

When IP phones are used, the desktop connection to the user's computer and phone must also be part of the switched Ethernet network. The user's phone is connected to the port on the Ethernet switch, and the user's computer or other data device is connected to the integrated two-port Ethernet switch inside the IP phone. In this configuration, the switch port connected to the phone must be configured to prioritize the voice packets from the phone above the data packets.

If an IP phone loses power, a PC connected through the IP phone loses its connection to the network.

Voice quality can be guaranteed by putting each of the ShoreTel voice switches and the ShoreTel server on its own Ethernet switch port. A network with this topology meets the bandwidth, jitter, and latency requirements for toll-quality voice without the additional need for special prioritization of voice packets.

Virtual LANs

An alternative method to prioritize voice over data is to create a separate virtual LAN (VLAN) strictly for your voice traffic. ShoreTel IP phones and voice switches can be configured on a specific VLAN.

Set the voice VLAN for higher prioritization in the network. The Ethernet switch infrastructure needs to be configured to prioritize the voice VLAN. This allows the voice traffic arriving at the switch to travel ahead of the data traffic.

Wide Area Network

To manage bandwidth in the wide area network, prioritize your voice traffic ahead of your data traffic. You can prioritize based on the voice switch IP address, the MAC address, or the physical port on the Ethernet switch. As an additional step, you can also prioritize the distributed call control signaling that always travels on UDP port 5440 through UDP port 5445.

If the voice traffic for the call needs to flow across a WAN link, the router needs to be configured to prioritize voice ahead of data using DiffServ/ToS.

Client Bandwidth

ShoreTel Communicator communicates with the ShoreTel server for call information and control, configuration changes, and advanced services such as extension monitoring. Table 13 provides an estimate of the client bandwidth used for each of the ShoreTel Communicator applications.

Table 13: Typical Bandwidth Use for ShoreTel Communicator

ShoreTel Communicator	Bandwidth Use
Personal	.2 Kbps
Professional	.2 Kbps
Operator	.2 Kbps + 1.5 Kbps
Extension Monitor	1.5 Kbps per monitored extension
Workgroup Agent	.25 Kbps
Queue Monitor	6.5 Kbps per queued call
Workgroup Supervisor	.25 Kbps
Queue Monitor	6.5 Kbps per queued call
Agent Monitor	1.5 Kbps per agent

Distributed Call Control Signaling

Voice switches maintain communication with each other. A single voice switch maintaining basic connectivity with 59 other voice switches consumes less than 1.5 Kbps of bandwidth.

Admission Control in the Wide Area Network

To ensure that voice traffic does not overwhelm your wide area network and degrade voice quality, the ShoreTel system has an Admission Control feature. From ShoreTel Director, you can limit the amount of WAN bandwidth used for telephone calls on a per-site basis. For a telephone call to be established between sites, admission control must be met at both sites. If the admission control limit is reached at a site, additional calls cannot be placed to or from the site, thus ensuring the voice quality of calls already in progress. If the user is making an outbound call, the call is automatically routed out of a trunk at the site. When making an extension-to-extension call, the user is informed that there is insufficient network bandwidth to complete the call. The user can try again later or dial the external number of the other user.

If PSTN failover is enabled for a user extension, the user's extension-to-extension calls are automatically routed to the public switched telephone network (PSTN) when there is insufficient bandwidth for an IP phone connection.

Spanning Tree Protocol

Spanning Tree Protocol (STP) is used by Ethernet switches and routers to determine if there are multiple paths on the network between any two endpoints. You must disable STP on any network port that has a ShoreTel voice switch or ShoreTel server connected.

Traffic Shaping to Reduce Bottlenecks

With many applications requiring WAN bandwidth, the need to optimize is increasingly important. This is particularly true for enterprises that want to deploy voice over virtual networks where quality of service and traffic shaping are required. With traffic shaping, it is possible to set policies that determine who or what gets top priority. For example, by prioritizing the various flows of traffic, an administrator can make sure that UDP (voice) traffic gets a higher priority than FTP (file download) traffic.

Echo Cancellation

Echo is a consideration for networks and IP phones.

Network

Echo in a voice communication system is caused by signal reflections generated by the electrical circuits (called hybrids) that convert between two-wire (shared transmit and receive pair) and four-wire circuits (separate transmit and receive pairs). These reflections cause the speaker's voice to be heard in the speaker's ear as delayed by many milliseconds. Echo is present even in the traditional circuit-switched telephone network, but because the delay in a local circuit-switched call is so low, the echo is not perceivable. On a packet-based voice network, there is more delay, and the speaker may perceive the echo if it is not properly cancelled.

The DSP software on ShoreTel voice switches provides dynamic echo cancellation. When a user places an extension-to-trunk call using an analog trunk on a ShoreTel voice switch, the user's voice bounces off the initial four-wire to two-wire conversion in the analog trunk circuit, then off the two-wire to four-wire in the central office, and finally off the called party's telephone. This echo returns from the central office and is cancelled by the echo canceller on the trunk port of the voice switch. The echo from the called party's phone, however, is usually cancelled or suppressed by the central office. If this echo is not cancelled, users might hear themselves talking.

In the opposite direction, the external person's voice bounces off the user's telephone. This echo returns from the telephone and is cancelled by the echo canceller on the telephone port of the voice switch. If this echo is not cancelled, the external party hears himself or herself talking. This same process of echo cancellation applies to extension-to-extension as well as trunk-to-trunk calls.

ShoreTel voice switches can cancel echo received up to 16 ms after being sent.

IP Phones

Most ShoreTel IP phones have hands-free, full-duplex speakerphones with built-in echo cancellation. The ShoreTel IP420, however, has a half-duplex speakerphone, and for this reason it is not appropriate for use as a speakerphone in a conference room.

WAN Technology Choices

Minimum Bandwidth Requirements

The minimum WAN bandwidth required to deploy a voice switch at a site depends on the number of calls expected. With ADPCM, a single call consumes 52 Kbps, and if this call becomes a conference call, another 52 Kbps is needed, yielding a total of 104 Kbps. From a broadband perspective, the first available technology is 128 Kbps (ISDN), which leaves only 24 Kbps for other IP traffic. For teleworking applications, where only a single call is needed, 128 Kbps can be used. For other sites on the voice network, the minimum bandwidth recommended is 384 Kbps.

Various technologies, as shown in Table 14, are available from different service providers to provide IP connectivity between locations.

Table 14: IP Connectivity Chart

Technology	Upstream Bandwidth Kbps	Downstream Bandwidth Kbps	Calls with ADPCM
T1	1544	1544	26
Frame Relay	Varies	Varies	Varies
SDSL	1544	1544	26
SDSL	1024	1024	17
SDSL	768	768	13
SDSL	512	512	8
SDSL	384	384	6
IDSL	144	144	1 call only
ADSL	128	1,000 (varies)	1 call only
Cable	128 (varies)	1,000 (varies)	1 call only
ISDN BRI	128	128	Not supported
Dial-up modem	28.8–56	28.8–56	Not supported

Note

Your bandwidth will vary, based on the WAN overhead for your particular system.

Leased T1

Leased T1 facilities are the most robust WAN technology available. Leased T1s are point-to-point links that inherently meet the network requirements for toll-quality voice because no ISP is involved. Dedicated T1s are priced on a per-unit distance basis, making this a very cost-effective option over short distances.

Frame Relay

Frame Relay is a viable option as long as you get a committed information rate (CIR) that meets the bandwidth and network requirements for toll-quality voice communications.

SDSL

SDSL is considered “business-to-business” DSL in which you can negotiate a service-level agreement with the service provider. Unlike T1, SDSL is priced on a flat bandwidth basis, making the price “distance insensitive” and cost-effective over long distances.

Although this is an excellent option, especially moving forward, ShoreTel has found the use of SDSL challenging, since the service providers often commit to a Service-Level Agreement (SLA) they cannot fulfill. Many service providers have grown very fast, and the IP network is a patchwork of devices. These service providers are usually geared toward providing bandwidth for typical data applications, and a voice application highlights weaknesses in their network. Only with joint troubleshooting of the service provider’s network, using tools such as ping plotters, has ShoreTel been able to achieve the SLA the service provider promised.

IDSL

IDSL modems, which have an uplink and downlink speed of 144 Kbps, can be considered for teleworking applications. Actual performance varies based on your service provider and your applications.

ADSL

ADSL modems, which have an uplink speed of 128 Kbps, can be considered for teleworking applications. Actual performance varies based on your service provider and your applications.

Cable Modems

Cable modems, which can have an uplink speed of 128 Kbps, can be considered for teleworking applications. Actual performance varies based on your service provider and your applications.

ISDN BRI

ISDN BRI modems, which have an uplink speed of 128 Kbps, can be considered for teleworking applications. Actual performance varies based on your service provider and your applications.

Dial-Up Modems

Because of their inherent latency and low bandwidth, dial-up modems are not supported.

IP Address Assignment

Each ShoreTel voice switch must have an IP address, and each ShoreTel server must have a static IP address. Use one of the following ways to assign an IP address to a voice switch:

- DHCP on a network server. (ShoreTel does not support DHCP on its servers.)
- The BOOTP server that ShoreTel Director has in its records.
- The maintenance port on the front of the ShoreTel voice switch. For information about the location of the maintenance port on the switch, see Appendix F, ShoreTel Voice Switches for all switch models or refer to the ShoreTel quick install guide for a specific ShoreTel voice switch model.

If a voice switch has been configured to request a dynamic IP address, it puts a DHCP/BOOTP request on the network when powered on. If the voice switch receives a response, it uses the new IP address. If no response is received, it reverts to the previous IP address. If there is no previous IP address, the voice switch continues trying to get an IP address.

If the network has a DHCP server, ShoreTel recommends that you reserve IP addresses so that the IP addresses of the voice switches do not dynamically change.

If the network does not have a DHCP server, the integrated BOOTP server within ShoreTel Director lets you assign IP addresses.

The maintenance port is for configuring the networking parameters.

The following recommendations can assist with the assignment of IP addresses:

- Ensure that only one DHCP server is on the network. Multiple DHCP servers can unexpectedly change IP addresses and disrupt operation of voice switches.
- The ShoreTel system must be on a private network in some situations and on a public network in other situations. For example:
  - If the enterprise is using a firewall with Network Address Translation (NAT), all remote facilities must establish VPN connections to headquarters and be on the same private network.
  - If the enterprise is using firewalls but not NAT, all remote locations must use public IP addresses.
- Each IP phone must have a unique IP address. You can configure the IP phone through DHCP or manually on the phone.
- Phones at different sites must be configured on different subnets or assigned from different address ranges so that the ShoreTel system can properly assign the voice switch for the IP telephone site.

Configuring DHCP for ShoreTel IP Phones

The ShoreTel server provides the latest application software and configuration information to ShoreTel IP phones. To receive this information, the ShoreTel IP phone must have the server's IP address. The configuration task in this section is for specifying the IP address and other necessary information.

Note

For information about DHCP settings for the ShoreTel 400-Series IP phones, see the *ShoreTel Maintenance Guide*.

The phone receives the necessary information through a vendor-specific DHCP option. ShoreTel IP phones have a built-in configuration to seek the ShoreTel server's address as Vendor Specific DHCP option 156. If these options are not available, ShoreTel's IP phones use option 66. ShoreTel IP phones that support DHCP option 156 are ShoreTel models IP110, IP115, IP212k, IP230, IP230g, IP265, IP420, IP480, IP480g, IP485g, IP560, IP560g, and IP655.

Note

The ShoreTel IP Phone 8000 does not support option 156 for this application.

The configuration task in this section involves a number for the country of the network or subnet where the phones reside. If necessary, find the number for a country in Table 15.

If your network has separate subnets, be sure to select the correct subnet. For example, if a multi-national organization needs the DHCP server to deliver Spanish tones and cadences to the IP phones in an office in Spain, specify the subnet for that office. Without this specification, all phones that boot from this DHCP server receive Spanish tones and cadences.

Another value for the configuration task is a number that points to a language by its country. Although this number refers to a language, it is bound to a country, not a language. For this reason, some countries with different languages have the same language number in the configuration of DHCP option 156. Table 16 lists the language numbers. (As Table 16 shows, language number 4 is a good example.) Selecting the correct language code ensures that the phone shows text in the desired language. Examples of this text are abbreviations for days and months and messages indicating that a requested service is unavailable.

Note

ShoreTel 400-Series IP phones do not use the language or country parameters in DHCP Option 156. Instead, these phones obtain country and language settings from ShoreTel Director as follows:

- The country is determined by the Country parameter on the Sites – Edit Site page.
- For an Available phone, the language is determined by the Language parameter on the Sites – Edit Site page. For an assigned phone, the language is determined by the Language parameter on the Users – Edit User page.

To configure DHCP Option 156 on a Microsoft DHCP Server for ShoreTel IP110, IP115, IP212k, IP230, IP230g, IP265, IP560, IP560g, and IP655 phone models:

1. Open DHCP Manager on the Microsoft DHCP server.
2. Right-click the DHCP server, and then select **Set pre-defined options**.
3. Click **Add**.
4. Set **Name** to IP Phone Boot Server.
5. Set **Data Type** to String.
6. Set **Code** to 156 and add a description, if desired.
7. Navigate to the **scope** options and add option 156.
8. Type the values for option 156 with the following syntax:

   `ftpservers=`*`ip_address`*`, country=`*`n`*`, language=`*`n`*`, layer2tagging=`*`n`*`, vlanid=`*`n`*

   Where

   - *`ip_address`* is the IP address of the ShoreTel Headquarters server.
   - *`n`* in `country=`*`n`* corresponds to the country number in Table 15.
   - *`n`* in `language=`*`n`* corresponds to the language number in Table 16.

Table 15: Country Numbers for DHCP Option 156

Number	Country
1	United States of America
2	Canada
3	France
4	Italy
5	Germany
6	Spain
7	United Kingdom
8	Australia
9	Hong Kong
10	Malaysia
11	Singapore
12	Brazil
13	Netherlands
14	New Zealand
15	Portugal
16	Ireland

Table 15: Country Numbers for DHCP Option 156 (Continued)

Number	Country
17	Belgium
18	Mexico
19	Denmark
20	Sweden
21	Switzerland
22	Austria
23	India
24	China
25	Norway
26	United Arab Emirates
28	Japan
29	Taiwan
30	South Korea
31	Luxembourg
32	Finland
33	Philippines
34	Thailand
35	Poland
36	Czech Republic
37	South Africa
38	Costa Rica
39	Greece
41	Monaco (France)
42	Israel
44	Indonesia
46	Hungary
48	Fiji
49	Mongolia

Table 16: Language Numbers by Country for DHCP Option 156

Number	Language (Country)
1	U.S., Canada, Mongolia, Philippines, Thailand
2	Spain (CALA)

Table 16: Language Numbers by Country for DHCP Option 156 (Continued)

Number	Language (Country)
3	Germany, Austria
4	English (UK), Czech Republic, Ireland, Malaysia, Greece, Hong Kong, New Zealand, Poland, India, Romania, Singapore, South Africa, United Arab Emirates, Indonesia, Finland
5	France (Parisian), Belgium, Luxembourg, Switzerland, Monaco (France)
6	Netherlands
7	Mexico, Cost Rica, Chile
8	Denmark
9	Italy
10	Sweden
11	China
12	Norway, Finland
13	Brazil (Portuguese)
14	Japan
15	South Korea
17	Taiwan (Mandarin)
18	Portugal
22	Bulgaria
23	Australia, Fiji

Configuring Automatic VLAN Assignment through DHCP

You can configure an IP phone to automatically determine its VLAN ID through DHCP. When the phone boots for the first time, it acquires an IP address via DHCP similar to any other network device. However, the DHCP response also specifies (using a proprietary DHCP option) the VLAN ID for the phone to use. The phone then releases the IP address originally assigned to it and reboots. After the phone reboots, all packets are tagged with the VLAN ID specified in the original DHCP response.

The Automatic VLAN Assignment feature is configured on the DHCP server rather than through ShoreTel Director.

To configure automatic VLAN assignment on a Microsoft DHCP server:

1. Open DHCP Manager on your Microsoft DHCP server.
2. Right-click the **DHCP server** and select **Set pre-defined options**.

3. Click **Add**.
4. Set Name to IP Phone Boot Server.
5. Set Data Type to String.
6. Set Code to 156 and add a description, if desired.
7. Navigate to the scope options and add option 156.
8. Set the value of option 156 as follows:

   `ftpservers=`*`ip_address`*`, layer2tagging=`*`n`*`, vlanid=`*`x`*

   Where

   - *`ip_address`* is the IP address of the ShoreTel Headquarters server.
   - *`n`* in `layer2tagging=`*`n`* is `0` (to disable 802.1Q) or `1` (to enable 802.1Q). The default is 0.
   - *`x`* in `vlanid=`*`x`* corresponds to a VLAN ID number between 0 and 4094 when 802.1Q is enabled. The default is 0.

   For example, the following would enable VLAN tagging using a VLAN ID of 10:

   ```
   FtpServers=192.168.0.13, Layer2Tagging=1, vlanid=10
   ```

Time Services

For ShoreTel IP phones, time services must be available to provide the telephone's date and time display. This requires a server that supports Simple Network Time Protocol (SNTP).

If an organization does not have an NTP server, it can use a publicly accessible time server. For information about publicly accessible time servers, see http://support.ntp.org/bin/view/Servers/WebHome.

ShoreTel 100-, 200-, 500-, and 600-Series IP phones receive SNTP server information from the DHCP server.

ShoreTel 400-Series IP phones depend on a Network Time Protocol (NTP) server to authenticate a secure connection and to provide the date and time to be displayed on for the phone's screen. The time displayed on the phone is the GMT value provided by the NTP server plus the offset from the time zone setting of the phone. On the ShoreTel IP480, IP480g, and IP485g phone models, users can change the time zone from the default value through the Options menu on the phone.

Virtual Private Network (VPN)

Internet Protocol Virtual Private Networks (IP VPNs) are often the secure access of choice. IP VPNs establish secure communications between employees, branches, or partners by using strong IP-based encryption and authentication techniques for transport security over the public Internet.

IP VPNs are typically viewed as falling into three major categories: remote access VPNs, intranets (company site-to-site), and extranets (business-to-business). These services are used by companies of all sizes because of the powerful combination of high-speed access links and public networks. An example is the use of high-speed, low-cost broadband DSL connectivity to enable teleworkers or branch offices to link securely with the company network via the Internet, as if they were accessing the LAN, including all network applications, at the office. A sample VPN configuration is shown in Figure 1 on page 60.

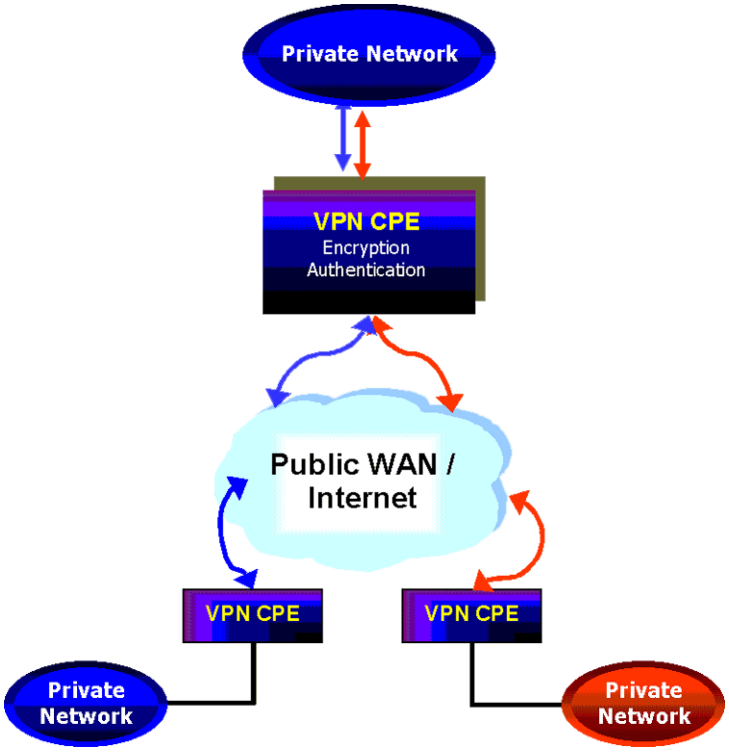

Figure 1: VPN Topology

IP VPNs can be provided via hardware or software solutions located at the remote facility (branch office or teleworker's home) and the customer premises. These devices or solutions use technologies such as tunneling, encryption, and authentication to guarantee secure communications across a public infrastructure.

All the components of your ShoreTel system must exist in the same enterprise private network. VPNs can be used to bridge your private networks across the Internet so that the networks for two buildings are both part of the same private network. For multiple locations that share a private network, bandwidth calculations should include the effective bandwidth inside the private network, rather than the raw bandwidth.

Tunneling

Tunneling encapsulates one type of data packet into the packet of another protocol. Multiple tunneling protocols are used today on the market:

- **PPTP (Point-to-Point Tunneling Protocol):** PPTP includes compression and encryption techniques. This protocol was introduced by Microsoft to support secure dial-up access for its desktop, which corresponds to a large share of the desktop market.
- **L2F (Layer 2 Forwarding):** Introduced by Cisco Systems, L2F was primarily used to tunnel traffic between two Cisco routers. It also allows IPX traffic to tunnel over an IP WAN.
- **L2TP (Layer 2 Tunneling Protocol):** L2TP is an extension the PPP (Point-to-Point Protocol) that merges the best features of L2F and PPTP. L2TP is an emerging IETF (Internet Engineering Task Force) standard.
- **IPSEC:** This is a collection of security protocols from the Security Working Group of the IETF. It provides ESP (Encapsulating Security Payload), AH (Authentication Header), and IKE (Key Exchange Protocol) support. This protocol, mature but still technically in a draft format, is currently considered the standard for encryption and tunneling support in VPNs.

For PPTP, IP VPN tunneling adds another dimension to the tunneling. Before encapsulation takes place, the packets are encrypted so that the data is unreadable to outsiders. Once the encapsulated packets reach their destination, the encapsulation headers are separated, and packets are decrypted and returned to their original format.

The L2TP tunneling protocol does not encrypt before encapsulation. It requires the IPSEC protocol to take the encapsulated packet and encrypt it before sending it over the Internet.

Performance

In the context of an IP VPN's performance, encryption can be a CPU-intensive operation. Therefore, an enterprise must answer two questions about encryption when it evaluates VPN products:

- With encryption, does the maximum throughput substantially decrease?
- With encryption, can the network have a consistent level of throughput?

Typically, a business considers the tradeoffs between performance, price, and the characteristics of software-based and hardware-based encryption.

Note

Although a VPN is useful for data, for VoIP a VPN might not offer enough protection against latency and packet loss.

Integrated Security Appliances

A number of major vendors provide integrated broadband security appliances to eliminate security concerns. These devices use custom ASICs to deliver wire-speed firewall, Triple DES IPSec VPN, and traffic shaping in an easy-to-deploy, cost-effective solution. Installing a security appliance, such as a NetScreen-5, eliminates the need to deal with complex PC software installations and allows IT to centrally manage the security policies of these remote offices and teleworkers. The firewall protection secures sensitive data at the remote site and can prevent both U-turn attacks and the launching of denial-of-service attacks from these computers. By combining broadband access technologies with an integrated security appliance, enterprises and service providers can safely and securely capitalize on all of the benefits of the broadband Internet.

Firewalls

A firewall is the foundation of network security (see Figure 2). It prevents unauthorized access to the network or web site by examining both incoming and outgoing traffic. Based on the predefined security policies, each individual packet is inspected and processed. Any type of traffic deemed “illegal” (based on rules that specify protocol type, source or destination IP address, and so on) is not allowed through the firewall. Using this tool, administrators can achieve tight control over the activities they allow into and out of their corporate network or e-business site. In a corporate network, a firewall prevents intruders from accessing corporate resources while allowing Internet access for employees. In an e-business site, it allows outside access to the web server while preventing unauthorized access or attacks.

Often, a typical network access point, called a DMZ (demilitarized zone), is implemented to offer an “outside” presence for e-commerce clients, e-business partners, and web surfers. The DMZ acts as the gateway through which all Internet communications with the company or site transpire. It allows for controlled access to front-end web servers while protecting mission-critical resources (databases, routers, servers, and so on). Thus, the DMZ needs to be flexible, reliable, and available.

The firewall is often the first line of defense in this environment. Always vigilant, this device must look into all traffic for the site. As part of its duty, the firewall recognizes and deals with denial-of-service attacks, such as TCP SYN flood and Ping of Death. In each of these attacks, the hackers are simply attempting to overwhelm the devices that provide an Internet presence for the company.

With a TCP SYN flood, a stream of TCP SYN packets is sent to the receiving device (often the firewall). The finite memory and size of the TCP entry tables can be overrun by spurious SYN packets, preventing any real users from making a TCP connection required for HTTP communications.

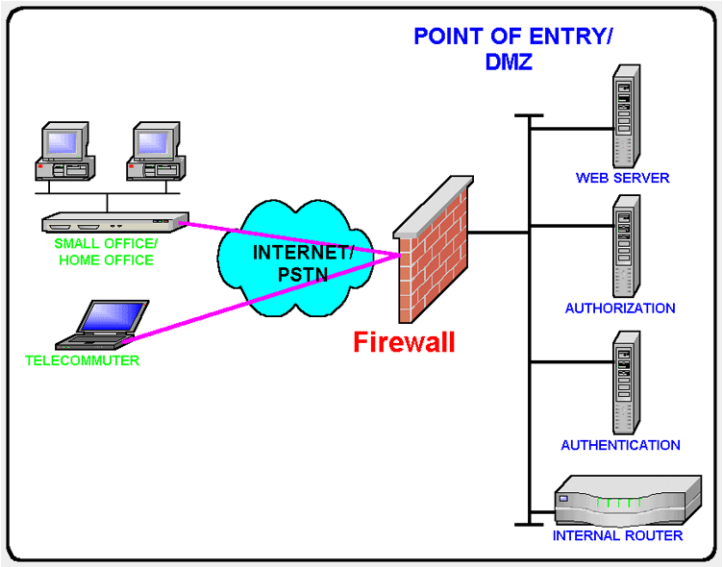

Figure 2: Firewalls

An ICMP flood attack also floods a device, by streaming ICMP echo packets at a recipient destination. This flood of packets requires the device to process and respond to these pings, burning precious resources and preventing other traffic from being serviced. By examining the site’s traffic patterns,

advanced firewalls can apply logical rules that prevent the device from trying to keep up with the denial-of-service attack traffic. They also prevent this traffic from reaching the valuable web, application, and database servers that create your Internet presence and service your customers.

By using firewalls in conjunction with the DMZ design technique, many businesses and service providers are striving to present as much information without permitting unwanted access to the corporate resources.

One way to keep your mission-critical resources as private as possible, while still allowing for a strong Internet presence, is to use Network Address Translation (NAT). NAT offers the outside world one, or a few, IP addresses. This allows a manager to set up whatever internal IP addressing scheme may be required by corporate policies and business needs. An internal resource's IP address (source IP) is changed as it passes through the NAT function to one of the "outside" IP addresses. Thus, the external world does not know any of the enterprise's internal IP addresses. Only the NAT device presents an IP address that is known, and used by external devices. The NAT device keeps track of these conversations and performs the IP address translation as needed.

Extending the private network of the corporate LAN to remote sites via VPN is a proven method of deploying a ShoreTel system across multiple sites. All IP telephony endpoints (such as ShoreTel servers, ShoreTel Voice Switches, and IP telephones) should participate in the same private network, with firewalls between ShoreTel equipment and the public Internet. If needed, you can elect to open access to the ShoreTel server to access ShoreTel Director via HTTP using the same precautions you would when exposing any critical web services server to the public network.

Configuring firewalls to function correctly with VoIP traffic is very difficult. ShoreTel does not recommend deploying ShoreTel equipment across firewalls.

Media Encryption

In addition to using a VPN or a firewall, another method of enhancing the security on your network is to enable media encryption through ShoreTel Director. Media encryption, as the name suggests, encrypts calls between users on a ShoreTel system. The encryption scrambles communications between callers so an intruder on the network cannot eavesdrop on the conversation.

For details about media encryption, see the *ShoreTel System Administration Guide*.

Security for ShoreTel 400-Series IP Phones

ShoreTel 400-Series IP phones use a combination of methods to provide secure communications.

The ShoreTel Headquarters server functions as a X.509 Certificate Authority for the system's public-key infrastructure (PKI). An X.509 certificate is a public key with identifying information, which has been digitally signed through either the associated private key (a self-signed certificate) or a Certificate Authority (CA). The X.509 certificate also includes an expiration date. In addition to the X.509 certificate, the ShoreTel system uses Secure Session Initiation Protocol (SIPS), which is SIP plus Transport Layer Security (TLS). This is a standard protocol that uses PKI to establish a secure connection between two entities on an IP network.

The ShoreTel Headquarters server software installation process generates its own self-signed CA certificate when it first boots up. This root certificate uses a 2048-bit RSA key-pair and is valid for 30 years.

ShoreTel IP phones download the Headquarters Certificate Authority X.509 certificate when provisioning into the system. Using that certificate, the phone is able to connect to the voice switches via SIPS, and to the server using HTTPS. The phones also have a pre-installed, unique certificate, signed by ShoreTel, that allows the voice switches and servers to authenticate the phone.

WARNING!

The root private keys, which are the basis for securing all connections, are stored in the Headquarters server in `<drive>:/Shoreline Data/keystore`. Because exposure of these private keys could invalidate the security of the system, access to this data must be physically restricted.

The following architecture also ensures system security:

- Access to ShoreTel 400-Series IP phones is restricted to the Headquarters server and Shoretel equipment. The only open in-bound ports are Secure Session Initiation Protocol (SIPS) and secure-shell (ssh) ports.
- Call signaling between 400-Series IP phones and voice switches is encrypted, and participants are authenticated using standards-based security.
- If enabled in ShoreTel Director, voice encryption uses standard SRTP AES-128 encryption. In this case, voice media is encrypted on all calls, with the following exceptions:
  - Media in calls between 400-Series IP phones and older ShoreTel IP phone models is not encrypted.
  - Media in calls that include non-Shoretel equipment is not encrypted.
  - Media in calls to softphone and to Windows-based voicemail, auto attendant, workgroups, and account codes is not encrypted.
- For 400-Series IP phones, Directory, History, visual voicemail, extension assignment, and user preference settings are communicated between the Headquarters server and the phones through Hypertext Transfer Protocol Secure (HTTPS).
- Low-level maintenance access to the ShoreTel 400-Series IP phone is limited to secure-shell (ssh) access from the Headquarters server (or any server that has a copy of the Headquarters server's private ssh key). Password-based login is not permitted. Login to the phone is permitted from some models of the controlling voice switch.

Session Initiation Protocol (SIP)

Deploying SIP does not involve special network requirements. The general system requirements should be adequate for SIP support. Note the following considerations:

- If third-party SIP devices (SIP phones) have a static configuration, they are supported behind NAT (Network Address Translation).

- To communicate with a SIP device or service provider providing IP trunks over the Internet, the network must be able to pass SIP traffic through a firewall. This requires a SIP application layer gateway, which is a feature provided by some firewall vendors.
- SIP signaling uses UDP port 5060.
- When using SIP, the RTP port for the voice media stream is dynamic and the SIP endpoints may not always use the same ports to exchange information.

Example Network Topologies

Single-Site Implementation

Figure 3 on page 65 shows an example of a simple, single-site implementation.

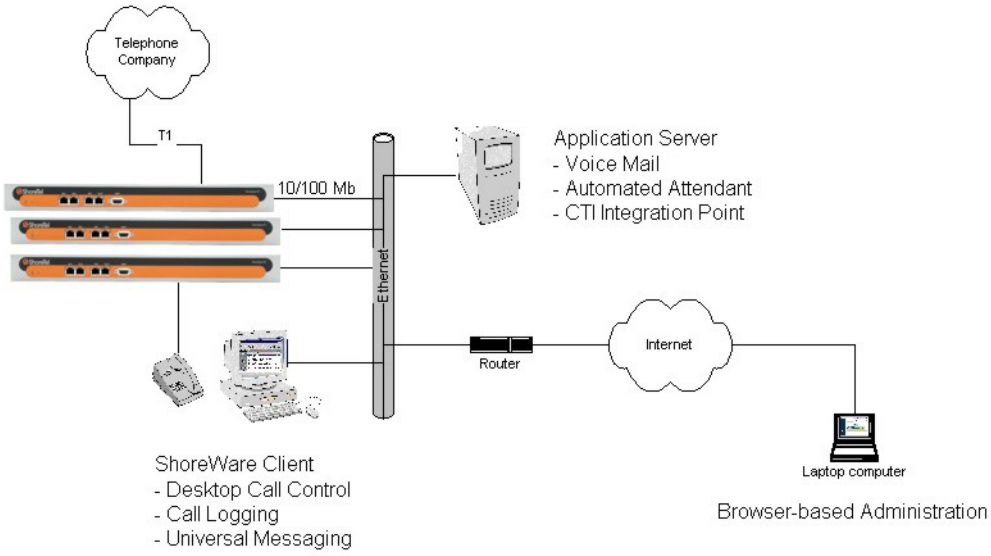

Figure 3: Single Site

Multisite Implementation

Figure 4 shows an example of a multisite implementation with various WAN technology choices.

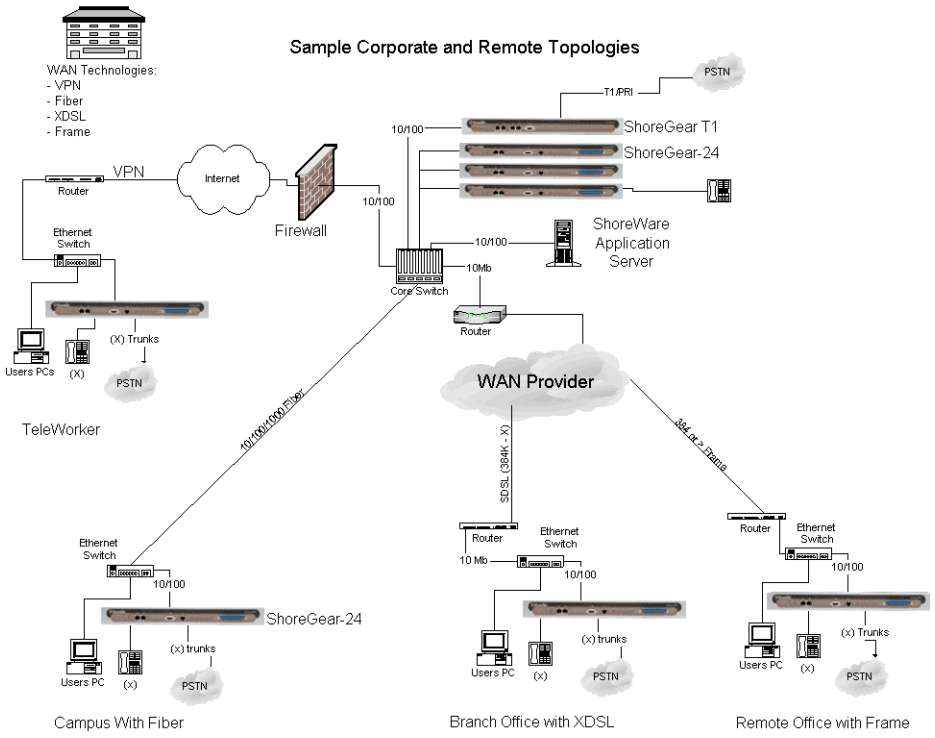

Figure 4: Multisite Options

Computing Admission Control Bandwidth

This section discusses how to compute the admission control bandwidth for the site you are configuring on the Site edit page—that is, the appropriate value for the **Admission Control Bandwidth** parameter. If you want to determine the admission control bandwidth for your site and the information is not available in this section, use one of the following formulas:

- To determine the admission control bandwidth:

  Bandwidth – (# of calls) x (bandwidth/call)

- To determine the number of calls supported with a specific admission control bandwidth value:

  # of calls – (admission control bandwidth) / (bandwidth/call)

ShoreTel automatically negotiates the proper voice encoder at call setup. For calls between sites, the call control software requests the voice encoder based on what is selected for intersite voice encoding as defined on the **Call Control Options** edit page. The call control software will then make sure both endpoints on the call can support the requested voice encoder.

For instance, for G.729a voice encoding to be used between two sites, the intersite voice encoding must be set to G.729a and the ShoreTel voice switches at each end of the call must be G.729a-capable.

WAN Bandwidth per Call (Full Duplex) without cRTP

Table 17 lists the bandwidth, including IP overhead, that is used for each voice call between sites when RTP Header Compression (cRTP) is not used. The bandwidth depends on the voice encoding used. For example:

- If you want to support 10 calls between this site and all other sites, and G.729a voice encoding is used, set the admission control bandwidth to 260 Kbps. Before you enter this value, make sure the bandwidth is available at this site.
- If you set your admission control bandwidth to 768 Kbps and G.729a voice encoding is used, you can support up to 29 calls between this site and all other sites.

ShoreTel recommends that you configure the admission control bandwidth to be less than the bandwidth of the actual WAN link. This provides sufficient bandwidth for call control signaling and other data traffic.

Table 17: Bandwidth Without cRTP

Bandwidth in Kbps per Number of Calls	Linear	G.711	ADPCM	G.729a
1	146	82	52	26
2	292	170	104	52
3	438	255	156	78
4	584	340	208	104
5	730	425	260	130
6	876	510	312	156
7	1022	595	364	182
8	1168	680	416	208
9	1314	765	468	234
10	1460	850	520	260
11	1606	935	572	286
12	1752	1020	624	312
13	1898	1105	676	338
14	2044	1190	728	364
15	2190	1275	780	390
16	2336	1360	832	416
17	2482	1445	884	442
18	2628	1530	936	468
19	2774	1615	988	494
20	2920	1700	1040	520

Table 17: Bandwidth Without cRTP (Continued)

Bandwidth in Kbps per Number of Calls	Linear	G.711	ADPCM	G.729a
21	3066	1785	1092	546
22	3212	1870	1144	572
23	3358	1955	1196	598
24	3504	2040	1248	624
25	3650	2125	1300	650
26	3796	2210	1352	676
27	3942	2295	1404	702
28	4088	2380	1456	728
29	4234	2465	1508	754
30	4380	2550	1560	780

WAN Bandwidth per Call (Full Duplex) with cRTP

Some routers support a feature called RTP Header Compression (cRTP) that significantly reduces the amount of IP overhead associated with voice over IP. Table 18 on page 68 lists the bandwidth used between sites when cRTP is used. For example:

- If you want to support 10 calls between this site and all other sites, and G.729a voice encoding is used, set the admission control bandwidth to 120 Kbps. Before you enter this value, make sure the bandwidth is available at this site.
- If you set the admission control bandwidth to 256 Kbps and G.729a voice encoding is used, you can support up to 21 calls between this site and all other sites.

ShoreTel recommends that you configure the admission control bandwidth to be less than the bandwidth of the actual WAN link. This provides sufficient bandwidth for call control signaling and other data traffic.

Table 18: Bandwidth with cRTP

Bandwidth in Kbps per Number of Calls	Linear	G.711	ADPCM	G.729a
1	132	68	38	12
2	264	136	76	24
3	396	204	114	36
4	528	272	152	48
5	660	340	190	60
6	792	408	228	72
7	924	476	266	84

Table 18: Bandwidth with cRTP (Continued)

Bandwidth in Kbps per Number of Calls	Linear	G.711	ADPCM	G.729a
8	1056	544	304	96
9	1188	612	342	108
10	1320	680	380	120
11	1452	748	418	132
12	1584	816	456	144
13	1716	884	494	156
14	1848	952	532	168
15	1980	1020	570	180
16	2112	1088	608	192
17	2244	1156	646	204
18	2376	1224	684	216
19	2508	1292	722	228
20	2640	1360	760	240
21	2772	1428	798	252
22	2904	1496	836	264
23	3036	1564	874	276
24	3168	1632	912	288
25	3300	1700	950	300
26	3432	1768	988	312
27	3564	1836	1026	324
28	3696	1904	1064	336
29	3828	1972	1102	348
30	3960	2040	1140	360

To set admission control, determine the expected number of simultaneous intrasite calls for a site and multiply this number by the bandwidth required for each call for your selected intersite encoding.

When admission control is set this way, calls routing between sites will be blocked if placing the call would exceed the number of calls supported by the configured bandwidth.

For information about ShoreTel's Admission Control feature, see Admission Control in the Wide Area Network on page 50.

Setting Admission Control

The Admission Control Bandwidth parameters are set in the Sites edit page of ShoreTel Director. For information on setting these parameters, see the chapter on configuring sites in the *ShoreTel System Administration Guide*.

CHAPTER

4

Routing Calls

This chapter contains information about identifying the appropriate routing for inbound and outbound calls in the following sections:

- Overview 72
- Recommendations 72
- Hunt Groups 73
  - Direct All Calls to an Auto Attendant 73
  - After-Hours Call Routing 75
  - Direct All Calls to a Live Operator 75
  - Direct All Calls to Extensions 79
- Blended Call Routing 80
  - Trunk Considerations 81
  - Analyze Outbound Call Routing 83

Overview

The purpose of this chapter is to help with identifying the appropriate routing for inbound and outbound calls. This information is important for determining the requirements for configuration and trunking.

Before installing a voice communications system, one of the most important decisions to make is how to route incoming calls. The voice communications includes the inbound calls to the ShoreTel customer, its individual employees, or a group of employees. The consideration is important for routing calls to their intended destination and also routing calls when they cannot reach their destination. Calls that fail to reach the intended person or group can then go to an auto attendant, operator, off-site number, pager, cell phone, or voice mail.

Another consideration is the outbound call routing. Every site has trunks that support outbound and inbound calls, and the outbound calling behavior also needs planning. At least one trunk at a site must also be able to support emergency calls.

For information about other aspects of designing a voice communications network, see Planning and System Design on page 25.

Call routing for a ShoreTel Enterprise Contact Center Solution is a separate task. This document does not describe Enterprise Contact Center. For more information on the ShoreTel Enterprise Contact Center Solution, refer to the *ShoreTel Enterprise Contact Center Solution Administration Guide*.

Recommendations

Consider the following recommendations when designing your call flow plan:

- Determine how calls should reach employees and workgroups. You need to identify the desired call routing for inbound calls at each site.
- Identify contingencies, such as alternate plans in the event that the receptionist has an unplanned absence, or the physical phone fails. For example, creating hunt groups can ensure an operator is available if the receptionist or workgroup is unavailable.
- Consider the inter-site call flow, such as your operator's or receptionist's role in handling inbound calls, and the role of others who are not physically present at the main site.
- Identify call flow early. Do not wait until the last minute, or try to identify the call flow the day of cut-over.
- Interview the key members of your organization, such as workgroups, operators, assistants, and executives, to determine their individual preferences and needs, and make sure they agree with any decisions that affect their respective areas.
- Create an off-hours call routing plan.

Hunt Groups

Hunt groups allow you to route calls to a list of extensions. Hunt groups can be accessed through an extension, DID, and/or DNIS. Hunt groups are supported by ShoreTel Voice Switches and remain available even when connectivity to the Headquarters server is lost. A single switch can host up to 8 hunt groups and a maximum of 16 hunt group extensions per switch. A hunt group can be used as the backup destination for an operator or workgroup, so that basic hunting occurs even when the operator or workgroup is not reachable. To maximize reliability, assign hunt groups to a switch close to the majority of the members and/or trunks associated with the hunt group.

Hunt groups can be used for:

- Backup Routing for a workgroup

  Hunt groups can be used when the workgroup server is not reachable because of a network outage or admission control. When the hunt group is set to offer each member a single call at a time, then call offering is similar to a workgroup.

- Hunt Group as a Call Forward Destination

  In a small office where individuals generally receive calls directly, users may want someone in the office to answer calls when they are unable to answer. Hunt groups can provide alternate destinations in this case.

- Distribution of Calls to Backup Operators

  A hunt group can provide backup operators for the primary operator who handles calls to a main company number.

- Common Line Monitoring

  A hunt group can enable users to monitor a phone line. For example, multiple operators can monitor a line and answer calls at the same time.

Direct All Calls to an Auto Attendant

You can direct all inbound calls to the auto attendant, and prompt the calling party to route the call, based on menu options. Auto attendant answering is typically used by smaller companies and smaller locations that do not choose to use direct inward dial (DID) numbers. Refer to Figure 5 for an illustration of auto attendant call flow.

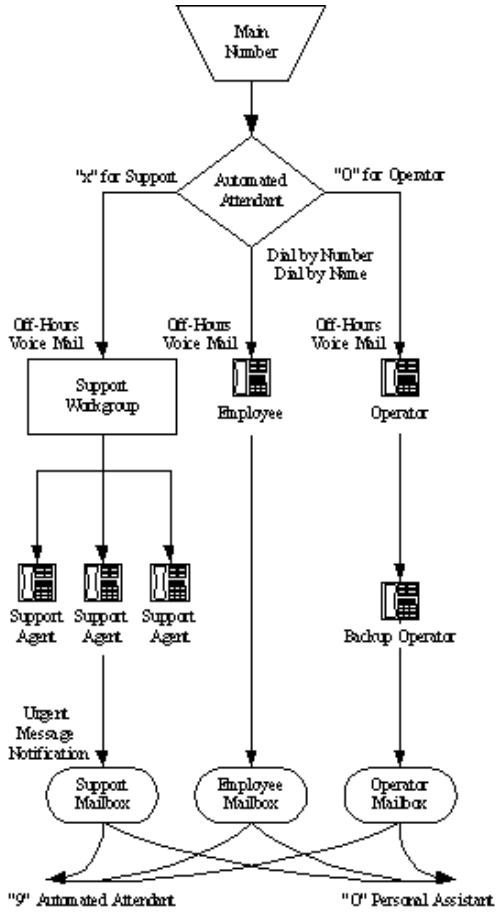

Figure 5: Auto Attendant Call Routing

Organize the auto attendant with options for various departments. In addition, include an out for callers if they must speak to a live attendant or have a rotary telephone. This destination must be one that will always be answered. In many cases, it is a receptionist's extension that is staffed at all times, or a night bell that can be answered by any employee. If you route calls to a receptionist's position that is not always staffed or the receptionist needs to be mobile, consider installing a cordless telephone for the receptionist to wear while roaming around the office. If this is not an option, make sure the receptionist's call handling modes are set up appropriately.

Trunk Considerations

An auto attendant menu can be reached through analog loop-start, digital loop-start, and T1/E1 PRI trunks by pointing the trunk group at the desired menu. You can also reach a specific menu using DID or DNIS entries received over analog wink-start, digital wink-start, or T1/E1 PRI trunks.

The ShoreTel system supports International Caller ID, Caller ID Name, Caller ID Number, ANI, and DNIS. The Caller ID and trunk group or DNIS information is provided to the user to assist in answering the call.

Call Routing and Collecting Caller ID Information

The switch delays each inbound loop-start call by 1.5 rings to collect caller ID information before ringing the user's telephone. This allows caller ID information to reach the user's client at the time the call rings the extension, rather than after it rings the extension.

Features available on trunks vary by trunk type. See Trunk Planning and Ordering on page 85, for more information.

After-Hours Call Routing

For after hours, weekends, and holidays, consider how your call flow will change. Typically, a different prompt is played, since callers are routed directly to voice mail rather than to workgroups or the operator.

Example

In the call flow example shown in Figure 5 on page 74, all calls are received by the auto attendant. The calling party can choose to be directed to one of the following:

- The support workgroup by dialing a digit

  Calls are presented to the support workgroup with a mailbox that provides coverage. The calling party can dial "0" in the mailbox to reach the workgroup assistant, or "9" to return to the auto attendant.

- An employee using Dial by Number or Dial by Name

  Calls are presented to the employee with a mailbox that provides coverage. The calling party can dial "0" in the mailbox to reach the employee's personal assistant, or "9" to return to the auto attendant.

- The operator by dialing the digit 0

  Calls are presented to the operator. If the operator does not answer, a backup operator provides coverage using the operator's call handling modes. If the backup operator does not answer, a mailbox provides coverage, and the calling party can dial "0" in the mailbox to reach the operator's personal assistant, or "9" to return to the auto attendant.

In this example, the workgroup, users, and operator route calls directly to voice mail after hours.

Direct All Calls to a Live Operator

Some companies choose to answer all inbound calls during business hours with a live operator to give callers a more personal experience. If you use a live operator, the most important thing to remember is that the operator's telephone must always be staffed. ShoreTel recommends the following:

- Use the ShoreTel Communicator - Operator Access software, because the standard telephone without ShoreTel Communicator manages only a single call at a time. When a second call arrives, using the Flash button invokes call waiting, generating a swap hold situation in which calls cannot be transferred. This problem is eliminated when you use the ShoreTel Communicator - Operator Access software.

- If the organization is a large one, consider using the ShoreTel IP Phone -BB24 button box. The button box provides additional shortcut functions for ShoreTel IP Phone multiline phones. The button box behaves like an additional set of 24 custom buttons that can be used by the operator to quickly and easily route calls to executives and to other employees who receive a high volume of phone calls. A maximum of 4 BB24 devices can be connected to each multiline phone.
- If the operator does not receive a lot of telephone calls and is required to roam around the office to deliver mail, pick up faxes, make copies, and so on, a two-line cordless telephone can be used. The first line is reserved for incoming calls, while the second line is the operator's personal extension.
- Create hunt groups to ensure someone is always available to take an incoming call.
- You can choose to have calls initially routed to the operator and then forwarded to the auto attendant after a fixed number of rings.

  Operators work in one of two modes:

  - Answer all calls and transfer them to the appropriate destination.
  - Answer all calls and hold them until the parties are found.

If your operator works in the second mode, you should consider installing an overhead paging system or should consider using the Paging Groups feature. Refer to the ShoreTel Administration Guide for details about Paging Groups.

The ShoreTel system supports single-zone overhead paging on a per-site basis, using the audio output jack on the switches supplied with the jack. When you need multiple-zone paging, please use ShoreTel's online knowledge base at www.shoretel.com to access the application note on paging.

Trunk Considerations

The operator can be reached through analog loop-start, digital loop-start, and T1/E1 PRI trunks by pointing the trunk group directly at the operator. You can also reach the operator using DID or DNIS entries received over analog wink-start, digital wink-start, or T1/E1 PRI trunks.

The ShoreTel system supports International Caller ID, Caller ID Name, Caller ID Number, ANI, and DNIS. The Caller ID and trunk group or DNIS information is provided to the user to assist in answering the call.

Features available on trunks vary by trunk type. See Trunk Planning and Ordering on page 85, for more information.

After-Hours Call Routing

If you route all calls to the operator's extension, auto attendant scheduling does not apply; only those calls routed to the auto attendant use the schedule. Therefore, if you want to use the off-hours, holiday, and custom schedules, set the operator's call handling mode to forward all calls to the auto attendant when the operator is unavailable.

Example

To route calls to a prioritized list of backup operators, create hunt groups with users who can serve as backup operators. In this scenario, a primary operator who handles calls to a main company number requires one or more secondary operators to receive the calls when the primary operator becomes too busy.

Complete the following steps to create a hunt group to back up the primary operator:

1. Create a hunt group with backup operators.
2. Enter the main operator and all the backups as members of the hunt group in the order in which they are to serve as backups.
3. Set the hunt group for multiple calls to be hunted to a given member.
4. Set the call stack size for each of the users to control the number of calls he or she can receive.

When there are incoming calls to the hunt group, the primary operator is offered the calls first. The operator may be offered multiple calls concurrently up to the limit of his or her call stack. If a member's call stack is full, the member is skipped and that particular call is not offered again unless the hunt group is set to hunt forever and no member picks up the call before the member is reached again in the hunt list.

If a member of the operator group does not answer the hunt call, the call is offered to the next member after the number of configured rings. Thus, even if the primary operator has room on his or her call stack, the call is offered to the next member in the list when the operator does not answer the call in time.

For more information on Hunt Groups, refer to Hunt Groups on page 149.

Example of Operator Call Routing

In the example call flow shown in Figure 6, all calls are received by the operator, who then transfers the calls to the appropriate destination.

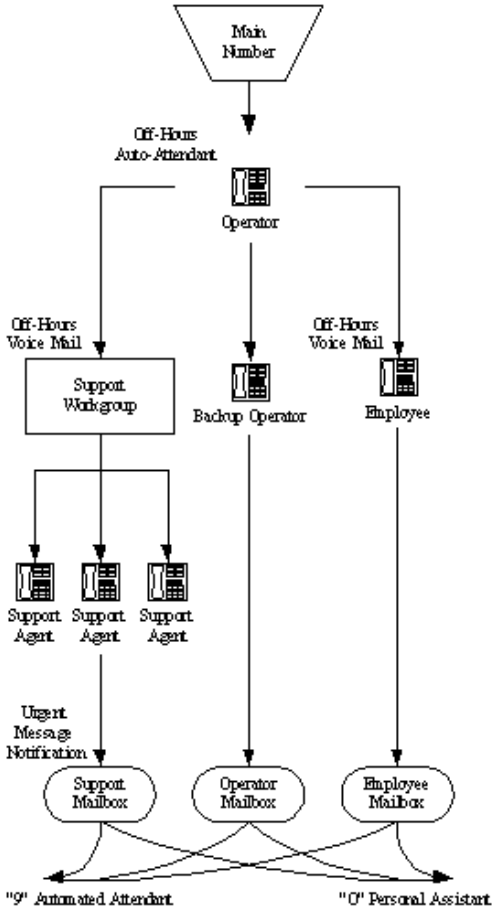

Figure 6: Operator Call Routing

- Calls are transferred to the support workgroup with a mailbox that provides coverage.

  The calling party can dial “0” in the mailbox to reach the workgroup assistant, or “9” to return to the auto attendant.

- Calls are transferred to the employees with a mailbox that provides coverage.

  The calling party can dial “0” in the mailbox to reach his or her personal assistant, or “9” to return to the auto attendant.

- If the operator does not answer, a backup operator provides coverage, using the operator’s call handling modes.

  If the backup operator does not answer, a mailbox provides coverage and the calling party can dial “0” in the mailbox to reach the operator’s personal assistant, or “9” to return to the auto attendant.

In this example, after-hours call routing is handled by an auto attendant in a very similar fashion to the previous example, which is shown in Figure 5 on page 74. To start after-hours call handling, the operator changes his or her call handling mode. This can be done automatically using Microsoft Outlook Calendar in conjunction with Automated Call Handling, although it does require the operator’s personal computer to remain connected with Microsoft Outlook running on it.

Direct All Calls to Extensions

ShoreTel recommends using Direct Inward Dial (DID) trunks so that callers can dial extensions directly without having to go through the operator. This provides the most efficient, professional call handling experience to your customers.

In the event that an individual is not available, preconfigured call handling modes route callers. This routing might include a cellular telephone, a pager, an alternate extension, or a personal assistant. Additionally, consider using the voice mail notification capabilities of the ShoreTel system when employees are not able to answer the telephone but need to stay in touch.

Even if you choose to direct all calls to extensions, you should still configure the auto attendant for Dial by Number, Dial by Name, and zero out to an operator.

Trunk Considerations

When using Direct Inward Dial, you must use analog wink-start, digital wink-start, SIP or T1/E1 PRI trunks. The ShoreTel system can receive Automatic Number Identification (ANI) over analog and digital wink-start trunks as well as Caller ID Number over T1/E1 PRI.

Features available on trunks vary by trunk type. See Trunk Planning and Ordering on page 85, for more information.

After-Hours Call Routing

By routing all calls to the individual extensions, each individual user and workgroup defines its after-hours call handling.

Example of Direct Inward Dial Call Routing

In the illustration shown in Figure 7, all calls are received by workgroups or by individuals.

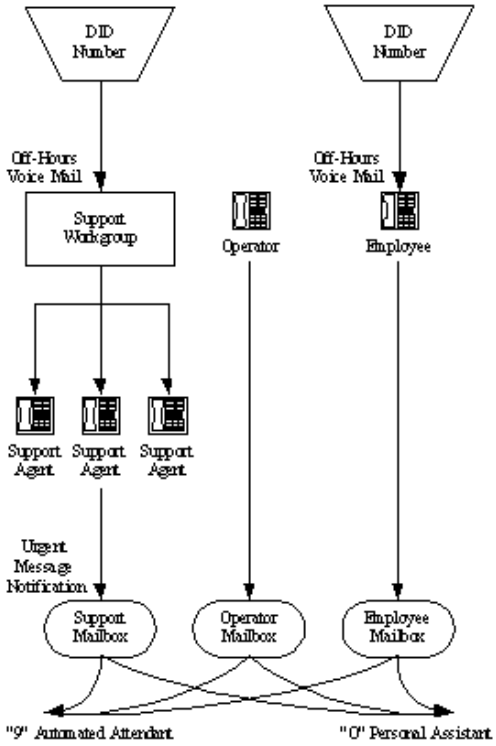

Figure 7: Direct Inward Dial Call Routing

- Calls are routed directly to the support workgroup with a mailbox that provides coverage.

  The calling party can dial “0” in the mailbox to reach the workgroup assistant or “9” to return to the auto attendant.

- Calls are routed directly to the employees with a mailbox that provides coverage.

  The calling party can dial “0” in the mailbox to reach his or her personal assistant, or “9” to return to the auto attendant.

- An operator provides limited call handling functions from individual mailboxes or the auto attendant.

  In this example, after-hours call routing is received by the workgroups and individual employees.

Blended Call Routing

Communication systems typically use a mix of automated, live, and DID call routing to maximize user satisfaction as well as efficiency and flexibility. This usually includes taking a published main telephone number and routing it to the auto attendant, as well as installing DID lines that route calls directly to different workgroups and individual employees.

Trunk Considerations

An auto attendant menu can be reached through analog loop-start, digital loop-start, SIP, and T1/E1 PRI trunks by pointing the trunk group at the desired menu. You can also reach a specific menu using DID or DNIS entries received over analog wink-start, digital wink-start, or T1/E1 PRI trunks.

The operator can be reached through analog loop-start, digital loop-start, and T1/E1 PRI trunks by pointing the trunk group directly at the operator. You can also reach the operator using DID or DNIS entries received over analog wink-start, digital wink-start, or T1/E1 PRI trunks.

The ShoreTel system supports International Caller ID, Caller ID Name, Caller ID Number, ANI, and DNIS. The Caller ID and trunk group or DNIS information will be provided to the user to assist in answering the call.

When using Direct Inward Dial, you must use analog wink-start, digital-wink start, or T1/E1 PRI trunks. The ShoreTel system can receive Automatic Number Identification (ANI) over analog and digital wink-start trunks as well as Caller ID Number over T1/E1 PRI.

Features available on trunks vary by trunk type. See Trunk Planning and Ordering on page 85, for more information.

After-Hours Call Routing

For after hours, weekends, and holidays, you should consider how your call flow will change. Typically, a different prompt should be played, since callers are routed directly to voice mail rather than to workgroups or the operator.

If you route all calls to the operator's extension, auto attendant scheduling does not apply; only those calls routed to the auto attendant use the schedule. Therefore, when you want to use the off-hours, holiday, and custom schedules, set the operator's call handling mode to forward all calls to the auto attendant when unavailable.

By routing all calls to the individual extensions, each individual user and workgroup defines its after-hours call handling.

Example of Blended Call Routing

In the example shown in Figure 8, a mix of inbound call routing is used.

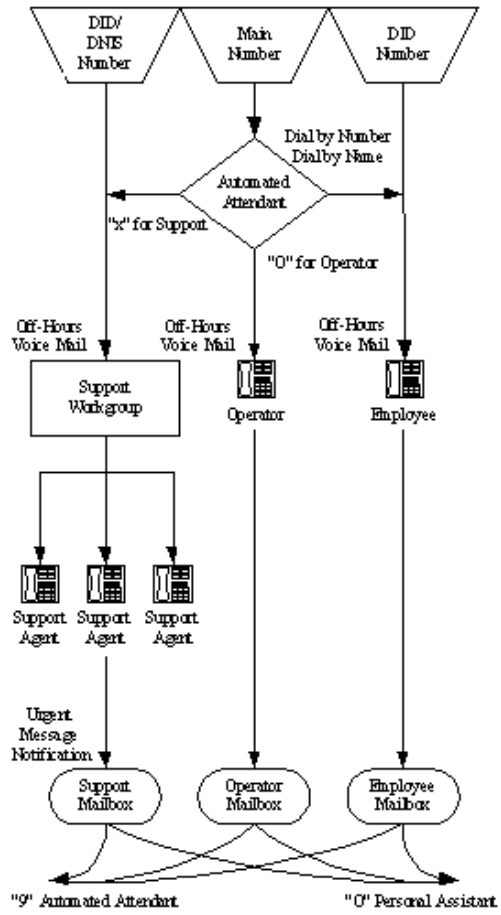

Figure 8: Blended Call Routing

- Calls are routed directly to the support workgroup using DID and DNIS entries and routed through the auto attendant with a mailbox that provides coverage.

  The calling party can dial “0” in the mailbox to reach the workgroup assistant, or “9” to return to the auto attendant.

- Calls are routed directly to the employees using DID and routed through the auto attendant using Dial by Number and Dial by Name with a mailbox that provides coverage.

  The calling party can dial “0” in the mailbox to reach his or her personal assistant, or “9” to return to the auto attendant.

- An operator provides limited call handling functions from individual mailboxes or the auto attendant.

  In this example, after-hours call routing changes at the auto attendant and for each of the workgroups, employees, and the operator, because each workgroup defines its own after-hours call routing.

Analyze Outbound Call Routing

In general, you should have trunks at every site that support both outbound and inbound calling. The following are general facts about outbound trunking:

- ISDN PRI provides the most feature-rich inbound and outbound calling experience.

  This includes the support for Caller ID, DID, and DNIS. Caller ID Number is supported for both inbound and outbound calls. Caller ID Name is supported only on inbound NI-2 trunks with the exception of outbound calls to off-system extensions.

- SIP trunks can be used to place outbound calls.
- Analog wink-start trunks do not support outbound calls.
- You may want to purchase some analog loop-start trunks for emergency dial tone in case of total power failure. For more information, see Analog Loop-Start Trunks (North America) on page 88.
- Calls can be automatically routed across your wide area network (WAN) using the Network Call Routing feature. This allows users to access local and nearby area codes at one site from another site.
- You need to plan for emergency calls, such as 911 in the United States, on your voice system.

  The ShoreTel system supports all the necessary signaling for emergency calls. Refer to the appendix on emergency 911 operations in the ShoreTel Administration Guide for information on how to configure your system for emergency calls.

If your system uses three-digit extensions, ShoreTel recommends that you do not assign x11 extensions to users.

For more information, see Trunk Planning and Ordering on page 85 and Dialing Plan on page 103.

CHAPTER

5

Trunk Planning and Ordering

This chapter provides information about trunk planning and ordering in the following sections:

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Recommendations

The following recommendations assist you in determining your trunk requirements and ordering your trunks from your service provider:

- Make sure you order telephone service early. T1 and PRI service can take up to one or two months to install.
- If you are reusing Centrex lines, be sure to change your old service and remove call waiting, call forwarding, and voice mail.
- When provisioning PRI service, be sure to confirm the protocol being used. The protocol may be NI-2, 4ESS, 5ESS, or DMS-100. Make sure that neither Non-Facility Associated Signalling (NFAS) nor the Call-by-Call feature of the 4ESS is being used, since they are not supported on the ShoreTel system.

Reviewing and Selecting Trunk Types

Trunks provide a connection from the ShoreTel system to a service provider for the purpose of making and taking calls to and from external parties.

Table 19 shows which trunk types are supported on individual ShoreTel Voice Switches. The next section provides more detailed information about the various trunk features.

Table 19: Supported Trunk Types

Voice Switch	Analog Loop-Start (North.Amer.)	Analog Loop-Start EMEA	Digital Loop-Start	Analog Wink-Start	Digital Wink-Start	T1 PRI	E1 PRI	SIP	BRI
ShoreTel 90	Yes	Yes	No	Yes	No	No	No	Yes	No
ShoreTel 90BRI	No	No	No	No	No	No	No	Yes	Yes
ShoreTel 50	Yes	Yes	No	Yes	No	No	No	Yes	No
ShoreTel 30	Yes	Yes	No	Yes	No	No	No	Yes	No
ShoreTel 220E1	No	No	No	No	No	No	Yes	Yes	No
ShoreTel 220T1	No	No	Yes	No	Yes	Yes	No	Yes	No
ShoreTel 220T1A	Yes	No	Yes	No	Yes	Yes	No	Yes	No
ShoreTel T1k	No	No	Yes	No	Yes	Yes	No	No	No
ShoreTel 120	Yes	No	No	Yes	No	No	No	Yes	No
ShoreTel 60	Yes	No	No	Yes	No	No	No	Yes	No
ShoreTel 40	Yes	No	No	Yes	No	No	No	Yes	No

Table 19: Supported Trunk Types(Continued)

Voice Switch	Analog Loop-Start (North.Amer.)	Analog Loop-Start EMEA	Digital Loop-Start	Analog Wink-Start	Digital Wink-Start	T1 PRI	E1 PRI	SIP	BRI
ShoreTel E1	No	No	No	No	No	No	Yes	No	No
ShoreTel T1	No	No	Yes	No	Yes	Yes	No	No	No

Analog Loop-Start Trunks (North America)

Analog loop-start trunks are typically used for inbound calls to a main telephone number that are directed to an auto attendant menu, company operator, or workgroup. A caller can route a call from the auto-attendant to a user extension by entering the extension number or by spelling the user's name from the telephone keypad. Analog loop-start trunks are also used to make outbound calls.

Analog loop-start trunks support the following:

- Inbound calls
- Outbound calls
- Caller ID number
- Caller ID name
- Caller ID blocking

Analog provisioning is provided by the loop-start protocol and Dual-Tone Multi-Frequency (DTMF) signaling.

Analog loop-start trunks are used to provide power-fail transfer to selected telephones — for instance, to the operator, security station, executives, and so on. When there is a complete power failure, including loss of UPS power backup, power-fail transfer connects a specified trunk port to a specified extension port. This power-fail transfer ability provides a dial tone for making and taking critical calls in the event of power failure. Refer to the ShoreTel System Administration Guide for more information about the power-fail transfer port on each ShoreTel Voice Switch that supports this feature.

Centrex lines are analog lines that can be used as analog loop-start trunks. Your organization may already have these installed, and want to use them instead of ordering new loop-start trunks. If you have Centrex lines and do not want to change your primary company telephone number, you can keep Centrex lines. Centrex lines support Caller ID. Be sure to remove the Centrex features, including call waiting, call forward, and voice mail.

EMEA analog loop start trunk support, based on the TBR 21 standard, is supported on all 1U Half Width ShoreTel voice switches. BT type 1, or on hook, caller ID support is based on SIN 227 and SIN 242 standards in the UK.

Analog Loop-Start Trunks (EMEA)

Analog Loop-Start trunks are supported in Europe, the Middle East, and Africa. These trunks use the TBR 21 standard.

Analog loop-start Trunks (EMEA) are typically used for inbound calls to a main telephone number that are directed to an auto-attendant menu, company operator, or workgroup. A caller can route a call from the auto-attendant to a user extension by entering the extension number or by spelling the user's name from the telephone keypad. Analog loop-start trunks are also used to make outbound calls.

Analog loop-start trunks (EMEA) support:

- Inbound calls
- Outbound calls

  BT type 1 (on hook) caller ID support is based on SIN 227 and SIN 242 standards in the UK.

Analog provisioning is provided by the loop-start protocol and Dual-Tone Multi-Frequency (DTMF) signaling.

Analog loop-start trunks are used to provide power-fail transfer to selected telephones — for instance, to the operator, security station, executives, and so on. When there is a complete power failure, including loss of UPS power backup, the ShoreTel Voice Switches provides power-fail transfer. Refer to the ShoreTel System Administration Guide for the power-fail transfer port on each ShoreTel Voice Switch that supports this feature. This power-fail transfer ability provides a dial tone for making and taking critical calls in the event of power failure.

Centrex lines are analog lines that can be used as analog loop-start trunks on the ShoreTel Voice Switches. Your organization may already have these installed, and want to use them instead of ordering new loop-start trunks. If you have Centrex lines and do not want to change your primary company telephone number, you can keep Centrex lines. Centrex lines support Caller ID. Be sure to remove the Centrex features, including call waiting, call forward, and voice mail.

Digital Loop-Start Trunks

Digital loop-start trunks are typically used for inbound calls to the main telephone number that are directed to an auto-attendant menu, company operator, or workgroup. A caller can route a call from the auto-attendant to a user extension by entering the extension number or by spelling the user's name from the telephone keypad. Digital loop-start trunks are also used to make outbound calls.

Digital loop-start trunks support the following:

- Inbound calls
- Outbound calls
- Caller ID number
- Caller ID name
- Caller ID blocking

Digital provisioning is provided by the loop-start protocol and Dual-Tone Multi-Frequency (DTMF) signaling. ShoreTel Voice Switches support the following:

- ESF or D4 framing formats
- B8ZS or AMI line coding.

Analog Wink-Start Trunks (Analog DID)

Analog wink-start trunks allow external callers to dial a user's phone number directly, without having to use an auto-attendant or operator. Analog wink-start trunks support only inbound calls; they are not capable of handling outbound calls.

Analog wink-start trunks support the following:

- Inbound calls (outbound calls are not supported)
- ANI
- DID
- DNIS

Analog provisioning is provided by the wink-start protocol and Dual-Tone Multi-Frequency (DTMF) signaling.

If ANI is being used, the star (*) key must be used to delimit the ANI digits from the DID/DNIS digits — that is:

- <DID>
- <DNIS>
- *<ANI>*<DID/DNIS>*

Digital Wink-Start Trunks

Digital wink-start trunks allow external callers to dial a user's phone number directly, without having to use an auto attendant or operator. Digital wink-start trunks support both inbound and outbound calls.

Digital wink-start trunks support the following:

- Inbound calls
- Outbound calls
- ANI
- DID
- DNIS

Digital provisioning is provided by the wink-start protocol, which is often called E&M wink-start, and Dual-Tone Multi-Frequency (DTMF) signaling.

ShoreTel Voice Switches support the following:

- ESF or D4 framing formats
- B8ZS or AMI line coding

If ANI is being used, the star (*) key must be used to delimit the ANI digits from the DID/DNIS digits — that is:

- <DID>
- <DNIS>
- *<ANI>*<DID/DNIS>*

BRI Trunks

BRI trunks are flexible trunks that support both inbound and outbound calls.

PRI trunks support the following:

- Inbound calls
- Outbound calls
- DID
- DNIS
- Caller ID number
- Caller ID name is supported for NI-2 configured trunks
- QSIG – Calling name is supported if the standard is similar to NI2
- Inbound calling name is fully supported, but outbound calling name is only supported for Off-System Extension calls

Digital provisioning is provided by the PRI protocol and D-channel signaling. ShoreTel Voice Switches support:

- DMS-100, 4ESS, 5ESS, and NI-2 signaling types
- ESF or D4 framing formats
- B8ZS or AMI line coding.

The NFAS and Call-by-Call features are not supported.

T1 PRI Trunks

T1 PRI trunks are flexible trunks that support both inbound and outbound calls.

PRI trunks support the following:

- Inbound calls
- Outbound calls
- DID
- DNIS
- Caller ID number
- Caller ID name is supported for NI-2 configured trunks
- QSIG – Calling name is supported if the standard is similar to NI2
- Inbound calling name is fully supported, but outbound calling name is only supported for Off-System Extension calls

Digital provisioning is provided by the PRI protocol and D-channel signaling. ShoreTel Voice Switch supports the following:

- DMS-100, 4ESS, 5ESS, and NI-2 signaling types
- ESF or D4 framing formats
- B8ZS or AMI line coding.

The NFAS and Call-by-Call features are not supported.

E1 PRI Trunks

E1 PRI trunks are flexible trunks that support both inbound and outbound calls for international locations.

E1 PRI trunks support the following:

- Inbound calls
- Outbound calls
- DID
- DNIS
- Caller ID number
- Caller ID name is supported for NI-2 configured trunks
- QSIG – Calling name is supported if the standard is similar to NI2
- Inbound calling name is fully supported, but outbound calling name is only supported for Off-System Extension calls

The ShoreTel Voice Switches support PRI signaling using Euro-ISDN as well as other international protocols. See International Planning and Installation on page 369.

SIP Trunks

SIP trunks are flexible trunks that support both inbound and outbound calls. SIP trunks are logical trunk end points that only handle SIP call control. Media flows directly between the call initiator and the call terminator.

SIP trunks support the following:

- Inbound calls
- Outbound calls
- Extension, Tandem, and default destinations for inbound calls
- Caller ID name
- Caller ID number
- DID
- DNIS

By default, the **Enable SIP Info for G711 DTMF signaling** check box is not selected. This check box must be enabled for ShoreTel-to-ShoreTel SIP tie trunks or for SIP devices that do not support RFC 2833 for G711.

Understanding Trunk Features

The ShoreTel system supports several different trunk types and trunk features. It is very important to understand the features available on these trunks, since some services are mutually exclusive. Table 20 shows each trunk type and the associated features.

Table 20: Trunk Features

Feature	Analog Loop-Start N.Am.	Analog Loop-Start EMEA	Digital Loop-Start	Analog Wink-Start	Digital Wink-Start	T1 PRI	E1 PRI	SIP	BRI
Inbound:									
Caller ID Number	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Caller ID Name	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes
Direct Inward Dial (DID)	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Dialed Number Identification Service (DNIS)	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes

Table 20: Trunk Features(Continued)

Feature	Analog Loop-Start N.Am.	Analog Loop-Start EMEA	Digital Loop-Start	Analog Wink-Start	Digital Wink-Start	T1 PRI	E1 PRI	SIP	BRI
Outbound:									
Caller ID Blocked	Yes (CO)	Yes (CO)	Yes (CO)	N/A	Yes (CO)	Yes	Yes	Yes	Yes
Caller ID Unblocked	Yes (CO)	Yes (CO)	Yes (CO)	N/A	Yes (CO)	Yes	Yes	Yes	Yes
Caller ID Blocking Override (*67, *82)	Yes	No	Yes	N/A	No	Yes	No	Yes	No

Note

- Via Automatic Number Identification (ANI).
- Caller ID Name is supported for NI-2 configured trunks.
- *67 and *82 codes do not work if the CO requires a pause between the code and the dialed number.

Legend to Table 20

- Yes — Feature is supported.
- No — Feature is not supported.
- Yes (CO) — Feature is provided by the central office (CO) or legacy PBX.
- N/A — Outbound calls are not supported on analog wink-start trunks.

Caller ID Number

Caller ID Number delivers to the ShoreTel system the number of the calling party, which is displayed in the ShoreTel Communicator as well as on Caller ID – compatible telephones. The delivery of the caller ID number can be blocked by the calling party. The caller ID number is delivered unless the calling party has blocked the call, in which case the call is marked as Blocked, or the service provider does not have the information, in which case the call is marked as Unavailable.

Caller ID Number has the following limitations:

- The calling party may block his or her caller ID number.
- The calling party may be calling from a business and the calling number may be incorrect.
- The calling party may be calling from someone else's number.

Caller ID Number is available on analog loop-start, digital loop-start, SIP, T1 PRI, and E1 PRI trunks.

Two different Caller ID Number formats are used to deliver caller information via loop-start trunks: Single Data Message Format (SDMF) and Multiple Data Message Format (MDMF). SDMF provides the calling number, while MDMF provides any combination of calling name and number. The ShoreTel voice switches support both SMDF and MDMF dynamically, without the need for configuration. When PRI is used, the caller ID number is delivered as a D-Channel message.

ShoreTel supports International Caller ID, ensuring that when a switch is configured for a certain site (e.g. Spain), the International ID information is automatically filled in as appropriate for that country. The feature is transparent from the user's standpoint, and no configuration is necessary.

Caller ID Name

Caller ID Name delivers the name of the calling party to the ShoreTel system. The name is displayed in the ShoreTel Communicator as well as on any telephones that support caller ID Name.

By default, the caller ID name is delivered unless the calling party has blocked the transfer of this information, in which case the call is marked as “Blocked”. If the service provider does not have the information, the call is marked as “Unavailable.”

Caller ID Name is available on analog loop-start and digital loop-start trunks, as well as SIP, T1 PRI, and E1 PRI trunks and is only supported on IP phone and analog phones in North America. This feature is not supported on analog phones in other countries.

When using NI-2 signaling on PRI trunks — for example in a tie-trunk scenario — Caller-ID Name is now also captured when available on all inbound calls. For outbound calls, Caller-ID Name is delivered for calls that are made to off-system extensions, but not for outbound calls.

Automatic Number Identification (ANI)

Automatic Number Identification (ANI) delivers the number of the calling party to the ShoreTel system. Although similar to Caller ID Number, ANI is tariffed differently and is not subject to the same blocking restrictions as Caller ID Number. For example, when you purchase ANI services from your service provider, you are always delivered the calling number for 800-number calls. Business practices can vary from region to region.

ANI is available on analog wink-start and digital wink-start trunks.

When ANI is being used, the star key (*) must be used to delimit the ANI digits from the DID/DNIS digits — that is, *<ANI>*<DID/DNIS>*.

Direct Inward Dial (DID)

Direct Inward Dial (DID) allows extensions on the system, such as users, menus, workgroups, route points, and so on, to be accessed directly, without the need of an auto-attendant or operator. This is particularly useful when users on the system want their own telephone number.

DID is available on analog wink-start, digital wink-start, PRI and SIP trunks.

DID numbers are ordered in blocks of 20 or more 10-digit telephone numbers. These numbers are assigned to a customer and are routed to a wink-start, PRI or SIP trunk connected to a voice switch. When a call is made, the service provider sends a predefined set of digits, from 3 to 10 digits, via the wink-start, PRI, or SIP trunk. The voice switches capture the digits and route the calling party to the called party.

If ANI is not being used on wink-start trunks, only the DNIS digits need to be delivered. If ANI is being used, the star (*) key must be used to delimit the ANI digits from the DID/DNIS digits as follows:

- <DID>
- <DNIS>
- *<ANI>*<DID/DNIS>*

Dialed Number Identification Service (DNIS)

Dialed Number Identification Service (DNIS) allows extensions on the system, such as users, menus, workgroups, route points, and so on, to be accessed directly without the need for an auto attendant or operator. This is particularly useful for workgroup and other call center applications. The DNIS information is delivered to the ShoreTel Communicator - Personal Access and stored in the call detail record.

DNIS is available on analog wink-start, digital wink-start, PRI, and SIP trunks.

DNIS numbers are ordered individually and map to a dialed number. When a calling party dials a specific telephone number, the service provider routes the call to a wink-start or PRI trunk connected to a voice switch. The service provider sends a predefined set of digits, from 3 to 10 digits — the DNIS digits — using DTMF signaling or a D-Channel message or SIP message. The voice switches capture the digits and route the calling party to the called party.

If ANI is not being used on wink-start trunks, only the DNIS digits need to be delivered. If ANI is being used, the star (*) key must be used to delimit the ANI digits from the DID/DNIS digits as follows:

- <DID>
- <DNIS>
- *<ANI>*<DID/DNIS>*

Outbound Caller ID

ShoreTel sends the user’s DID number as the caller ID number for outbound calls over PRI or SIP trunks. If the DID number is unavailable, the site Caller Emergency Service ID (CESID) is used. If that number is unavailable, no caller ID is sent.

Additionally, the outbound caller ID can be configured on a per-user basis such that the configured value can take precedence over the user's DID number or the site CESID. Note that this feature is only available on outbound calls using a T1 PRI trunk.

- To send a single main number rather than individual user DID numbers, assign DNIS entries instead of DID numbers to each user. The Site Contact Number will be sent on outbound calls.

- To block all outbound caller ID numbers from being sent, you can configure the PRI trunk group to always block the caller ID number.
- On wink-start and loop-start trunks, the outbound caller ID is defined by the service provider.
- On T1 PRI and loop-start trunks, users can override the Caller ID Blocking configuration on a call-by-call basis by using commands at the telephone, such as *67, *82. Users cannot override the Caller ID Blocking configuration of wink-start and E1 PRI trunks.

For more information on configuring outbound caller ID, please refer to the ShoreTel System Administration Guide.

Tandem Trunking

Tandem trunking allows legacy voice systems to utilize a ShoreTel system for outbound dialing. The ShoreTel system supports both user-side and network-side PRI, allowing ShoreTel systems to flexibly support digital tie trunks to other systems.

You can enable tandem trunking support for any PRI trunk group with a check box in ShoreTel Director. Tandem calls are associated with a user group for outbound trunk selection. Inbound calls recognized as tandem calls are redirected to an outbound trunk based on user group call permissions and trunk group access. When needed, a “dial-in prefix” can be specified that is prepended to digits collected on tandem calls. The concatenated set of digits is then used in outbound trunk selection for the tandem call.

Tie Trunks

The addition of network-side PRI support makes PRI tie trunks easier and more compelling to deploy. ShoreTel Voice Switches that support T1 PRI can act as either the user-side or network-side of a PRI tie trunk. The tie trunk may be used to tie a ShoreTel system to a legacy voice system, or potentially to another independent ShoreTel system.

Performing Traffic Calculations

The number of trunks required on your system will vary depending on the number of users and your specific application needs. It is important to order your trunking correctly; too few can lead to blocked calls when all trunks are busy, and too many trunks can lead to wasted money on monthly access charges.

For information about calculating the trunk requirements, refer to Planning and System Design on page 25.

Ordering Telephone Service

Once you have determined the types of trunks you need, you will have to either place a new order or make a change order. You can use the associated Telephone Service Order Forms that are available on the ShoreTel USB flash drive or on the ShoreTel support web site. Three order forms are provided for your use:

- Analog Service
- T1 Service
- T1 PRI Service

ShoreTel does not provide an E1 PRI form because this service varies by country. Instead, we provide a table of the E1 PRI parameters that must be set. See International Planning and Installation on page 369, for more information.

When the form is completed, arrange a meeting with your telephone company service representative to order the new telephone services. The forms contain specific information that the service representative must have before services can be ordered.

Before ordering your telephone service, pay special attention to the installation date and time, as follows:

- If you are ordering new service, it should be installed one week before the planned cut-over date. This allows the services to be terminated on the ShoreTel system and tested before cut-over.
- If you are changing existing service, any changes before the cut-over date might render your existing service unusable. You must schedule these changes outside normal business hours and work closely with your service provider for a seamless transition.

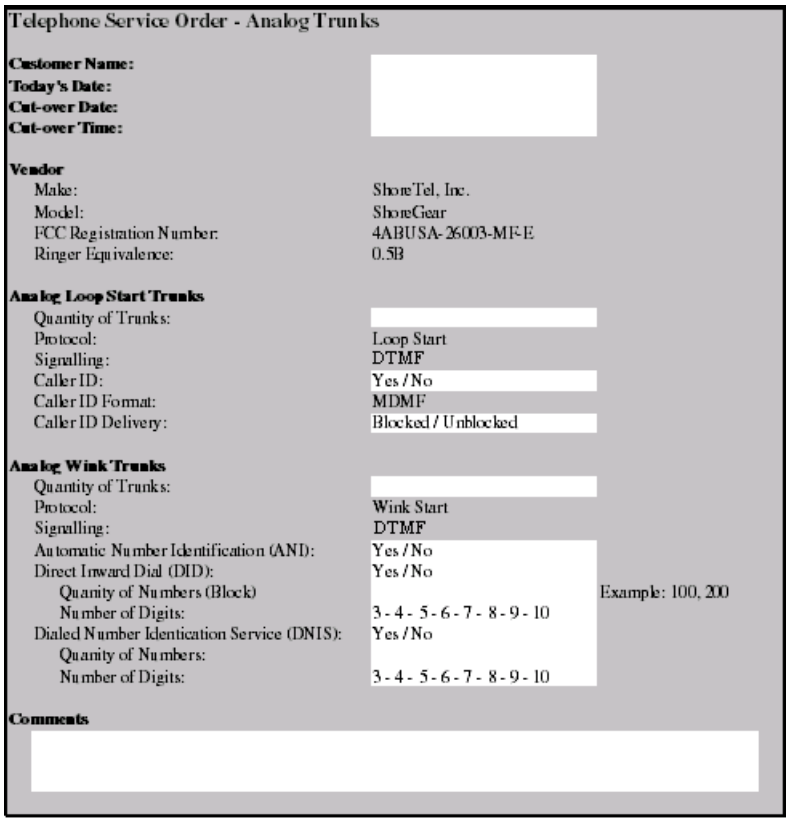
When ordering DID service, the last digits of the DID numbers should match your extension numbers for ease of use. You must make sure your extension numbers do not begin with a trunk access code, zero, or any emergency numbers such as 911 in North America.

Please see the appendix on emergency 911 operations in the ShoreTel System Administration Guide for information on how to configure your system for emergency calls.

Analog Service

Note the following before requesting analog service from a telephone service provider:

- Caller ID Name and Number are supported on loop-start trunks
- ANI is supported on wink-start trunks
- ANI on wink-start trunks must be delivered as *<ANI>*<DNIS>*



Telephone Service Order - Analog Trunks

Customer Name:
Today's Date:
Cut-over Date:
Cut-over Time:

Vendor
- Make: ShoreTel, Inc.
- Model: ShoreGear
- FCC Registration Number: 4ABUSA-26003-MF-E
- Ringer Equivalence: 0.5B

Analog Loop Start Trunks
- Quantity of Trunks:
- Protocol: Loop Start
- Signalling: DTMF
- Caller ID: Yes / No
- Caller ID Format: MDMF
- Caller ID Delivery: Blocked / Unblocked

Analog Wink Trunks
- Quantity of Trunks:
- Protocol: Wink Start
- Signalling: DTMF
- Automatic Number Identification (ANI): Yes / No
- Direct Inward Dial (DID): Yes / No
  - Quanity of Numbers (Block) — Example: 100, 200
  - Number of Digits: 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10
- Dialed Number Identication Service (DNIS): Yes / No
  - Quanity of Numbers:
  - Number of Digits: 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10

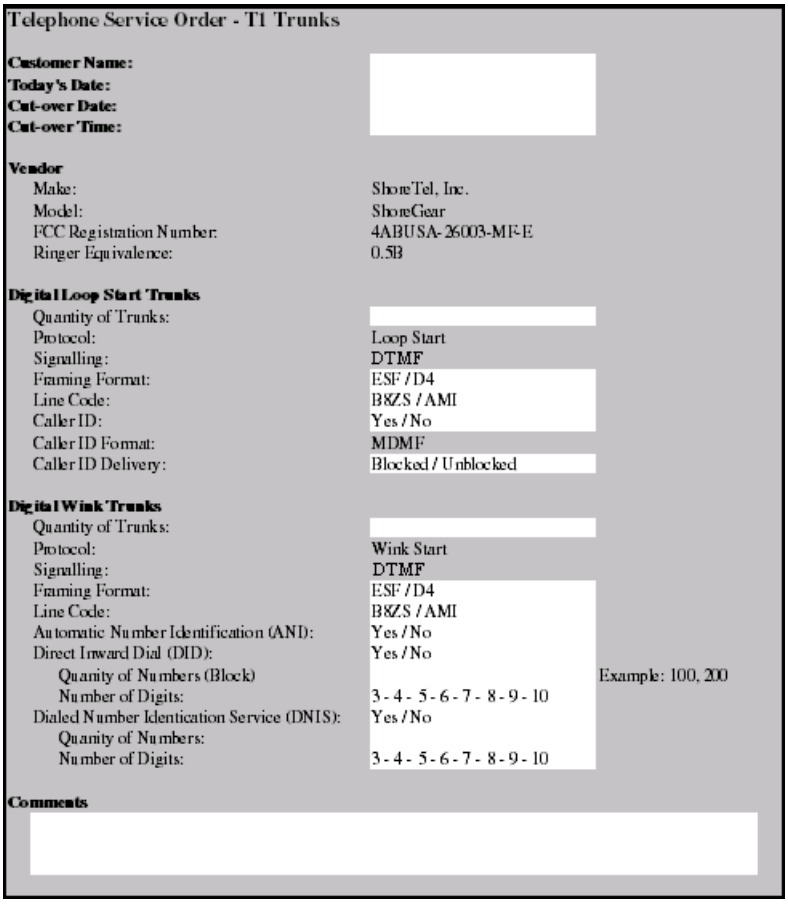
Comments

Figure 9: Telephone Service Order Form—Analog Trunks

T1 Service

Use the T1 Telephone Service Order form, shown in Figure 10, to order T1 trunks. Note the following about T1 service:

- Caller ID Name and Number are supported on loop-start trunks
- ANI is supported on wink-start trunks
- ANI on wink-start trunks must be delivered as *<ANI>*<DNIS>*A channel service unit (CSU) is built into the voice switch



Telephone Service Order - T1 Trunks

Customer Name:
Today's Date:
Cut-over Date:
Cut-over Time:

Vendor

Make:	ShoreTel, Inc.
Model:	ShoreGear
FCC Registration Number:	4ABUSA-26003-MF-E
Ringer Equivalence:	0.5B

Digital Loop Start Trunks

Quantity of Trunks:		
Protocol:	Loop Start	
Signalling:	DTMF	
Framing Format:	ESF / D4	
Line Code:	B8ZS / AMI	
Caller ID:	Yes / No	
Caller ID Format:	MDMF	
Caller ID Delivery:	Blocked / Unblocked	

Digital Wink Trunks

Quantity of Trunks:		
Protocol:	Wink Start	
Signalling:	DTMF	
Framing Format:	ESF / D4	
Line Code:	B8ZS / AMI	
Automatic Number Identification (ANI):	Yes / No	
Direct Inward Dial (DID):	Yes / No	
Quanity of Numbers (Block)		Example: 100, 200
Number of Digits:	3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Dialed Number Identication Service (DNIS):	Yes / No	
Quanity of Numbers:		
Number of Digits:	3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	

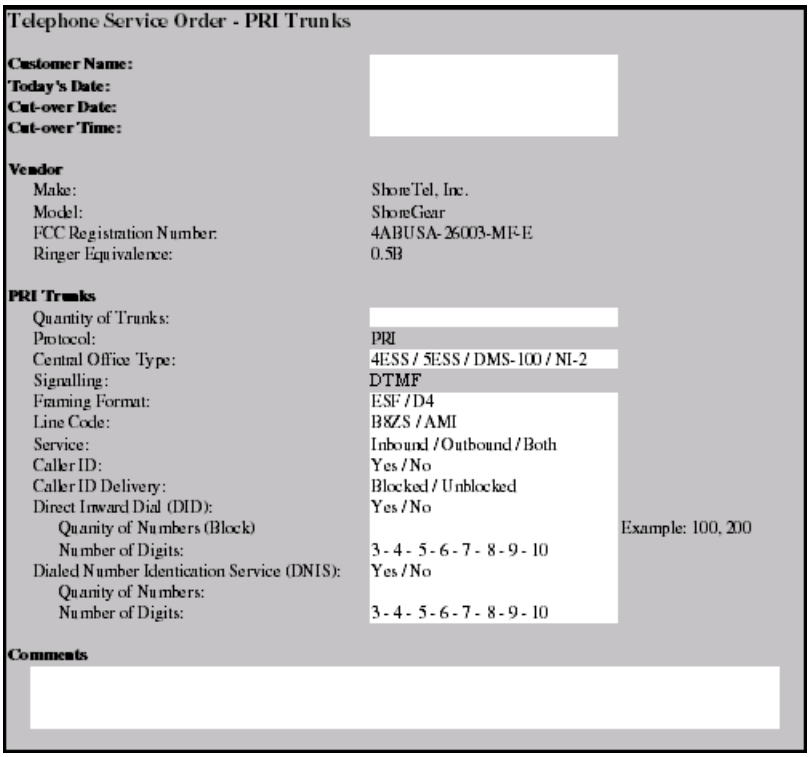
Comments

Figure 10: Telephone Service Order Form—T1 Trunks

T1 PRI Service

Use the T1 PRI Telephone Service Order form, shown in Figure 11, to order T1 PRI trunks. Note the following about T1 PRI service:

- Caller ID Number is supported on T1 PRI trunks. Caller ID Name is supported in NI-2 configured trunks.
- A channel service unit (CSU) is built into the voice switch.



Telephone Service Order - PRI Trunks

Customer Name:
Today's Date:
Cut-over Date:
Cut-over Time:

Vendor

Make:	ShoreTel, Inc.
Model:	ShoreGear
FCC Registration Number:	4ABUSA-26003-MF-E
Ringer Equivalence:	0.5B

PRI Trunks

Quantity of Trunks:		
Protocol:	PRI	
Central Office Type:	4ESS / 5ESS / DMS-100 / NI-2	
Signalling:	DTMF	
Framing Format:	ESF / D4	
Line Code:	B8ZS / AMI	
Service:	Inbound / Outbound / Both	
Caller ID:	Yes / No	
Caller ID Delivery:	Blocked / Unblocked	
Direct Inward Dial (DID):	Yes / No	
Quanity of Numbers (Block)		Example: 100, 200
Number of Digits:	3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Dialed Number Identication Service (DNIS):	Yes / No	
Quanity of Numbers:		
Number of Digits:	3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	

Comments

Figure 11: Telephone Server Order Form—PRI Trunks

Ordering Service

When you order service, be sure to do the following:

- State that a new ShoreTel system is being installed.
- State the date and time the new telephone service must be cut over.
- Review all the items on the telephone service order form with the service representative.
- Review any existing and new telephone numbers and have the telephone company representative confirm the order.

E1 PRI Service

See International Planning and Installation on page 369, for more information about ordering E1 PRI service.

CHAPTER

6

Dialing Plan

This chapter provides an overview of the dialing, call routing, and digit-manipulation capabilities of the ShoreTel system in the following sections:

Overview 104
Dialing 104
Define Digit Collection 104
Configuring Internal Numbers 104
Configuring External Numbers 107
Define Digit Manipulation 110
On-Net Dialing 112
Quick Reference of Star Codes 118
Common Star Codes 118
Extension Assignment Star Codes 119
Trunk Star Codes 120

Overview

This chapter provides an overview of the dialing, call routing, and digit-manipulation capabilities of the ShoreTel system. The information in this chapter is useful for administrators of larger, multisite installations.

Dialing

When a phone number is dialed in a ShoreTel system, the system performs two distinct operations on a telephone number:

- Digit collection — Voice switches collect the digits in a telephone number.
- Digit manipulation — The switches manipulate the dialed numbers before outpulsing them to the service provider.

Define Digit Collection

When someone picks up a telephone in a ShoreTel system and begins dialing a telephone number, the voice switch software (or, on ShoreTel 400-Series IP phones, the phone software) examines each digit in the number and determines whether digit collection should continue or be terminated.

Configuring Internal Numbers

In a ShoreTel system where users dial internal numbers without an access code, the rules for digit collection are relatively straightforward.

Digit collection rules are configured through ShoreTel Director. To view the Dialing Plan edit page, click **Dialing Plan** under System Parameters. Figure 12 shows the Dialing Plan edit page.

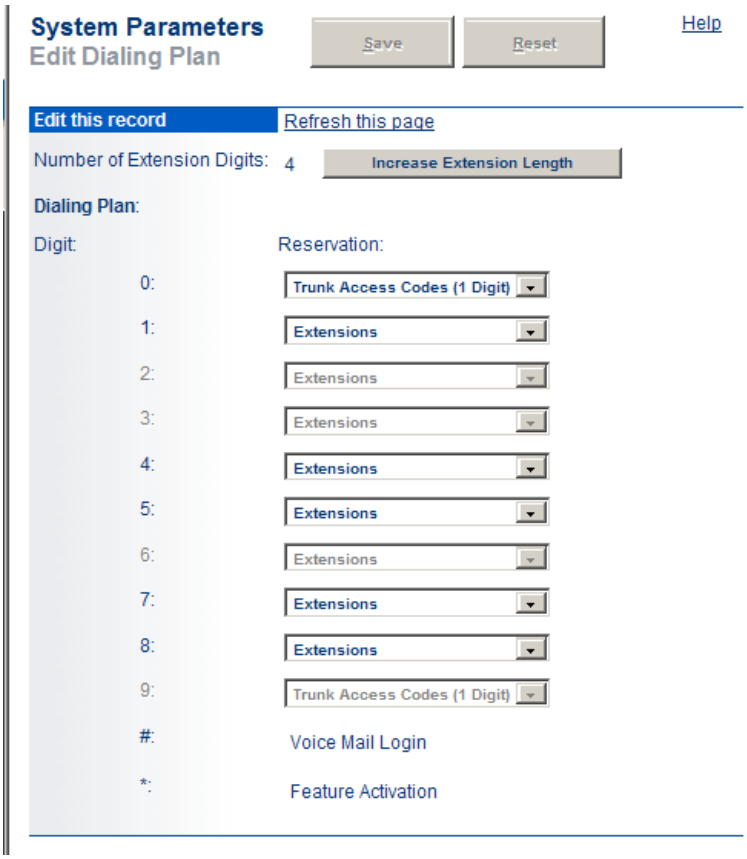


Figure 12: Dialing Plan Edit Page

Planning Your Dialing Configuration

When setting up a dialing plan for internal numbers, you need to consider the following:

- Choose an extension length. ShoreTel supports 3-, 4-, and 5-digit dialing for internal numbers. 4-digit dialing works for most enterprises. Use an extension number scheme that conforms to your company's size and the convenience of your users.
- Map extension ranges. After choosing the extension length, you can allocate blocks of numbers for use by extension, starting with the first number.

  For example, if you want to reserve the range of numbers 3000-3999 for extension assignment, you allocate the "3" number block for extensions.

For maximum usability, map extension numbers to the final digits of your DID (if DID is used).

Note

Extensions cannot begin with the following combinations that include 911: 911, 911x, or 911xx.

Digit Collection Rules

When routing calls, the ShoreTel system follows the digit collection rules specified on the Dialing Plan edit page in ShoreTel Director.

For the first digit collected, specific rules are in effect.

Table 21: Digit Collection Rules

Digit	Rule
0	By default, 0 is configured in the dialing plan as the Operator digit. However, 0 can be configured as a trunk access code, and some other digit can be configured as Operator. Digit collection is stopped and the call is routed to the site operator or to provide trunk access.
#	Digit collection is stopped and the call is routed to voice mail login.
Any other digit	Digit collection continues until a complete extension number is dialed. If the number is valid, the call is routed to the extension. For valid off-system extensions, the call is routed to a trunk. For invalid extensions, the call is routed to the Backup Automated Attendant. This rule does not apply to trunk access codes.

Exception for 911 Emergency Calls

Emergency calls do not require an access code. The following rules apply only to emergency 911 calls:

- If “911” is dialed, the switch routes the call to a 911-capable trunk group associated with the caller’s User Group.
- Before switching the emergency call, the switch invokes a brief timeout for insurance against accidental 911 calls. If any digit is entered during the timeout, the switch routes the call to the Backup Automated Attendant.

Although this section focuses on emergency calls made within the United States, the same rules apply in other countries. Refer to the appendix on emergency 911 operations in the ShoreTel System Administration Guide for information on how to configure your system for emergency calls.

Defining digit collection for internal numbers

In ShoreTel Director, go to the Dialing Plan edit page under System Parameters and edit the dialing plan parameters.

Changing Extension Length

Note

Once you increase an extension length, you cannot decrease an extension length. For example, once it is increased to 4, the minimum is 4.

The ShoreTel system supports 3-, 4-, and 5-digit extensions.

Complete the following steps to change the extension length:

1. Click **Increase Extension Length**.
2. Specify 4 or 5 digits for the increased length.

If your system uses 3-digit extensions, ShoreTel recommends that you do not assign x11 extensions to users.

Configuring External Numbers

The ShoreTel system supports 1-, 2-, and 3-digit trunk access codes. When an access code is dialed, the system looks for a valid digit in the parameters.

If an invalid number is dialed, the system plays a recording to the calling party.

There are several types of valid telephone numbers, which are described in the following sections.

The ShoreTel system allows the system administrator to provide users at each site with a unique dialing plan to match the dialing plan of the site's geographic region. The ShoreTel system supports 7-digit local dialing, 10-digit local dialing, and mixed local dialing.

External numbers are converted into a standard "canonical format" by call control software to provide a globally consistent way of handling phone numbers. The canonical format starts with a "+" representing the international prefix, followed by the country code, area code, and subscriber number.

- External numbers that can be converted into canonical format are considered "routable" and will leverage the network call routing feature of the call control software.
- External numbers that are unique to the country (n11, 112, 911, and so on) are considered "unroutable" and will not leverage the network call routing software. These calls will be placed from the local site or the associated proxy site.

Configuring 7-Digit Local Dialing

The Local Area Code on the Site edit page, shown in Figure 13, defines 7-digit dialing for all users at the site. When a user dials an access code followed by 7 digits, the switching software assumes the site local area has been dialed. The switching software then converts the 7-digit number into canonical format before checking call permissions and doing network call routing.

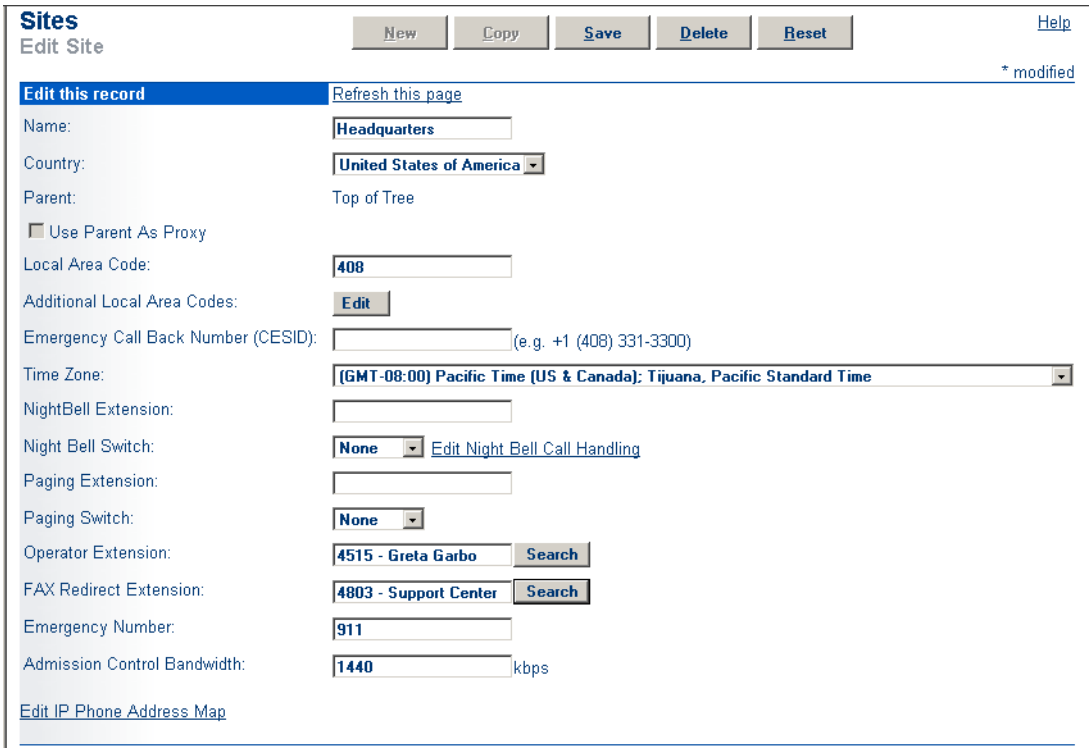


Figure 13: Site Edit Page

The Local Area Code and Additional Local Area Codes set on the Site edit page have nothing to do with the Local Area Code, Additional Local Area Codes, and Nearby Area Codes on the Trunk Group edit page. Area codes on the Site edit page relate only to digit collection, whereas those on the Trunk Group edit page relate only to Network Call Routing and Digit Manipulation.

Complete the following steps to define 7-digit dialing:

1. Open the Site edit page in ShoreTel Director.
2. Enter the 3-digit area code in **Local Area Code**.

Configuring 10-Digit Local Dialing

If the site is in a location with overlay area codes, it can be configured to support 10-digit dialing for all the local area codes. The Additional Local Area Codes field on the Site edit page defines the area codes for 10-digit dialing. When a user dials an access code followed by a local area code, the system collects 7 additional digits, which comes to 10 digits total, before stopping digit collection. The switching software then converts the 10-digit number into canonical format before checking call permissions and doing network call routing.

Defining 10-digit dialing

1. Open the Site edit page in ShoreTel Director.
2. Click **Edit** next to the **Additional Local Area Codes** field.

The Additional Local Area Codes dialog box, shown in Figure 14, appears.

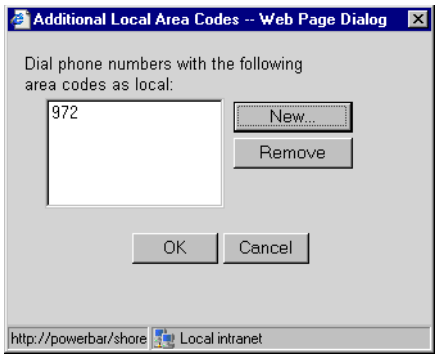


Figure 14: Additional Local Area Codes Dialog Box

Configuring Mixed Dialing in the Same Area

In locations where users are forced to dial 7 digits for some prefixes and 1+10 digits for other prefixes in the same area, the ShoreTel system supports permissive dialing — that is, you can dial these numbers either as 7 digits or as 1+10 digits. It also supports permissive dialing in locations with mixed 10-digit and 1+10 digit dialing in the same area.

From a digit-manipulation, or outpulsing, point of view, the trunk group must be configured properly because some service providers do not support permissive dialing. See Define Digit Manipulation on page 110.

1+10 Digit Long-Distance Dialing

The ShoreTel system supports long-distance dialing. When a user dials an access code followed by “1,” the software collects 10 additional digits before stopping digit collection.

International Dialing

The ShoreTel system supports international dialing. If the user dials a trunk access code followed by an international access code, digit collection is terminated after a timeout. The timeout can be bypassed by dialing pound (#).

n11 Dialing

The ShoreTel system supports “n11” dialing, including 411 for information and 611 for support. If the user dials an access code followed by “n11,” digit collection is terminated after a brief timeout and the call is routed to a trunk.

If your system uses three-digit extensions, ShoreTel recommends that you do not assign x11 extensions to users.

911 Dialing

The ShoreTel system supports 911 dialing to emergency services. If the user dials an access code followed by “911,” digit collection is terminated immediately and the call is routed to a trunk.

911 calls are routed out of the local site's associated trunks. If there are no 911 trunks available at the local site, the call is routed via the designated proxy site.

Explicit Carrier Selection (101xxxx) Dialing

The ShoreTel system supports explicit carrier selection. If the user dials an access code followed by "101," the next four digits collected are for explicit carrier selection (101xxxx). The carrier information is retained and passed to the trunk.The digits collected are treated as unroutable calls; the digits are routed "as-is" out either local site or proxy site trunks only.

Operator-Assisted (0, 00) Dialing

The ShoreTel system supports operator-assisted dialing. If the user dials an access code followed by "0x," digit collection is terminated after a brief timeout and the call is routed to a trunk.

Vertical Service Code (*67, *82) Dialing

The ShoreTel system supports some vertical service codes for feature activation. If the user dials an access code and then the star (*) button, the system collects the subsequent digits and then terminates after a brief timeout. The digits collected are treated as unroutable calls — they are routed "as-is" out either local site or proxy site trunks only. If the trunk is a PRI or SIP trunk, the trunk strips and interprets *67 to block outbound Caller ID, and *82 to unblock outbound Caller ID.

End Digit Collection (#)

In some cases, digit collection ends after a timeout period. To bypass the timeout and immediately send the call, the caller presses the (#) button.

Define Digit Manipulation

Once the route decision has been made, the call is passed to the trunk. The dialed number, which is normally passed within the system in canonical format, is examined and manipulated based on the trunk group configuration. This ensures that the number can be properly received by the service provider.

First, the trunk access code dialed by the user is removed. If the number is in canonical format, which is local, long distance, ERC, or international, digit manipulation can occur. If the number is unroutable, which is n11, ECS, operator, and vertical service code numbers, digit manipulation, other than the dial-out prefix, is not applied.

Specifying trunk digit manipulation

1. Open the Trunk Digit Manipulation page, shown in Figure 15.

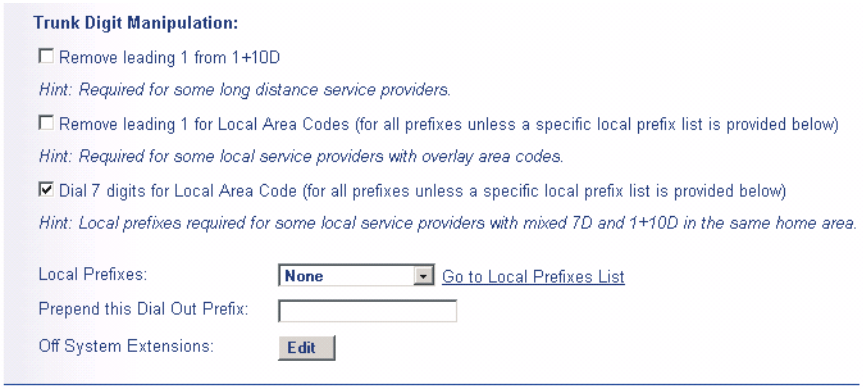


Figure 15: Digit Manipulation on the Trunk Group Edit Page

2. Select the options and specify numbers as needed, using Table 22 as a guide.

Table 22: Digital Manipulation Options

Option	Description	Example
Remove leading 1 from 1+10D	This option is required by some long-distance service providers that only accept numbers dialed as 10 digits.	AT&T typically only supports 10-digit dialing.
Remove leading 1 for Local Area Codes	This option is required by some local service providers that have mixed 10-digit and 1+10 digit dialing in the same area code. Local Area Codes include both the Local Area Code and Additional Local Area Codes configured against the trunk group.	Atlanta has three local area codes that must be dialed as 10 digits. This could also be called “Dial 10 digits for Local Area Codes.”
Dial 7 digits for Local Area Code	This option is required by some local service providers that have mixed 10-digit and 1+10 digit dialing in the same area code.	Massachusetts and Maine.
Prepend this Dial Out Prefix	The Dial Out Prefix is prepended to the number. This feature is typically used when connecting the ShoreTel system to a legacy PBX system using a ShoreTel voice switch. The Dial Out Prefix enables the ShoreTel system to seize a trunk on the legacy PBX. The Dial Out Prefix is not applied to Off-System Extensions.	Not applicable.

Table 22: Digital Manipulation Options(Continued)

Option	Description	Example
Vertical Service Codes	If a Vertical Service Code was dialed, digit manipulation rules do not apply. Vertical Service Codes work with ISDN PRI and SIP trunks and some loop-start trunks. With PRI and SIP trunks, Vertical Service Codes for Caller ID Blocking control will be converted to D-Channel messages. With loop-start trunks, the service provider must be able to accept the outpulsed digits with only 50 msecs of pause between each digit, including the service codes. Vertical Service Codes are typically not supported by service providers on wink-start trunks. If you have outbound access on wink-start trunks and you dial a vertical service code, you will likely get an error message from the service provider.	Not applicable.
Off System Extensions	Off System Extensions define ranges of extensions that when dialed will be routed out of this trunk group. This is typically used to interface to a legacy PBX system using a T1 or E1 circuit provided by a ShoreTel voice switch. Off-system extensions digits can be manipulated using a translation table. Digit manipulation, including the Dial Out Prefix, will not be applied to these calls.	Not applicable.

On-Net Dialing

ShoreTel supports On-Net Dialing (OND), an enhancement that allows users to create more flexible dialing plans than before. The On-Net Dialing feature allows users to divide phone numbers into two separately-managed parts:

- Extension prefix - typically 3 digits in length; similar in concept to a site code

- User extension - typically 4 digits in length; acts as the number you would dial to reach other users in your organization

By dividing phone numbers into two parts, the OND feature provides customers with a more seamless method of migrating from their legacy phone systems to the newer ShoreTel system. OND allows customers to preserve their existing dialing plans when integrating ShoreTel equipment with their legacy equipment. While previous releases allowed customers to integrate ShoreTel equipment with their legacy PBX, the configurations needed to maintain the customer's existing dialing plan were complex and the complexity increased with the number of people and extensions involved.

For example, if one company acquired another company and the two companies wanted to merge their phone systems, then no two users could have the same user extension, even if they were at different sites with different prefixes.

With OND, users can call other users within a site by dialing only the user extension. For inter-site calls, the users press the numbers of the prefix and the user number. Legacy PBX systems still use off-system extensions (OSEs) to route inbound calls.

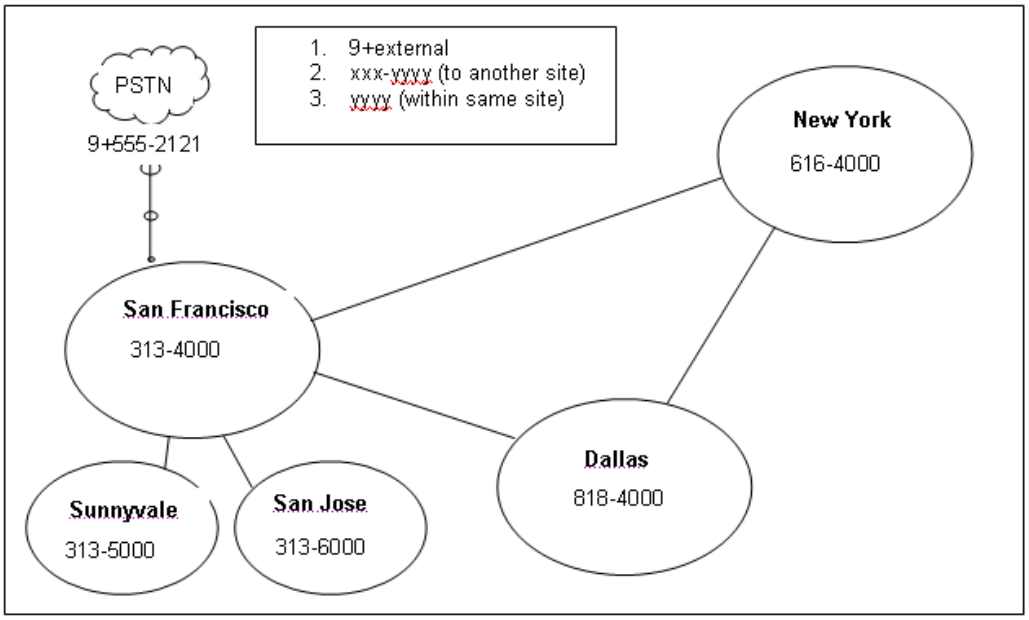


Figure 16: Abbreviated Four-digit Dialing with Extension Prefix

As Figure 16 shows, On-Net Dialing assigns extension prefixes to each site or to a group of sites. All calls are placed on the network if they are within the same prefix, and the user need only dial the user extension. Calls preceded with the trunk access code, which is usually 9, are sent to the PSTN.

Benefits of On-Net Dialing

- Scalability — For larger organizations, On-Net Dialing enables the creation of a common and consistent dialing plan that can be replicated throughout an organization that has many offices. For example, a department store might have a phone in each of its different departments with one for clothing, furniture, kitchenware, etc. With On-Net Dialing, a user can assign the extensions of 4000, 5000, 6000, and 7000 to each of these departments. By modifying the 3-digit site code/ extension prefix at each location, this approach of assigning 4-digit extensions to departments can

be replicated across an entire department store, nationwide, so that a user who knows the extension for the automotive department in one city could travel to another city and would know how to reach the automotive department if he knew the site code.

- Preserve existing legacy dialing plans — To preserve the existing dialing plans when adding ShoreTel equipment to a deployment with legacy equipment, assign a new prefix to each new site or to users on the new ShoreTel system.
- Legacy integration via OSEs (Off-System Extensions) — Ability to call multiple legacy PBXs from the ShoreTel system.
- Multi-tenant — On-Net Dialing allows a landlord to maintain one phone system at a building that houses two or more businesses or organizations in such a way that neither organization is aware that the infrastructure or trunk lines are being shared. Despite the fact that both organizations are in the same building, you can assign different prefixes to each company and could then hide one organization's phone numbers from the other group so that neither group would see the other.

Configuration

The process of configuring On-Net Dialing consists of the following tasks:

- Planning and configuring the dialing plan
- Adding sites
- Associating an extension prefix with a site
- Assigning user extensions

The following sections include details for each of these tasks.

Note

ShoreTel's Small Business Edition does not support On-Net Dialing.

Enabling On-Net Dialing is an irreversible process. It permanently changes the database. Therefore, plan carefully before proceeding with the configuration.

Planning and Configuring the Dialing Plan

Assigning extension prefixes to a specific digit must be done all at once. Once the dialing plan window, which is shown below, has been configured and saved, there is no way to make changes to the extension prefix assignments without erasing the database and starting all over. Therefore, we recommend carefully planning and reviewing your dialing plans before configuring the dialing plan window.

Complete the following steps to configure the dialing plan using Director:

1. Launch **ShoreTel Director** and enter the user ID and password.
2. Click the **Administration** link to expand the list if it has not already been expanded.
3. Click the **System Parameters** link and then the **Dialing Plan** link to display the Edit Dialing Plan window, as shown below:

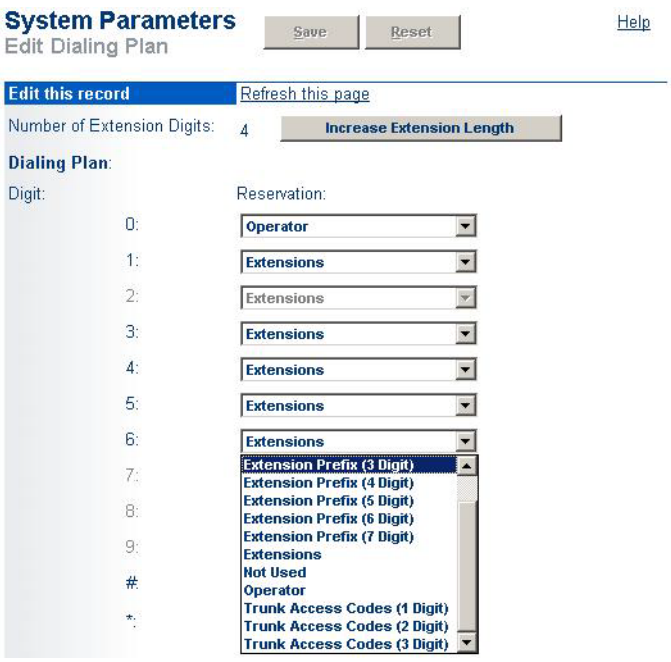


Figure 17: Configuring dialing plan

4. Click the drop-down menu to the right of the desired digit and select the number of digits you would like the extension prefix, such as a site code, to contain. Extension prefixes can range from 1 to 7 digits in length. The leading digit determines the length of the prefix. Extension prefixes with different leading digits do not have to contain the same number of digits.

5. Repeat this process for any other extension prefixes, unused extensions, or trunk access codes.

6. Click **Save** to store your changes. The Configure Extension Prefix Warning dialog box, similar to the one in Figure 18, appears with a list of each of the sites in your system.

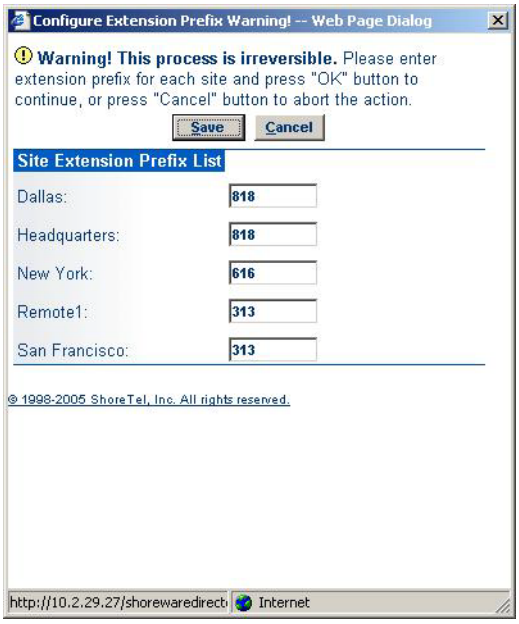


Figure 18: Make sure to back up your system before clicking Save

The Extension Prefix Warning message lists each site in your system. Next to the list of sites you will find a blank field that requires you to enter the desired extension prefix.

Note

This prefix will be applied to every dialable number at that particular site, so if the site is an existing one, they will see their phone numbers converted to the new prefix.

System extensions are not associated with a hard port in the system. They are always global and will have a user number and a null extension prefix. Therefore, these system extensions are not affected by changes made to the extension prefix in the Edit Dialing Plan window. Only dialed numbers, such as user extensions, menus, workgroups, and distribution lists, are affected by changes to the extension prefix.

7. Click the **Save** button to store your changes.

Adding Sites

You can add the sites via ShoreTel Director before configuring your dialing plan, or you can configure your dialing plan and then add sites at a later time. To add a site via Director, follow the procedure below:

1. Launch ShoreTel Director and enter the user ID and password.
2. Click the **Administration** link to expand the list if it has not already been expanded.
3. Click the **Sites** link.
4. Click **Add a new site** in the drop-down menu and select the country where the site will be added.

5. Click the **Go** link to display a window similar to the one shown below.

Figure 19: Add a new site

6. Enter the name of the site, along with all other relevant information, in the appropriate fields. Refer to Chapter 3, ShoreTel Sites on page 79 in the ShoreTel System Administration Guide for additional information on configuring this window.

   The Extension Prefix field will not appear in this window until after you have modified the Dialing Plan window, which is covered in the next task.

7. Click **Save** to store your changes.

8. Repeat this process to add any other sites that you would like to include in the dialing plan.

   Once you have created the dialing plan and saved your dialing plan configurations, you can return to the Edit Sites window in Director to verify that the changes have been propagated throughout the system. After clicking the name of the site, you will see the **Extension Prefix** field. The field should be populated with the value entered in the Extension Prefix Warning window, as shown in Figure 20.

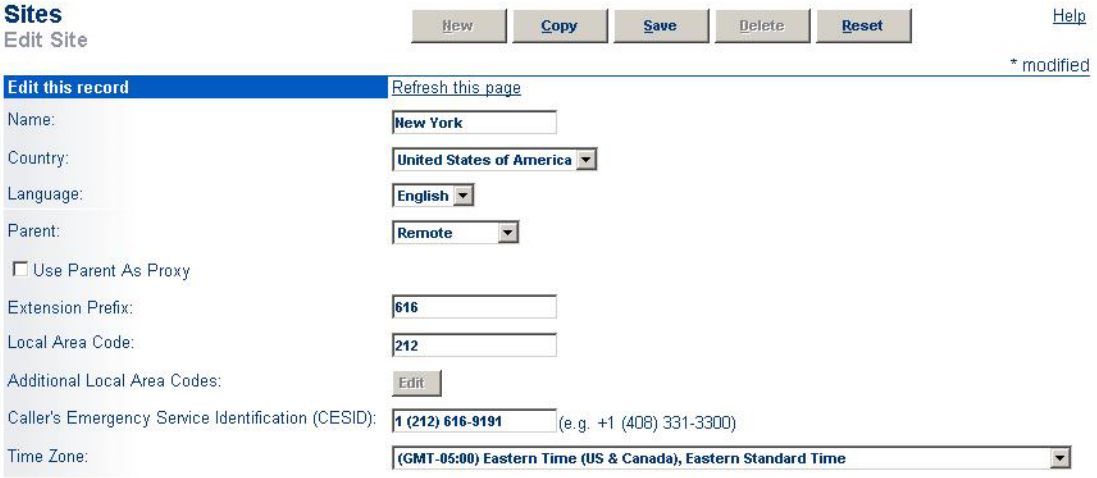


Figure 20: Extension Prefix field now populated

Adding Users to the System

When the On-Net Dialing feature has been enabled and the extension prefix for a site has been updated, the first new user added to the system may not receive the site's new prefix. This issue is caused by cookies in the system populating the new user's extension with outdated information. However, after this first user has been added, subsequent users will have their extensions automatically populated with the correct site prefix.

Note

User numbers can vary in length from 3 to 5 digits. All user numbers in the system must be the same length.

Quick Reference of Star Codes

Certain features and functions can be performed via the telephone interface through the use of star codes. By pressing the star key, or asterisk, on your phone's keypad, followed by a combination of numbers, you can perform many tasks that would otherwise require the use of a soft key, option button, or programmable button.

Common Star Codes

Table 23: Common Star Codes

Function	Star Code
Park a call	*11 + ext.
UnPark a call	*12 + ext.
Picking Up a Remote Extension	*13 + ext.
Picking Up the Night Bell	*14
Using the Intercom	*15 + ext.
Barge In	*16 + ext.
Silent Monitor	*17 + ext.
Toggling the Hunt Group Status	*18 + Hunt Group ext.
Whisper Page	*19 + ext.
Silent Coach	*22 + ext.
Changing Call Handling Mode and Forwarding	VoiceMail + password +# + 72
Changing Extension Assignment	VoiceMail + password + # + 731

Table 23: Common Star Codes(Continued)

Function	Star Code
Unassign Extension Assignment	VoiceMail + password + # + 732
Assign Extension to External Number	VoiceMail + password + # + 733

Extension Assignment Star Codes

Table 24: Extension Assignment Star Codes

Function	Star Code
Transfer a call	** + destination + # #
Conference a call	** + destination + **
Hold a call	**
Hang up	# #
Access other “common” star codes	** + *star code (between 11 and 19) + ext.

Trunk Star Codes

Table 25: Trunk Star Codes

Function	Star Code
Blocking and Caller ID	*67 + ext. When a user places an external call, they can block their Caller ID using the “*67” command. The user dials the trunk access code, followed by *67, followed by the external number. When dialing in this manner, the call will be considered “non-routable” and will only access trunks at the local site. The number is dialed “as is” (i.e. as if a user dialed it). No digit manipulation will be performed.
Unblocking Caller ID	*82 + ext. When a user places an external call, they can unblock their Caller ID delivering using the “*82” command. The user dials the trunk access code, followed by *82, followed by the external number. When dialing in this manner, the call will be considered “non-routable” and will only access trunks at the local site. The number is dialed “as is” (i.e. as if a user dialed it). No digit manipulation will be performed.

CHAPTER

7

Network Call Routing

This chapter provides an overview of call routing and digit-manipulation capabilities of the ShoreTel system. The information in this chapter is particularly useful for administrators of larger, multisite installations. The topics discussed include the following:

- Overview 122
- Define Network Call Routing 122
  - Call Permissions 122
  - Account Codes 124
  - Trunk Availability 125
  - Specifying Parameters for the Routing Decision 126

Overview

When a phone number is dialed in a ShoreTel system, the system performs three distinct operations on telephone numbers:

Digit collection — Voice switches collect the digits in a telephone number.

Network call routing — After collecting the digits, the switch checks the number against a user's call permissions, adds trunks to the route list, and makes a final route decision for the call.

Digit manipulation — The switches manipulate the dialed numbers before outpulsing them to the service provider.

In this chapter you will learn how to plan your network call routing.

Define Network Call Routing

Once an external telephone number has been collected, the switching software checks the number against the user's call permissions, finds the list of available trunks, and then makes a routing decision based on several criteria.

Call Permissions

Each dialed number is compared against the user's call permissions. If the call is denied, the calling party will be routed to a fast busy intercept tone. If the call is allowed, the routing continues.

Complete the following steps to define call permissions:

1. Open the **Call Permissions** edit page, which is shown in Figure 21.

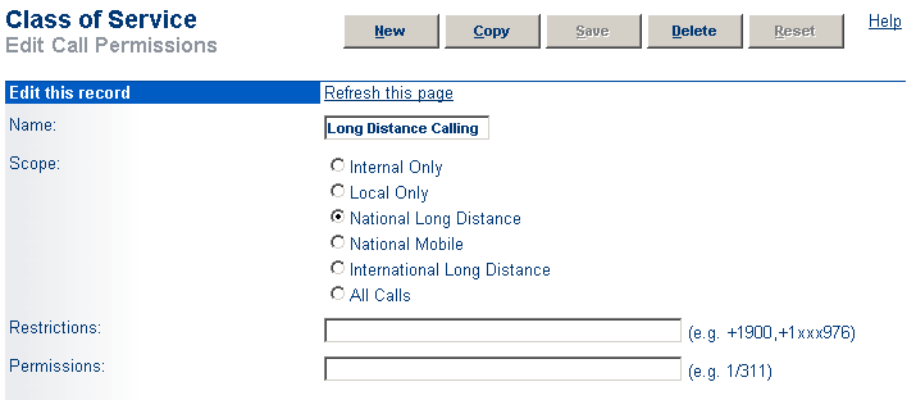


Figure 21: Call Permissions Edit Page

2. Specify a **Scope**. Scope allows you to set a general permission level and is presented from the most restrictive to the most permissive. The **Restrictions** and **Permissions** listed are applied in addition to the general scope setting for the Class of Service.

   - Internal Only allows calls only to internal extensions and to the configured emergency number.
   - Local Only allows calls only to local or additional local area codes, as defined on the site edit page. The call permission does not apply to any of the trunk group area codes.
   - National Long Distance also allows calls to long-distance numbers within the country, as defined on the Site edit page.
   - National Mobile allows calls to mobile phones in countries (e.g. Ireland) with “caller pays” billing plans.
   - International Long Distance also allows calls to international numbers, as defined on the Site edit page.
   - All Calls allows calls to any number, including 1900, Operator Assisted, and Carrier Select numbers, as well as use of Vertical Service Codes. This is the default.

3. Enter restriction and permission rules. The **Restrictions** and **Permissions** listed are applied in addition to the general scope setting. The comma-separated restriction expressions are limited to a total of 50 characters.

   Use the following guidelines for entering restrictions:

   - In general, numbers must be entered in canonical format including the international designation “+” and country code. For example, to restrict calls to the 408 area code in the U.S., use +1408. All 7-digit and 10-digit numbers must be entered in canonical format: +Country Code, Area Code, and Subscriber Number.
   - Non-routable calls, such as 311, 411, and so on, for a country must be designated by the country code plus the “/” character. For example, to restrict 311 in the U.S., use 1/311.
   - Each field can contain multiple entries as long as they are separated by commas or semicolons.
   - Each entry must consist of numbers only.
   - Access codes, such as 9, must not be included.
   - To simplify the entering of call permissions, the wild-card character “x” can be used to represent any number. For instance, to block all calls to 976 prefixes, enter “+1xxx976” as a restriction.
   - When a call is both restricted and permitted, it is permitted. For example, restricting +1 408 and permitting +1 408 331 restricts all calls to the 408 area code except those to 408 331-xxxx.

Account Codes

If Account Code Collection Service is enabled, when a user dials a number that is outside the scope of his or her call permissions, the call is automatically routed to the Account Code Collection Service extension on the headquarters (HQ) server or Distributed Voice Server (DVS). The Account Code Collection Service captures call details that can be reviewed in the call detail reports. For more information on these reports, refer to the ShoreTel System Administration Guide.

The collection of account codes is enabled on a per-user group basis and can be set to be one of three states: disabled, optional, or forced.

The Account Code Collection Service is associated with a configurable extension and has a dedicated user group that defines ultimate call permissions and trunk group access.

When account code collection is enabled or forced for a member of the user group, calls placed via the telephone or the ShoreTel Communicator are first filtered by call permissions. Calls restricted by call permissions are automatically routed to the extension associated with the Account Code Collection Service. Upon receiving the call, the Account Code Collection Service prompts the user to enter an account code and press the pound (#) key.

If the user enters an account code that does not match the digits in a stored account code, the system plays a message explaining the problem and prompts the user to re-enter the account code. When the user enters an account code that matches one of the stored codes, the code is collected, and the call is completed.

Call Permissions specifies the dialed numbers that are directed to the Account Code Collection Service for any user groups configured for account codes.

Calls redirected to the account codes extension are completed using the trunk access and call permissions associated with the Account Code Collection Service.

The Account Code Collection Service examines outbound calls against two sets of permissions:

- Checks call permissions for the caller's user group to determine if an account code must be collected.
- If user group permissions specify the collection of an account code, a check is performed on the call permissions for the Account Code Collection Service to determine whether call will be permitted or rejected.

  If the call is rejected, the intercept tone is played.

The Account Code Collection Service is associated with a system extension hosted on a SoftSwitch that runs on the HQ server or user's managing DVS.

If the SoftSwitch is unavailable to the ShoreTel Voice Switch from which a call originates, the call is handled according to the permissions set for the caller's user group. Calls placed by users who are configured for optional account code collection are placed. Calls placed by users who are configured for forced account code collection are rejected.

Wildcard characters, which are represented with a question mark, can be used in place of DTMF digits in the account code. When wildcards are used, a length check is performed instead of a more thorough validation of the code. Although this reduces the stringency of the validation process, it allows the system to support far more than 50,000 account codes — the previous account code limitation.

For more information about account codes and account code wildcards, refer to the Setting Call Control Options chapter in the *ShoreTel System Administration Guide*.

Trunk Availability

For a trunk to be included in the list of possible trunks that can be hunted, the following conditions must apply:

- The trunk must have an access code that matches the access code dialed.
- The trunk must be assigned to the user. Trunk groups are assigned to user groups.
- The trunk must be capable of the requested service — Local, Long Distance, International, n11, 911, Easily Recognizable Codes, Explicit Carrier Selection, and Operator Assisted. These services are defined on the Trunk Group edit page as shown in Figure 22.

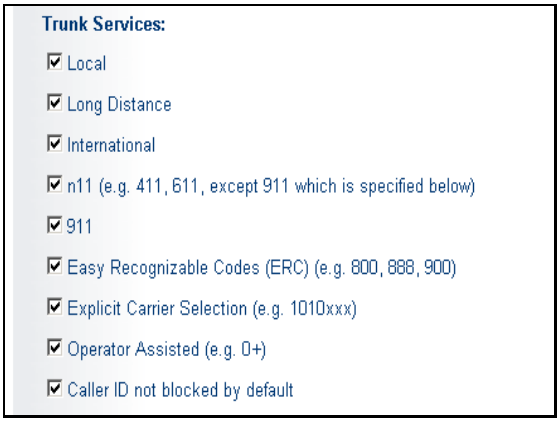


Figure 22: Trunk Services on the Trunk Group Edit Page

- The trunk must be in service.
- The trunk must not already be in use.
- The trunk must be on a switch that the user's switch can reach, meaning the network is up and running.
- For multisite calls, the admission control must be met at both sites. Admission control is defined on the Site edit page.
- If the call is long distance from the trunk, it was not local to the caller. For example, network call routing will not send a local call via a trunk in another state.

Defining Trunk Services

1. Open the Trunk Services dialog box on the Trunk Group edit page.
2. Select the services that will be available for the selected trunk.
3. Refer to the ShoreTel System Administration Guide for more information about the Trunk Group edit page.

Defining Admission Control

1. Open the Site edit page.
2. Enter the proper amount in **Admission Control Bandwidth**.
3. Refer to the ShoreTel System Administration Guide for more information about the Site edit page and for instructions about computing Admission Control Bandwidth.

Specifying Parameters for the Routing Decision

Once the available set of trunks is established, the switching software makes a routing decision, with the goal of minimizing toll charges and WAN bandwidth. The Network Call Routing algorithm bases the routing decision on the Local Area Code, Additional Local Area Codes, and Nearby Area Codes defined on the Trunk Group edit page.

Network Call Routing Algorithm

When multiple trunks meet the same criteria, a trunk is seized randomly. In general, trunks that are configured last are hunted first. Over time, however, as trunks are deleted and added, hunting becomes increasingly random.

SIP trunks are given precedence over Digital trunks, which are given precedence over analog trunks in all routing decisions. When asking the Routing decision, the algorithm poses the following questions:

1. A trunk at the originating site for which the call is local?
2. A trunk at the proxy site for which the call is local?
3. A trunk at any other site for which the call is local?
4. A trunk at the originating site for which the call is considered nearby?
5. A trunk at the proxy site for which the call is considered nearby?
6. A trunk at any other site for which the call is considered nearby?
7. A trunk at the originating site designated for long distance?
8. A trunk at any proxy site designated for long distance?
9. A trunk at any other site designated for long distance?
10. Any remaining trunk available at originating site?

11. Any remaining trunk available at the proxy site?

Specifying Parameters for the Routing Decision

1. Open the Network Call Routing page on the Trunk Group edit page, shown in Figure 23.

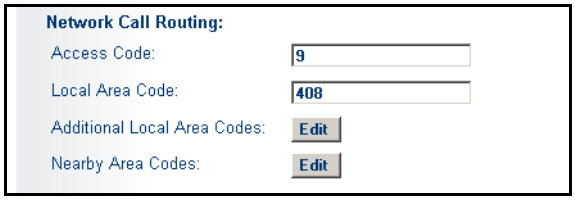


Figure 23: Network Call Routing on the Trunk Group Edit Page

2. Enter values into the **Local Area Code**, **Additional Local Area Codes**, and **Nearby Area Codes** fields.

3. Open the Trunk Group edit page and, toward the bottom of the page, click **Go to Local prefixes**.

   The Local Prefixes dialog box appears. It allows you to enter prefix exceptions against a local area code. The Network Call Routing algorithm handles prefix exceptions for the local area code as long distance, which minimizes toll charges.

   Refer to the ShoreTel System Administration Guide for more information about the Trunk Group edit page and the Local Prefixes dialog box.

   The area codes on the Site edit page have no impact on call routing decisions.

CHAPTER

8

Planning Applications and Services

This chapter reviews the key ShoreTel applications and services to use to plan your system configuration and determine the equipment you need for completing deployment. The topics discussed include the following:

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  - Distributed Voice Mail 132
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  - Auto-Deletion of Voice Mail Messages 134
  - Mailbox Full Notifications 134
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Account Code Collection Service

ShoreTel supports account codes for external calls when you enable the Account Code Collection Service. When a user dials a number that is not included in the scope of his or her call permissions, the call is routed to the Account Code Collection Service extension, where the user is prompted to enter a valid account code. Account code collection is enabled on a per-user-group basis and can be set to be one of three states: disabled, optional, or forced. The Account Code Collection Service is associated with a configurable extension and has a dedicated user group that defines ultimate call permissions and trunk group access.

A new user group is created during installation for use by the Account Code Collection Service. This user group is named Account Codes Service. Since it is only intended for use by the Account Code Collection Service, this group does not appear in drop-down lists for the assignment of User Groups to users and other objects such as workgroups. You can, however, change all attributes of the Account Codes Service User Group except the fields indicating whether Account Codes are disabled, optional, or required.

The Account Code Collection Service is distributed across all HQ and DVS servers and is associated with a system extension that is hosted on the SoftSwitches running on each HQ and DVS server. If the SoftSwitch is not reachable by the originating ShoreTel Voice Switch, the call is handled according to the setting on the caller's user group. Specifically, during such a connectivity outage, calls placed by users who have optional account code collection are automatically placed, and calls placed by users who have forced account code collection are automatically rejected.

Account Codes

Account Code Collection Service supports up to 50,000 account codes with a maximum of 20 characters. You can include non-numeric characters, such as hyphens and slashes, in the account codes; however, non-numeric characters are not used in account code collection or in the account code reports. An account code can be the same as a prefix for another account code. For example, the account codes 1234 and 12345 can coexist.

Table 26 gives example account codes and how the Account Code Collection Service interprets the code.

Table 26: Account Code Interpretation Example

Sample Account Code	Recorded Code
Sales 200	200
1001-3	10013
1.234A	1234
3000 Exec 2	30002

Account codes can also have user-friendly names of up to 50 characters.

Call Permissions

The call permissions define what dialed numbers are directed to the Account Codes Service for user groups configured with account codes. For calls that are redirected to the account codes extension, the call is completed with the trunk access and call permissions of the Account Codes Service.

This structure imposes two sets of permissions on outbound calls:

- The call permissions for the user group of the user who places the call are used to determine if an account code must be collected or not.
- The call permissions for the Account Codes Service determine whether calls are finally placed, or if the intercept tone is to be played.

Distributed Voice Mail

ShoreTel Distributed Voice Mail provides greater availability. Each ShoreTel Distributed Voice Server (DVS) has an instance of the telephony platform, allowing full functionality of voice mail and auto attendant services at that location during WAN outages. The Distributed Voice Mail feature allows users with mailboxes on that server to receive and pick up voice mail messages without having to depend on a WAN connection to the headquarters server that hosts the configuration database. The message waiting indicator (MWI) lights correctly update local users about voice mail with or without WAN connectivity.

Additionally, incoming calls reach the auto attendant, access the dial-by-name directory, and reach their intended local party during a WAN outage. If a party cannot be reached directly and his call handling setting would send unanswered calls to voice mail, the call is handled by the local voice mail server. If the user’s voice mailbox resides on a different voice mail server, the local ShoreTel server will accept, store, and forward the message when connectivity to the proper voice mail server is restarted. The caller hears a generic greeting, including the intended party's recorded name, and the caller has the option to leave a message. This message will be forwarded at a later time to the home voice mail server for the addressee via SMTP.

Although each voice mail server is autonomous in delivering voice services, it must have connectivity to the headquarters server in order to carry out configuration changes. Specifically, users on an isolated remote server are not able to change call handling modes or make other changes that require modification to the configuration database on the headquarters server.

The ShoreTel Communicator applications may provide limited call control access and may not display some contents on IP phones at a remote site during WAN outages. These both require connectivity to the headquarters server for full service. For users who have their ShoreTel Communicator application running at the time of a WAN outage, graphical access to their voice mail box is provided, including the ability to compose and playback messages, but ShoreTel Communicator may not display the corresponding call activity associated with any actions.

You should provision a DVS at any site with more than 100 users to effectively manage your WAN bandwidth between that site and the headquarters or main site. In addition, you must add a distributed server with the voice mail application at any site where the required number of mailboxes exceeds 1,000.

Users should be configured for the server that is located at their home or most frequent site. If that site does not have a server, the nearest server or headquarters server should be used.

When there are multiple voice mail servers, the system-wide voice mail extension automatically maps to the extension of the local server. Voice mail media streams are therefore recorded in the CDR reports by the voice mail extension that actually handles the call.

The ShoreTel system provides each user with five call handling modes, and workgroups with four call handling modes, allowing employees and workgroups to customize how calls are routed. Employees typically use Standard call handling mode to route calls to voice mail after three or four rings, and use Out of the Office call handling mode to route calls directly to voice mail.

Users should consider the following:

- Forwarding calls to a cell phone
- Forwarding calls to an external answering service for critical users or workgroups

You must enable external call handling as part of the class of service for users who want to use these options.

The Message Notification feature delivers a notice to users that a message has arrived for them. Notifications can be sent upon receipt of all messages, or only upon receipt of urgent messages. The system can deliver a notification to the following destinations:

- An E-mail address, which can also include a voice mail attachment in WAV format
- A pager model that allows message notification
- An extension that allows message playback
- An external number, such as a cell phone if it allows message playback.
- Users who address and compose voice mail through the Telephone User Interface (TUI), the Visual Voicemail application, or the Outlook Voicemail form can mark their messages with a request for a return receipt.

Escalation Notifications

Similarly, the ShoreTel system can send any of these notifications types to specific members of an escalation profile, in support of an Escalation Notification feature.

The Escalation Notifications feature is a traditional voice mail feature that allows support groups to offer round-the-clock service to their customers. For example, if a customer calls into the ShoreTel system and leaves a message, the voice mail system sends out a page, phone call, or email to a designated employee in the support department. If this first employee ignores his beeping pager, the next designated employee within the escalation profile list is contacted, and so on.

Employees in the escalation profile will continue to be contacted sequentially until someone listens to the voice mail. Refer to Chapter 10, Configuring Users on page 331 in the ShoreTel System Administration Guide for more information.

Auto-Deletion of Voice Mail Messages

The ShoreTel system also supports the ability to automatically delete user voicemail messages that are older than a specified time limit. The system administrator can set a maximum time limit for the storage of voice mail messages, and if this time limit is exceeded, messages are automatically deleted. The tool can be used to encourage users to better manage their voice mailboxes.

Mailbox Full Notifications

The ShoreTel system can be configured to notify users when their voice mailboxes are almost full. This features warns users of the impending lack of storage space to give them ample time to delete messages, as opposed to logging into their voice mailbox only to discover that the mailbox is full. Once a user's mailbox has passed a threshold, the system sends a notice informing them that their mailbox is almost full and that there is only enough room for 10 additional messages. This prevents users from being caught off-guard by an unexpected notification that their mailbox is full.

Refer to Chapter 10, Configuring Users on page 331 in the ShoreTel System Administration Guide for more information.

AMIS Protocol Support

The ShoreTel system can send and receive voice mail messages to and from legacy voice mail systems that use the AMIS protocol Version 1 - Specification; February 1992. To send voice mail messages to remote AMIS sites, ShoreTel dials the access phone number for the remote system. Likewise, to receive voice messages from a remote system, the remote system must know the number to dial into the ShoreTel system. To reach the ShoreTel system, the remote system must be configured to dial any number that reaches an auto-attendant menu.

Note

The ShoreTel Small Business Edition system does not support AMIS.

ShoreTel enables AMIS call support by default. Incoming AMIS voice mail is delivered in the same manner as other voice mail; however, replies cannot be sent. To send outbound AMIS voice mail, you must create AMIS systems in ShoreTel Director.

ShoreTel negotiates the setup, handshaking, and teardown of AMIS system calls. Each voice mail requires a call over the AMIS delivery and call-back numbers.

Simplifying AMIS Systems, and Increasing Usability

- Use the same extension length across your enterprise.
- Use off system extensions to match remote users' mail boxes with their extension numbers.
- To identify the remote site location, assign each system a System ID.

For more information on AMIS systems, refer to the ShoreTel System Administration Guide.

SMDI Protocol Support

The ShoreTel system supports the SMDI protocol. Two modes of operation are supported:

- In the first mode of operation, the ShoreTel system acts as a PBX for a legacy voice mail system. The ShoreTel system provides call information for forwarded or direct calls to the legacy voice mail system, and receives incoming message waiting indication from the legacy voice mail system.
- In the second mode of operation, the ShoreTel system acts as the voice mail system for a number of users on a legacy PBX.

Both configurations require a serial link between a ShoreTel server and the legacy voice mail system, as this is the medium required by the SMDI protocol.

If using the first mode mentioned above, a group of analog trunks must be used to connect the ShoreTel system to the legacy voice mail system where the ShoreTel system is on the extension side of the trunks. The ShoreTel voice mail application manages the group of outgoing extensions. The ShoreTel server can provide digit translation if the legacy voice mail and ShoreTel system have different extension lengths.

It is possible to have some ShoreTel users on the ShoreTel voice mail and some on the legacy voice mail. However, these users will not be able to send messages to each other unless AMIS is implemented between the two systems. Voice mailboxes for workgroups and agents must be on the ShoreTel voice mail system.

ShoreTel Communicator operates the same way it does when a user has no mailbox:

- Voice mail viewer is not available
- Windows Control Panel does not contain Voice Mail tab
- Find Me and Notification features are not available
- Dial Mailbox and Transfer to Mailbox are not available for this user from other user’s clients
- To Voice Mail button on ShoreTel Communicator transfers the call to the system voice mail extension.

For more information about using a serial link and SMDI protocol to integrate the ShoreTel system with a legacy voice mail system, refer to SMDI Protocol Support on page 336.

Find Me Call Handling

Find Me and Auto Find Me call handling allow callers to find users at other locations when they reach the user’s voice mail. When Find Me is enabled for the current Call Handling Mode, inbound callers that reach a ShoreTel user's voice mail box can activate Find Me call handling by pressing “1.” If the caller activates Find Me call handling, the system plays a prompt indicating that it is now finding the called party: “Please hold while I try to find your party.”

ShoreTel users can specify two Find Me destinations, which can be internal or external numbers. These numbers can be enabled or disabled for each Call Handling Mode. If a call is forwarded to the first number and is not answered within a configurable number of rings, the call can either be forwarded to a second Find Me destination or can be returned to voice mail.

The Caller ID that appears on Find Me calls is the voice mail Caller ID and not the ID of the original caller. However, if the source of the original call is external to the system, then the Caller ID will be displayed. Personal Assistant (pressing “0”) also works when Find Me forwarding is enabled. The voice mail system dials the configured Find Me numbers in sequence. When a Find Me call is answered, voice mail announces the call through a sequence of prompts.

The party that answers a Find Me call hears prompts similar to the following:

- “I have a call for Sam Smith from 4085551212.”
- “To accept this call, press one.”
- “To send this call to voice mail, press two.”
- “To repeat the caller ID, press three.”

The party at the Find Me number has three options for directing the call:

- Pressing 1 connects the original caller with the intended party at the Find Me destination.
- Pressing 2 directs the voice mail system to immediately start taking a message for the intended party from the original caller.
- Pressing 3 repeats the Caller ID information available on the call, if any. This also extends the timeout by 1 ring, or 6 seconds.

The voice mail system does not automatically notify callers of the Find Me call handling option. ShoreTel users can elect to tell callers of the Find Me option in their recorded greeting. For example, they can tell callers to “press 1 to Find Me.” If the user does not tell callers about the Find Me option in their greeting, the Find Me option can remain a hidden capability available only to selected callers. Conversely, users can automate the Find Me behavior so that when a call enters voice mail and Auto Find Me is enabled, the call is immediately sent to the Find Me destination numbers without requiring any action on the part of the caller.

Call Sender

Users can place a return call to the originator of a voice mail by pressing “5” from the phone during message playback. Users can also call back the voice mail sender from ShoreTel Communicator, Agent Monitor, or Microsoft Outlook, if the user is so provisioned. To use this feature, the user must belong to a user group with trunk-to-trunk transfer Class of Service enabled. For more information, see the ShoreTel System Administration Guide.

The user has the option of replying with either a voice message or a phone call if Caller ID information is available on the call. If no Caller ID information is available for the call, such as on calls from an outside caller, the “reply with a call” option is not available for that message.

When the user chooses to reply with a phone call, the call is transferred to the number of the originating party. When the originating party is an external caller, the message recipient must have the dialing permission to dial the Caller ID number. Once the message recipient is transferred to the number of the message originator, there is no option to return to the mailbox.

Time Stamps

The time stamp of the message is relative to the time on the server where the message is taken, as shown in the following examples:

- When the user views messages in the Voice Mail Viewer or Outlook Form, the user interface will adjust the time stamp based upon the time of the user's computer.
- When the user dials into voice mail to retrieve their messages, the time stamp will be based on the time of the server.

Planning Fax Handling

The ShoreTel system supports fax calls. There are several ways to configure your fax service:

- A direct fax number for each site
- Direct fax numbers for each user using either individual fax machines or a fax server
- Redirect faxes that are sent to the site's main number to a fax machine extension at the site
- Redirect faxes that are sent to a user's extension to user's local fax extension

Fax Options

Figure 24 shows how to plan your fax options.

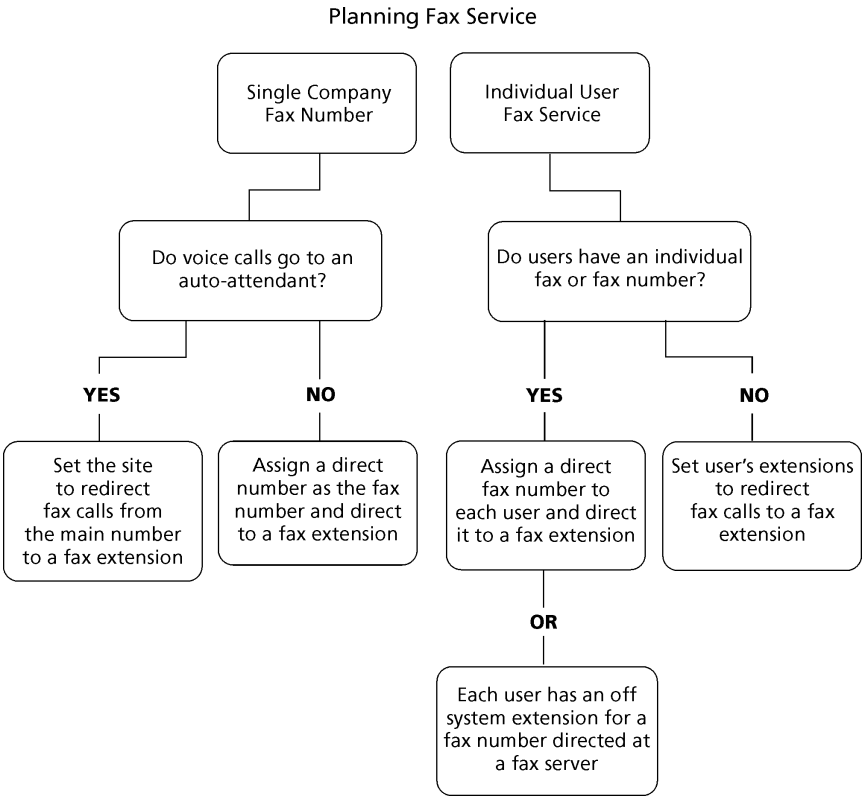

Figure 24: Planning Fax Service

Determining how you configure your fax service with ShoreTel Director depends on which method of fax call handling you have chosen. Refer to the steps in the following sections for information about using each method.

Using the Main Number for Voice and Fax calls, and the Main Number Goes to an Auto-Attendant

1. Configure the fax extension through the User edit page of ShoreTel Director.

   Make sure that fax redirection is disabled for fax extension users.

2. Enter a fax extension you created in the Site edit page.

Using the Main Number for Voice and Fax Calls, and the Main Number Goes to an Operator

1. Configure the fax extension through the User edit page of ShoreTel Director.
2. Assign a direct number as the fax number.
3. From the Trunk Group edit page, which is on the DNIS map page, set the destination to the fax extension.

If Users Have Their own Faxes or Fax Service

1. Configure the fax extensions through the User edit page of ShoreTel Director.
2. Assign a range of direct fax numbers.
3. From the Trunk Group edit page, which is on the DNIS map page, set the destination for each fax number to the appropriate fax extension.

If you Plan for Each User to Have a Single Number for Both Voice and Fax

1. Configure the fax extensions through the User edit page of ShoreTel Director.
2. Enable fax redirection from the User edit page and enable fax redirect for the site by entering a fax extension on the site edit page.

For more information on these settings, refer to the ShoreTel System Administration Guide.

Using a Fax Server

A fax server improves services available to your users, helping them be more productive. With a fax server, users can perform the following functions:

- Send faxes directly from the desktop eliminating the need to print faxes to send.
- Receive faxes directly on the desktop.
- Integrate fax communications with e-mail and voice mail applications.
- Have individual fax numbers
- Maintain soft copies of all faxes for easy printing and document management

Using a fax server with the ShoreTel system provides the following benefits:

- Share inbound and outbound trunks for fax services.
- Reduce toll charges by leveraging your VoIP network for outbound faxes.

For inbound fax support, users can be assigned a personal fax number from the DID range of one of the trunk groups and this DID number can be the same as the user's regular telephone extension. When a call is received, if the fax redirect feature is enabled, the system can differentiate between voice calls and fax calls and react appropriately.

Outbound faxes are queued by the server and then sent across the IP network to the best available trunk.

Fax Server Requirements

- Sufficient ports on ShoreTel voice switches
- Sufficient ShoreTel User Licenses
- Sufficient DID trunks to support both fax and voice DID for all users

Network Requirements

The network requirements for faxing over IP are more stringent than for voice over IP. For voice communications, a 1% packet loss has negligible impact on voice quality. However, a 1% packet loss for fax communications means a loss of approximately 3 lines per fax page. ShoreTel recommends that packet loss not exceed 0.1% across the LAN and WAN when using fax servers with the ShoreTel system.

Fax communications are also impacted by voice compression. Since fax machines typically require 19.2 Kbps, ShoreTel recommends that you use G.711 voice encoding for fax calls. For more information on fax requirements, refer to ShoreTel IP Phones on page 166.

Note

The fax redirect feature will not work with calls that come in on SIP trunks.

Fax Server Integration Details

Instead of requiring users to have two separate DID numbers — one for voice and one for fax — a single DID line can handle voice calls and inbound/outbound faxing.

A user's extension, which can be 3, 4, or 5 digits, is sent to a fax server via in-band Dual Tone Multi Frequency (DTMF) digits. The fax server uses this information to create a mapping between the user's extension and e-mail address.

Once configured, incoming fax calls are received at the user's phone extension. The fax server listens for the fax tone, and takes over the call when the fax redirect radio button has been selected in Director. When the fax transmission is complete, the loop current is automatically turned off to terminate the fax call, and the and fax is forwarded to the associated e-mail address. Figure 25 shows the flow for a fax call.

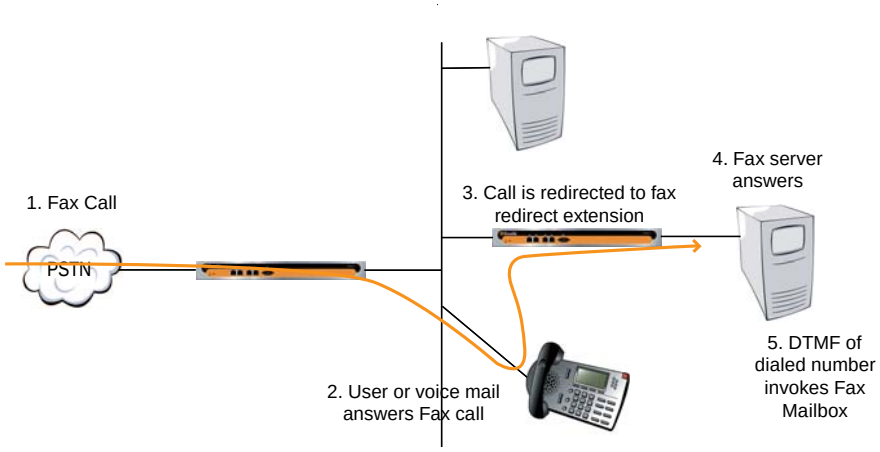

Figure 25: Fax server integration call flow

Enhanced FAX Server Integration

The ShoreTel system delivers digits to a Fax Server for DID calls routed directly to a FAX server, thus allowing the call to go directly to the fax extension and provide DID/DNIS digits, instead of to an extension number and then to the fax server.

Configuring Fax Server Integration

At a high level, the process of setting up the Fax Server Integration feature involves three tasks:

- Connecting the hardware (i.e. connecting the fax server ports to the analog ports on the switch)
- Creating a user account to represent each analog port
- Enabling the Fax Server Integration feature for each user account

Configuring the Fax Server Integration Feature:

1. Configure a fax server per the manufacturer's instructions.
2. Connect the fax server to one of the analog ports on a ShoreTel Voice Switch that supports analog.

   Next, you will create user accounts to represent each analog switch port that connects to the fax server.
3. Launch ShoreTel Director.
4. Click on the **Administration > Users > Individual Users**.
5. Click **Add a New User**. The Edit User window appears, as shown in Figure 26. Arrows in the illustration mark fields that must be configured. Refer to the bulleted list below the illustration for details.

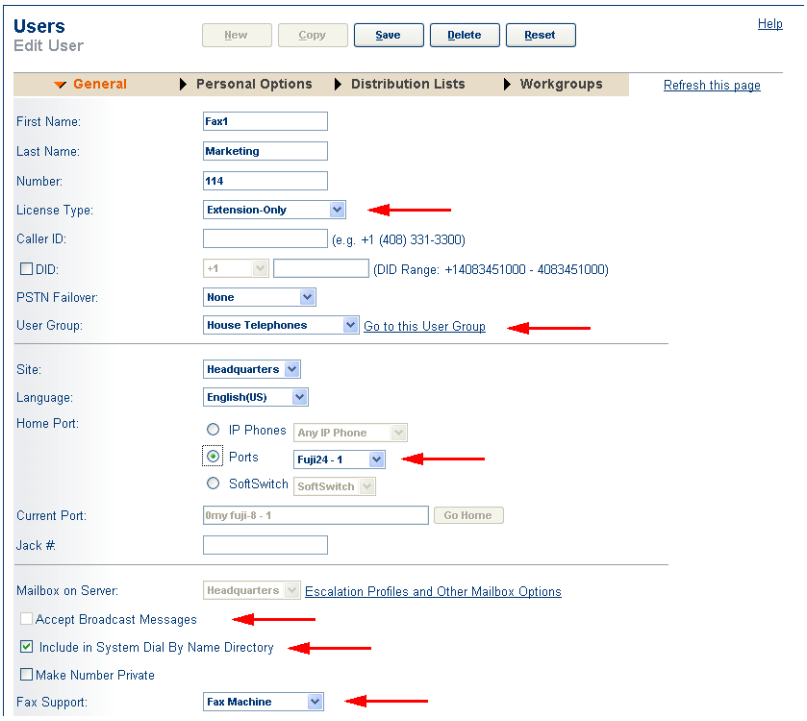

Figure 26: Creating a user account for the fax server

6. Enter information for each of the fields as shown below for each field:

   - License Type — Extension-Only
   - User Group — You must create a User Group appropriately configured for a fax server. The User Group should have the Class of Service for Call Permissions set to No Restrictions to transfer inbound and outbound faxes.
   - Home Port — Select the Ports radio button and then use the drop-down menu to select the switch where the fax server will be connected.
   - Accept Broadcast Messages — Should appear grayed-out or be deselected because the port will not be assigned a mailbox.
   - Include in System Dial By Name Directory — Check box may be selected if you want callers to be able to locate the fax number using the Dial by Name feature.
   - Fax Support — This Extension is Connected to a Fax Server radio button must be selected.

7. Click the **Save** button to store your changes.

8. Click the **Personal Options** tab and enter 1 in **Current call stack size**.

9. Click **Save** to store your changes.

   Next, configure the call handling mode for each of the user accounts associated with a port connected to the fax server.

10. In Director, select the user account representing the fax server connection.
11. Click the **Personal Options** tab.
12. Click the **Standard** link under Edit Call Handling Modes.
13. Under Call Forward Condition, select the **No Answer/Busy** radio button as shown in Figure 27.

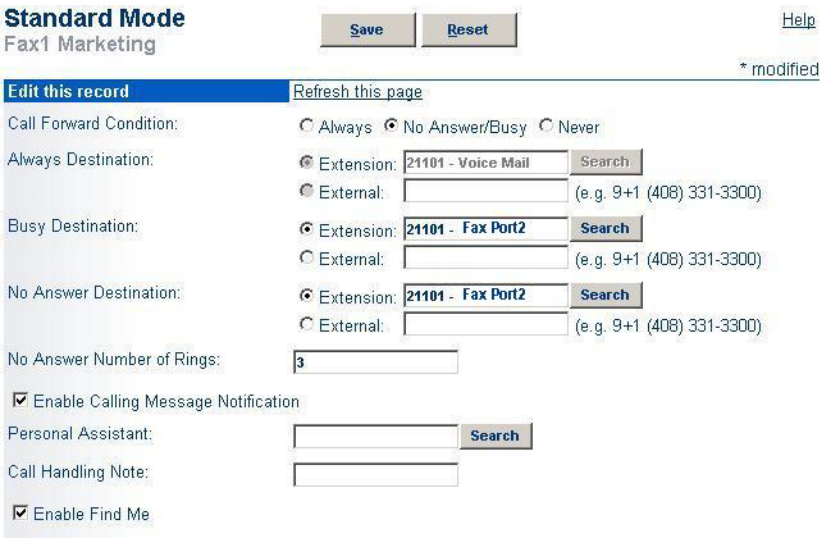

Figure 27: Configuring Call handling mode for Busy/No Answer failover

14. In the Busy Destination and No Answer Destination radio buttons, select **Extension** and specify the analog port where incoming fax calls will be directed if the first fax port is busy.

    For example, if you have set up three ports to receive fax calls, you might configure the first port in this series to redirect to the second port, and the second port would specify the third as a failover.

15. Click **Save** to store your changes.

    This configuration assumes multiple analog ports will be used to connect the switch to the fax server. If only one fax server port will be used to connect to the fax server, then the call forwarding must be set to **Never**. Similarly, if this port is the last one in a chain of ports dedicated to the fax server, then the call forwarding must be set to **Never**.

    If you are using multiple analog switch ports to connect to the fax server you must specify the first redirect extension in that chain. This is the site's fax redirect extension.

1. Under the **Administration** link, click **Sites**.
2. Click the site where the switch and fax server are located, for example either Headquarters or Remote. The Edit Site page appears as shown in Figure 28.

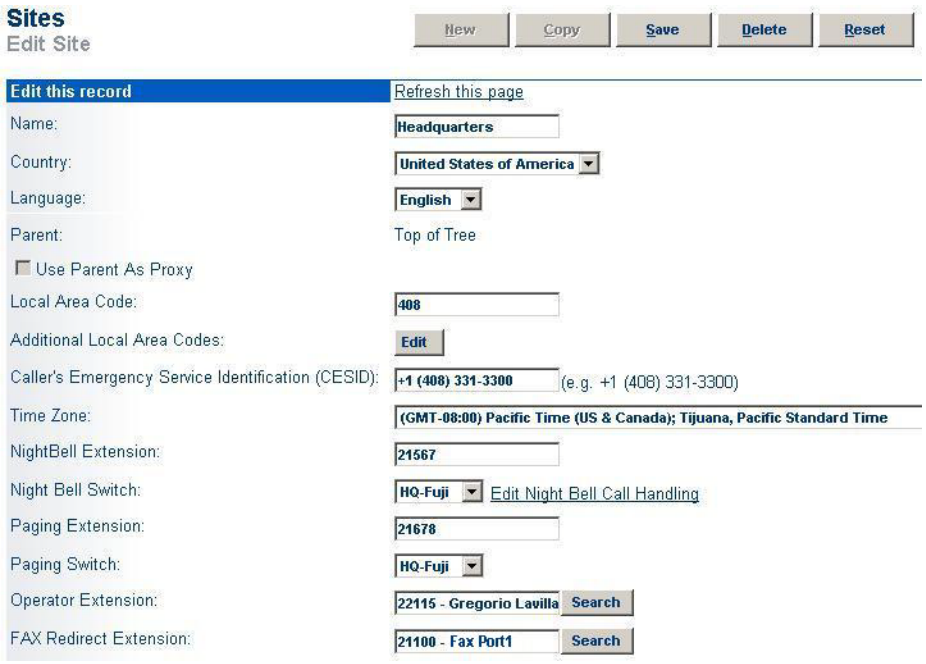

Figure 28: Configuring Fax Redirect extension for primary fax server port

3. Under **FAX Redirect Extension**, which is near the bottom of the Site window, enter the extension associated with the first port in the chain of fax server ports.This is the first place incoming faxes will be sent. Click **Save** to store your changes.

   Next, you must configure settings for each user that will be using the new Fax Server Integration feature.

4. Click the **Users** link and then the **Individual Users** link.

5. Click the name of a user who will be using the enhanced Fax Server Integration feature.

6. The Edit User window appears as shown in Figure 29.

Figure 29: Enabling Fax Redirect For a User

7. Select **Redirect Inbound Fax Calls to Site Fax Extension** for the Fax Support radio button.
8. Click the **Save** button to store your changes.

Private Numbers

Users can have private numbers that are not listed in the System Directory or in ShoreTel Communicator Quick Dialer and for which Caller ID information suppressed. Private Numbers are enabled through a check box on the User edit page in ShoreTel Director. When checked, the user's extension becomes a Private Number.

Conditions for Private Numbers

- Private Numbers do not appear in the QuickDialer for dial-by-name operations or in the ShoreTel Directory Viewer.
- Calls placed from a Private Number to an internal party show the caller's name but not his or her number to the dialed party.
- Calls placed from a Private Number to an external party do not deliver a Direct-Inward-Dial (DID) number as Caller ID when PRI trunks are used for the outbound call. The site CESID number is used for the outbound Caller ID.
- Calls from a Private Number to an off-system extension on PRI trunks with NI2 signaling deliver calling name information but not calling number information.
- Routing slips and the ShoreTel Communicator History viewer show the Private Number user's name but not his or her extension number.
- The Private Number users are listed with name and number in the Extension Monitor extension selection dialog box.
- The Private Number user can be dialed directly via the telephone or the ShoreTel Communicator if his or her extension is known.
- Contacts imported from Outlook or Exchange are never private and are fully visible in the ShoreTel Communicator Quick Dialer.
- CDR database records show both number and name for Private Number users. However, the Caller-ID Flags field indicates that only the name is valid.
- CDR legacy log files show the number of Private Number user calls that are inbound or outbound calls.
- ShoreTel Director shows number information for Private Number users as with other users, for example on the User list page.

Auto Attendant

The ShoreTel system comes bundled with an automated attendant feature that runs on the HQ servers and DVSs. The system supports up to 1000 menus, with every server having all menus and with four scheduled modes, providing a simple, flexible solution.

Applications for the Auto Attendant Menus

- Answering the main number
- Routing calls to workgroups, such as sales, support, and so on
- Providing automated directions

- Providing a way for users to log in to voice mail. ShoreTel recommends using the “#” button

Although the automated attendant is a useful tool, you should take care to design a menu structure that does not frustrate your callers. Here are some helpful hints to keep in mind:

- Create no more than two or three levels of menus.
- Provide a “zero-out” option on every menu, so the call can go to a live person. ShoreTel recommends using the “0” key for this option.
- Provide an option to return to the previous menu. ShoreTel recommends using the “*” key for this option.
- Keep prompts short, quick, and efficient.

Users can record auto attendant menu prompts from their own telephone instead of having to go through Director. This ability frees the system administrator from having to be involved with the task of recording attendant menu menus, allowing him or her to delegate the task to more appropriate team members. For details on enabling this feature, refer to the ShoreTel System Administration Guide.

Call Handling Delegation

Some users of the ShoreTel system, particularly senior management, often have an administrative assistant who helps them manage items such as their e-mail, calendar, and voice communication. The ShoreTel system administrator can grant permission from ShoreTel Director to individual users to change another’s current call handling mode (CHM) settings. Users who have been delegated to change CHM settings can make changes to the current CHM settings for other users using Operator ShoreTel Communicator. For more information on configuring call handling delegation, refer to the ShoreTel System Administration Guide.

ShoreTel Communicator for Windows

ShoreTel Communicator for Windows is the Windows-based client application that runs on the user’s computer. This application allows users to access and manage their ShoreTel extension. Examples of tasks that a Communicator user can perform are:

- View and manage the content of their voice mailbox.
- View and manage the call history of their extension.
- Change their call handling mode.
- Configure extension options.
- Initiate and end a phone call.
- Start conferences.

For a list of all the capabilities and other details about ShoreTel Communicator, refer to the ShoreTel Communicator for Windows Guide or other platform-specific Communicator guide. Refer to the ShoreTel System Administration Guide for configuration details.

ShoreTel Communicator for Mac

ShoreTel Communicator for Mac is a native Mac OS X application, which offers the features available in Communicator for Web, plus additional Mac-specific features.

ShoreTel Communicator for Web

Communicator for Web is the browser-based interface that lets users access and manage their ShoreTel extension. Communicator for Web has a subset of the functions available in Communicator for Windows. The following list includes examples of tasks a Communicator user can perform:

- View and manage the content of their voice mailbox.
- View and manage the call history of their ShoreTel extension.
- Change their call handling mode.
- Configure extension options.
- Initiate and end calls.

Accessing ShoreTel Communicator for Web from Within your Network

1. Open a browser.
2. In the URL address field type:

   `http://<servername>/`

   where `<servername>` is the name of your ShoreTel server. You can also use the IP address of the ShoreTel server.
3. Press **Enter**.
4. If prompted, enter your client ID and password.
5. The ShoreTel Communicator page appears in your browser.

Bridged Call Appearances

The Bridged Call Appearances (BCA) feature provides “bridged” information between many separate IP phones, offering the benefit of faster call handling between users. The feature is intended for key system environments, such as a small office with a moderate number of trunks, ShoreTel IP Phones, and users.

Custom buttons are configured on each IP phone so that information about incoming calls to a BCA extension is shared among the phones via blinking colored LEDs. Similarly, IP phones can share information about outbound calls placed from a BCA extension by blinking green or red on each phone. Refer to the ShoreTel System Administration Guide for details.

Custom buttons can be programmed on an IP phone such that each button represents a position in the call stack.

Pressing the top-most BCA custom button for outbound calls does not necessarily access trunk 1. There is no one-to-one correlation between the custom buttons programmed for BCA extensions and a particular trunk. Trunks can be associated with BCA extensions in any manner specified by the system administrator.

Switch Support for Bridged Call Appearances

The ShoreTel voice switches support BCA functionality with the following caveats:

- Up to 24 BCA extensions can be configured per switch.
- The sum of all the trunks that are assigned to a BCA, plus the call stack size of all BCAs used for extension appearances on a switch cannot exceed 24. For example, you can configure 8 BCAs, each targeted with 3 trunks on the same switch.
- A maximum of 32 phones can be configured to point to the same BCA extension.
- Up to 128 BCA extensions on other switches can be monitored.

For details on configuring the BCA feature, refer to the ShoreTel System Administration Guide.

Hunt Groups

Hunt groups allow you to route calls to a list of extensions. Hunt groups can be accessed through an extension, DID, and/or DNIS. Hunt groups are supported by ShoreTel Voice Switches and remain available when connectivity to the ShoreTel servers is lost. The hunt group can be used as the backup destination for a workgroup, which allows basic hunting even when the workgroup server is not reachable. To maximize reliability, assign hunt groups to a switch close to the majority of the members and/or trunks associated with the hunt group.

A maximum of 8 hunt groups can be assigned to a single switch. A total of 16 user numbers can be assigned to hunt groups on a single switch — for example, 8 hunt groups with 2 extensions each, 2 hunt groups with 8 extensions, or 1 hunt group with 16 extensions.

Hunt groups have scheduled call handling modes similar to route points. For more information about route points, refer to the Setting Call Control Options chapter in the *ShoreTel System Administration Guide*. There are call handling modes for on-hours and off-hours/holiday (combined). For on-hours, destinations can be set for Always, Busy, and No Answer. For the other call handling modes, only a call forward always destination is provided. When the hunt group is in a call handling mode other than on-hours, the hunt group forwards calls to the Call Forward Always destination.

A hunt group can be a destination anywhere in the system where a workgroup is allowed as a destination. This includes call forward destinations from users, workgroups, route points, personal assistants, site operators, site fax redirect extensions, and Find Me destinations.

Hunt Group Busy State

The hunt group can be set as busy from both the switch maintenance page in Director and with a star code from the Telephone User Interface. This feature allows hunt group members to disable hunt group routing when they are temporarily unavailable or leave work early. The busy state of the hunt group is maintained by the hunt group's switch and is not saved in the configuration database or to flash memory. When a switch boots or reboots, the hunt group is in the available state.

Use the star code "*18" followed by the hunt group extension to toggle the busy state of the hunt group from a telephone. A class of service setting controls whether a user can change the hunt group busy state.

When the hunt group is in the busy state during on-hours, calls are forwarded to the busy destination.

Configurable Hunting

There are two types of hunting available with hunt groups: top down or simultaneous ring. All hunt group members are hunted for each call received. For example, in top-down hunting, if the switch is hunting members for an initial call when a second call is received, the second call hunts through all the members again. In other words, each call is hunted independently and in the case of top down, hunting starts at the top.

You can also configure the following:

- The number of rings per member. The same number of rings are used for each member to whom the call is offered.
- Whether calls should go to a no answer destination after all members have been hunted once or whether members are hunted again.
- Whether multiple calls are offered to a member simultaneously when the hunt group receives multiple calls. Calls are not offered to members with full call stacks.
- Whether members should be hunted when the member's call handling is set to Call Forward Always (DND).

Hunt Group Applications

Hunt groups provide solutions to a several call routing scenarios.

Backup Routing for Workgroup

To use a hunt group as a backup when the workgroup server cannot be reached, create a hunt group with workgroup members who will serve as backup members. To use the hunt group when the workgroup server is not reachable because of a network outage, admission control, or a server outage, set the workgroup's backup number to the hunt group. When the hunt group is set to offer each member a single call at a time, then call offering is similar to a workgroup. Hunt group members are hunted even though they are logged out or in wrap-up with respect to the workgroup.

Hunt Group as a Call Forward Destination

In a small office where individuals generally receive calls directly, users may want someone in the office to answer calls when they are unable to answer. To handle this situation, create a hunt group with everyone in the small office as a member. Individual users can set their call forward destinations to this hunt group. The hunt group can be configured with simultaneous ring, which rings to hunt members only once, and to go to voice mail with Call Forward Busy and Call Forward No Answer conditions.

When configured as described above, if a user's call was forwarded to the hunt group after it wasn't answered, the hunt switch hunts everyone in the office. If the call was not answered after the maximum number of rings, the call is forwarded to voice mail where the caller can leave a message in the original target's mailbox.

Distribution of Calls to Backup Operators

In this scenario, a primary operator who handles calls to a main company number requires one or more secondary operators to receive the calls when the primary operator becomes too busy.

To create a hunt group to back up the primary operator, create a hunt group with backup operators. Enter the main operator and all the backups as members of the hunt group in the order in which they are to serve as backups. Set the hunt group for multiple calls to be hunted to a given member, and set the call stack size for each of the users to control the number of calls he or she can receive.

When there are incoming calls to the hunt group, the primary operator is offered the calls first. The operator may be offered multiple calls concurrently up to the limit of his or her call stack. If a member's call stack is full, the member is skipped and that particular call is not be offered again unless the hunt group is set to hunt forever and no member picks up the call before the member is reached again in the hunt list.

If a member of the operator group does not answer the hunt call, the call is offered to the next member after the number of rings configured for call forwarding. Thus, even if the primary operator has room on his or her call stack, the call is offered to the next member in the list when the operator does not answer the call in time.

If you want calls to go directly to a backup when the primary operator is not available, then set the hunt group not to hunt the members when their current call handling mode is set to Call Forward Always (DND). Operators can use this configuration to pass calls to other hunt group members by changing their call handling mode to Call Forward Always.

You may wish to have a hunt group that goes immediately to voice mail or another number during non-working hours. The hunt group can be configured with an off-hours schedule. Setup a schedule for on-hours during which the call handling mode for the hunt group is configured to forward calls to another

number only if the hunt group is busy or no one answers. For off-hours, set the hunt group to call forward always to voice mail or another number. The auto-attendant automatically changes the hunt group's current call handling mode based upon the configured schedule.

Common Line Monitoring

A hunt group can be used for line monitoring. For example, several operators may wish to monitor the same line and all have an opportunity to answer calls at the same time. For this case, set up a hunt group with simultaneous ring. When a call is received, the hunt switch rings all operators in the hunt group whose call stack is not full to the number of rings configured. If the hunt group is set to hunt forever, when the number of rings is reached the hunt switch hunts the same users again. However, the members who have room on their call stack for additional calls may have changed, so each additional hunt may result in different phones ringing.

Pickup Groups

Group Pickup is a traditional PBX and key system feature used in group environments. The feature allows users in a pickup group to answer any ringing phone in that group, and the feature works best in places where several people work together on a daily basis, such as design firms. If a group member is away from her desk and across the room while her phone rings, she can quickly answer the call from another person's IP phone by pressing the relevant soft key or programmable button, or by using a simple star command from an analog phone.

The following example may help illustrate how this feature is used.

Assume three users — Mike, Joe, and Sarah — work together and have jobs that require extensive collaboration. They also sit near one another. Their extensions — x1001, x1002, x1003, respectively — would be added to an extension list, and then this list would be associated with a pickup group.

The pickup group would have its own extension, for example x3755. Note that this extension is invalid and cannot be dialed, and thus acts more like a code than an extension. This non-dialable extension could be programmed into a ShoreTel Communicator toolbar button or an IP phone programmable button on Mike's, Joe's, and Sarah's phones.

So, assume Joe's phone, x1002, rings while he is having a conversation with Sarah at her desk. He would hear his phone ringing at his desk, yet he could press the pre-programmed button on Sarah's IP phone to answer his own call.

Alternatively, if Sarah had an analog phone, Joe could press *13 + 3755 to answer the call.

Types of Extensions for Pickup Groups

- User extensions
- Workgroup extensions
- Bridged Call Appearance (BCA) extensions

Details

- Pickup groups can be associated with a programmable toolbar button, or with a programmable button on an IP phone, and can work with Extension Assignment.
- The user whose phone will be picked up must have class of service “Call Pickup Allowed” to use this feature. However, other users need not be members of the pickup group to pickup a call.
- This feature is not supported on the ShoreTel T1 and ShoreTel E1 voice switches.
- The call pickup feature will support:
  - 24 members per group
  - 16 groups per switch
  - The sum of all members assigned to all Pickup Groups on a switch cannot exceed 80.
  - A single user can be a member of up to 5 Pickup Groups.
- A single switch can host a combined total of up to 24 Hunt Groups, Bridged Call Appearances, and Pickup Groups.
- Users can use this feature in several different ways:
  - IP Phone — If a programmable button has been configured for Pickup Groups, the user can press the button, or key, and enter the extension for the Pickup Group to answer the call.
  - IP Phone — If a soft key has been programmed, the user can press the “pickup” soft key and enter the extension to answer the call.
  - ShoreTel Communicator — If one of the pre-programmed buttons in ShoreTel Communicator has been set up for Pickup Groups, a user can enter the extension of the Pickup Group to answer the call. If the key has already been programmed with the extension of the Pickup Group, then it is not necessary to enter the extension.
  - ShoreTel Communicator — Alternatively, the user can access the “pickup” command from the Call Menu, followed by the extension.
  - Analog Phone — The user can enter the *13 command, followed by the Pickup Group extension to answer calls from an analog phone.

Workgroups

The ShoreTel system supports up to 256 workgroups, with up to 300 members per workgroup, with a maximum of 300 agents total in the ShoreTel system. A workgroup enables a group of users to appear as a single unit to calling parties. Calls can be routed in top-down, longest-idle, round-robin, and simultaneous-ring fashion. The Simultaneous Ring feature is limited to workgroups that contain a maximum of 16 members. Workgroups are typically used by support and sales groups to help automate call handling.

The ShoreTel system provides a ShoreTel Communicator - Workgroup Agent Access and ShoreTel Communicator - Workgroup Supervisor Access with the proper software licenses. In addition, you can run workgroup reports on the server to help you understand and assess workgroup activity and performance.

ShoreTel analog phones do not display Caller ID for calls forwarded from a workgroup.

Agent Multiplicity

Users can be members of multiple workgroups. The workgroups can be configured for any hunt pattern and can have queuing enabled.

A single agent status is applied to all workgroups of which the user is a member. With one status, an agent is either logged-in, logged-out, or in wrap-up for all workgroups of which he or she is a member. In order to manage their own logged in status, users must be provisioned with ShoreTel Communicator - Workgroup Agent. Agents can manage their logged-in state via ShoreTel Communicator, or through the TUI menu in their voice mailbox or via their IP phone programmable button.

When an agent is a member of more than one workgroup, that agent can receive calls from any of the workgroups. When an agent is available to take calls from more than one workgroup, and the workgroup would select that agent based on the current hunt pattern for a call, the oldest call is offered to the agent.

Queue Monitor shows calls from all the queues of which the user is a member. If the user is a member of only one queue, there is no change to the interface. However, if the user is a member of multiple workgroups, the Queue Monitor shows statistics for each workgroup, and for all workgroups. The user can specify a filter to show only a subset of the queues. The filter only changes the information displayed and does not alter the hunting behavior; the user will still be offered calls from all workgroups of which the user is a member.

For workgroup supervisors the Agent Monitor shows all agents from the workgroups of which the supervisor is a member. The Agent Monitor also allows supervisors to filter agents being monitored by selecting individual workgroups.

Call Monitor and Barge In

Call Monitor creates a limited conference call where the monitoring party hears the other parties, but the monitored parties do not hear the monitoring party. When a call is being monitored, a warning tone may be played to the participants of the call. The warning tone can be disabled using an option for an Auto-Attendant Menu. Call center administrators typically disable the warning tone to silently evaluate agent performance. When the warning tone is disabled, the menu prompt typically informs the caller that their conversation may be monitored or recorded.

Barge In allows one party to join an existing call as a fully conferenced participant. When Barge In is initiated, a brief intrusion tone is played to the other participants.

A recording warning tone may be played to the customer during silent monitor. The warning tone is enabled from ShoreTel Director. No tone is played during a Barge In call.

WARNING!

ShoreTel, Inc. does not warrant or represent that your use of silent monitoring or barge in features of the Software will be in compliance with local, state, federal, or international laws that you may be subject to. ShoreTel, Inc. is not responsible for ensuring your compliance with all applicable laws. Before configuring the call monitoring features, you may wish to consult with legal counsel regarding your intended use.

To simplify discussion of this feature, we will refer to three parties: the supervisor, the agent, and the customer. The supervisor initiates the silent monitor by selecting an agent. The agent is on a call with the customer. The customer may be an internal or external caller, but supervisors and agents must be on extensions.

In Silent Monitor, a supervisor hook flash is ignored. However, a hook flash by the other parties works the same as in a two-party call. In particular, an agent flash puts the call on hold and allows a consultative transfer or conference.

Because there is a limit of three parties in a conference call, if the agent or customer makes a consultative transfer or conference, the supervisor is automatically dropped. Similarly, if another party barges in a monitored extension, then the silent monitor is dropped.

If a conference call is already in progress, it cannot be monitored. If a silent monitor is already in progress, no one else can monitor the call.

The supervisor can barge in on a call he or she is silent monitoring. It is not possible to revert a barge in call to a monitored call. If desired, the supervisor can hang up and restart monitoring.

After a barge in, the agent remains the controlling party of the call. A subsequent agent hook flash disconnects the supervisor, who is the last party added.

Barge In and Silent Monitor Telephony COS Configuration

Each telephony class-of-service (COS) permission has several additional check boxes and radio buttons in ShoreTel Director to configure Intercom/Paging, Barge In, Call Recording, and Silent Monitor.

Table 27: Barge In and Silent Monitor Telephony COS Configuration Parameters

Parameter	Definition
Allow initiation for Intercom/Paging	If this check box is selected, users within this COS may place an intercom call or page to other system users. If cleared, then no intercom/paging can be initiated.
Accept Intercom/Paging	Accept None — If selected, users within this COS may not receive intercom calls or pages. Accept All — If selected, users within this COS may receive intercom calls or pages from anyone in the COS. Accept Only From — If selected, users within this COS may only receive intercom calls or pages from the person specified in the associated field.

Table 27: Barge In and Silent Monitor Telephony COS Configuration Parameters(Continued)

Parameter	Definition
Allow initiation for barge in	If this check box is selected, users within this COS may barge in on the calls of other system users. If cleared, then no barge in can be initiated.
Accept barge in	Accept None — If selected, users within this COS may not receive barge-in's from anyone. Accept Al — If selected, users within this COS may receive barge-in's from anyone else with this COS permission. Accept Only From — If selected, users within this COS may only receive barge-in's from the person specified in the field accosted with this radio button.
Allow initiation for record others calls	If this check box is selected, users within this COS may record the calls of other system users. If cleared, then no call recording of others can be initiated.
Accept record others calls	Accept None — If selected, users within this COS may not have their calls recorded from anyone. Accept All — If selected, users within this COS may have their calls recorded from anyone else with this COS permission. Accept Only From — If selected, users within this COS may only have their calls recorded by the person specified in the field associated with this radio button.
Allow initiation for silent monitor	If this check box is selected, users within this COS may monitor other system users. If cleared, then no monitoring of others can be initiated.
Accept silent monitor	Accept None — If selected, users within this COS cannot be monitored by anyone. Accept All — If selected, users within this COS can be monitored by anyone else with this COS permission. Accept Only From — If selected, users within this COS can only be monitored by the person specified in the field associated with this radio button.

There are no special permissions for ShoreTel Enterprise Contact Center agents or supervisors. They must have these same COS permissions with appropriate settings to enable contact center silent monitoring and barge in.

Enterprise Telephony Features

Music on Hold

ShoreTel provides two options for implementing music on hold (MOH).

- Jack-Based Music on Hold: Audio is provided through the audio input port on the ShoreTel Voice Switches that support MOH. A site needs only one MOHsource. Appendix F describes the switches that support MOH.
- File-Based Music on Hold: Audio is provided through a digital file.

Jack-Based Music on Hold

Connecting the desired music source to the selected ShoreTel Voice Switch provides MOH. The source can be recorded music or custom music, with prerecorded announcements or other information for callers.

Each site with music on hold must have its own music source. To conserve bandwidth, music is not sent across the WAN between sites, and MOH is selected by the ShoreTel Voice Switch where the CO trunks are configured (i.e., the holding party). IP phone users do not receive MOH when they are on an internal call. See the *ShoreTel System Administration Guide* for additional information.

Before installing the system, confirm that you have music sources for each site, including the music and the required equipment for playback.

Details related to MOH over SIP Trunks

- Music On Hold for SIP trunks is offered for environments where external users reach the ShoreTel system through SIP trunks (such as BRI via a SIP gateway).
- If there is a MOH source at the same site as a SIP trunk, these trunks are connected to that source when placed on hold, and the device at the other end of the trunk connects directly to the MOH switch.
- The existing rules for MOH also apply to MOH for SIP Trunks:
  - MOH is not sent across sites.
  - The MOH source must be at the same site as the SIP trunk that utilizes it.
- If one of the parties in a conversation places the other party on hold, only the person who was placed on hold hears MOH.
- MOH is supported on a SIP tie trunk to IP Phones in the following scenarios:
  - From an IP phone to another IP phone.
  - From an analog phone to an IP phone (i.e. putting the call on hold from an analog phone).
  - From any trunk (PRI/analog) while placing an IP phone caller on hold.
  - From any phone type to a SIP trunk device such as a Hitachi phone over the SIP tie trunk and onto the SIP trunk device.

File-Based Music on Hold

Music on hold audio files can be added to the system using ShoreTel Director. The file can be recorded music or custom music, with prerecorded announcements or other information for callers. When file-based MOH is enabled, files can be played to all endpoints, except SIP-tie trunks.

To enable file-based MOH, MOH source(s) must be configured to play the uploaded music files. Any combination of Headquarters Server, DVS Server(s), or V-Switch(es) can be configured as MOH sources.

When an MOH file is added to the system, the file is stored on the Headquarters server, and is then automatically distributed to each server in the system that has file-based MOH enabled.

An MOH music file can be assigned to a specific user or group of users via Director. See the *ShoreTel System Administration Guide* for additional information.

When a call is put on hold with file-based MOH enabled, the streaming source is selected from the configured sources for the site. Sources with a higher maximum concurrent call limit are selected more frequently.

After a source reaches the maximum call limit, the source is no longer available for additional MOH calls. In this case, another configured MOH source for the site is tried. If all the sources at a site are unavailable or unreachable, MOH falls back to the parent sites and repeats the process. If all file-based MOH sources for the site and all its parents are exhausted, the call attempts to fall back to jack-based MOH using the rules described in Jack-Based Music on Hold on page 157.

The resources used to generate MOH are shared with other voicemail services on these sources. When planning, it is important to consider if a source will be able to handle concurrent usage of MOH calls, VM, and AA activity. If more resources are required, an additional source dedicated to MOH can be added to the ShoreTel system. For example, a DVS can be added with file-based MOH enabled and no voice mailboxes or other server features configured. For more information, see "General Feature Limitations on page 393.

Which File is Played When a Call is Put On Hold?

The file played when a call is put on hold is selected using the following rules:

1. If the call is incoming through DNIS and an MOH file is configured for that DNIS number, the MOH file is played for the duration of the call, even after a transfer.
2. If the first rule does not apply and an MOH file is configured for the User Group of the user holding the call, that User Group's MOH file is played.
3. If neither of the rules above applies and an MOH file is configured for the default system MOH file, the system MOH file is played.
4. If none of the rules above applies, MOH uses the Jack-based MOH according to the rules described in Jack-Based Music on Hold on page 157.

Jack-Based MOH vs. File-Based MOH

Table 28 compares jack-based MOH and file-based MOH.

Table 28: Jack-Based MOH vs. File-Based MOH

MOH Feature	Jack-Based MOH	File-Based MOH
Can control music to be played?	Yes, per site.	Yes, by DNIS, User Group or System Default.
Can stream music crosssite?	No.	Yes.
Can stream music to internal phones?	No, external only.	Yes.
Can stream music to SIP extensions?	No, external only.	Yes.
Music streaming source?	MOH Jack on switches.	File saved on server or voicemail model switches.
When call is first held, does music start from the beginning?	No.	Yes.
If call is held a second time, does the music resume from where it last ended?	No.	Yes.
Does each stream use its own bandwidth?	No, bandwidth is used only once per switch, except for SIP trunks.	Yes.

Overhead Paging

The ShoreTel system can provide single-zone overhead paging for each site by using the audio output port on those ShoreTel voice switches that provide an audio output port.

For sites that require overhead paging, you must designate one of the ShoreTel voice switches to provide paging. In addition, you must provision your selected paging equipment for connection to the ShoreTel system.

Multi-site Paging Groups

As an alternative to a paging system, you can designate groups of system extensions that can be paged by dialing a single system extension. In this way, audio is routed to a group of phones and played on the phone speaker as opposed to playing the audio announcement on an overhead paging system.

You can also add a paging extension, which is associated with a site's overhead paging system, to a paging group in order to simultaneously play audio on a group of phones and also an overhead paging system. Refer to the ShoreTel System Administration Guide for details.

Additionally, if more than one server is installed in the ShoreTel system, an administrator can choose to record and deliver the group page to another site using that site's DVS. This will decrease WAN bandwidth consumption if there is a need to deliver a page to users at a remote site.

Pages to on-hook IP phones will automatically be announced on the IP phone speaker. Pages to IP phones or analog phones that are already on a call are treated as a normal call. Call handling modes do not apply to page calls.

A maximum of 100 extensions can be paged at one time. Group paging is not available to external callers.

Refer to the ShoreTel System Administration Guide for more information about establishing and managing paging groups.

Night Bell

The ShoreTel system can provide an overhead night bell on a per site basis using the audio output port associated with ShoreTel Voice Switches that provide an audio output port.

Intercom

A user can initiate an intercom call through a programmable button on an IP phone that has been programmed with the Intercom feature, via the ShoreTel Communicator, or via the phone by entering "*15" + extension number. Users must be configured to use the intercom feature through ShoreTel Director.

All intercom calls defeat the user's call coverage, or Call Handling Mode settings, and cannot be forwarded.

An intercom call to an idle IP phone is auto-answered and connected through the called party's speakerphone. Immediately after the call is auto-answered, the called party hears an announcement tone and the calling party hears a beep tone. If the called phone was taken off-hook automatically, the switch puts the phone back on-hook when the intercom call terminates.

An intercom call to an analog phone or SoftPhone that is off-hook with no active call, such as in hands-free mode, is auto-answered through the audio device that is currently active. If the called party is on-hook or is on an active call, the call is offered as an ordinary call, except that call coverage is still defeated.

An intercept tone (fast-busy) is played if the calling user does not have the appropriate permissions. If the called party does not accept intercom calls due to CoS permissions, the call is offered as an ordinary call.

Intercom Telephony COS Configuration

Each telephony class-of-service permission has two additional check box settings in ShoreTel Director to configure intercom permissions:

- Allow initiation for Directed Intercom/Paging — If enabled, users with this COS may make intercom calls to other users of the system. If disabled, then intercom calls cannot be made.

- Accept Directed Intercom/Paging — If enabled, users with this COS may accept intercom calls. If disabled, then intercom calls are received as normal calls.

Call Recording

The ShoreTel system provides the capability for users to record calls. To be available, call recording must be configured in ShoreTel Director by a system administrator. Refer to the ShoreTel System Administration Guide for details on configuring this feature.

Users can use ShoreTel Communicator -Personal Access to request that a call be recorded to voice mail. Supervisors may use Agent Monitor to record an agent's call. Ordinarily, both ShoreTel Communicator and Agent Monitor will indicate when a call is being recorded, but this behavior can be overridden with the Silent Recording feature to prevent agents from knowing that their calls are being recorded.

With Silent Recording, if the call is recorded by the workgroup supervisor, the indicator does not appear in Agent Monitor. The person invoking the recording sees the indicator — other parties do not. In this way, calls can be silently recorded to allow operators and supervisors to hide the fact that they are recording agents' calls. This hidden behavior may be desirable when a supervisor is monitoring the telephone manners of a new employee. When the recording is silent or hidden, ShoreTel Communicator offers no visual or audible indication that the call is being recorded, and the periodic beeping sound, which is used to notify call participants that their calls are being recorded, is suppressed.

The maximum number of simultaneous recordings equals the number trunk ports.

The following limitations apply to call recording:

- Call recording is only available via ShoreTel Communicator - Personal Access or a programmable button on IP phones.
- Only calls on trunks (not extensions-to-extensions) can be recorded.
- 2-way and 3-way calls can be recorded if one of the legs of the call is a trunk.
- Calls to a legacy ShoreTel Conference Bridge cannot be recorded.
- Recording stops when the call is parked, unparked, or transferred.

ShoreTel, Inc. does not warrant or represent that your use of call monitoring or recording features of the software will be in compliance with local, state, federal or international laws that you may be subject to. ShoreTel, Inc. is not responsible for ensuring your compliance with all applicable laws. Before configuring the call recording feature, you may wish to consult with legal counsel regarding your intended use.

Make Me Conferencing

The ShoreTel system allows up to six callers to participate in a conference call without the use of a ShoreTel Conferencing Service or ShoreTel Converged Conferencing Solution. To use the Make Me conference feature you need a ShoreTel IP Phone and, for calls greater than 3 parties, the proper

Class of Service must be configured in ShoreWare Director. If you do not have an IP phone, the feature can also be used from the soft button “join” on an analog phone, in conjunction with ShoreTel Communicator. The conference ports must also be reserved on the ShoreTel Voice Switch. The Make Me conference feature does not require ShoreTel Conferencing Services or a ShoreTel Converged Conference Bridge.

ShoreTel Enterprise Contact Center Solution

If you purchased the ShoreTel Enterprise Contact Center Solution, you must configure an appropriate number of route points with adequate call stacks. Route points are a licensed feature. Ensure that you have sufficient licenses to support your planned deployment.

For information on route points, see the ShoreTel System Administration Guide. For information on the ShoreTel Enterprise Contact Center Solution, please review the ShoreTel Enterprise Contact Center Solution Installation Guide and the ShoreTel Enterprise Contact Center Solution Administration Guide.

CHAPTER

9

Telephone Planning and Ordering

This chapter provides information about the types of telephones supported by the ShoreTel system and what to consider when planning phones for your system. The topics discussed include:

- Recommendations 164
- Considerations for Selecting Phones 164
  - Operators and Call Center Agents 164
  - Administrative Assistants and Receptionists 164
  - Executives and Professionals 165
  - Roaming Workers 165
  - General Users 165
  - Conference Rooms 165
  - Lobby Phones 165
  - Teleworkers 165
- ShoreTel IP Phones 166
- Planning Considerations for ShoreTel IP Phones 167
- Analog Phone Requirements 168
  - Caller ID Standard Support for Analog Phones 169
- Fax Machines and Modems 171
  - Fax Machines 171
  - Modems 172

Recommendations

The following recommendations can assist you with planning, ordering, and installing your telephones:

- Select your telephones based on user requirements, your wiring infrastructure, and system objectives.
- Order your telephones early. If you need a large quantity of them, you should order them several weeks in advance.
- Have your cabling contractor place and test all your telephones. Have the contractor unpack, assemble, place, and test every telephone so that you can avoid this simple but time-consuming task.
- If the telephone you choose requires local power, make sure an outlet is available at each location.

Considerations for Selecting Phones

Before ordering telephones, you should consider how the phone will be used by various types of users or in certain locations (such as in a conference room or lobby). This section describes the phone features and functionality that different types of users or locations typically require.

Operators and Call Center Agents

Operators and other employees who answer and transfer large numbers of calls could benefit from phones that support the following features:

- The programmable buttons feature, which is available on ShoreTel multi-line IP phones and on the Button Box (BB24) device, allows users or administrators to assign functions to custom keys. For example, an operator could assign speed dial numbers to programmable buttons.
- The Automatic Off-Hook Preference feature, which is available on ShoreTel multi-line IP phones, allows users to select which audio path (speakerphone or headset) is automatically activated when a call is placed or received. In addition, the HandsFree Mode feature suppresses the dial tone, which is a preference that people who use headsets often prefer. With these supports, employees can use ShoreTel Communicator to answer and transfer calls rapidly. Many employees is this type of job role stop using their telephone, opting instead to use Communicator and their headset

Administrative Assistants and Receptionists

Phone users in these roles are typically satisfied with a standard desk telephone that has speakerphone and mute buttons and supports Caller ID and Message Waiting. In addition, administrative assistants or receptionists could benefit from ShoreTel multi-line phones that offer programmable buttons that support extension monitoring. With this feature, users can monitor multiple system extensions.

Executives and Professionals

Most executives and professionals need advanced phones with full feature sets to handle multiple calls themselves or enable assistants to monitor their extension. For this reason, people in this role generally need multi-line phones with several programmable buttons to support features such as shared call appearance and speed dial.

Roaming Workers

Employees whose jobs involve walking around rather than sitting at a desk need a cordless telephone that they can carry with them so that they can receive calls wherever they roam at the work site. The ShoreTel IP Phone 930D is a DECT cordless phone that meets these needs.

Workers who need the flexibility to work inside or outside the office can use the ShoreTel Mobility applications integrated with a smartphone.

General Users

Typically, most general users are satisfied with a standard desk telephone that has speakerphone and mute buttons and supports Caller ID and Message Waiting. ShoreTel IP phones are fully featured and appropriate for most users. IP phones come with the ShoreTel features such as Directory and Conference available on preprogrammed buttons.

Conference Rooms

Most conference rooms need a speakerphone that supports discussions including multiple people. In addition, a phone in a conference room should offer single-button access to features such as transferring and conferencing calls.

Lobby Phones

A cost-effective wall-mount, slim-line, or desk telephone is adequate for most lobby phones, hall phones, and the like.

Teleworkers

Both analog and IP phones can be included in a ShoreTel system as remote phones. Analog phones require use of the Extension Assignment, while IP phones are supported by setting an IP address range through ShoreTel Director.

ShoreTel IP Phones

Table 29 on page 166 provides information about ShoreTel IP phones. For complete details about each model, see http://www.shoretel.com/products/ip_phones and http://media.shoretel.com/documents/IP+Phones+specs.pdf.

The ShoreTel IP Phone BB24 (“button box”) is a unit that plugs into supported phone models to add 24 extension buttons.

Table 29: ShoreTel IP Phone Models

Phone Model	User or Purpose	Features
IP 930D	Roaming employees such as floor managers, filing clerks, and security guards	Cordless (DECT technology), 3 lines
IP 655	Executives, advanced professionals, remote workers, conference rooms	12 lines, large color touch screen, integrated VPN client, Gigabit Ethernet Enhanced directory and call history applications, with real-time telephony presence information and visual voicemail
IP 565g	Executives, advanced professionals, remote workers	6 lines, integrated VPN client, Gigabit Ethernet, Bluetooth
IP 560g	Operators, contact center agents, assistants, receptionists, advanced professionals, remote workers	6 lines, integrated VPN client, Gigabit Ethernet
IP 485g	Executives, advanced professionals	8 lines, large color screen, SIP, Gigabit Ethernet, USB port, visual voicemail, enhanced directory and call history applications, real-time telephony presence information
IP 480g	Operators, contact center agents, assistants, receptionists, advanced professionals	8 lines, large black and white screen, SIP, Gigabit Ethernet, visual voicemail, enhanced directory and call history applications, real-time telephony presence information
IP 480	Professionals, contact center agents	8 lines, large black and white screen, SIP, visual voicemail, enhanced directory and call history applications, real-time telephony presence information
IP 420	Contact center agents, lobbies, break rooms, classrooms	2 lines, SIP
IP 530	Professionals	3 lines, InstaDial™ functionality
IP 265	Operators, contact center agents, assistants, receptionists, advanced professionals	6 lines, color screen

Table 29: ShoreTel IP Phone Models

Phone Model	User or Purpose	Features
IP 230g	Professionals, advanced professionals, contact center agents, remote workers	3 lines, integrated VPN client, Gigabit Ethernet
IP 230	Professionals	3 lines
IP 212k	Small business	12 lines
IP 115	Contact center agents, lobbies, break rooms, classrooms	Single-line, speakerphone
IP 110	Contact center agents, lobbies, break rooms, classrooms	Single-line
BB24	Operators, assistants, receptionists	24 lines, feature keys, Ethernet switch port allows connection of a PC or an additional BB24 or IP phone Supported by ShoreTel 100-, 200-, and 500-Series IP Phones

Planning Considerations for ShoreTel IP Phones

Be aware of the following important installation planning considerations for ShoreTel IP230, IP230g, IP420, IP480, IP480g, IP485g, IP560g, IP565g, and IP655 phones:

- The ShoreTel IP230, IP230g, IP420, IP480, IP480g, IP485g, IP560g, IP565g, and IP655 models require a power-over-Ethernet (POE) power supply that complies with IEEE802.3af. For Gigabit Ethernet service, the POE switch must provide Gigabit Ethernet support.

  For capacity planning, use the following details:

  - The IP230 is a Class 2 device with a maximum consumption of 4.4 watts. Use 4.4 watts for capacity planning with POE switches on multiple deployments.
  - The IP230g is a Class 2 device with a maximum consumption of 5.9 watts. Use 5.9 watts for capacity planning with Gigabit Ethernet POE switches on multiple deployments.
  - The IP420 phone is a Class 1 device with a maximum consumption of 3.84 watts. Use 3.84 watts for capacity planning with POE switches on multiple deployments.
  - The IP480 phone is a Class 2 device with a maximum consumption of 6.49 watts. Use 6.49 watts for capacity planning with POE switches on multiple deployments.
  - The IP480g phone is a Class 2 device with a maximum consumption of 6.49 watts. Use 6.49 watts for capacity planning with Gigabit Ethernet POE switches on multiple deployments.
  - The IP485g phone is a Class 0 device with a maximum consumption of 12.95 watts. Use 12.95 watts for capacity planning with Gigabit Ethernet POE switches on multiple deployments.

  - The IP560g phone is a Class 3 device with a maximum consumption of 8.2 watts. Use 8.2 watts for capacity planning with Gigabit Ethernet POE switches on multiple deployments.
  - The IP565g phone is a Class 3 device with a maximum consumption of 8.2 watts. Use 8.2 watts for capacity planning with Gigabit Ethernet POE switches on multiple deployments.
  - The IP655 phone is a Class 3 device with a maximum consumption of 9.1 watts. Use 9.1 watts for capacity planning with Gigabit Ethernet POE switches on multiple deployments.

- The ShoreTel IP560g, IP565g, and IP655 models require more power than the other ShoreTel models, and thus these phones are not compatible with the ShoreTel IP Phone power adapter used with other ShoreTel phone models.
- The ShoreTel IP560g and IP565g models cannot be daisy-chained from the Button Box (BB24). The BB24 pass-through power is limited to Class 2 devices, and these phones are Class 3 devices. This means the BB24 cannot forward adequate power to these phones.
- The ShoreTel IP420, IP480, IP480g, IP485g, and IP655 phone models cannot be deployed with a Button Box (BB24).
- The ShoreTel IP480g, IP485g, IP560g, IP565g, and IP655 phone models require Category 5e or Category 6 Ethernet cables when deployed in Gigabit Ethernet configurations. We do not certify the use of Category 5 Ethernet cables because they can lead to lower connection speed or performance issues during high-rate data transfers.

Analog Phone Requirements

The ShoreTel system supports standard analog 2500-type telephones, including the CLASS (Custom Local Area Signaling Services) features of Caller ID Name, Caller ID Number, and Message Waiting in the United States and Canada.

Outside the United States and Canada, the ShoreTel system supports the local standard analog telephones that support DTMF signaling. Analog Caller ID Number and Message Waiting are supported in the following countries:

- France
- Germany
- Italy
- Spain
- United Kingdom

Outside of the United States, Canada, and the countries mentioned in the bulleted list above, the features of Caller ID Name, Caller ID Number, and Message Waiting are not supported. See International Planning and Installation on page 369, for more information.

The following list summarizes key requirements for analog phones:

- **2500-type telephones:** The ShoreTel system supports standard 2500-type telephones. (It does not support 500-type rotary telephones.)

- **DTMF signaling, even during power failure:** The ShoreTel system uses DTMF tones for signaling with telephones and trunks. It is mandatory that the telephone support DTMF signaling even when power is interrupted, to allow users to make calls in emergency situations.
- **Flash button:** A Flash button is required on analog phone sets to activate call control features from the telephone, including transfer, conference, pickup, and park. ShoreTel *does not* recommend using the hook switch to simulate the Flash button, since this can lead to accidental hang-ups.

If a speakerphone is required:

- **Mute button:** Users in the enterprise typically demand that their speakerphone have a mute button. Since telephones are often designed with the residential market in mind, some speakerphones do not have a mute button, which may lead to end-user complaints.

If message waiting is required (United States and Canada only):

- **CLASS (FSK) message waiting indicator:** CLASS message waiting–compatible telephones provide a highly reliable method for turning message waiting lights on and off.

Telephones that rely on a stutter dial tone to control the message waiting light are unreliable and should be avoided.

ShoreTel does not support telephones that use voltage-driven message-waiting lights.

Select telephones from a reputable manufacturer. Although most phones on the market have good quality, we recommend that customers avoid “clone” or “low-end” phones.

Here are some additional considerations:

- **Not too many buttons:** Some telephones come with lots of complicated buttons and options that drive up the price of the device. The ShoreTel system delivers advanced features through desktop applications that are integrated with your enterprise tools. Telephones with lots of features and buttons are not necessary.
- **No answering machine:** The ShoreTel system includes an integrated voice mail system for all users at all sites. Telephones with integrated answering machines are not necessary.
- **No hold button:** Telephones with a hold button do not actually put the caller on system hold, so the caller will not hear music on hold or have the correct call control status details.

Caller ID Standard Support for Analog Phones

Table 30 lists the caller ID standards the ShoreTel system supports for analog telephones by country.

Table 30: Caller ID Standard Support for Analog Phones by Country

Caller ID Standard	Country
BELLCORE	United States
BELLCORE	Canada
BELLCORE	Hong Kong

Table 30: Caller ID Standard Support for Analog Phones by Country (Continued)

Caller ID Standard	Country
BELLCORE	Singapore
BELLCORE	Mexico
BELLCORE	China
BELLCORE	United Arab Emirates
BELLCORE	South Korea
BELLCORE	Philippines
BELLCORE	South Africa
BELLCORE	Costa Rica
BELLCORE	Israel
BELLCORE	Indonesia
BELLCORE	Fiji
BELLCORE	Mongolia
ETSI	France
ETSI	**Luxembourg
ETSI	Monaco
ETSI	**Saudi Arabia
ETSI	Romania
ETSI	Chile
ETSI	Hungary
ETSI	Germany
ETSI	Switzerland
ETSI	Austria
ETSI	Norway
ETSI	**Taiwan
ETSI	**Thailand
ETSI	Poland
ETSI	**Czech Republic
ETSI	Italy
ETSI	Spain
ETSI	*Argentina
BT	United Kingdom
BT	Ireland
None	Australia

Table 30: Caller ID Standard Support for Analog Phones by Country (Continued)

Caller ID Standard	Country
None	Malaysia
None	Brazil
None	Netherlands
None	New Zealand
None	Portugal
None	Belgium
None	Denmark
None	Sweden
None	India
None	Japan
None	Finland (unsupported DTMF variation)
None	Greece
None	Bulgaria

**Indicates uncertainty as to whether country supports configured standard.

Fax Machines and Modems

The ShoreTel system supports fax machines and modems in the United States and Canada (and not elsewhere).

Fax and modem calls are more sensitive to network problems than voice conversations. The human ear does not notice a lost packet during a voice conversation, but when a packet is lost during a fax transmission the line may be dropped. During a modem call, a lost packet can cause a retransmission. In the worst case, fax machines and modems will not establish a connection or may drop the call altogether. In general, fax and modem calls work across a local area network, but work on wide area networks only when there is virtually no packet loss and little jitter.

The ShoreTel system automatically detects both fax and modem tones, and boosts the voice encoding to a higher value to increase throughput. (G.711 at 64 Kbps is recommended.) It also stops the nonlinear processing of the echo canceller and fixes the size of the jitter buffer to a preset level. In addition, for modems, the echo canceller is frozen or stopped, since the modems use their own network echo cancellers.

Fax Machines

Fax machines require a high-quality IP network for proper operation.

The ShoreTel system supports distinctive ringing for inbound calls: calls from external parties have the classic single ring, whereas calls from internal parties have a distinctive double ring. Some fax machines detect the ringing pattern before answering and might not answer internal calls because of the distinctive ring pattern. In particular, you must turn off the “Intelligent Ring Mode” on some Hewlett-Packard fax machines to receive calls from internal parties.

Modems

The ShoreTel system supports “moderate-use” modem applications on the system. This is generally considered to be modem calls up to 28.8 Kbps that do not last longer than 15 minutes. If your application demands greater performance, you should bypass the ShoreTel system or move your modem application to a pure IP-based solution.

The expected modem performance in different configurations is as follows:

- Analog connection speeds will not exceed 33.6 Kbps and could be lower. External factors, including poor-quality trunk lines, ISP limitations, and multiple analog-to-digital conversions in the network, can have a significant impact on connection speeds.
- Modem calls demand a high-quality network with virtually no packet loss. Packet loss should not exceed 0.1%, which can be achieved on a local area network or in a wide area network using leased T1 facilities.
- Analog trunk ports should not be used if a digital trunk (T1) is available, since performance will be limited to 28.8 Kbps maximum. Digital trunks should be used instead.
- Connection speeds are significantly affected by multiple packet-to-circuit conversions (including modem calls from one ShoreTel system to another). If a T1 line is used, modems should be able to connect at K56Flex/V.90 or approximately 48 Kbps.

CHAPTER 10

Server Requirements

This chapter provides specific hardware and software requirements for ShoreTel Headquarters servers and ShoreTel Distributed Voice servers. The topics in include:

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- Requirements for ShoreTel Enterprise Systems 175
  - Capacity and Hardware Requirements for Headquarters Servers 176
  - Capacity and Hardware Requirements for Distributed Voice Servers 177
  - Operating System Requirements for All Servers 178
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General Recommendations

The following recommendations can help the customer to select the servers to buy:

- Buy a server from a reputable manufacturer to host ShoreTel's software. We advise against using servers from clone manufacturers for business-critical applications.
- Be sure each server that runs ShoreTel server software has enough processing capacity to support the planned telephony workload. ShoreTel servers perform call control (call setup and tear-down functions) and provide the services of voicemail, automated attendant, workgroup management, configuration databases, and more. The headquarters server also hosts the system configuration tool, Web pages for the user-interface and conferencing; and maintains call records and the history database.
- Do not use a ShoreTel server as a domain controller.

Requirements for ShoreTel Enterprise Systems

This section provides information necessary to provision servers on which to install ShoreTel Enterprise software.

The ShoreTel Enterprise Edition system is scalable. In the spirit of economy and efficiency, ShoreTel Enterprise customers provide their own server hardware allowing them to build the optimum phone system for their environment. To assist in creating the optimum system, ShoreTel has defined a tier system based on the number of users the system is to support and set minimum server requirements for each tier. The tiers ShoreTel defines are:

- Branch office bundle (functions only as a DVS server) or an SBE server the customer has upgraded to Enterprise Edition—both support up to 100 users.
- Small servers that support up to 500 users.
- Medium servers that support up to 2,500 users.
- Large servers that support up to 10,000 users.
- Very large servers that support up to 20,000 users.

Note

If a planned upgrade to the current release means that the current server cannot adequately support the new release of ShoreTel software, upgrade the server to a model with greater capacity before doing the server software upgrade.

Note

SBE systems upgraded to Enterprise support the same capacities as the small Enterprise system.

Capacity and Hardware Requirements for Headquarters Servers

Table 31 shows information about system capacity for each tier of the Headquarters servers. The table shows the number of users, calls, and reports that the server can support for each tier. Table 32 shows our recommendations for each tier of Headquarters server. Use these tables to determine the needs for Headquarters servers in the ShoreTel deployment. You can mix servers of different capacities, but choose the right servers for the telephony environment.

Table 31: Headquarter Server Capacity for Enterprise System

Size	Maximum number of users per System	Maximum number of users assigned to HQ Server	Maximum System BHCC	Maximum BHCC per server Reports run outside business hours	Maximum BHCC per server Reports run during business hours
If an upgrade from SBE	500	100	500	Not Recommended	Not Recommended
Small	500	500	5,000	1,000	Not Recommended
Medium	2,500	1,000	25,000	5,000	1,000
Large	10,000	1,000	50,000	10,000	5,000
Very Large	20,000	500 or 1,000	100,000	10,000	10,000

Note

- BHCC (Busy Hour Call Completion) per system is the total number of system calls during the busy hour including internal and external calls, calls terminated to desk phones, softphones, trunks or server applications such as voicemail.
- BHCC per server is based on the number of calls actually handled by the server during the busy hour including workgroup calls in menus and queues, auto-attendant calls and calls to the voicemail service.
- By default, the ShoreTel report generation tools that run on the server have a lower priority than other, more critical services. Low-demand report generation should have little or no affect on a server with adequate performance specifications. If you are a heavy report user or experience any degradation of voicemail or other server prompts on an underpowered server, you must move up to the next tier level of servers.
- For very large system deployments (10K to 20K), the number of ShoreTel Communicator for Windows users is 500. The number of ShoreTel Communicator for Web and mobile users in 1000.

Note

Report generation has an impact on system performance. ShoreTel recommends that customers run reports outside of business hours. If a customer needs reports during business hours, the supported calls per server for the medium and large server tiers is reduced as noted in the table.

Table 32 displays the minimum hardware requirement for ShoreTel Headquarters servers.

Table 32: Headquarter Server Hardware Recommendations for Enterprise System

Size	Processor	RAM	Network
Small	Intel Core 2 Duo E8400, Single Dual Core 3.00 GHz or Intel Core i3-540 Processor (4M Cache, 3.06 GHz)	4 GB	100 Base-T
Medium	Intel Xeon 5520 Single Quad Core 2.27 GHz	8 GB	100 Base-T or Gigabit Ethernet
Large	Intel Xeon 5520 Dual Quad Core 2.27 GHz	8 GB	Gigabit Ethernet
Very Large	Intel Xeon 5680 Dual Six Core 3.33 GHz	12GB	Gigabit Ethernet

Table 33 displays maximum usage ShoreTel DVS supports by usage type per server type.

Capacity and Hardware Requirements for Distributed Voice Servers

Table 33 provides information about system capacity for each of the tiers for ShoreTel Distributed Voice Servers (DVS). The table provides information about the number of users and calls that a DVS in each tier can support. Table 34 shows the minimum equipment capacities for each tier for DVSs. Use these tables to calculate the requirements for the DVSs in the ShoreTel deployment. You can mix servers of different capacities. Choose the right servers for the entire telephony environment.

Note

The system supports a maximum of ten distributed voice servers.

Table 33: Distributed Voice Server (DVS) Capacity

Size	Maximum Users per DVS Server
Branch Office Bundle	100
Small	500
Medium	1,000
Large	1,000
Very Large	500 or 1,000

Note

For very large system deployments (10K to 20K), the number of ShoreTel Communicator for Windows users is 500. The number of ShoreTel Communicator for Web and mobile users in 1000.

Table 34: DVS Hardware Minimums

Size	Processor	RAM	Networks
Branch Office Bundle	Intel Pentium G680, DualCore 2.7 Ghz.	2 GB	100 Base-T
Small	Intel® Core 2 Duo E8400, Single DualCore 3.00 GHz	4 GB	100 Base-T
Medium	Intel® Xeon 5520 Single QuadCore 2.27 GHz	8 GB	100 Base-T or Gigabit Ethernet
Large	Intel® Xeon 5520 Dual QuadCore 2.27 GHz	8 GB	Gigabit Ethernet
Very Large	Intel® Xeon 5520 Dual QuadCore 2.27 GHz	8 GB	Gigabit Ethernet

Operating System Requirements for All Servers

This section lists the operating systems that ShoreTel supports on the Headquarters server and distributed voice servers. If you are upgrading a system, refer to the Release Notes for the current ShoreTel version for special instructions that might apply.

ShoreTel supports the following operating systems in enterprise environments:

- Windows Server 2008 32-bit, SP2 (Standard, Enterprise). Prioritization of traffic type is not supported on this platform.
- Windows Server 2008 R2, SP1, 64-bit, (Standard, Enterprise). Prioritization of traffic type is not supported on this platform.
- Windows Server 2012, 64-bit (Standard, Datacenter). Prioritization of traffic type is not supported on this platform.

Note

ShoreTel servers (Headquarters and DVS) on the same ShoreTel network can have different operating systems.

Requirements for the ShoreTel SBE and SBE 100 Systems

The section describes the requirements for the ShoreTel Small Business Edition (SBE) and SBE 100 systems. It begins with a summary of the major differences between the features supported on the SBE, the SBE 100, and the EE (ShoreTel Enterprise Edition).

Table 35 lists the major differences between the features supported on the SBE, SBE 100, and the EE systems.

Table 35: Major differences between the features supported on SBE, SBE 100, and EE

Feature	SBE	SBE 100	EE
Sites	3	5	500
Switches	5	7	500
Users (with extensions)	50	100	20,000
Telephones	50	100	20,000
Trunks	50	100	10,000
Simultaneous calls, extension-to-extension	25	50	10,000
Busy Hour Call Completion	500	1,000	100,000
DVS	None	4	20
Integration with 3rd party PBX	No	No	Yes
On-net dialing	No	No	Yes
Voice mailboxes	100	120	20,000
simultaneous calls per server	10	25	254
AMIS	No	No	Yes
SMDI - External voicemail	No	No	Yes
SMDI - ShoreTel voicemail	No	No	Yes
Service Appliance 100 (SA100)	1	2	5
SA100 audio/web/IM ports	50/30/50	100/60/100	256/300/128
Service Appliance 400 (SA400)	No	No	Yes
Workgroups (groups, agents, supervisors)	50/50/50	100/100/100	256/300/128
ShoreTel Mobility clients	50	100	5,000

Note

- Both the SBE and the SBE 100 are available with a ShoreTel-provided server or a customer-provided server. The Server supplied by the customer must meet the minimum server requirements as indicated below.
- Both the SBE and the SBE 100 can be upgraded to the Enterprise Edition (EE).
- The SBE can be upgraded to the SBE 100; however, the Headquarters server must be at least dual-core and have 4GB of RAM.

SBE Requirements

ShoreTel can ship the Small Business Edition (SBE) with or without a server. If ShoreTel ships an SBE with a server, the server has the embedded Microsoft Windows Server OS for Telecommunications Systems. ShoreTel configures, tests, and prepares the server for the installation of the ShoreTel Director SBE software.

ShoreTel SBE Option with the ShoreTel Server

The server ShoreTel uses for its SBE meets or exceeds the following specifications:

- Processor: Intel Celeron E3400, DualCore 2.6 Ghz, 1MB Cache, and 800FSB
- Memory: 2.0GB, Non-ECC, 800 MHz DDR2
- Keyboard: No Keyboard
- Monitor: No Monitor Option
- Hard Drive: 80GB, SATA
- Floppy Disk Drive: No Floppy Drive
- Operating System: Microsoft Windows Server 2008 R2 for Telecommunications Systems
- Mouse: No Mouse Option
- NIC: On board Network Adapter
- Optical Drive: 16X DVD-ROM SATA

ShoreTel SBE Option without the ShoreTel Server

For customers who buy their own server, the server must meet or exceed the following specifications:

- Celeron Dual Core 2.5 GHz or higher
- 2 GB or more of RAM
- 80 GB or more on the hard disk
- 10/100 Ethernet NIC or higher
- 1 or more USB ports
- Only Microsoft Windows Server 2008 Standard or Enterprise edition is supported

Note

ShoreTel's SBE server is usually appropriate for up to 50 users. However, some customers might have plans to grow fast (for example, to more than 50 users) by buying an SBE upgrade to an Enterprise license. Also, some customers might plan for more expensive uses of the ShoreTel SBE, such as paging to multiple phones, using more than 10 workgroups simultaneously, or running Web Reports. These customers should consider buying their own server with at least 4 GB of RAM.

Using a ShoreTel SBE Server in the Enterprise Setup

If an SBE customer gains more than 50 phone users, an upgrade from a ShoreTel SBE to the ShoreTel Enterprise edition is mandatory. The customer can use the SBE server in the Enterprise system as either a Headquarters server or a DVS server.

Option1: Using the SBE server as a Headquarters server

With this configuration, the number of users in the system cannot exceed 100. Other restrictions include:

- Simultaneous media paths have a limit of 10 (media paths provide access for voice mail, workgroups, or auto-attendant).
- Busy hour call completion has a limit of 500.
- The SBE does not support Web Reports.

Option 2: Using the SBE server as a Distributed Voice Server (DVS)

With this configuration, the number of users in the system cannot exceed 500, and the maximum number of users on the DVS cannot exceed 100. Other characteristics include:

- Simultaneous media paths have a limit of 10 (media paths provide access for voice mail, workgroups, or autoattendant).
- Busy hour call completion has a limit of 500.
- The SBE supports Web Reports because these reports run on the Headquarters server.

SBE 100 Requirements

ShoreTel can ship the Small Business Edition (SBE) with or without a server. If ShoreTel ships an SBE with a server, the server has the embedded Microsoft Windows Server OS for Telecommunications Systems. ShoreTel configures, tests, and prepares the server for the installation of the ShoreTel Director SBE software.

ShoreTel SBE 100 Option with the ShoreTel Server

The server that ShoreTel uses for its SBE 100 (ShoreTel UC Server 20) meets or exceeds the following specifications:

- Processor: Intel Celeron E3400, DualCore 2.6 Ghz, 800FSB
- Memory: 4.0GB, DDR3
- Hard Drive: 500GB, SATA
- Rack-Mountable (1U) Form-factor
- Windows 2008 R2 Embedded OS

ShoreTel SBE 100 Option without the ShoreTel Server

For customers who buy their own server, the server must meet or exceed the specifications of the server shipped by ShoreTel specified above. For customer-provided servers, Microsoft Windows Server 2008 Standard or Enterprise edition is supported.

Note

The ShoreTel server that is shipped with SBE 100 (ShoreTel UC Server 20) is usually appropriate for up to 100 users. However, some customers might have plans to grow fast (for example, to more than 100 users) by buying an SBE/SBE 100 upgrade to the Enterprise license. Also, some customers might plan for more expensive uses of the ShoreTel SBE 100 system, such as paging to multiple phones, using more than 25 workgroups simultaneously, or running Web Reports. These customers should consider buying their own server that has, at a minimum, the hardware parameters of the ShoreTel Small Enterprise Server specified inTable 32.

Using a ShoreTel SBE 100 Server in the Enterprise Setup

If an SBE 100 customer gains more than 100 phone users, an upgrade from a ShoreTel SBE 100 to the ShoreTel Enterprise edition is mandatory. When upgrading from the SBE 100 to the Enterprise Edition, the customer can use the server shipped with the SBE 100 (the ShoreTel UC Server 20) in the Enterprise system as either a Headquarters server or a DVS server.

Option1: Using a ShoreTel UC Server 20 as a Headquarters server

With this configuration, the number of users in the system cannot exceed 200. Other restrictions include:

- Simultaneous media paths have a limit of 25 (media paths provide access for voice mail, workgroups, or auto-attendant).
- Busy hour call completion has a limit of 1000.
- The SBE 100 does not support Web Reports.

Option 2: Using a ShoreTel UC Server 20 as a Distributed Voice Server (DVS)

With this configuration, the number of users in the system cannot exceed 500, and the maximum number of users on the DVS cannot exceed 200. Other characteristics include:

- Simultaneous media paths have a limit of 25 (media paths provide access for voice mail, workgroups, or auto-attendant).

- Busy hour call completion has a limit of 1000.
- The SBE supports Web Reports because these reports run on the Headquarters server.

SBE and SBE 100 Operating System Requirements

For SBE and SBE 100, ShoreTel supports the operating systems listed below.

OS Requirements for Servers Shipped by ShoreTel

- Windows Server 2003, Embedded Telecom Edition
- Windows Server 2008 R2, 64-bit, SPx, Embedded Telecom Edition

OS Requirements for Servers Shipped by End-Customer

- Windows Server 2008, 32-bit, SP2 (Standard, Enterprise) - SBE only, not supported with SBE 100
- Windows Server 2008 R2, 64-bit, SP1 (Standard, Enterprise)

Requirements for VMware Environments

This section provides information necessary to install the ShoreTel system software on servers running VMware.

ShoreTel only supports the core telephony platform in VMware. Other professional services applications are not supported on the ShoreTel virtual servers.

ShoreTel Capacity in VMWare Environments

Table 36 provides information about ShoreTel capacities when installed on servers running VMware.

Table 36: VMware Capacity

Size	Maximum Users per DVS Server	Maximum DVS per Server BHCC Reports run outside business hours	Maximum BHCC per Server Reports run during business hours
SBE	50	500	Not Recommended
Small	500	5,000	1000
Medium	2,500	25,000	5,000
Large	10,000	50,000	10,000

Hardware Requirements for VMware Installation

Table 37 provides information about server requirements for installing ShoreTel Headquarters and DVS on servers with VMware.

Table 37: VMware Hardware Recommendations

Size	Cores per VM	Processor	RAM	Hard Disk for HQ VMWare Server	Hard Disk Size for DVS VMWare Server
SBE	2	Quad-core Intel Xeon X550, 2.66 GHz	4 GB	60 GB	40GB
Small	2	Intel® Core 2 Duo E8400, Single DualCore 3.00 GHz	4 GB	60 GB	40 GB
Medium	4	Intel® Xeon 5520 Single QuadCore 2.27 GHz	8 GB	150 GB	80 GB
Large	8	Intel® Xeon 5520 Dual QuadCore 2.27 GHz	8 GB	260 GB	130 GB

Operating System Requirements for VMware

This section lists the operating systems ShoreTel supports that you can use with VMware. You can install these operating systems on both headquarters and distributed voice servers.

ShoreTel supports the following operating systems in enterprise environments:

- Windows Server 2008 32-bit, SP2 (Standard, Enterprise)
- Windows Server 2008 R2, SP1, 64-bit, (Standard, Enterprise)

VMware Software Requirements

ShoreTel supports the use of VMware on both headquarters servers and distributed voice servers. You can install the following versions of VMware on headquarters servers and distributed voice servers:

- VMware ESXi 4.0 for High Availability or VMotion configurations.
- VMware ESXi 4.1 for High Availability or VMotion configurations.
- VMware ESXi 5.0 for High Availability or VMotion configurations.
- VMware ESXi 5.1 for High Availability or VMotion configurations.

Virtual Desktop Services

ShoreTel does not support the use of VMware® Horizon View™ (formerly known as VMware View) or any other desktop virtualization tool on headquarters servers or distributed voice servers.

Deploying ShoreTel servers under VMware

For details on how to deploy ShoreTel servers under VMware, see the example given in ShoreTel Application Note AN 10391, “Deploying ShoreTel Servers under VMware 5.0,” on the ShoreTel Partners web site: http://support.shoretel.com/.

Requirements for Microsoft Hyper-V Environments

Hyper-V is the Microsoft virtual computing infrastructure, consisting of Hyper-V servers, Hyper-V Manager, and related components.

This section provides information necessary to install the ShoreTel system software on servers running Hyper-V.

Supported Configurations and Hyper-V Features

ShoreTel supports the following configurations and features on Hyper-V:

- ShoreTel 14.2 and later
- ShoreTel HQ and DVS servers with 2 to 8 virtual CPUs (the minimum recommended VM size is 2 virtual CPUs)

ShoreTel Capacities in Hyper-V Environments

When you create a virtual machine (VM), you must specify various properties related to size, such as the number of CPUs, the amount of memory, and the size of the disk.

Table 38 provides the recommended configuration values for small, medium, and large ShoreTel deployments.

Note

The values shown in Table 38 are typical, but they may not be appropriate for all deployments.

Table 38: Recommended Sizing Parameters

System Size	Users	Call Load per System	Call Load per Server (w/o Reports)	Minimum Virtual Processors per VM	RAM per VM (GB)	Storage System Through-put (MB/s)	Voice Network Through-put (Mb/s)	Disk Size per HQ VM (GB)	Disk Size per DVS VM (GB)
Small	500	5,000	1,000	2	4	0.17	16	60	40
Medium	2,500	25,000	5,000	4	8	0.83	80	150	80
Large	10,000	50,000	10,000	8	8	3.1	320	260	130

Hardware Requirements for Hyper-V Installation

Intel and AMD CPUs that meet the Hyper-V 3.0 CPU requirements include the following types:

- Intel Virtualization Technology (Intel VT) or AMD Virtualization (AMD-V) technology.
- Hardware-enforced Data Execution Prevention (DEP) must be available and enabled. Specifically, enable Intel XD bit (execute disable bit) or AMD NX bit (no execute bit).

Operating System Requirements for Hyper-V

- ShoreTel supports Hyper-V on Microsoft Windows Server 2012 with Hyper-V role installed, Standard and Datacenter Editions.

Software Requirements for Hyper-V

- ShoreTell supports Hyper-V version 3.0.

Deploying ShoreTel Servers Under Hyper-V

For details on how to deploy ShoreTel servers under Hyper-V, see the ShoreTel Application Note AN-14008, “Deploying ShoreTel Servers under Microsoft Hyper-V 3.0,” in the Technical Knowledge Base on the ShoreTel Partners support site: http://support.shoretel.com/.

Double-Take Availability Software for Failover

For system failover in the current release, ShoreTel supports Double-Take Availability software version 5.3 only. This section describes how ShoreTel supports the upgrade of different releases of Double-Take Availability software for the current release.

- If upgrading the system to the current version of ShoreTel, you can directly upgrade Double-Take Availability version 5.1 or later to Double-Take Availability version 5.3.
- If the system currently is using Double-Take Availability version 5.0 or earlier:

  a. Uninstall the Double-Take Availability software after you finish installing the current version of ShoreTel.

  b. Install Double-Take Availability version 5.3.

Double-Take Availability Software on Windows Server 2012

ShoreTel supports Double-Take Availability software version 6.0 on Windows Server 2012 Standard and Datacenter editions.

Note

Double-Take Availability software version 5.3 is not supported on Windows server 2012.

If upgrading the system to the current version of ShoreTel, you can directly upgrade Double-Take Availability version 5.3 to Double-Take Availability version 6.0.

Upgrading Double-Take Availability to version 6.0 from version 5.3

Perform the following steps to upgrade Double-Take Availability to version 6.0 from version 5.3:

1. Uninstall Double-Take Availability version 5.3 after you finish installing the current version of ShoreTel.
2. Install Double-Take Availability version 6.0.

Note

Double-Take Availability version 5.3 must be uninstalled before Double-Take Availability version 6.0 can be installed.

Hard Disk Requirements

This section provides information about the general hard disk requirements for ShoreTel servers and clients and information about the hard disk utilization of critical ShoreTel functions. Consider the utilization of these resources before selecting a hard drive for the server. Table 39 shows the minimum amount of hard disk required for ShoreTel applications. In addition, hard disk space is needed for the dynamic files for voice mail, the call detail records on the Headquarters server only, and the log files.

Table 39: Hard Disk Space Requirements

Type	Space Required
ShoreTel Headquarters Server	1600 MB
ShoreTel DVS Server	800 MB
ShoreTel Client	600 MB

Note

Additional space to install the client might be necessary if you are installing from off the network. In this situation, the process creates a copy of the installer.

Voicemail Utilization

The space used for user voicemail messages on the server hard drive depends on the number of users, the number of messages per user, and the duration of each message. You need approximately 30 MB of hard disk space per hour for voice mail storage.

Table 40 provides some conservative guidelines to estimate the amount of hard disk space used for voice mail, assuming each user has 15 one-minute voice messages.

Table 40: Voice Mail Hard Disk Space

# Users	# Messages	Length (minutes)	Storage (hours)	Storage (GB)
100	15	1	25	0.8 GB
500	15	1	125	3.8 GB
1,000	15	1	250	7.5 GB
2,000	15	1	500	15.0 GB
3,000	15	1	750	22.5 GB
4,000	15	1	1,000	30.0 GB
5,000	15	1	1,250	37.5 GB

Call Detail Records

For each call on the system, call detail records are generated on the Headquarters server. The hard disk space used on the server for call detail records varies depending on the call load on the system. The amount of hard disk space for a typical system is shown in Table 41.

Table 41: Call Detail Records

# Calls/Day	# Calls/Month (20 days)	Storage/Month	Storage/ 3 Months
100	2,000	3 MB	9 MB
1,000	20,000	30 MB	90 MB
10,000	200,000	300 MB	900 MB
50,000	100,0000	1,500 MB	4,500 MB

Note

20 working days per month (4 weeks/month X 5 days/week = 20)

Log Files

Log files are generated on the system for technical support. The hard disk space used on the server for log files varies, depending on the overall system activity.

The size of the log files on the server is determined by parameters set in ShoreTel Director. Log files can remain 1–30 days (the default is 7 days), with a size in the range 0.5–5.0 GB (the default is 4 GB). Table 42 shows the hard disk space that log files need.

Table 42: Log File Hard Disk Space

File Size	Storage (GB)
Minimum	0.5 GB
Default	4.0 GB
Maximum	30.0 GB

Preparing the Server for ShoreTel Operation

This section describes how to prepare the server for operation in the ShoreTel telephony network.

Server IP Address

The ShoreTel server should have a static IP address. If the server suddenly gets a new IP address, system operation can be unpredictable.

Note

You should always configure the server to be part of a domain and make sure that it remains in the domain.

DHCP on the ShoreTel Server

ShoreTel recommends that the ShoreTel server not be used as a Dynamic Host Configuration Protocol (DHCP) server.

Microsoft Windows Server 2008 Configuration

Before you install ShoreTel server software, you must prepare Microsoft Windows Server 2008 to run ShoreTel services by enabling IIS, COM+, SMTP, and FTP, as well as changing the SMTP and FTP startup type to automatic. This section describes how to prepare a Microsoft Windows Server 2008 server to use ShoreTel software.

Note

Windows Server 2008 must be activated through Microsoft before installing the ShoreTel server software.

Application Server Role

This section describes how to configure the server roles required to run the ShoreTel server. In this procedure, you will add application server and the web server roles, then add services for each role.

1. On the Windows desktop, click **Start > Programs > Administrative Tools > Server Manager** to launch the Server Manager as shown in Figure 30.

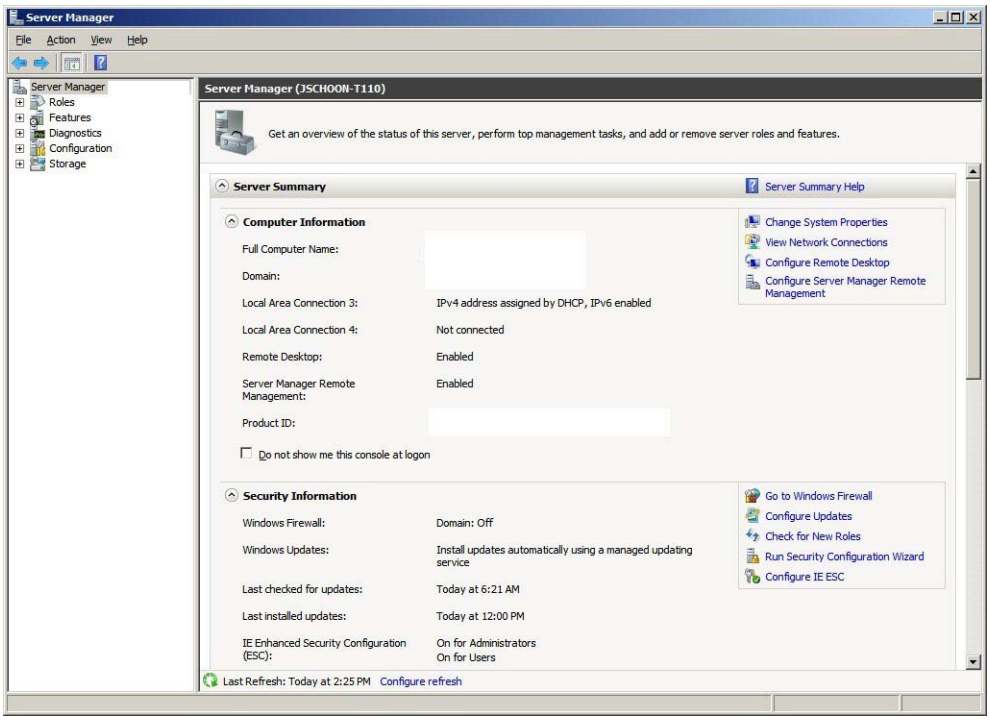

Figure 30: Installation Windows Server Manager

2. In the Server Manager, click **Roles** in the left panel to open the Roles pane as shown in Figure 31.

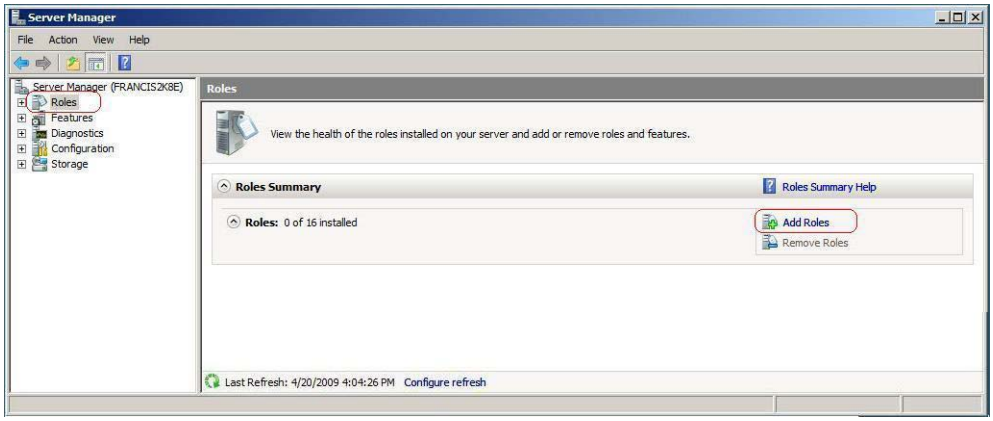

Figure 31: Installation Windows Role Services

3. In the Roles pane, click the **Add Roles** icon. The Add Roles Wizard appears.

4. In the left pane of the Add Roles Wizard page, click **Server Roles**. The Server Roles menu is displayed is displayed.
5. Check the **Application Server** and **Web Server (IIS)** check boxes.
6. In the left pane of the Add Roles Wizard page, locate Application Server and click **Role Services**. The Application Server Role services menu is displayed.
7. Perform the following steps:
   a. Select .NET Framework 3.5.1
   b. Select Web Server (IIS) Support
   c. Select COM+ Network Access
   d. Select TCP Port Sharing
   e. Select all Windows Process Activation Service Support features.
   f. Select all Distributed Transactions features.
8. In the left pane of the Add Roles Wizard page, locate Web Server (IIS) and click **Role Services**. The Web Server Role services menu is displayed.
9. Perform the following steps:
   a. Select all Common HTTP Features
   b. Select all Application Development Features
   c. Select the following Health and Diagnostics Features
      - HTTP Logging
      - Logging Tools
      - Request Monitor
      - Tracing
   d. Select all Security options
   e. Select all Performance options
   f. Select all Management Tools options.
   g. Select all FTP Publishing Service options.
10. Click **Next**. The Confirm Installation Selections page appears.
11. Click **Install**.

Installing SMTP

ShoreTel requires the installation of SMTP Server. To install SMTP, do the following:

1. On the Windows desktop, click **Start > Programs > Administrative Tools > Server Manager**. The Service Manager page appears.
2. Click Features. The Features panel appears on the right.
3. Click the Add Features icon. The Add Features Wizard appears.
4. Select Features in the menu. The Select Features Installation page appears.
5. Check the SMTP Server check box.
6. Click **Next**. The Confirm Installation Selections page appears.
7. Click **Install**.

Setting SMTP and FTP Properties

After SMTP and FTP are installed, the startup type must be changed from manual to automatic. The following procedure changes the startup type for SMTP and FTP.

Note

Verify that the FTProot folder in the Inetpubs directory has at least read access.

1. Access the Services table by selecting **Server Manager > Configuration > Services**.
2. Right click **Simple Mail Transfer Protocol** and select **Properties** on the menu. The Simple Mail Transfer Protocol (SMTP) Properties page appears as shown in Figure 32.

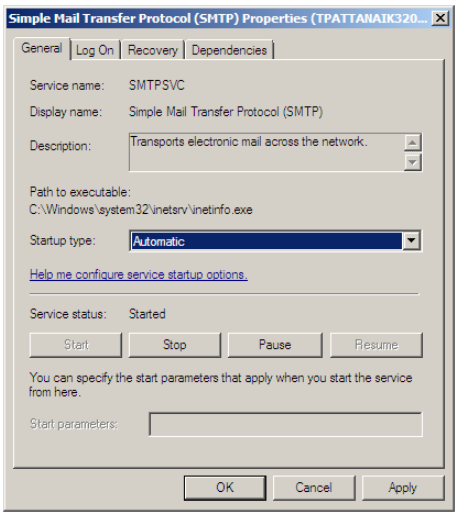

Figure 32: Simple Mail Transfer Protocol Properties Page

3. Select **Automatic** on the Startup Type drop down menu, then click the **OK** button.
4. Return to the Services page.

5. On a Windows 2008 32-bit server: Right click **FTP Publishing Service** and select **Properties** on the menu. The **FTP Publishing Service** properties page appears. In the Startup Type field, select **Automatic** and click the **OK** button.

6. On a Windows 2008 R2 64-bit server: Right click **Microsoft FTP Service** and select **Properties** on the menu. The **Microsoft FTP Service** properties page appears. In the Startup Type field, select **Automatic** and click the **OK** button.

Microsoft Windows Server 2012 Configuration

Before you install ShoreTel server software, you must prepare Microsoft Windows Server 2012 to run ShoreTel services by enabling IIS, COM+, SMTP, and FTP, as well as changing the SMTP and FTP startup type to automatic. This section describes how to prepare a Microsoft Windows Server 2012 server to use ShoreTel software.

Note

Windows Server 2012 must be activated through Microsoft before installing the ShoreTel server software.

Application Server Role

This section describes how to configure the server roles required to run the ShoreTel server. In this procedure, you will add application server and the web server roles, then add services for each role.

1. On the Windows desktop, click **Start > Programs > Administrative Tools > Server Manager** to launch the Server Manager Dashboard as shown in Figure 33.

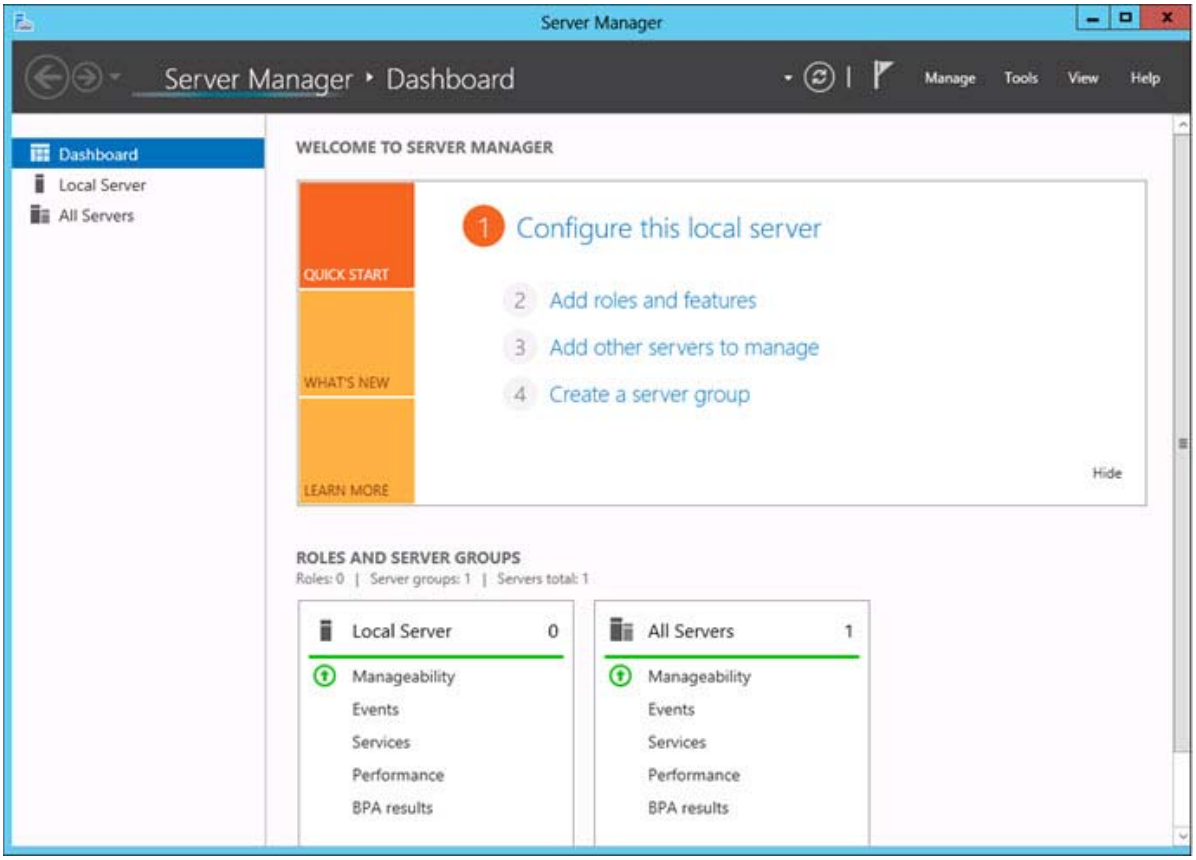

Figure 33: Server Manager Dashboard

2. In the Server Manager Dashboard, under Configure this local server, click **Add roles and features**. The Add Roles and Features Wizard appears, showing the Before you begin page. After reading this page, click **Next**. The Select installation type page appears as shown in Figure 34.

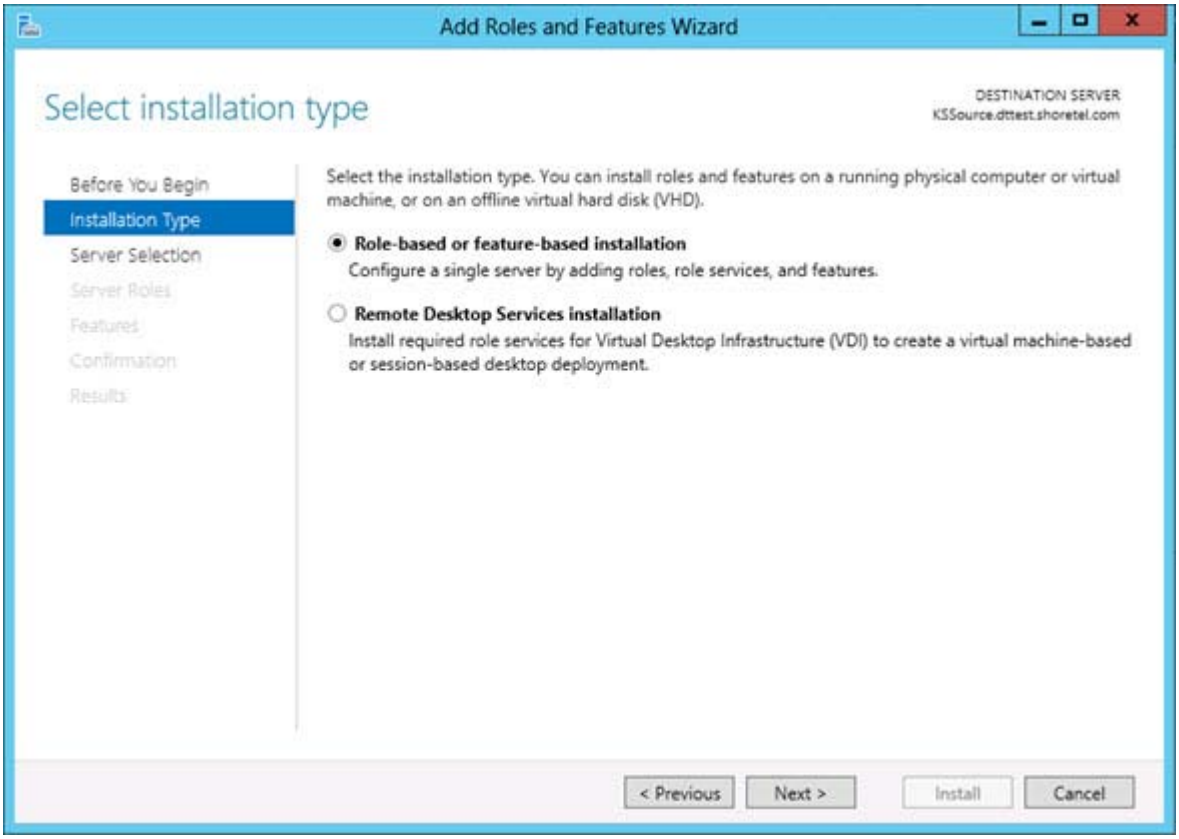

Figure 34: Add Roles and Features Wizard

3. In the middle pane, select **Role-based or feature-based installation**, then click **Next**. The Select destination server page appears.
4. Check **Select a server from the server pool**, then highlight a server in the pool and click **Next**. The Server roles page appears.
5. Check the **Application Server** and **Web Server (IIS)** check boxes, then click **Next**. The Select features page appears, showing the Application Server Features menu.
6. Perform the following steps:
   a. Select .NET Framework 3.5 Features
   b. Select SMTP Server
   c. Select Quality Windows Audio Video Experience
7. Click **Next**. The “Add features that are required for Web Server (IIS)?” screen appears.
8. Click **Add Features**.
9. In the left pane of the Add Roles and Features Wizard page, under Application Server, locate and click **Role Services**. The Application Server Role services menu is displayed.
10. Perform the following steps:

d. Select all Application Development Features

e. Select all Common HTTP Features

f. Select all FTP Server Server options

g. Select the following Health and Diagnostics Features:

- HTTP Logging
- Logging Tools
- Request Monitor
- Tracing

h. Select all IIS Hostable Web Code options

i. Select all Management Tools options

j. select all Security options

k. Select all Performance options

11. Click **Next**. The Confirm installation selections page appears.

12. Click **Install**.

Setting SMTP and FTP Properties

After SMTP and FTP are installed, the startup type must be changed from manual to automatic. The following procedure changes the startup type for SMTP and FTP.

Note

Verify that the FTProot folder in the Inetpubs directory has at least read access.

1. Access the Services table by selecting **Server Manager > Configuration > Services**.

2. Right click **Simple Mail Transfer Protocol** and select **Properties** on the menu. The Simple Mail Transfer Protocol (SMTP) Properties page appears as shown in Figure 35.

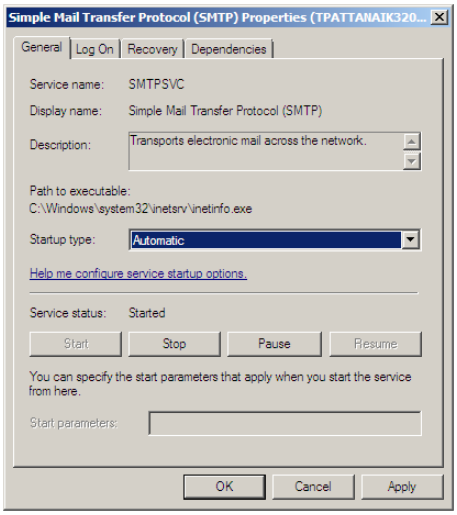

Figure 35: Simple Mail Transfer Protocol Properties Page

3. Select **Automatic** on the Startup Type drop down menu, then click the **OK** button.
4. Return to the Services page.
5. Right click **Microsoft FTP Service** and select **Properties** on the menu. The Microsoft FTP Service properties page appears.
6. In the Startup Type field, select **Automatic** and click the **OK** button.

Additional Considerations

This section discusses additional recommendations and requirements for installing the ShoreTel server.

Maximum Transmission Unit (MTU) Size for Connections

The default Maximum Transmission Unit (MTU) setting for PPP (Point-to-Point Protocol) clients, VPN (Virtual Private Network) clients, PPP servers, or VPN servers running Routing and Remote Access on ShoreTel systems is 1400. To change the MTU value, you must edit the registry. For further information, contact ShoreTel TAC.

Adobe Acrobat Reader

Install Adobe Acrobat Reader on the server if you do not already have it, so that you can access the online documentation. You can install Adobe Acrobat Reader from the ShoreTel USB flash drive or download it from the Adobe web site.

Internet Information Server (IIS) Default Web Site

The web site for ShoreTel Director is `http://<server_name>/shorewaredirector`. You should not change the default IIS web site of the server to redirect to ShoreTel Director, since this will cause navigation problems within ShoreTel Director.

Access to the Distributed Server Maintenance Page

If you are using Microsoft Internet Explorer and the distributed server is configured with an IP address rather than a server name, you must enable session cookies on your client computer to access the Distributed Server Maintenance Page. To enable session cookies:

1. Launch Internet Explorer.
2. Click **Tools > Internet Options**. The Internet Options dialog box appears.
3. Click the **Privacy** tab then the **Advanced** button. The Advanced Privacy Settings dialog box appears.
4. Check the **Override automatic cookies** check box.
5. Select **Always allow session cookies**.
6. Click **OK** to save the change.

Microsoft Updates on the Server

When releasing a new build, ShoreTel publishes build notes listing the Microsoft patches that are certified against the build. ShoreTel also highlights software changes required by the Microsoft patches. No additional Microsoft updates should be applied to your ShoreWare server between ShoreTel builds. If you install Microsoft updates between ShoreTel builds, they may have an adverse effect on your telephone system.

Virus Protection on the Main and Distributed Servers

ShoreTel allows the use of industry-standard virus protection software on the main and distributed servers.

ShoreTel Anti-Virus Folder Exclusions

The following folders and sub folders MUST be excluded from Virus checker software or disk backup/restore software:

- Communicator Client
  - 32-Bit:

    ```
    Drive:\Program Files\Shoreline Communications
    Drive:\Documents and Settings\%User%\Application Data\Shoreware Client\
    ```

  - 64-Bit:

    ```
    Drive:\Program Files (x86)\Shoreline Communications
    Drive:\Users\%User%\AppData\Roaming\ShoreWare Client
    ```

- Contact Center Agent Toolbar
  - 32-Bit:

    ```
    Drive:\Documents and Settings\%User%\Application Data\ShoreTel Contact Center
    ```

```
Drive\Documents and Settings\%User%\Local Settings\Application Data\ShoreTel
Contact Center
```

- 64-Bit:

```
Drive:\Users\%user%\AppData\Roaming\ShoreTel Contact Center
Drive:\Users\%user%\AppData\Local\ShoreTel Contact Center
```

- HQ/ DVS Server
  - 32-Bit:

```
Drive:\Program Files\Shoreline Communications
Drive:\Shoreline Data\
```

  - 64-Bit:

```
Drive:\Program Files (x86)\Shoreline Communications
Drive:\Shoreline Data\
```

- Communicator Client
  - 32-Bit:

```
Drive:\Program Files\ShoreTel
```

  - 64-Bit:

```
Drive:\Program Files (x86)\ShoreTel
```

WARNING!

If the folders listed above are not excluded before installation, your installation of the current version of ShoreTel will fail and your system will rollback to the previous version of ShoreTel. This will also result in a corrupted database if you perform nightly backups.

Requirements for ShoreTel Mobility Router

ShoreTel 14.1 supports the following versions of ShoreTel Mobility:

- Enterprise:
  - ShoreTel Mobility Routing 4.6, 4.7
  - ShoreTel Mobility Routing 5.0
  - ShoreTel Mobility Routing 6.0
- Small Business Edition:
  - ShoreTel Mobility Routing 4.6, 4.7
  - ShoreTel Mobility Routing 5.0
  - ShoreTel Mobility Routing 6.0

- ShoreTel Mobility Router Appliance
  - MR2000
  - MR4000
  - MR6000

Third-Party Applications Supported

ShoreTel 14.1 supports the following third-party applications:

- Microsoft OCS 2007 R2 Standard/Enterprise Editions
- Microsoft Lync 2010 Standard/Enterprise Editions

CHAPTER

11

ShoreTel Server Installation

This chapter describes installation procedures for main and distributed ShoreTel headquarters servers and distributed servers. The topics discussed in this chapter include:

- Checking Server Compatibility 203
  - Running the Compatibility Checker 203
- Headquarters Server Software 204
  - Upgrade Paths for the Headquarters Server Software 205
  - Before You Upgrade the Headquarters Server Software 205
  - Backing up a ShoreTel Server 205
  - Upgrading the Headquarters Server Software 210
  - Installing the Headquarters Server Software 211
  - Registering the Headquarters Server Software 213
  - Installing License Keys 216
  - Obtaining Licenses 217
  - Installing the Diagnostics & Monitoring Service on a Remote Server 217
- Distributed Voice Server Software 218
  - Upgrading the DVS Software 219
  - Installing the DVS Software 219
  - Installing the Software from the Web 220
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- Verifying the Installation 221
- Server Operating System 222
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Upgrading the Uboot Version 224
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Upgrading Servers from Windows 2008 32-bit to Windows 2008 R2 64-bit 229
Upgrading Servers from Windows 2003 32-bit to Windows 2012 64-bit 229
Preparing to Upgrade from Windows 2008 R2 32-bit or 64-bit to Windows 2012 64-bit 230
Upgrading the Uboot Version 230
Upgrading Servers from Windows 2008 R2 32-bit to Windows 2012 64-bit 231
Upgrading Servers from Windows 2008 R2 64-bit to Windows 2012 64-bit 235
Upgrading the System to New Hardware (Same OS) 238
Ensuring Proper Server Performance 240
Setting the Server to Maximize for Network Performance 241

Checking Server Compatibility

A compatibility checker is available for identifying potential issues prior to installing or upgrading the ShoreTel Server software. The compatibility checker is included as part of the installer and as a separate utility.

When running the compatibility checker on a system that does not currently have the ShoreTel Server software installed, the utility checks for the following:

- Roles and features needed for HQ and DVM
- Supported OS and service packs
- VBScript issues that may occur during installation
- Amount of space needed for the installation

When running the compatibility checker prior to upgrading the ShoreTel Server software, the utility checks for the following:

- Roles and features needed for HQ and DVM
- Supported OS and service packs
- Supported upgrade paths
- Amount of space needed for the installation
- State of MySQL services and ShoreTel services

Running the Compatibility Checker

This section describes how to run the compatibility checker.

1. Insert the ShoreTel DVD into the DVD drive.
2. Navigate to the DVD drive on your computer, open the Sever folder and then open the Compatibility Checker folder.
3. Double-click CompatibilityChecker.exe. The Compatibility Checker window appears.
4. Click Compatibility Checker. All components and any compatibility issues are listed.

Note

You must address all compatibility issues before beginning the software installation.

The compatibility checker is also available as part of the installer and can be run from the installation wizard.

Headquarters Server Software

This section describes how to install the ShoreTel headquarters server software. Use the procedures for upgrades or new installations.

Before beginning software installation or upgrade, do the following:

- Make sure that the server meets the physical requirements for the implementation. For more information, see Chapter 10, Server Requirements.
- Close all programs on the server.
- Verify that no anti-virus software or endpoint software is running during installation
- Connect the server to the Ethernet network. The server must be connected to the network with the correct IP address before installing the software.
- Install ShoreWare Server software on an NTFS partition.
- (Optional) Run the compatibility checker. You can run the compatibility checker from the installation wizard. For more information, see Checking Server Compatibility on page 203.
- Your server must be equipped with at least 2-GB RAM. If it has less than 2-GB RAM, the installer displays the message show in Figure 36 before it starts the installation or upgrade.

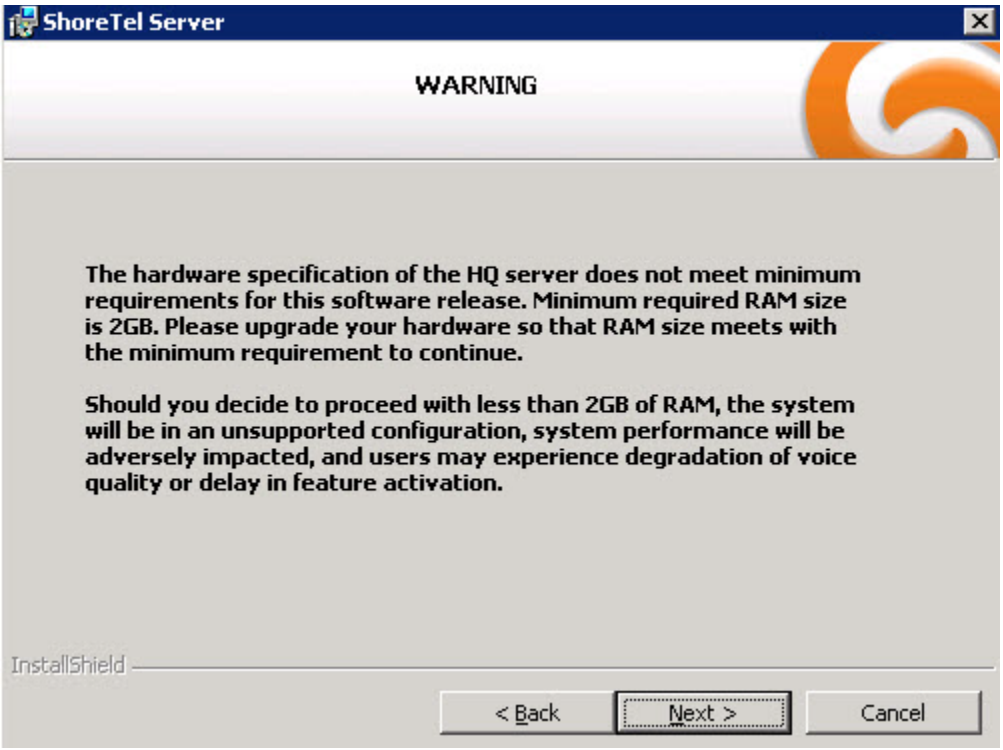

Figure 36: Minimum RAM Warning Message

Upgrade Paths for the Headquarters Server Software

You can directly upgrade to the current release of the ShoreTel software from one of the following versions:

- ShoreTel 12
- ShoreTel 12.1
- ShoreTel 12.2
- ShoreTel 12.3
- ShoreTel 13

If upgrading an earlier version of ShoreTel software to the current release, you might have to make intermediate upgrades to one of the versions in the above list before upgrading to the current version.

Before You Upgrade the Headquarters Server Software

Before starting the upgrade, you must complete the following tasks:

- Back up the server.
- Make sure that Windows 2008 R2 Server or Windows 2008 SP2 (32-bit) Server is installed.

Backing up a ShoreTel Server

You have multiple options for backing up a ShoreTel server: The first two options take the system down during the backup, while the third halts the system for 10-20 seconds (but it can degrade voice quality over a long period of time).

Option 1. Run the Stop All script and copy the Shoreline Data folder

1. Stop and disable all ShoreTel services, then reboot after confirming services are stopped:

   For 32-bit systems: `C:\Program Files\Shoreline Communications\ShoreWare Server\Scripts\hq_shoretel-stop-svcs.bat`

   For 64-bit systems: `C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\Scripts\hq_shoretel-stop-svcs.bat`

2. Copy the Shoreline Data folder to a safe location, and label the version and build in the folder in which it is located.

3. Run the start services script to get the phone system services running:

   For 32-bit systems: `C:\Program Files\Shoreline Communications\ShoreWare Server\Scripts\hq_shoretel-start-svcs.bat`

   For 64-bit systems: `C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\Scripts\hq_shoretel-start-svcs.bat`

Option 2. Run the ShoreTel Back-up Scripts

Note

This option explains how to automate the back-up task using the Windows Task Scheduler.

1. Navigate to the following directory:

   For 32-bit systems: `C:\Program Files\Shoreline Communications\ShoreWareServer\Scripts\Sample_Backup_Restore`

   For 64-bit systems: `C:\Program Files (x86)\Shoreline Communications\ShoreWareServer\Scripts\Sample_Backup_Restore`

2. Edit the file sw_backup_restore.ini:

```
[Backup Options]
 Backup.Drive = C:
 Backup.Root.Directory = \Shoreware Backup\Backup
 Backup.ShoreWare.Directory = Shoreline Data\
 Backup.Archive.Size = 2 ;folders
```

   - Make sure the `Shoreware.Drive =` statement is correct for where you have the Shoreline Communications folder.
   - If you have V-switches, enter them in the `VMB.ip.list =` section (comma-separated).
   - If you have conference bridges, enter them in the `UCB.ip.list =` section (comma-separated).
   - Make sure the backup is labeled correctly, and that it is on the correct drive and folder location, as shown in the following example:

Note

If you chose a network drive for your backup, be sure the user profile that runs the task has permissions to write to that drive and directory.

3. Open the Task Scheduler by clicking **Start > Programs > Accessories > System Tools > Task Scheduler**.
4. Right click and select **Create new Task**.

   The Create Task screen appears, as shown in Figure 37.

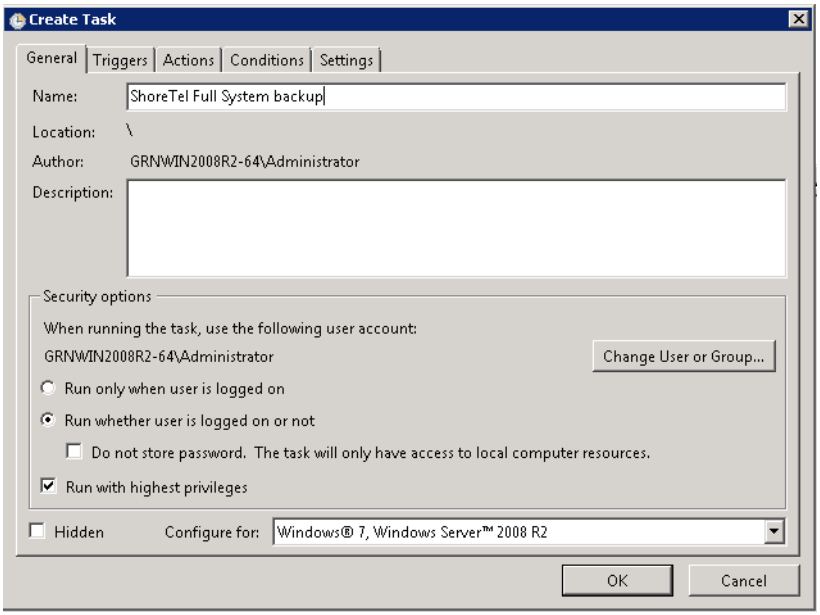

Figure 37: Create Task

5. Enter a name for the task.
6. Choose the following Security options:
   - **Run whether user is logged on or not**
   - **Run with highest privileges**
   - **Configure for: Windows 7, Windows Server 2008 R2**
   - Configure **Change User or Group** to be a user you created to be the back-up user, or the server administrator. You must enter your password for this user.
7. Click the **Triggers** tab.
8. Click **New** to create a new trigger, or click **Edit** to change an existing trigger.

   The Edit Trigger screen appears, as shown in Figure 38.

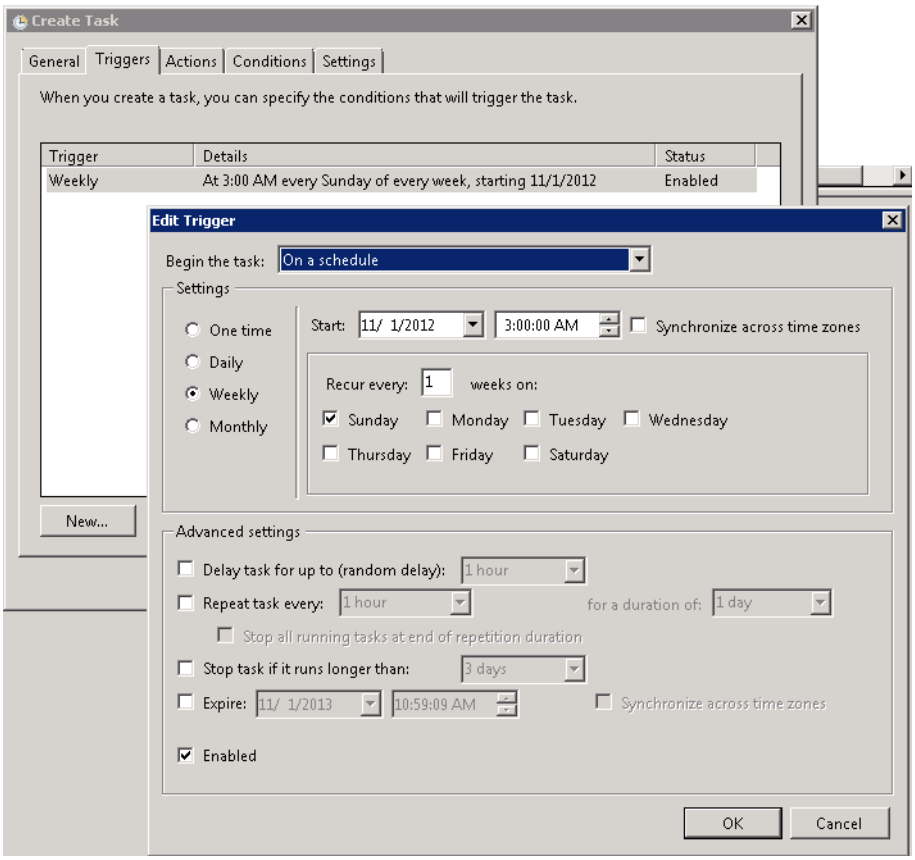

Figure 38: Create Task: Triggers

9. Fill out the schedule for when you want the process to run.
10. Click the **Actions** tab and then click **New**.

    The **New Action** screen displays, as shown in Figure 39.

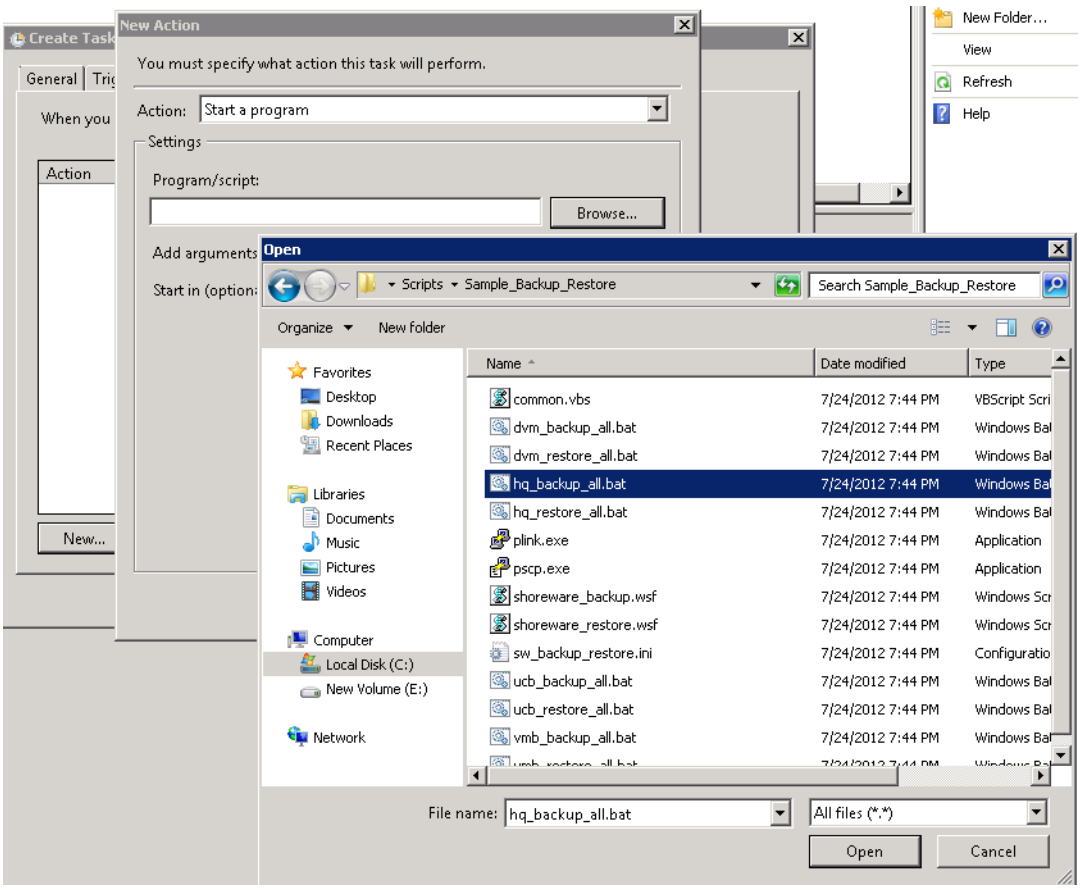

Figure 39: Create Task: Actions

11. Click **Browse** to locate the script: `shoreware_backup.bat`.

12. Enter the path to the script in the **Start in (optional)** field and be sure the script name is shown in the **Program/script** field, as shown in Figure 40.

13. Click **OK**.

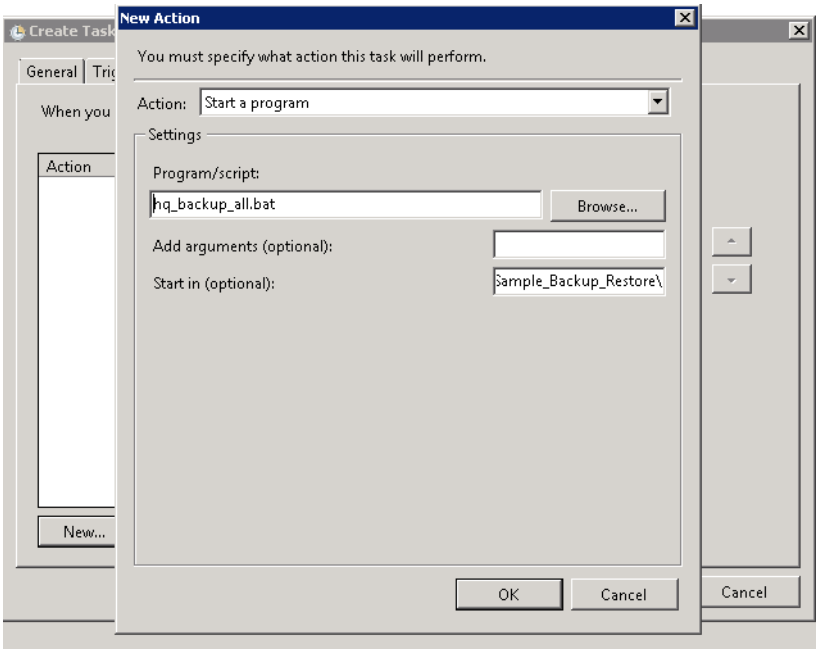

Figure 40: Create Task: New Action

14. Click the **Conditions** tab and fill in the form according to your business requirements.
15. Click the **Settings** tab and fill in the form according to your business requirements.
16. Click **OK** to save the task.

Note

During non-business hours, be sure to right-click the script task and run it to ensure that it works.

Option 3. VMWare

If you are running VMware, you can run a Snapshot during a low-traffic period. For more information, refer to the VMware documentation that accompanied you product.

WARNING!

According to VMware documentation, you should not take Snapshots during business hours, because, over time, taking Snapshots can degrade the voice mail quality of your phone system. As a safer alternative, you can take a Snapshot during a low-traffic period and reboot the system every 1-3 months.

Upgrading the Headquarters Server Software

If you are upgrading the server software, follow the instructions in Installing the Headquarters Server Software on page 211. The Setup script will automatically determine that an upgrade is in process, and you will be presented with a subset of the installation wizard screens. (There is no need to change the destination folders of the ShoreTel files.)

Setup looks for the ShoreTel database. If an older version of the database is found, Setup makes a back-up copy and converts the database to the latest version. Setup will not overwrite an existing database.

All voice applications (voice mail, automated attendant, workgroups, and so on) are affected until the upgrade is complete. The installation will stop all ShoreTel services.

Note

If during the installation process the installer discovers unsupported characters in user names, the installation will halt. A pop-up window will open showing the user names that contain unsupported characters. You must remove the unsupported characters before the installation can proceed. You can remove the unsupported characters from user names using the Individual User's page in ShoreTel Director. Supported user-name characters include the alphanumerics (a-z, 0-9), dash (-), underscore (_), dot (.), and @. Extra spaces are not supported and can cause the install to fail.

Installing the Headquarters Server Software

The default parameters presented by the ShoreTel installer are recommended. However, if ShoreTel software is to be located in a different location, select the correct installation path during the install process. The Shoreline data folder on x86 systems must be installed on the C: drive. On 32-bit servers, the software can be installed on a D: drive. The software cannot be installed on a D: drive on 64-bit servers.

1. Insert the ShoreTel USB flash drive. The installer launches automatically.

Note

If the installer does not launch automatically, navigate to the USB flash drive on your computer, open the Server and Setup folders, and then double-click `setup.exe`.

2. Click **Install ShoreTel Server**.

   The ShoreTel installation software performs an initial check of your system. You are prompted to install any required software that is not already installed. You must install the required software before continuing.

   The ShoreTel Server InstallShield Wizard appears.

3. The installation wizard checks for any compatibility issues.

Note

You must address all compatibility issues before continuing with the installation.

4. Follow the instructions in the wizard to install the server software.

Note

The data files are unique to your system and include your system configuration, voice messages, and automated attendant prompts. These files will be stored in a ShoreTel data folder and should be included as part of your back-up plan for the server.

5. When the installation completes, you are prompted to restart your server. Click **Finish** to restart.

   After the server restarts, you may be prompted to configure a TAPI service provider. Enter the appropriate area code and access code and continue.

Note

The current software release does not support port 5004. If you are upgrading from an older release with port 5004 enabled, the installer will display the warning shown in Figure 41.

6. If upgrading, restart the ShoreTel Voice Switches to finish the upgrade.

   This process upgrades the firmware on the switches but also affects all calls in progress.

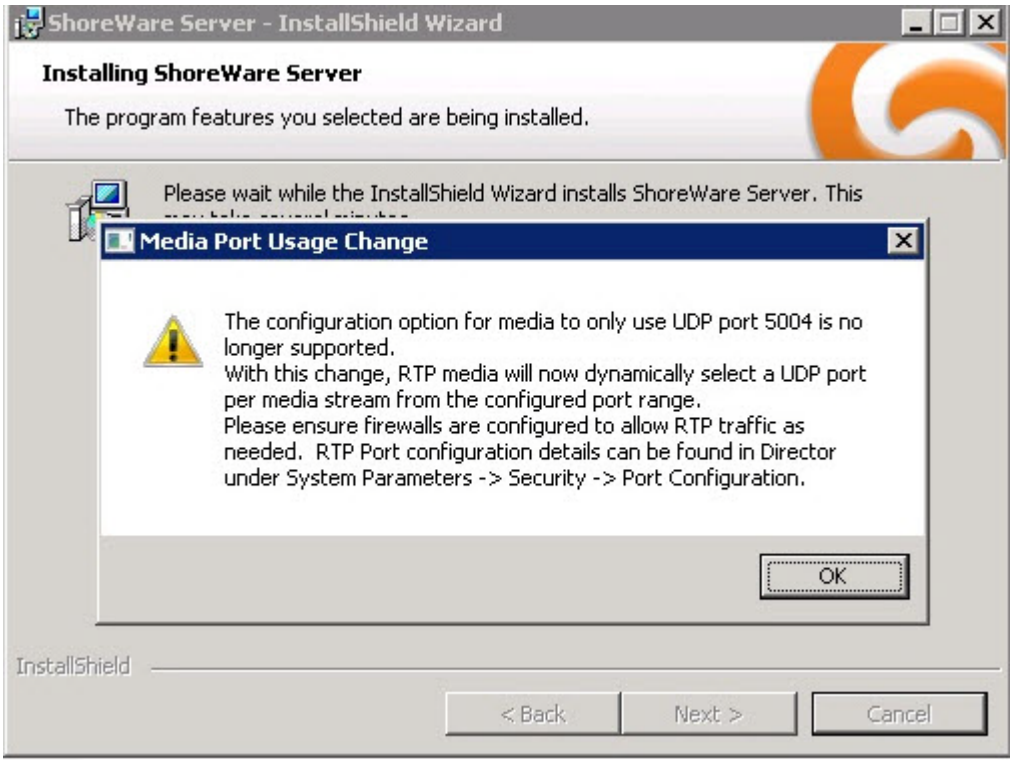

Figure 41: Media Port Usage Change

7. Register the software (this is mandatory). See Registering the Headquarters Server Software on page 213.

8. Install your license keys. See Installing License Keys on page 216.

Registering the Headquarters Server Software

After upgrading or installing headquarters server software, you must register the software with ShoreTel. Registration is mandatory.

ShoreTel encourages you to register the software promptly so that we have the most up-to-date information concerning your ShoreTel products and installation. If registration is not received by ShoreTel within 45 days of installation, access to Director is denied (Director is locked).

The software can be registered automatically, over the internet, or through email.

When registering automatically or over the internet, registration data is transmitted to ShoreTel over a secure connection to ensure integrity and privacy. The software is registered automatically for upgrades that meet the following prerequisites:

- Contact Information is saved in Director before starting the upgrade process.
- A valid ShoreTel system license key is installed before starting the upgrade process.
- Your system can connect through the internet to the ShoreTel support web site (https://support.shoretel.com).

For new installations or upgrades that do not meet these prerequisites, you are prompted to register the software the first time you launch Director after installing or upgrading.

You can also choose to register the software over the internet or through email. Registration over the internet is quicker than registration through email.

If an installation does not have adequate or current licenses, ShoreTel Director opens at the License Preview page when you have completed or skipped registration. If registration is not received by ShoreTel within 45 days of installation, access to Director is denied (Director is locked).

Information Collected through Product Registration

When a customer performs an upgrade or performs a fresh install and requests license keys, the following information is collected through product registration:

- Contact information
- License key list: features activated; features available for activation for each licensed feature
- Server MAC address
- Sales Order Number (for initial installations only)
- Switch inventory: switch types; MAC addresses; serial numbers
- Installed software version information: product name; build number; install timestamp

All this information is included in the EULA (End User License Agreement) provided for an upgrade or installation.

Automatic Registration

1. Upgrade ShoreTel software.
2. Start up ShoreTel HQ Services.

   Registration information is sent over the internet to ShoreTel. Upon receipt, a response is sent. When the response is received, a Compliance Token is created on the Headquarters server, and Director is unlocked.Until registration is completed, a Reminder Notification message (“out-of-date”) is posted in red letters on the Contact Information page.
3. Confirm registration:

   1. Click **Administration** > **System Parameters** > **Contact Information** to navigate to the Contact Information page.
   2. Click **Refresh this page**.

      The Reminder Notification message is no longer posted.
4. Install your license keys, if necessary. See Installing License Keys on page 216.

   If registration information is not received by ShoreTel (for any reason), Director submits the information every hour for seven days after upgrading. If the process is unsuccessful, you must submit the Contact Information again (over the internet or through email) as often as necessary until registration is completed. If registration is not completed in 45 days, Director is locked.

Internet Registration

1. Upgrade or install ShoreTel software, and launch Director.
2. Do one of the following to display the Contact Information page:

   - When prompted to register, click **Now**.
   - Click **Administration** > **System Parameters** > **Contact Information**.
3. Enter the requested information in the applicable fields.

   The Server MAC Address field is automatically populated with information from the ShoreTel Server. You should change this information only if you want a license for a server other than the one to which you are currently connected. If you have changed this information but instead want the defaults, click **Refresh this page**. The Sales Order Number is on the ShoreTel packing slip. (Supplying this information is optional for system upgrades.)
4. Click **Now to Register and request product verification**. The License Preview page appears.
5. Request a license key, if you do not have one:

   1. Review the information in the License Preview page.
   2. Do one of the following:

   - Click **Print** at the top of the page to print the information.

- Click **Submit** to send the request immediately to ShoreTel, Inc. After verifying the information, ShoreTel emails the license key within three business days. Until the license key arrives, you can click on Later in the ShoreTel Director Welcome screen to enter ShoreTel Director. You have up to 45 days to install the license key.
- Click **Save to File** to save the request for later submission.

6. Click **Submit**.

   Registration information is sent over the internet to ShoreTel. Upon receipt, a response is sent. When the response is received, a Compliance Token is created on the Headquarters server, and Director is unlocked. Until registration is completed, a Reminder Notification message ("out-of date") is posted in red letters on the Contact Information page.

7. Confirm registration:

   1. Exit and then relaunch Director.
   2. Navigate to the Contact Information page.
   3. Click **Refresh this page**. The Reminder Notification message is no longer posted.

8. Install your license keys, if necessary. see Installing License Keys on page 216.

   If registration information is not received by ShoreTel (for any reason), Director submits the information every hour for seven days after upgrading. If the process is unsuccessful, you must submit the Contact Information again (over the internet or through email) as often as necessary until registration is completed. If registration is not completed in 45 days, Director is locked.

Email Registration

1. Upgrade or install ShoreTel software, and launch Director.
2. Display the Contact Information page by doing one of the following:
   - Click **Now** when prompted to register.
   - Click **Administration** > **System Parameters** > **Contact Information**.
3. Enter the requested information in the applicable fields.

   The Server MAC Address field is automatically populated with information from the ShoreTel Server. You should change this information only if you want a license for a server other than the one to which you are currently connected. If you have changed this information but instead want the defaults, click **Refresh this page**. The Sales Order Number is on the ShoreTel packing slip. (Supplying this information is optional for system upgrades.)

4. Click **Now to Register and request product verification**. The License Preview page appears.
5. Request a license key, if you do not have one:
   1. Review the information in the License Preview page.
   2. Do one of the following:

- Click **Print** at the top of the page to print the information.
- Click **Submit** to send the request immediately to ShoreTel, Inc. After verifying the information, ShoreTel emails the license key within three business days. Until the license key arrives, you can click on Later in the ShoreTel Director Welcome screen to enter ShoreTel Director. You have up to 45 days to install the license key.
- Click **Save to File** to save the request for later submission.

6. Click **Save to File**. Follow the steps required to save the (SLR) file on your desktop.
7. Email the SLR file to ShoreTel at: licensekeyrequest@shoretel.com.

   Upon receipt, a response is sent containing a compliance token granting access to Director. This token (or, license key) is associated with the Server MAC address and a System Build Number.
8. Verify the compliance token.
   1. Click **Administration** > **System Parameters** > **Product Verification**. The Product Verification page appears.
   2. Enter the Compliance Token and click Verify. If the token is valid, a confirmation message is displayed.
9. Confirm registration:
   1. Exit then relaunch Director.
   2. Navigate to the Contact Information page.
   3. Click **Refresh this page**. The Reminder Notification message is no longer posted.
10. Install your license keys, if necessary. See Installing License Keys on page 216.

    If registration information is not received by ShoreTel (for any reason), Director submits the information every hour for seven days after upgrading. If the process is unsuccessful, you must submit the Contact Information again (over the internet or through email) as often as necessary until registration is completed. If registration is not completed in 45 days, Director is locked.

Installing License Keys

1. View the license packet that you received from ShoreTel.
2. Launch ShoreTel Director.
3. In the ShoreTel Director menu, click **Administration** > **System Parameters** > **Licenses** > **Key**s.

   The License Key Info dialog box appears.
4. Click the **New** button at the top of the page.
5. In the Key field, enter the license key that you received from ShoreTel.
6. In the Comment field, enter a description of the license.

7. Click **Save**.

   The license activates and the information is posted in the License Key page.

   If you have not already obtained your license keys, see below.

Obtaining Licenses

1. Contact your ShoreTel partner or reseller and purchase the number and type of needed licenses. The partner or reseller will give you a purchase order number.
2. Launch ShoreTel Director and then log in.
3. Navigate to **Administrator > System Parameters >Licenses > Keys**.

   The License Keys page appears.
4. Click the **Register and Request System Key** button at the top of the page. The Contact Information page appears.
5. Enter the information requested in the Register and request system key section. Be sure to include the Sales order number from the purchase order and the customer's primary contact information.
6. Click the **Now** button above the information fields.

   The system sends the request to ShoreTel for processing. After processing the request, ShoreTel sends the licenses.

Installing the Diagnostics & Monitoring Service on a Remote Server

Although the installation wizard automatically installs a Monitoring service instance on the Headquarters server when you initially install or upgrade to the current ShoreTel release, you can also choose to install it on a remote server.

If your system has more than 10,000 busy-hour call attempts (BHCA), ShoreTel recommends that you install the Monitoring service instance on a remote server to reduce the processing load on the Headquarters server. You would then be able to use the remote server for monitoring the system; however, the system still stores the Diagnostics & Monitoring database on the Headquarters server.

Note

You must install the Monitoring service instance on a server that is not running either ShoreTel Headquarters server software or ShoreTel Distributed Voice Server software. The remote server must be running a currently supported version of Microsoft Windows Server software and, at a minimum, meet the requirements for a small server as described in Table 10 on page 37.

After you install the Monitoring service instance on a remote system, you must also change the role of the Headquarters server and the remote server, so that the Headquarters server becomes the Event Collector and the remote server is the Main Service.

To install a Monitoring service instance on a remote server and change the role of the servers, follow these steps:

1. On the USB flash drive that contains the ShoreTel installation software, navigate to the Monitoring Service folder.
2. To start the installation wizard, double-click **ShoreTelMonitoringService**.
3. Click **Run**.
4. Follow the instructions in the wizard to install the Monitoring service instance.

Note

When the installation wizard prompts you to enter the IP address of the Headquarters server, you must enter the actual IP address and not the server name.

5. After the installation wizard completes, restart the standalone server.
6. On the Headquarters server, open ShoreTel Director and in the navigation menu, click **Maintenance > Diagnostics & Monitoring**.
7. In the navigation menu, click **Configuration > Monitoring Service**.

   The Monitoring Service page appears and displays both the Headquarters server and the remote server.
8. Use the **Role** drop-down list to change the role of the Headquarters server to **Event Collector** and the role or the remote server to **Main Service**.
9. Click **Save**.

   For more information, see the Diagnosing and Monitoring chapter in the *ShoreTel System Administration Guide*.

Distributed Voice Server Software

The ShoreTel Distributed Voice Server (DVS) must be a dedicated server with no other applications installed. This means you should **not** use this server for any of the following: Windows Domain controller, Terminal Server, Database Server (with MySQL), Web server, nor exchange server. This DVS server must be exclusively dedicated to supporting ShoreTel.

A DVS has the same software prerequisites as the ShoreTel Headquarters server.

Before beginning software installation, do the following:

- Make sure that the server meets the physical requirements for the implementation. For more information, see Server Requirements on page 179.
- Close all programs on the server.

- Verify that no anti-virus software is running.
- Verify that the System Performance Settings have been set to **Turn on DEP for essential Windows and program services only**.
- Verify that Microsoft Visual C ++ with the SP1 Redistributable Package (x86) is installed.
- Install the remote server software on an NTFS partition.
- Connect the server to the Ethernet network. The server must be connected to the network with the correct IP address before installing the software.
- (Optional) Run the compatibility checker to check for any compatibility issues. The compatibility checker is available as part of the server installation and as a standalone utility. For information about using the compatibility checker, see Checking Server Compatibility on page 203.

Upgrading the DVS Software

If you are upgrading the server software, follow the instructions in the Installing the DVS Software on page 219 or Installing the Software from the Web on page 220. Setup will automatically determine that an upgrade is in process, and you will be presented with a subset of the installation wizard screens. (There is no need to change the destination folders of the ShoreTel files.)

Installing the DVS Software

Note

ShoreTel supports the use of a remote desktop to install the remote server software.

1. Insert the ShoreTel USB flash drive.

   The installer launches automatically and the ShoreTel Intelligent Phone Systems splash screen appears

Note

If the installer does not launch automatically, navigate to the USB drive on your computer, open the Server and Setup folders, and then double-click `setup.exe`.

2. Click **Install ShoreTel Remote Server**. The ShoreTel Server InstallShield Wizard appears.
3. The installation wizard checks for any compatibility issues.

Note

You must address all compatibility issues before continuing with the installation.

4. Follow the instructions in the wizard to install the server software.

   The wizard prompts you to enter the IP address of the Headquarters server. Make sure that the IP address of the remote server does not conflict with the IP address of the Headquarters server.

Note

During installation, the installer pauses and prompts you to install Microsoft .NET Framework 4, which is required for the current software release. The installer downloads .NET Framework 4 from the Microsoft site, so you will need an Internet connection to complete the installation.

5. When the installation completes, click **Finish**. A dialog box appears, prompting you to restart the server.
6. Click **Yes**.

   After the server restarts, all the necessary software restarts automatically. It typically takes about 30 to 60 seconds after the operating system is up and running for the Microsoft Internet Information Services (IIS) and ShoreTel voice services to be running.

Installing the Software from the Web

1. Start the Web browser.
2. In the URL field enter **support.shoretel.com**. The ShoreTel Support page appears.
3. Under **By Release**, click **1**. The Customers and Partners login page appears.
4. Enter your login information, and then click **Sign In**. The **1** page appears.
5. Under **Downloads**, click the current version of ShoreTel Remote server to download the remote server software.
6. Navigate to the file on your computer and double-click to launch the installer. The ShoreTel Intelligent Phone Systems splash screen appears.
7. Click **Install ShoreTel Remote Server**.

   The ShoreTel Server InstallShield Wizard appears. The installation wizard checks for any compatibility issues.

Note

You must address all compatibility issues before continuing with the installation.

8. Follow the instructions in the wizard to install the server software.

   The wizard prompts you to enter the IP address for the Headquarters server. Make sure that the IP address for the remote server does not conflict with the IP address for the Headquarters server.
9. When the installation completes, click **Finish**. A dialog box appears, prompting you to restart the server.
10. Click **Yes**.

    After the server restarts, all the necessary software restarts automatically. It typically takes about 30 to 60 seconds after the operating system is up and running for the Microsoft Internet Information Services (IIS) and ShoreTel voice services to be running.

Upgrading the DVS Software to Windows Server 2012 64-bit Standard or Datacenter Edition

If you are upgrading the server software to Windows 2012 64-bit from Windows 2008 R2 32-bit/64-bit or Windows 2003 32-bit, perform the steps below.

1. Take a backup of the Shoreline Data/Shoreware registry folder.
2. Upgrade the operating system to Windows Server 2012, Standard or Data Center Edition.
3. Install the ShoreTel system software.
4. If your current server is 64-bit, restore the Shoreline Data/Shoreware registry folder.

   If your current server is not 64-bit, manually copy the registry entries modified specifically for your system.

Verifying the Installation

It typically takes about 30 to 60 seconds after the operating system is up and running for the Microsoft Internet Information Services (IIS) and ShoreTel voice services to be running. You can do the following to verify that these applications are running..

1. Click the ShoreTel Director desktop icon to launch ShoreTel Director.

   If IIS is not running, an error message appears. If IIS is running, the ShoreTel Director log in page appears.
2. Log in to ShoreTel Director.
   a. In the User ID field, enter the user name that you want to use.

      The default user ID is admin.
   b. In the Password field, enter the password for the user.

      The default password is changeme.
   a. Click Login. The Welcome page appears.
3. Click Later in regards to the registration. The navigation menu and Quick Look panel appear.
4. Ensure that the Services column in the Server/Appliance section displays **Running** for the status of the headquarters server.

Server Operating System

This section describes how to upgrade the server operating system. It begins with a summary of the scenarios for upgrading the server from ShoreTel release 11.x through ShoreTel 14.

This section includes the following topics:

- Upgrade Scenarios on page 222
- Preparing to Upgrade from Windows 2003 32-bit to Windows 2008 R2 64-bit on page 224
- Upgrading the Uboot Version on page 224
- Upgrading Servers from Windows 2003 32-bit to Windows 2008 R2 32-bit or 64-bit on page 225
- Upgrading Servers from Windows 2008 32-bit to Windows 2008 R2 64-bit on page 229
- Upgrading Servers from Windows 2003 32-bit to Windows 2012 64-bit on page 229
- Preparing to Upgrade from Windows 2008 R2 32-bit or 64-bit to Windows 2012 64-bit on page 230
- Upgrading the Uboot Version on page 230
- Upgrading Servers from Windows 2008 R2 32-bit to Windows 2012 64-bit on page 231
- Upgrading Servers from Windows 2008 R2 64-bit to Windows 2012 64-bit on page 235
- Upgrading the System to New Hardware (Same OS) on page 238

Upgrade Scenarios

This section summarizes the scenarios for upgrading the ShoreTel server from release 11.x through release 14.

Upgrading ShoreTel 11.x on Windows 2003 to ShoreTel 14 on Windows 2012

Perform the procedure below to upgrade your system from ShoreTel release 11.x on Windows server 2003 to ShoreTel release 14 on Windows server 2012:

1. Perform the steps in Upgrading Servers from Windows 2003 32-bit to Windows 2008 R2 32-bit or 64-bit on page 225.
2. Upgrade ShoreTel 11.x to ShoreTel 13.x.
3. Upgrade ShoreTel 13.x to ShoreTel 14.
4. Perform the steps in Upgrading Servers from Windows 2008 R2 32-bit to Windows 2012 64-bit on page 231, or Upgrading Servers from Windows 2008 R2 64-bit to Windows 2012 64-bit on page 235.

5. If the Distributed Database was enabled on ShoreTel 11.x, enable it again on all distributed servers on ShoreTel 14.

Upgrading ShoreTel 12.x on Windows 2003 to ShoreTel 14 on Windows 2012

Perform the procedure below to upgrade your system from ShoreTel release 12.x on Windows server 2003 to ShoreTel release 14 on Windows server 2012:

1. Perform the steps in Upgrading Servers from Windows 2003 32-bit to Windows 2008 R2 32-bit or 64-bit on page 225.
2. Upgrade ShoreTel 12.x to ShoreTel 14.
3. If your current server is 64-bit, restore the Shoreline Data/Shoreware registry folder on ShoreTel 14.
4. If your current server is not 64-bit, manually copy to ShoreTel 14 the registry entries modified specifically for your system.
5. Perform the steps in Upgrading Servers from Windows 2008 R2 32-bit to Windows 2012 64-bit on page 231, or Upgrading Servers from Windows 2008 R2 64-bit to Windows 2012 64-bit on page 235.
6. If the Distributed Database was enabled on ShoreTel 12.x, enable it again on all distributed servers on ShoreTel 14.

Upgrading ShoreTel 12.x/13.x on Windows 2008 to ShoreTel 14 on Windows 2012

Perform the procedure below to upgrade your system from ShoreTel release 12.x/13.x on Windows server 2008 to ShoreTel release 14 on Windows server 2012:

1. If the Distributed Database was enabled on ShoreTel 12.x/13.x, enable it again on all distributed servers on ShoreTel 14.
2. Upgrade ShoreTel 12.x/13.x to ShoreTel 14.
3. Perform the steps in Upgrading Servers from Windows 2008 R2 32-bit to Windows 2012 64-bit on page 231, or Upgrading Servers from Windows 2008 R2 64-bit to Windows 2012 64-bit on page 235.
4. If the Distributed Database was enabled on ShoreTel 12.x/13.x, enable it again on all distributed servers on ShoreTel 14.

Upgrading ShoreTel 14 on Windows 2008 to ShoreTel 14 on Windows 2012

Perform the procedure below to upgrade your system from ShoreTel release 14 on Windows server 2008 to ShoreTel release 14 on Windows server 2012:

1. Perform the steps in Upgrading Servers from Windows 2008 R2 32-bit to Windows 2012 64-bit on page 231, or Upgrading Servers from Windows 2008 R2 64-bit to Windows 2012 64-bit on page 235.

Preparing to Upgrade from Windows 2003 32-bit to Windows 2008 R2 64-bit

Upgrading your Windows Server 32-bit operating system to a Windows Server 64-bit operating system can cause your ShoreTel switches to not re-connect. To ensure a seamless migration without disruptions in your telephone services, you must make sure that your entire ShoreTel installation is compatible with the Windows Server 64-bit operating system.

Be aware that after the ShoreTel software is installed on the server, the server is considered a Telephony Appliance. As a Telephony Appliance, it does not adhere to the same policies, procedures, or security as a data server.

Note

For new installations of the 64-bit OS, you do not need to prepare the server (the steps below are not necessary).

Before upgrading the server operating system, perform the following intermediate steps; otherwise, the ShoreTel switches will not reconnect and connectivity will be lost.

1. Make sure ShoreTel server software version 11 (Build Number 16.5.8506.0) or later is installed on the Headquarters server and all Distributed servers in the system.
2. Reboot all switches in the system.
3. Confirm that all half-width switches in the ShoreTel network are running Uboot version 1.1.3.27 or higher (see Viewing the Uboot Version Information for a Switch on page 224).

   Uboot version 1.1.3.27 or higher supports FTP service on both port 150 (for the 64-bit OS) and port 125 (for the 32-bit OS).
4. See Upgrading Servers from Windows 2003 32-bit to Windows 2008 R2 32-bit or 64-bit on page 225 for more details on upgrading from Windows 2003 to Windows 2008 R2 (64-bit).

Upgrading the Uboot Version

ShoreTel 11 (Build 16.5.8506.0) or higher automatically updates the Uboot code on the Voicemail Model Switches (voice switches that also provide voicemail—the ShoreTel Voice Switch 90V, for example) as part of the installation.

If you have a ShoreTel VxWorks-based switch (not a voice mailbox switch), you must update the Uboot version to 1.1.3.27 (see Upgrading the Uboot Version on page 225).

Viewing the Uboot Version Information for a Switch

1. Launch Director and then click Quick Look.

2. Under Sites, click a site to view.
3. Under **Switch/Appliance**, click the switch to view.

   The Uboot version running on the switch is displayed as Boot ROM Version under Details.

Upgrading the Uboot Version

1. Telnet or SSH to the half-width switch (non V-switch).
2. Go to Shell.
3. Enter the command `uboot_update` on the CLI.

Note

Do not turn off the unit during this process.

4. Reboot the switch after the update is complete.

Upgrading Servers from Windows 2003 32-bit to Windows 2008 R2 32-bit or 64-bit

The following procedure is required when upgrading the operating system to Windows Server 2008 SP2 (32-bit) or Windows Server 2008 64-bit R2 on a server that is running ShoreTel server software.

Be aware that after the ShoreTel software is installed on the server, the server is considered a Telephony Appliance. As a Telephony Appliance, it does not adhere to the same policies, procedures, or security as a data server.

Note

Disable a user's Active Directory settings before proceeding with the upgrade process. If a user's Active Directory setting is not disabled, you will not be able to log into ShoreTel Director after upgrading.

1. Ensure that the server meets the hardware requirements as set forth in the Build Notes.
2. Disable a user's Active Directory setting (if enabled). This is an administrator's account into Director.
3. Perform the upgrade during a time window that allows you between 3-8 hours. Systems with only 1-5 switches usually take anywhere between 1-3 hours. The time frame depends on the size of your ShoreTel system.

WARNING!

You will be taking services down in order to perform this backup and upgrade. Be sure to perform this during a maintenance window.

4. Back up the following databases with the commands listed:

Note

The default location for the database dumps is C:\.

- CDR database

Note

Before you back up the CDR database, stop archiving on the headquarters server.

```
C:\Program Files\Shoreline Communications\
   ShoreWare Server\MySQL\MySQL Server 5.0\Examples\backupCDR.bat
```

- Configuration database

```
C:\Program Files\Shoreline Communications\
   ShoreWare Server\MySQL\MySQL Server 5.0\Examples\backupConfig.bat
```

- WebBridge database

```
C:\Program Files\Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server 5.0\Examples\backupWebBridge.bat
```

- Archive database on ShoreTel 12.3 and before: (If your system has an archived database, run the following command.)

```
C:\Program Files\Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server 5.0\bin\mysql.exe --user=root --
   password=shorewaredba --port=4309 --database databasename >
   "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
```

- Archive database on ShoreTel 13 and above: (If your system has an archived database, run the following command.)

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
   MySQLConfig\MySQL Server\bin\mysql.exe --user=root --
   password=shorewaredba --port=4309 --database databasename >
   "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
```

Note

The \Database folder is excluded from the backup because, in a few rare cases, Windows 2008 is unable to read database files after they are moved from Windows 2003. To avoid this scenario, ShoreTel recommends that you backup and restore the databases.

5. For all the backups, be sure the file size is greater than 0 KB.

6. Stop and disable all ShoreTel services by running the following batch file:

   C:\Program Files\Shoreline Communications\ShoreWare Server\
   Scripts\hq_shoretel-stop-svcs.bat

7. Confirm that all ShoreTel services have stopped.
8. Reboot.
9. Copy the Shoreline Data folder (excluding the \Database folder) to a safe location and label the version and build in the folder in which it is located. It is recommended that you copy off the server to a safe location.
10. Restart the ShoreTel services by running the following command:

    C:\Program Files\Shoreline Communications\ShoreWare Server\Scripts\
    hq_shoretel-start-svcs.bat
11. Ensure that everything is up and running properly.
12. Reboot.
13. Pull off to a safe location the ShoreTel Director Installation files and any other files that you may want to keep.
14. After everything is off the server, reboot and boot from the Windows 2008 (32-bit) CD-ROM.
15. Format the hard drive and install Windows 2008 (32-bit).
16. Log in via the local Admin Account.
17. Adjust the NIC so that it has the same static IP and name that it did before.
18. Add the server to the domain (be sure that it is placed in an empty Organizational Unit (OU) with Block Inheritance). No Group Policies should be applied. If Group Policies do need to be applied, be sure that they have already been tested against ShoreTel.

WARNING!

Do not install any Anti-Virus software or Network security software. The ShoreTel Server is a Telephony Appliance. If you absolutely need Anti-Virus software or Network security software due to security regulations, use KB16704 to configure this properly.

19. Turn off User Access Control (UAC).
20. Ensure that all of the Application Server Roles and Web Server Roles are installed (see Microsoft Windows Server 2008 Configuration on page 189).
21. Install the SMTP Role under Features (see Microsoft Windows Server 2008 Configuration on page 189).
22. Set DEP to Windows Programs and Services.
23. Install all of the Windows updates approved to the date specified in the Build Notes for the build on your system.
24. Disable Windows updates.
25. Disable Internet Explorer Enhanced Security.

26. Disable the pop-up blocker.

27. Copy your old Shoreline Data folder back to the drive where you want to install the software.

28. Install overtop the old Shoreline Data folder the **exact same** version of the ShoreTel Server software that was installed before.

Note

When installing the ShoreTel server on Windows Server 2008 (32-bit), you must launch Setup.exe using "`Run as Administrator`."

29. Copy the following database dumps to the C:\ directory:

    - CDR
    - Config
    - WebBridge
    - Archive SQL (if your system has an archived database)

30. Import the SQL database dumps by running the following commands:

    - To import the CDR database dump:

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQL\MySQL Server\Examples\RestoreCDR.bat
      ```

    - To import the Config database dump:

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQL\MySQL Server\Examples\RestoreConfig.bat
      ```

    - To import the WebBridge database dump:

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQL\MySQL Server\Examples\RestoreWebBridge.bat
      ```

    - To import the Archive database dump on ShoreTel 12.3 and before (if your system has an archived database):

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQL\MySQL Server 5.0\bin\mysql.exe --user=root --
         password=shorewaredba --port=4309 --database databasename >
         "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
      ```

    - To import the Archive database dump (if your system has an archived database):

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQLConfig\MySQL Server\bin\mysql.exe --user=root --
         password=shorewaredba --port=4309 --database databasename >
         "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
      ```

31. Log into Director.

Upgrading Servers from Windows 2008 32-bit to Windows 2008 R2 64-bit

ShoreTel supports a particular 64-bit version of the Windows Server 2008 operating system. Specifically, support for Windows Server 2008 R2 64-bit only (no non-R2 versions) began with the first release of ShoreTel Release 11 (Build Number 16.5.8506.0) and continues in subsequent builds.

Be aware that after the ShoreTel software is installed on the server, the server is considered a Telephony Appliance. As a Telephony Appliance, it does not adhere to the same policies, procedures, or security as a data server.

Release 11 Build 16.5.8506.0 and higher supports heterogeneous environments. For example, ShoreTel Release 11 software or higher supports a mix of the Headquarters Server and DVSs running either the 32-bit OS or the R2 64-bit OS until you get to version 13. In ShoreTel 13, Windows 2003 is no longer supported.

Verify that the version of the Uboot code on all switches is 1.1.3.27 or later prior to the installation of Windows Server 2008 R2 on the headquarters system. Use Quick Look to confirm the version of boot ROM on each switch. Only ShoreTel 12.3 and above has this new Uboot code.

If you are not on ShoreTel 12.3 or above and you are upgrading to Windows 2008 R2 (64-bit), follow the procedure in Upgrading Servers from Windows 2003 32-bit to Windows 2008 R2 32-bit or 64-bit on page 225.

Upgrading Servers from Windows 2003 32-bit to Windows 2012 64-bit

The following procedure is required when upgrading the operating system to Windows Server 2012 on a server that is running ShoreTel server software.

Be aware that after the ShoreTel software is installed on the server, the server is considered a Telephony Appliance. As a Telephony Appliance, it does not adhere to the same policies, procedures, or security as a data server.

1. Upgrade your Windows 2003 32-bit server to your Windows 2008 32-bit or 64-bit server. Follow the procedure in Upgrading Servers from Windows 2003 32-bit to Windows 2008 R2 32-bit or 64-bit on page 225.
2. Upgrade your Windows 2008 R2 32-bit or 64-bit server to your Windows 2012 64-bit server. Follow the procedure in Upgrading Servers from Windows 2008 R2 32-bit to Windows 2012 64-bit on page 231, or Upgrading Servers from Windows 2008 R2 64-bit to Windows 2012 64-bit on page 235.

Preparing to Upgrade from Windows 2008 R2 32-bit or 64-bit to Windows 2012 64-bit

Upgrading your Windows Server 32-bit operating system to a Windows Server 64-bit operating system can cause your ShoreTel switches to not re-connect. To ensure a seamless migration without disruptions in your telephone services, you must make sure that your entire ShoreTel installation is compatible with the Windows Server 64-bit operating system.

Be aware that after the ShoreTel software is installed on the server, the server is considered a Telephony Appliance. As a Telephony Appliance, it does not adhere to the same policies, procedures, or security as a data server.

Note

For new installations of the 64-bit OS, you do not need to prepare the server (the steps below are not necessary).

Before upgrading the server operating system, perform the following intermediate steps; otherwise, the ShoreTel switches will not reconnect and connectivity will be lost.

1. Make sure ShoreTel server software version 12 (Build Number 16.5.8506.0) or later is installed on the Headquarters server and all Distributed servers in the system.
2. Reboot all switches in the system.
3. Confirm that all half-width switches in the ShoreTel network are running Uboot version 1.1.3.27 or higher (see Viewing the Uboot Version Information for a Switch on page 230).

   Uboot version 1.1.3.27 or higher supports FTP service on both port 150 (for the 64-bit OS) and port 125 (for the 32-bit OS).
4. See Upgrading Servers from Windows 2003 32-bit to Windows 2008 R2 32-bit or 64-bit on page 225 for more details on upgrading from Windows 2003 to Windows 2008 R2 (64-bit).

Upgrading the Uboot Version

ShoreTel 12 (Build 16.5.8506.0) or higher automatically updates the Uboot code on the Voicemail Model Switches (voice switches that also provide voicemail—the ShoreTel Voice Switch 90V, for example) as part of the installation.

If you have a ShoreTel VxWorks-based switch (not a voice mailbox switch), you must update the Uboot version to 1.1.3.27 (see Upgrading the Uboot Version on page 231).

Viewing the Uboot Version Information for a Switch

1. Launch Director and then click Quick Look.
2. Under Sites, click a site to view.
3. Under **Switch/Appliance**, click the switch to view.

The Uboot version running on the switch is displayed as Boot ROM Version under Details.

Upgrading the Uboot Version

1. Telnet or SSH to the half-width switch (non V-switch).
2. Go to Shell.
3. Enter the command `uboot_update` on the CLI.

Note

Do not turn off the unit during this process.

4. Reboot the switch after the update is complete.

Upgrading Servers from Windows 2008 R2 32-bit to Windows 2012 64-bit

The following procedure is required when upgrading the operating system to Windows Server 2012 64-bit on a server that is running ShoreTel server software.

Be aware that after the ShoreTel software is installed on the server, the server is considered a Telephony Appliance. As a Telephony Appliance, it does not adhere to the same policies, procedures, or security as a data server.

Note

Disable a user's Active Directory settings before proceeding with the upgrade process. If a user's Active Directory setting is not disabled, you will not be able to log into ShoreTel Director after upgrading.

1. Ensure that the server meets the hardware requirements as set forth in the Build Notes.
2. Disable a user's Active Directory setting (if enabled). This is an administrator's account into Director.
3. Perform the upgrade during a time window that allows you between 3-8 hours. Systems with only 1-5 switches usually take anywhere between 1-3 hours. The time frame depends on the size of your ShoreTel system.

WARNING!

You will be taking services down in order to perform this backup and upgrade. Be sure to perform this during a maintenance window.

4. Back up the following databases with the commands listed:

Note

The default location for the database dumps is C:\.

- CDR database

Note

Before you back up the CDR database, stop archiving on the headquarters server.

```
C:\Program Files\Shoreline Communications\
   ShoreWare Server\MySQL\MySQL Server\Examples\backupCDR.bat
```

- Configuration database

```
C:\Program Files\Shoreline Communications\
   ShoreWare Server\MySQL\MySQL Server\Examples\backupConfig.bat
```

- WebBridge database

```
C:\Program Files\Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server\Examples\backupWebBridge.bat
```

- Archive database on ShoreTel 12.3 and before: (If your system has an archived database, run the following command.)

```
C:\Program Files\Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server 5.0\bin\mysql.exe --user=root --
   password=shorewaredba --port=4309 --database databasename >
   "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
```

- Archive database on ShoreTel 13 and above: (If your system has an archived database, run the following command.)

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
   MySQLConfig\MySQL Server\bin\mysql.exe --user=root --
   password=shorewaredba --port=4309 --database databasename >
   "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
```

Note

The \Database folder is excluded from the backup because, in a few rare cases, Windows 2008 is unable to read database files after they are moved from Windows 2003. To avoid this scenario, ShoreTel recommends that you backup and restore the databases.

5. For all the backups, be sure the file size is greater than 0 KB.
6. Stop and disable all ShoreTel services by running the following batch file:

   C:\Program Files\Shoreline Communications\ShoreWare Server\
   Scripts\hq_shoretel-stop-svcs.bat

7. Confirm that all ShoreTel services have stopped.

8. Reboot.
9. Copy the Shoreline Data folder (excluding the \Database folder) to a safe location and label the version and build in the folder in which it is located. It is recommended that you copy off the server to a safe location.
10. Restart the ShoreTel services by running the following command:

    C:\Program Files\Shoreline Communications\ShoreWare Server\Scripts\
    hq_shoretel-start-svcs.bat
11. Ensure that everything is up and running properly.
12. Reboot.
13. Pull off to a safe location the ShoreTel Director Installation files and any other files that you may want to keep.
14. After everything is off the server, reboot and boot from the Windows 2012 64-bit CD-ROM.
15. Format the hard drive and install Windows 2012 64-bit.
16. Log in via the local Admin Account.
17. Adjust the NIC so that it has the same static IP and name that it did before.
18. Add the server to the domain (be sure that it is placed in an empty Organizational Unit (OU) with Block Inheritance). No Group Policies should be applied. If Group Policies do need to be applied, be sure that they have already been tested against ShoreTel.

WARNING!

Do not install any Anti-Virus software or Network security software. The ShoreTel Server is a Telephony Appliance. If you absolutely need Anti-Virus software or Network security software due to security regulations, use KB16704 to configure this properly.

19. Turn off User Access Control (UAC).
20. Ensure that all of the Application Server Roles and Web Server Roles are installed.
21. Install the SMTP Role under Features.
22. Set DEP to Windows Programs and Services.
23. Install all of the Windows updates approved to the date specified in the Build Notes for the build on your system.
24. Disable Windows updates.
25. Disable Internet Explorer Enhanced Security.
26. Disable the pop-up blocker.
27. Copy your old Shoreline Data folder back to the drive where you want to install the software.

28. Install overtop the old Shoreline Data folder the **exact same** version of the ShoreTel Server software that was installed before.

Note

When installing the ShoreTel server on Windows Server 2012 64-bit, you must launch Setup.exe using "`Run as Administrator`."

29. Copy the following database dumps to the C:\ directory:
    - CDR
    - Config
    - WebBridge
    - Archive SQL (if your system has an archived database)
30. Import the SQL database dumps by running the following commands:
    - To import the CDR database dump:

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQL\MySQL Server\Examples\RestoreCDR.bat
      ```

    - To import the Config database dump:

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQL\MySQL Server\Examples\RestoreConfig.bat
      ```

    - To import the WebBridge database dump:

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQL\MySQL Server\Examples\RestoreWebBridge.bat
      ```

    - To import the Archive database dump on ShoreTel 12.3 and before (if your system has an archived database):

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQL\MySQL Server 5.0\bin\mysql.exe --user=root --
         password=shorewaredba --port=4309 --database databasename >
         "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
      ```

    - To import the Archive database dump (if your system has an archived database):

      ```
      C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
         MySQLConfig\MySQL Server\bin\mysql.exe --user=root --
         password=shorewaredba --port=4309 --database databasename >
         "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
      ```

31. Log into Director.

Upgrading Servers from Windows 2008 R2 64-bit to Windows 2012 64-bit

The following procedure is required when upgrading the operating system to Windows Server 2012 64-bit on a server that is running ShoreTel server software.

Be aware that after the ShoreTel software is installed on the server, the server is considered a Telephony Appliance. As a Telephony Appliance, it does not adhere to the same policies, procedures, or security as a data server.

Note

Disable a user's Active Directory settings before proceeding with the upgrade process. If a user's Active Directory setting is not disabled, you will not be able to log into ShoreTel Director after upgrading.

1. Ensure that the server meets the hardware requirements as set forth in the Build Notes.
2. Disable a user's Active Directory setting (if enabled). This is an administrator's account into Director.
3. Perform the upgrade during a time window that allows you between 3-8 hours. Systems with only 1-5 switches usually take anywhere between 1-3 hours. The time frame depends on the size of your ShoreTel system.

WARNING!

You will be taking services down in order to perform this backup and upgrade. Be sure to perform this during a maintenance window.

4. Back up the following databases with the commands listed:

Note

The default location for the database dumps is C:\.

- CDR database

Note

Before you back up the CDR database, stop archiving on the headquarters server.

```
C:\Program Files (x86)\Shoreline Communications\
   ShoreWare Server\MySQL\MySQL Server\Examples\backupCDR.bat
```

- Configuration database

```
C:\Program Files (x86)\Shoreline Communications\
   ShoreWare Server\MySQL\MySQL Server\Examples\backupConfig.bat
```

- WebBridge database

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server\Examples\backupWebBridge.bat
```

- Archive database on ShoreTel 12.3 and before: (If your system has an archived database, run the following command.)

```
C:\Program Files (x86)Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server 5.0\bin\mysql.exe --user=root --
   password=shorewaredba --port=4309 --database databasename >
   "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
```

- Archive database on ShoreTel 13 and above: (If your system has an archived database, run the following command.)

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
   MySQLConfig\MySQL Server\bin\mysql.exe --user=root --
   password=shorewaredba --port=4309 --database databasename >
   "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
```

Note

The \Database folder is excluded from the backup because, in a few rare cases, Windows 2008 is unable to read database files after they are moved from Windows 2003. To avoid this scenario, ShoreTel recommends that you backup and restore the databases.

5. For all the backups, be sure the file size is greater than 0 KB.
6. Stop and disable all ShoreTel services by running the following batch file:

   C:\Program Files\Shoreline Communications\ShoreWare Server\
   Scripts\hq_shoretel-stop-svcs.bat
7. Confirm that all ShoreTel services have stopped.
8. Reboot.
9. Copy the Shoreline Data folder (excluding the \Database folder) to a safe location and label the version and build in the folder in which it is located. It is recommended that you copy off the server to a safe location.
10. Restart the ShoreTel services by running the following command:

    C:\Program Files\Shoreline Communications\ShoreWare Server\Scripts\
    hq_shoretel-start-svcs.bat
11. Ensure that everything is up and running properly.
12. Reboot.
13. Pull off to a safe location the ShoreTel Director Installation files and any other files that you may want to keep.
14. After everything is off the server, reboot and boot from the Windows 2012 64-bit CD-ROM.
15. Format the hard drive and install Windows 2012 64-bit.

16. Log in via the local Admin Account.
17. Adjust the NIC so that it has the same static IP and name that it did before.
18. Add the server to the domain (be sure that it is placed in an empty Organizational Unit (OU) with Block Inheritance). No Group Policies should be applied. If Group Policies do need to be applied, be sure that they have already been tested against ShoreTel.

WARNING!

Do not install any Anti-Virus software or Network security software. The ShoreTel Server is a Telephony Appliance. If you absolutely need Anti-Virus software or Network security software due to security regulations, use KB16704 to configure this properly.

19. Turn off User Access Control (UAC).
20. Ensure that all of the Application Server Roles and Web Server Roles are installed.
21. Install the SMTP Role under Features.
22. Set DEP to Windows Programs and Services.
23. Install all of the Windows updates approved to the date specified in the Build Notes for the build on your system.
24. Disable Windows updates.
25. Disable Internet Explorer Enhanced Security.
26. Disable the pop-up blocker.
27. Copy your old Shoreline Data folder back to the drive where you want to install the software.
28. Install overtop the old Shoreline Data folder the **exact same** version of the ShoreTel Server software that was installed before.

Note

When installing the ShoreTel server on Windows Server 2012 64-bit, you must launch Setup.exe using "`Run as Administrator`."

29. Copy the following database dumps to the C:\ directory:
    - CDR
    - Config
    - WebBridge
    - Archive SQL (if your system has an archived database)
30. Import the SQL database dumps by running the following commands:
    - To import the CDR database dump:

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server\Examples\RestoreCDR.bat
```

- To import the Config database dump:

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server\Examples\RestoreConfig.bat
```

- To import the WebBridge database dump:

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server\Examples\RestoreWebBridge.bat
```

- To import the Archive database dump on ShoreTel 12.3 and before (if your system has an archived database):

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
   MySQL\MySQL Server 5.0\bin\mysql.exe --user=root --
   password=shorewaredba --port=4309 --database databasename >
   "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
```

- To import the Archive database dump (if your system has an archived database):

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\
   MySQLConfig\MySQL Server\bin\mysql.exe --user=root --
   password=shorewaredba --port=4309 --database databasename >
   "c:\ArchiveCDRdump.sql" 2>>C:\\RestoreArchiveCDR.log
```

31. Log into Director.

Scenarios for upgrading Headquarters and DVS Servers

Upgrading the System to New Hardware (Same OS)

WARNING!

This procedure will take down all services performed by the server. ShoreTel recommends that you perform this procedure during non-business hours.

Be aware that after the ShoreTel software is installed on the server, the server is considered a Telephony Appliance. As a Telephony Appliance, it does not adhere to the same policies, procedures, or security as a data server.

Perform the following steps on the new server

1. Ensure that the server meets the hardware requirements as set forth in the Build Notes.
2. Format the hard drive and install Windows Server 2012 64-bit Standard or Datacenter.
3. Log in via the local Admin Account.

4. Add the server to the domain (be sure that it is placed in an empty Organizational Unit (OU) with Block Inheritance). No Group Policies should be applied. If Group Policies need to be applied, be sure that they have already been tested against ShoreTel.

WARNING!

Do not install any Anti-Virus software or Network security software. The ShoreTel Server is a Telephony Appliance. If you absolutely need Anti-Virus software or Network security software due to security regulations, use KB16704 to configure this properly.

5. Turn off User Access Control (UAC).
6. Ensure that all of the Application Server Roles and Web Server Roles are installed.
7. Install the SMTP Role under Features.
8. Set DEP to Windows Programs and Services.
9. Install all of the Windows updates approved to the date specified in the Build Notes for the build on your system.
10. Disable Windows updates.
11. Disable Internet Explorer Enhanced Security.
12. Disable the pop-up blocker.

Perform the following steps on the old server

1. Disable a user's Active Directory setting (if enabled). This is an administrator's account into Director.
2. Stop and disable all ShoreTel services by running the following batch file:

   C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\Scripts\hq_shoretel-stop-svcs.bat

3. Confirm that all ShoreTel services have stopped:

   a. Go to the Run menu (WIN + R).

   b. Type `services.msc`.

   c. Review all of the ShoreTel services to ensure that they show "`Manual`" and that the services are stopped.

4. Reboot.
5. Copy the Shoreline Data folder (excluding the \Database folder) to a safe location and label the version and build in the folder in which it is located. It is highly recommended that you copy off the server to a safe location.

   ShoreTel recommends that you back up these files to a storage device separate from the server that you intend to upgrade.

6. Restart the ShoreTel services by running the following batch file:

   C:\Program Files\Shoreline Communications\ShoreWare Server\Scripts\
   hq_shoretel-start-svcs.bat

7. Confirm that all ShoreTel services are up and running:

   a. Go to the Run menu (WIN + R).

   b. Type `services.msc`.

   c. Review all of the ShoreTel services to ensure that they show "`Automatic`" and that the services are started.

8. Change the name of the server.

9. Change the IP of the server to something different.

10. Reboot.

Perform the following steps on the new server

1. Change the IP of the new server to the IP of the original server.

2. Change the Name of the new server to the Name of the original server.

3. Reboot.

4. Copy the Shoreline data folder that you copied from Step 5 to the new server.

5. Install overtop the old Shoreline Data folder the **exact same** version of the ShoreTel Server software that was installed before.

   When installing the ShoreTel server on Windows Server 2008 (64-bit), you must launch Setup.exe using "`Run as Administrator`."

6. Log into Director.

Ensuring Proper Server Performance

This section contains guidelines for ensuring the best performance from your ShoreTel server. This list is not exhaustive.

Note

For more server maintenance information, refer to the Microsoft system recommendations at http:\\www.microsoft.com.

- Verify the server meets the hardware requirements, especially memory.
- Regularly defragment your hard drive and perform disk checks at least every other month.

- Optimize server performance for background services rather than for applications.

  The voice services running on the server are real-time services that could be negatively affected by having an application running in the foreground. Perform the following steps to optimize server performance:

  a. On the ShoreTel server desktop click **Start > Control Panel > System**.

  b. Select the **Advanced** tab or click **Advanced system settings**.

  c. Depending on your system, do one of the following:

  - Click **Performance Options**. The **Performance Options** dialog box appears.
  - Under Performance, click **Settings**, and then select the **Advanced** tab.

  d. Select the **Background services** radio button.

  e. Make sure the paging file size (virtual memory) on the server is large enough.

Note

The paging file size should be 1 to 3 times larger than the physical memory on the server. If you have 512 MB of memory, the paging file size should be between 512 MB and 1536 MB. To increase the paging file size, click **Change**.

Setting the Server to Maximize for Network Performance

1. On the ShoreTel server desktop click **Start > Control Panel > Network and Internet Connections > Network Connections**.
2. Depending on your system, do one of the following:

   - Right-click the Local Area Connection icon, and then choose **Properties**.
   - Click **Local Area Connection**, and then click **Properties**.

   The Local Area Connection Properties dialog box appears.
3. Select the **File and Printer Sharing for Microsoft Networks** check box.
4. Deselect the **Internet Protocol Version 6 (TCP/IPV6)** check box.

Note

The current release of ShoreTel software does not support IPv6. For all ShoreTel applications to run properly, you must disable IPv6 on all servers.

5. Click **OK**.

CHAPTER

12

Site Requirements and Preparation

This chapter provides information about preparing a site for the ShoreTel system. The topics are:

Recommendations 244
Switch Models 244
Voice Switch Requirements 244
Physical Requirements 244
Input Power 245
Power and Heat Dissipation 246
Environmental Requirements 247
Reliability and Availability 247
Memory and Processing 249
Connectors 249
Racks and Cabling 252
General Cabling Overview 252
Rack Overview 253

Recommendations

The following recommendations can assist in the planning and preparation of a site for a ShoreTel system.

- Hire a cabling contractor to install the equipment racks, patch panels, and cabling.
- Have RJ-48C cables available for each ShoreTel Voice Switch.

Switch Models

You can locate the model number of your switches on the rear panel as shown in Figure 42. This document distinguishes between switches based on the model number and the number of RUs the switch occupies.

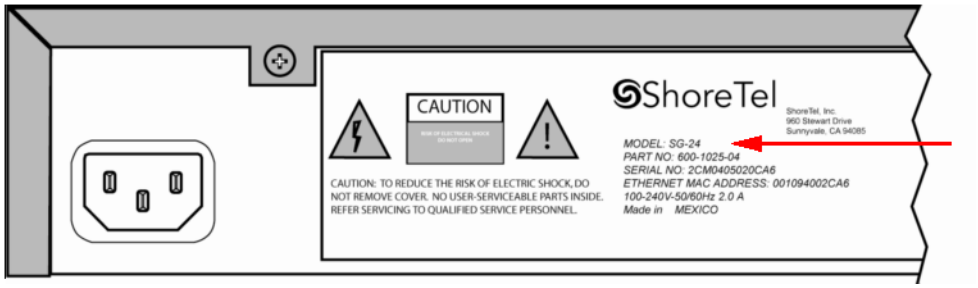

Figure 42: ShoreTel 120 Model Number Label

See Appendix F, ShoreTel Voice Switches for information about all ShoreTel Voice Switches. The information describes phone capabilities, connectors, and LED behavior.

Voice Switch Requirements

This section includes requirements for mounting the ShoreTel voice switches, along with other switch-related requirements and specifications.

Physical Requirements

The ShoreTel voice switches are designed to be mounted in a standard 19-inch rack. Table 43 shows the specifications for each voice switch. For more information refer to the *Quick Install Guide*, included with each ShoreTel voice switch.

Table 43: ShoreTel Voice Switch Physical Specifications

Parameter	ShoreTel 120 ShoreTel 60 ShoreTel 40	ShoreTel T1 ShoreTel E1
Dimensions (H x W x D)	1.72” x 17.16” x 14.28 “ 43.68 x 435.86 x 362.71 mm	1.72” x 17.16” x 14.28 “ 43.68 x 435.86 x 362.71 mm
Rack mount units	1 RU	1 RU
Mounting position	Front, Center	Front, Center
Weight	9 lbs 4.08 kg	8 lbs 3.62 kg
Maximum stacked per shelf	3 switches	3 switches

Table 44 shows the latest hardware line, designed to increase port density.

Table 44: Half-Width ShoreTel Voice Switch Physical Specifications

Parameter	Dimension
Dimensions (H x W x D)	1.69” x 8.39” x 14.28 “ 43 x 213 x 378 mm
Rack mount units	1 RU
Mounting position	Front, Center
Weight	5.3 lbs 2.4 kg
Maximum stacked per shelf	6 switches

Input Power

For backup purposes, ShoreTel recommends that all ShoreTel voice switches and the ShoreTel server be connected to an uninterruptable power supply (UPS). This ensures that telephone service will continue in the event of a power interruption.

Table 45 shows the power requirements for the full-width ShoreTel voice switches.

Table 45: ShoreTel Voice Switch Power Input (Full-Width Switches)

Parameter	ShoreTel 120 ShoreTel 60	ShoreTel 40	ShoreTel T1 ShoreTel E1
Input voltage	100–240 VAC 50–60 Hz	100–240 VAC 50–60 Hz	100–240 VAC 50–60 Hz
Current consumption @110 VAC (maximum)	2A max	1A max	1A max

Table 45: ShoreTel Voice Switch Power Input (Full-Width Switches) (Continued)

Parameter	ShoreTel 120 ShoreTel 60	ShoreTel 40	ShoreTel T1 ShoreTel E1
Number of grounded 110 VAC outlets per switch	1	1	1
Power consumption (typical)	90W typical	50W typical	50W typical

Table 46 shows the power requirements for the half-width ShoreTel voice switches.

Table 46: ShoreTel Voice Switch Power Input (Half-Width Switches)

Parameter	ShoreTel 90 ShoreTel 90BRI ShoreTel 50 ShoreTel 30	ShoreTel 220T1 ShoreTel 220T1A ShoreTel 220E1 ShoreTel T1k
Input voltage	100–240 VAC 50–60 Hz	100–240 VAC 50–60 Hz
Current consumption @110 VAC (maximum)	1A max	1A max
Number of grounded 110 VAC outlets per switch	1	1
Power consumption (typical)	40W	17W

Power and Heat Dissipation

The voice switches dissipate power and heat. ShoreTel recommends that you use the information in Table 47 and Table 48 to help calculate the ventilation requirements of the room that contains the switches.

Table 47: ShoreTel Voice Switch Power and Heat Dissipation (Full-Width Switches)

Parameter	SG 120/24	SG 60/12	SG 40/8	SG T1	SG E1
Power dissipation (typical)	90 W typ	90 W typ	50 W typ	50 W typ	50 W typ
Heat dissipation	215 BTU/hour	140 BTU/hour	85 BTU/hour	61 BTU/ hour	65 BTU/hour

Table 48: ShoreTel Voice Switch Power and Heat Dissipation (Half-Width Switches)

Parameter	SG 90 SG 90BRI SG 50 SG 30	SG 220T1 SG 220T1A	ShoreTel 220E1
Power dissipation (typical)	40 W typ	40 W typ	17 W typ
Heat dissipation	137 BTU/hour	137 BTU/hour	58 BTU/hour

Environmental Requirements

The ShoreTel voice switches require that the environmental specifications provided in Table 49 be met.

Table 49: ShoreTel Environmental Specifications

Parameter	Specification
Operating temperature	0° to 50° C (32° to 122° F)
Operating humidity (non-condensing)	10% to 90%
Storage temperature	–30° C to 70° C (-34.4° to 158° F)

Reliability and Availability

Each ShoreTel voice switch is an embedded product with a highly reliable fan. In addition, the power supply contained within the voice switch has a very high individual mean time before failure (MTBF), as shown in Table 50.

Table 50: ShoreTel Voice Switch Dependability

Voice Switch	Predicted MTBF (hours)	Demonstrated MTBF (hours)	MTTR (hours)	Availability
ShoreTel 24A				
ShoreTel 30	190,606	n/a	1	99.9994%
ShoreTel 30BRI	172,659	n/a	1	99.9994%
ShoreTel 40/8	132,300	515,581	1	99.9997%
ShoreTel 50	190,606	n/a	1	99.9994%
ShoreTel 50V	175,803	n/a	1	99.9994%
ShoreTel 60/12	91,000	519,359	1	99.9993%
ShoreTel 90	171,493	n/a	1	99.9994%
ShoreTel 90V	159,416	n/a	1	99.9994%

Table 50: ShoreTel Voice Switch Dependability (Continued)

Voice Switch	Predicted MTBF (hours)	Demonstrated MTBF (hours)	MTTR (hours)	Availability
ShoreTel 90BRI	172,659	n/a	1	99.9994%
ShoreTel 90BRIV	162,931	n/a	1	99.9994%
ShoreTel 120/24	84,500	518,134	1	99.9997%
ShoreTel T1	158,229	312,709	1	99.9997%
ShoreTel T1K	189,373	n/a	1	99.9994%
ShoreTel E1	154,229	312,709	1	99.9997%
ShoreTel E1K	189,373	n/a	1	99.9994%
ShoreTel 220T1	189,373	n/a	1	99.9994%
ShoreTel 220T1A	163,516	n/a	1	99.9994%
ShoreTel 220E1	189,373	n/a	1	99.9994%
MTBF – Mean time before failure MTTR – Mean time to repair Availability – %uptime/time – MTBF/(MTBF+MTTR)				

Since the ShoreTel system is plug-and-play, a switch can be replaced in minutes.

Distributed call control software means there is no system-wide single point of failure. If a single ShoreTel voice switch fails, all the other voice switches continue to operate.

Table 51 shows the reliability information for the ShoreTel IP phones. Hourly numbers shown are based on demonstrated reliability (as opposed to calculated).

Table 51: ShoreTel IP Phone Dependability

Phone	MTBF hours (calculated)	MTBF hours (demonstrated)
IP110	64,800	490,000
IP115	N/A	TBD
IP212k	58,200	350,000
IP230	58,200	350,000
IP265	N/A	TBD
IP420	N/A	N/A
IP480	N/A	N/A
IP480g	N/A	N/A
IP485g	N/A	N/A
IP560	56,300	360,000

Table 51: ShoreTel IP Phone Dependability (Continued)

Phone	MTBF hours (calculated)	MTBF hours (demonstrated)
IP560g	56,400	TBD
IP565g	N/A	TBD
IP 655	TBD	TBD
BB24	72,600	TBD

Memory and Processing

Each ShoreTel voice switch has the same memory and processing (see Table 52).

Table 52: ShoreTel Voice Switch Memory and Processing

Type	Details
Flash Memory	16 MB
Random Access Memory	128 MB
Main Processor	PowerPC 8245
Digital Signal Processor	Texas Instruments 5409A

Connectors

Table 53 summarizes all of the connectors on the ShoreTel voice switches. Diagrams showing where these connectors are located are provided later in this chapter.

Table 53: ShoreTel Voice Switch Connectors

Port/Connector	SG 120/24 SG 60/12 SG 40/8	SGT1/220T1 SG E1/220E1	SG 220T1A
Power	110 VAC	110 VAC	110 VAC
Ethernet	2 RJ-45	2 RJ-45	2 RJ-45
Analog telephone/trunk	RJ-21X male 0–2,000 feet	— —	RJ-21X male 0–2,000 feet
Digital trunk	—	RJ-48C	RJ-48C
T1 trunk monitor	—	RJ-48C	RJ-48C
Audio input (Music on Hold)	3.5 mini-mono	3.5 mini-mono	3.5 mini-mono
Audio output (Paging, Night Bell)	3.5 mini-mono	3.5 mini-mono	3.5 mini-mono
Maintenance	DB-9 female	DB-9 female	DB-9 female

Note

2000 ft. length uses 26AWG wire

Audio input/output on 220T1 and 220E1, but not T1/E

Power Cabling

Each ShoreTel voice switch comes equipped with a standard 110 VAC modular power cord. A localized modular power cord can be ordered from ShoreTel. ShoreTel recommends that every ShoreTel voice switch, as well as the ShoreTel server, be connected to an uninterruptable power supply (UPS).

Ethernet Cabling

Each ShoreTel voice switch has two RJ-45 connectors that provide an auto-sensing 10/100M Ethernet interface. These are connected to the local area network using standard Category 5 cabling.

ShoreTel voice switches come with two network interfaces, LAN1 and LAN2, allowing for a network fault tolerant deployment. You can connect to either or both connectors; there is no primary/secondary relationship. When both are connected, only one will be active at any time. If the currently active interface loses the link, the alternate interface becomes active. Both interfaces will use the same MAC Ethernet address, and IP address.

There are two levels of fault tolerance. To protect against Ethernet switch failure, connect LAN1 and LAN 2 to separate Ethernet switches. To protect against port or cable failure, connect LAN1 and LAN2 to separate ports on the same Ethernet switch.

10 Base-T and 100 Base-T can typically support up to 100 meters.

IP Phone Cabling

Each ShorePhone IP phone has an RJ-45 connector that provides an auto-sensing 10/100M Ethernet interface. This is connected to the local area network using standard Category 5 cabling.

10 Base-T and 100 Base-T can typically support up to 100 meters.

Analog Telephone and Trunk Cabling

ShoreTel voice switches that support analog protocols provide an RJ-21X male connector for mass termination of the telephones and trunks. This should be connected using a standard 25-pair cable. ShoreTel recommends using the RJ-21X and connecting to a patch panel to provide simple moves, adds, and changes.

Telephones can be supported from 0 to 2,000 feet from the voice switch over standard cabling. Use larger gauge wires for longer distances.

It is recommended that an analog telephone be provisioned in the equipment room for troubleshooting purposes.

Pinout information for ShoreTel Voice Switches is provided in the quick install guide for each voice switch.

Digital Trunk and Trunk Monitor Cabling

ShoreTel voice switches that support digital trunks have an RJ-48C connector as the telco interface to the T1/E1 trunk from the telephone service provider.

These voice switches provide an internal Channel Service Unit (CSU).

ShoreTel voice switches that support T1 and E1 trunks have an additional RJ-48C connector that is wired to the telco interface for the purpose of troubleshooting the T1 or E1 interface with specialized test equipment. This connector is normally not used.

Audio Input (Music on Hold) Cabling

Various ShoreTel voice switches have a 3.5 mm mini-stereo input connector that provide music or some other recording to callers when they are on hold. The input port supports low-level line audio from a preamplifier or mini-CD player, at 47 kΩ nominal impedance. The audio input cable can be up to 10 feet long. Refer to the ShoreTel quick install guide for your voice switch to determine whether your switch provides the 3.5 mm mini-stereo input connector.

The audio input port on the ShoreTel voice switches is a mono connection. If you connect a stereo input, the stereo signal is converted to a mono signal.

To minimize bandwidth, music on hold is not streamed across the wide area network, so you will need one music source per site.

The music and music source are not included with the ShoreTel system.

WARNING!

In accordance with United States copyright laws, a license may be required from the American Society of Composers, Authors, and Publishers, or a similar organization, if radio or TV broadcasts are played for music on hold. As an alternative, an ASCAP-approved CD or tape can be used. ShoreTel, Inc. disclaims any liability out of failure to obtain such a license.

Audio Output (Paging and Night Bell) Cabling

Various ShoreTel voice switches have a 3.5 mm mini-stereo audio output connector for overhead paging and night bell on a per site basis. The audio output port provides low-level line audio with a sufficient input level for a typical amplifier. The paging port output is about one volt peak to peak, similar to the line output of a CD player, and can drive inputs that are 600 ohms or higher. Refer to the ShoreTel quick install guide for your voice switch to determine whether your switch provides the 3.5 mm mini-stereo input connector.

The audio output is mono signal. If you use a stereo jack, the signal is available on one channel, but the other channel will be silent.

This is a single-zone paging system. If more zones are required, see the application note on ShoreTel's online knowledge base.

Maintenance Cabling

ShoreTel voice switches support a maintenance port for connection terminal using a standard, straight-through DB-9 female connector. This maintenance port is typically used only when assigning networking parameters if DHCP or BOOTP is not being used.

Racks and Cabling

General Cabling Overview

The diagram in Figure 43 highlights the key components with respect to cabling for your voice network.

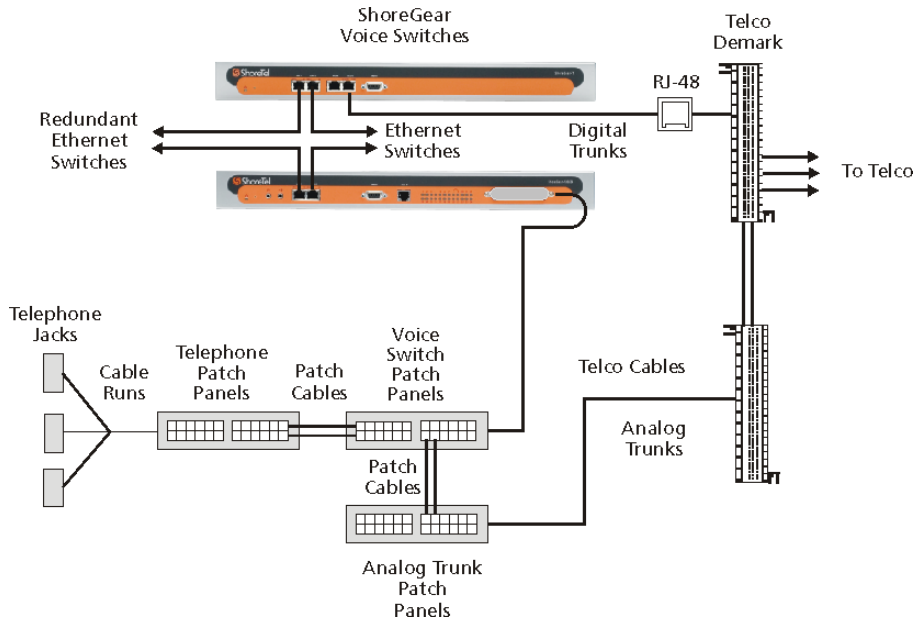

Figure 43: Cabling Overview

Starting from the lower left in this diagram, the telephone cabling is organized as follows:

- A telephone jack (RJ-11) is provided for each telephone.
- Telephone cabling (Category 3 or better) is terminated on the telephone jack and runs back to the equipment room to a modular connector (RJ-21X) on a telephone patch panel.
- The telephone patch panel provides a flexible cable management solution for the telephone cabling. The patch panel has RJ-21X connections for the telephone cabling and RJ-11 connections on the front.
- Patch cords are connected from the telephone patch panel (RJ-11) to the voice switch patch panel (RJ-11).

- The voice switch patch panel provides a flexible cable management solution for the voice switches. The patch panel has RJ-21X connections running to the voice switches and RJ-11 connections on the front.

Starting from the right in Figure 43 on page 252, the trunk cabling is organized as follows:

- The digital (T1/E1) and analog trunks are terminated on a punch-down block.
- The digital service is further terminated at a service provider demark with an RJ-48 connector.
- An RJ-48 cable from the T1/E1 demark connects to the ShoreTel T1 or ShoreTel E1.
- The analog service is cross-connected to a modular (RJ-21X) punch-down block.
- A telco cable is connected to the modular (RJ-21X) punch-down jack and runs to a modular connector (RJ-21X) on an analog trunk patch panel.
- Like the telephone cabling, patch cords are connected from the analog trunk patch panel (RJ-11) to the voice switch patch panel (RJ-11).

As an alternative, patch panels can be replaced with punch-down blocks. This may be more cost-effective but is less flexible.

Rack Overview

Figure 44 shows a typical rack installation.

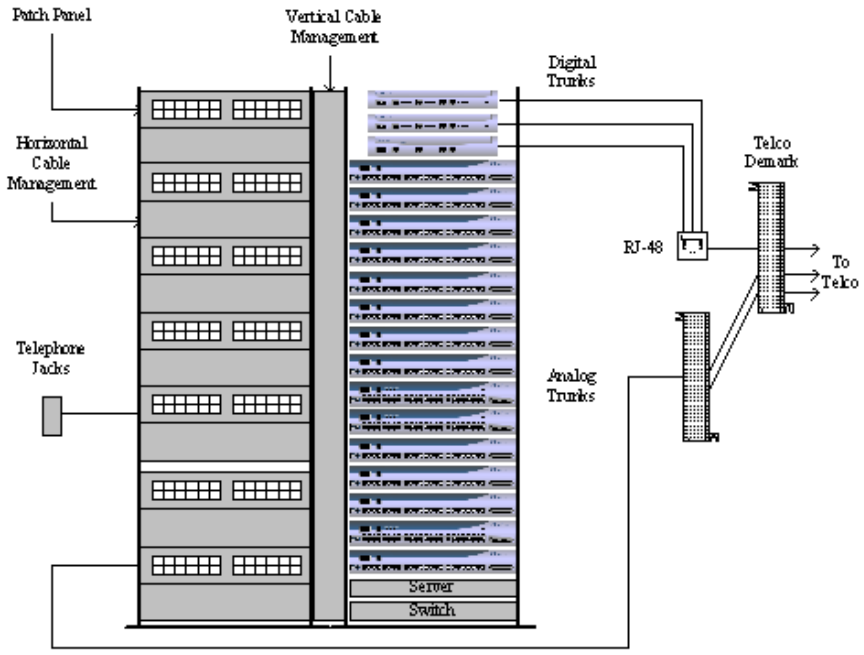

Figure 44: Rack Installation

A 19-inch data rack, shelf, and modular patch panels can be purchased from most major electrical suppliers.

CHAPTER

13

Installing ShoreTel Voice Switches

This chapter provides planning and installation information for the ShoreTel voice switches, virtual switches, and virtual Service Appliances. Information on switch connectors and LEDs can be found in Site Requirements and Preparation on page 243. The topics discussed include the following:

- Planning 256
- Mounting the ShoreTel Voice Switches 256
  - Stacking the ShoreTel Voice Switch in a Rack 256
  - Mounting a Full-width ShoreTel Voice Switch in a Rack with Brackets 256
  - Mounting a Half-width ShoreTel Voice Switch in a Rack with brackets 256
- Installing ShoreTel Voice Switches 257
  - Installing a ShoreTel Voice Switch 257
  - RJ-21X Cable Retainer Installation 257
  - Installing the Retainer 258
- Virtual Switches and Service Appliances 258
  - Default Configurations 258
  - Installing a Virtual Device 261
- ShoreTel Director Switch Configuration 262
  - Environmental Requirements 263
  - Packaging Requirements 263
  - Regulatory Compliance 264
  - General Specifications 265
- Reference 263

Planning

In the ShoreTel system, switches perform vital roles in connecting endpoints in a call whether the endpoints are located on the ShoreTel network, another private network, or the PSTN. Every IP phone on the ShoreTel network must register with a switch. The switch provides dial and ring tone to the phone when required, performs call setup and teardown task, sets up call legs, communicates with other switches and devices. ShoreTel switches also provide the physical and logical interface that allows the system to connect with external service providers and other phone networks. When you plan for switches, consider the following:

- The number of IP phone that will connect to the switch.
- The type of interface you provision from the external service provider.
- Failover

Mounting the ShoreTel Voice Switches

Stacking the ShoreTel Voice Switch in a Rack

1. Remove the voice switch from its shipping container.
2. Place the switch on a flat platform, such as a shelf.
3. Stack up to three switches on top of each other.

Mounting a Full-width ShoreTel Voice Switch in a Rack with Brackets

1. Remove the voice switch from its shipping container.
2. Attach the two included mounting brackets by using the screws ShoreTel provides.
3. Use standard screws to mount the switch in the rack.

Mounting a Half-width ShoreTel Voice Switch in a Rack with brackets

Note

Refer to the Quick Install Guide for the ShoreTel Dual Tray, which is included with half-width switches, for details.

1. Remove the voice switch from its shipping container.

2. Mount a ShoreTel Dual Tray into the rack with the screws provided.
3. Install the half-width switch into the tray on either the left or right side of the tray. Two half-width switches can be placed in the same tray.
4. Use standard screws to mount the switch in the tray.

Installing ShoreTel Voice Switches

Before applying power to a new ShoreTel voice switch, configure the DHCP/BOOTP server.

Installing a ShoreTel Voice Switch

1. Connect the switch to the appropriate LAN segment, such as a LAN switch, with the Category 5 RJ-45 interface cable. For guaranteed voice quality, all ShoreTel voice switches can be connected to an isolated LAN segment.
2. Plug an AC surge protector into a grounded AC power source (not provided). Electrical surges, typically lightning transients, are very destructive to equipment connected to AC power sources.
3. Plug the power cord into the power receptacle on the switch's back panel and then into an available socket on the AC surge protector. Most ShoreTel Voice Switch models do not have a power switch. They turn on when you connect the switch to a power source.

   The power LED flashes momentarily, and remains lit. If the LED is not lit, ensure that the power cord is plugged into the switch and the power source. If the LED continues flashing, there is an internal error. Unplug the switch to power it off, then power it back on. Refer to the ShoreTel System Administration Guide for a description of the flash patterns and their meaning.

   Once network communications are established, the network LEDs will indicate that the switch is connected to a 10 Mbps or 100 Mbps Ethernet environment, and that the switch is receiving and transmitting data.
4. If applicable, connect the music-on-hold source to the audio input port.
5. If applicable, connect your site's paging system to the audio output port.
6. Configure the ShoreTel voice switch according to your site's requirements. Refer to the ShoreTel System Administration Guide to for information about this procedure.
7. Connect your trunk and telephone lines using the appropriate connector for your switch. Refer to the quick install guide for your ShoreTel switch for connector pinout information.

RJ-21X Cable Retainer Installation

A cable retainer for the RJ-21X port is included with some ShoreTel voice switches. The retainer consists of a metal bracket with a velcro strap.

Installing the Retainer

1. Using a number 1 Phillips screwdriver, remove the two black Phillips head screws on either side of the RJ-21X port.
2. Place the retainer in the recessed area around the RJ-21X port.
3. Reinstall the two screws.
4. Plug in the RJ-21X cable.
5. Pull the velcro strap tightly around the connector on the RJ-21X cable, and fasten it.

Virtual Switches and Service Appliances

This section describes the following virtual devices:

- ShoreTel Virtual Phone Switch (vPhone Switch)
- ShoreTel Virtual Trunk Switch (vTrunk Switch)
- ShoreTel Virtual Service Appliance (SA-vCollab)

These virtual devices get delivered as separate OVA files and are part of the system installation on the Headquarters Server and the DVS.

You deploy a virtual device by using a VMware vSphere client on a vSphere ESXi server.

Default Configurations

The installation process creates default configurations for Shortel virtual switches and service appliances.

- Memory: 2 GB
- CPU/Cores: 1 socket, 4 cores
- Hard disk: 100 GB, thin provisioned
- Video card: 1 display, 4 MB video memory, no 3D support
- SCSI controller: BusLogicParallel
- Network adapter: vmxnet3 (VM network)

Note

For recommended virtual service appliance capacities, see Chapter 6, Configuring the Service Appliance, in the *Conferencing and Instant Messaging Planning and Installation Guide*.

Virtual Phone Switch Capacity Requirements

The following table shows the virtual phone switch capacity requirements for the following three system sizes:

- Up to 250 phones
- Up to 500 phones
- Up to 1000 phones

Table 54: Virtual Phone Switch Capacity Requirements

	Up to 250 Phones	Up to 500 Phones	Up to 1,000 Phones
Memory	2 GB	2 GB	2 GB
CPU * cores	750 MHz * 1	1.5 GHz * 1	2.9 GHZ *1
Disk	20 GB	20 GB	20 GB
Hypervisor	VMware vSphere ESX/ESXi 5.0 or 5.1		

Virtual Phone Switch Feature Capacities

The following table provides the feature capacities for the following three virtual switch capacities:

- Up to 250 phone
- Up to 500 phones
- Up to 1000 phones

Table 55: Virtual Phone Switch Feature Capacities

	Up to 250 Phones	Up to 500 Phones	Up to 1000 Phones
Backup Auto-attendant Streams	10	25	50
Make-me Conferences	12	30	60
Extension monitor buttons	1,000	2,500	5,000
BHCC	5,000	12,500	25,000
Hunt Groups			
Total hunt groups	8	20	40
Total hunt-group users	32	80	160
Users per hunt group	32	8	16
Pick-up Groups			
Total pick-up groups	16	40	80
Total pick-up group users	80	200	400
Users per pick-up group	48	12	24

Table 55: Virtual Phone Switch Feature Capacities

	Up to 250 Phones	Up to 500 Phones	Up to 1000 Phones
Busy Call Appearances (BCA)			
Total BCA	24	60	120
BCA call stack	48	12	24
BCA extensions	64	16	32

Virtual Trunk Switch Capacity Requirements

Table 56 provides the virtual trunk switch capacity requirements.

Table 56: Virtual Trunk Switch Capacity Requirements

	Up to 100 Trunks	Up to 200 Trunks	Up to 500 Trunks
Memory	2 GB	2 GB	2 GB
CPU * Cores	2.9 GHz*4	2.9 GHz * 8	2.9 GHz *24
Disk	20 GB	20 GB	20 GB
Hypervisor	VMware vSphere ESX/ESXi 5.0 or 5.1		

Virtual Trunk Switch Feature Capacities

provides the virtual trunk switch feature capacities.

Table 57: Virtual Trunk Switch Feature Capacities

Feature	Available	Capacity
Phone	No	N/A
SIP trunks	Yes	500
BAA	Yes	500
Make-me conference	No	N/A
Hunt groups	No	N/A
Pick-up groups	No	N/A
BCA	No	N/A

Installing a Virtual Device

To install a virtual device, follow these steps:

1. Create a virtual machine (VM) for the switch and allocate the required resources, depending on the capacity of the virtual phone or virtual trunk switch you want to create:
   - 250, 500, or 1000 IP phones
   - 100, 250, or 500 SIP trunks

Note

The ShoreTel system analyzes the allocated resources and determines the capacity of the switch. To change the capacity of the switch, you must change the allocated VM resources.

2. Run vSphere Client and connect to an EXSi server, version 5.0 or higher.
3. Select **File > Deploy OVF/OVA**.
4. Enter the URL to the OVA file for the type of device you want to install.
   - To install a ShoreTel Virtual Phone and Virtual Trunk Switch, enter the following URL:

     `http:<HQ or DVS IP address>/ftproot/tsv/BareMetalInstall.ova`

   - To install a ShoreTel Virtual Service Appliance, enter the following URL:

     `http:<HQ or DVS IP address>/ftproot/tsu/VMWareShoreTelVSA.ova`

Note

You can also download the OVA file directly from ShoreTel Director. Click **Download switch image** from the **Edit ShoreGear vPhone Switch** or **Edit ShoreGear vTrunk Switch** page.

5. Click **Next**.
6. Enter a name for the virtual swtich and click **Next**.
7. On the Storage screen, highlight the datastore1 hard drive and click **Next**.
8. On the Disk Format screen, accept the default option, **Thick Provision Lazy Zeroed**, and click **Next**.
9. On the Ready to Complete screen, check the **Power On after deployment** checkbox.
10. Finish the installation by following the on-screen instructions.

    The installation process creates a virtual machine with the default hardware configuration. For more information about default virtual device configurations, see Default Configurations on page 258.

Note

You can only increase the disk size before you power on the virtual machine. If you need to have more disk space for conference recording, you must change it before you power on the virtual machine.

11. Power on the virtual machine.
12. Open the console on the virtual switch you want to configure and log in with the following credentials:
    - User ID: **root**
    - Password: **ShoreTel**
13. Enter the DHCP and server IP information that the server will use to download firmware updates.
14. Restart the virtual switch.

    The updated firmware begins downloading and installing automatically. After the firmware upgrade completes, the virtual machine reboots automatically.
15. When the virtual switch comes back online, open its console and log back in using root/ShoreTel.
16. To open the ShoreTel parameters screen, enter **stcli**.
17. On the ShoreTel parameters screen, note the values for IP address and MAC address. Save these values for configuring the virtual switches in Step 18.
18. Configure the virtual device.
    - To configure virtual switches, see Chapter 5, Configuring Voice Switches, in the *ShoreTel System Administration Guide*.
    - To configure virtual Service Appliances, see Chapter 6, Configuring the Service Appliance, in the *ShoreTel Conferencing and Instant Messaging Planning and Installation Guide*.

ShoreTel Director Switch Configuration

To complete the installation, configure the ShoreTel voice switches with ShoreTel Director. For more information, refer to Chapter 5, Configuring Voice Switches, in the *ShoreTel System Administration Guide*.

Reference

Environmental Requirements

The ShoreTel voice switches require that the environmental specifications provided in Table 58 be met.

Table 58: ShoreTel Voice Switch Environmental Specifications

Parameter	Specification
Operating temperature	0° C to 50° C
Operating humidity (non-condensing)	0% to 90%
Storage temperature	–30° C to 70° C
Storage humidity (non-condensing)	20% to 95%

Packaging Requirements

Table 59 lists the packaging requirements for the following ShoreTel voice switches:

- Full-width switches – (ST-120/24, ST-60/12, ST-40/8, ST-T1/E1)
- Half-width switches – (ST-90, ST-50, ST-220T1/E1/T1A)

Table 59: ShoreTel Voice Switch Packaging Specifications

Parameter	Specification
Vibration	
Power:	0.4 Grms, 1h per axis
Spectral Density:	5-500Hz @ 0.000323303 g2/Hz
Operation	
Power:	1.5G RMS
Spectral Density:	5-500Hz @ 0.00454645 g2/Hz
Packaged Transportation	
Material:	275 C Brown
Dimensions (full-width switches):	21+1/8 x 19 x 5+3/4
Dimensions (half-width switches):	19+1/8 x 12+1/2 x 6+1/2
Mechanical Shock:	80 Gs non-operating
Packaged Bounce:	8-corner standard drop test

Regulatory Compliance

Table 60: ST-E1 Voice Switch Physical Specifications

Parameter	ShoreTel-24
Safety	UL 60950, 3rd Edition, CAN/CSA 22.2 No. 60950, EN60950 (2000)
EMI	FCC Part 15, ICES-003, EN 55022, Class A/Class B
	Radio and Telecommunications Terminating Device Directive (R&TTE) 99/5/EC
	Low Voltage Directive 73 / 23 / EEC
	EMC Directive 89 / 336 / EEC With Amendment 93 / 68 / EEC
	GS Mark from TUV Rheinland (Notified Body)
	EN 55024: 1998 +A1:2001 +A2:2003

Table 61: ST 120/24, ST 90, ST 60/12, ST 50, ST 40/8, ST 30Voice Switch Physical Specifications

Parameter	Physical Specification
Safety	UL 60950, 3rd Edition, CAN/CSA 22.2 No. 60950, EN60950 (2000)
Telephony Registration	FCC Part 68, Canada CS-03
EMI	FCC Part 15, ICES-003, EN 55022, Class A
	Radio and Telecommunications Terminating Device Directive (R&TTE) 99/5/EC
	Low Voltage Directive 73 / 23 / EEC
	EMC Directive 89 / 336 / EEC With Amendment 93 / 68 / EEC
	GS Mark from TUV Rheinland (Notified Body)
	EN 55024: 1998 +A1:2001 +A2:2003

Physical Specifications

Table 62: ST T1, ST-220T1, ST 220T1A, ST T1k Voice Switch Physical Specifications

Parameter	Physical Specification
Safety	UL 60950, 3rd Edition, CAN/CSA 22.2 No. 60950, EN60950 (2000)
Telephony Registration	FCC Part 68, Canada CS-03
EMI	FCC Part 15, ICES-003, EN 55022, Class A
	Radio and Telecommunications Terminating Device Directive (R&TTE) 99/5/EC

Table 62: ST T1, ST-220T1, ST 220T1A, ST T1k Voice Switch Physical Specifications(Continued)

Parameter	Physical Specification
	Low Voltage Directive 73 / 23 / EEC
	EMC Directive 89 / 336 / EEC With Amendment 93 / 68 / EEC

General Specifications

Table 63: ST-120/24, ST-90, ST-60/12, ST-50, ST-40/8, ST-E1/T1, and ST-220T1/E1/T1A Voice Switch Specifications

Parameter	ShoreTel-24
Power Supply	100-240 VAC 50-60 Hz 2A max (full-width switches) 1A max (half-width switches)
Mounting Options	19 inch rack mount
Integrated OA&M	

CHAPTER

14

IP Phone Installation

This chapter describes the steps required to install IP phones. It contains the following information:

Overview 268
Preparing Your ShoreTel System for IP Phones 268
Configuring Voice Switches for IP Phone Support 268
Assigning the Configuration Switches 268
Setting IP Address Ranges 269
Implementing LLDP-MED 270
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DHCP Settings 272
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Manually Configuring ShoreTel IP Phones 273
Manual Configuration at Bootup 273
Manual Configuration from the Keypad 276
Displaying Settings for a ShoreTel IP Phone 277
Resetting a ShoreTel IP Phone 278
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Overview

ShoreTel's IP phones are pre-configured to work with a ShoreTel system and the network's Dynamic Host Configuration Protocol (DHCP) server. After you configure the servers and voice switches and plug the phones into the network, the ShoreTel system automatically adds the phones to the network.

This chapter describes prerequisites, network considerations, and procedures for installing IP phones in your system.

Preparing Your ShoreTel System for IP Phones

Preparing your system for IP phones involves the following steps:

- Configure voice switches to support IP phones.
- Assign configuration switches to phones.
- Set IP address ranges for each site if your system includes more than one site.

Configuring Voice Switches for IP Phone Support

To provide PSTN local dialing for IP phone users, every site where IP phones are in use must have a ShoreTel voice switch configured to support the number of IP phones at the site, plus local analog or T1 trunks.

Configuring IP phone support on a ShoreTel voice switch involves reserving ports for IP phones. You do this through the Voice Switches edit page in ShoreTel Director. For additional information, see the chapter on configuring switches in the *ShoreTel System Administration Guide*.

ShoreTel voice switches send a heartbeat to the IP phones every 60 seconds. If the heartbeat is not acknowledged within approximately 4 seconds, the switch considers the IP phone to be offline or unavailable. The voice switches continue to broadcast the heartbeat every 60 seconds. If an IP phone that was previously offline recovers and returns an acknowledgement, it is then considered online and available.

Assigning the Configuration Switches

You need to designate a voice switch to handle configuration, including initial service requests, for IP phones installed on your ShoreTel system. Every IP phone installation must have at least one configuration switch. In addition, to provide a backup in case of network problems, you have the option of assigning two switches for the IP phone configuration function. If you do not assign a switch for configuration, the ShoreTel system automatically assigns the first two ShoreTel voice switches added to the system that are managed by the Headquarters server.

To be added to the system, IP phones must be able to contact at least one voice switch, as follows:

- ShoreTel 400-Series IP phones must be able to contact any voice switch at the site to which their IP address is mapped or at Headquarters.

- ShoreTel 100-, 200-, 500-, and 600-Series IP phones must be able to contact at least one of the assigned configuration switches when first connected to the network.

1. Launch ShoreTel Director.
2. Click **Administration > IP Phones > Options**.

   The IP Phone Options page is displayed.
3. In the **IP Phone Configuration Switch 1** drop-down list, select a switch to serve as the first configuration switch.
4. In the **IP Phone Configuration Switch 2** drop-down list, select a switch to serve as the second configuration switch.
5. Click **Save**.

Setting IP Address Ranges

If your ShoreTel system consists of more than one site, you must define an IP address range for IP phones at each site. Setting IP address ranges for each site ensures that new phones added to the system are associated with the correct voice switch at the designated site.

If a phone with an IP address that is not within a specified range for any site is added or there are no IP address ranges defined for any site, the phone is automatically assigned to the Headquarters site. As a result:

- Any seven-digit numbers dialed from the IP phone are dialed as numbers within the area code of the Headquarters site.
- All calls to users who are not at the Headquarters site use the configured intersite voice encoding for that system.

To set the IP address range for phones at each site:

1. Launch ShoreTel Director.
2. Click **Administration > IP Phones > IP Phone Address Map**.

   The page lists sites and their associated IP address ranges.
3. Click the **New** button.

   The Site IP Address Range edit page opens.
4. In the **Site** field, select a site to configure its IP address range.
5. In the **Low IP** Address field, enter the lowest IP address to use for the site. The IP address must be valid for the network in which the site is located.
6. In the **High IP Address** field, enter the highest IP address to use for the site. The IP address must be valid for the network in which the site is located.

7. In the **Caller's Emergency Service Identification (CESID)** field, type the caller ID number that the system passes to emergency responders when an emergency call originates on an IP phone at the site. For information about configuring a system for emergency calls, see the *ShoreTel System Administration Guide*.
8. If teleworkers might use the site, select the **Teleworkers** check box.
9. Click **Save**.

   The information you configured for the site is listed on the IP Phone Address page.
10. Repeat steps 3-9 to set IP address ranges for other sites in the system.

Implementing LLDP-MED

Link Layer Discovery Protocol-Media Endpoint Discovery (LLDP-MED) is an enhancement to the Link Layer Discovery Protocol (LLDP) that addresses the following aspects:

- Device location discovery to support location databases and VoIP E911 services
- Auto-discovery of LAN policies to support "plug and play" networking
- Extended and automated power management of PoE endpoints
- Inventory management

Implementing LLDP-MED requires network switches that support the protocol.

ShoreTel implements LLDP-MED through the following methods:

- By setting a parameter on ShoreTel IP phones:
  - On ShoreTel 100-, 200-, 500-, and 600-Series IP phones, you can enable or disable LLDP-MED through the LLDP Enable option, which you can access through MUTE **73887#** (SETUP#). The default is "On" (enabled).
  - On ShoreTel 400-Series IP phones, you can enable or disable LLDP-MED through the **Use LLDP-MED** option available in the **Admin options > Network policy** menu, which you can access through MUTE **73887#** (SETUP#). The default is "On" (enabled).
- By modifying configuration settings. When setting up ShoreTel IP phones, parameter settings are obtained from the following sources, listed in order of highest to lowest precedence:
  - Configuration files
  - DHCP (if active)
  - LLDP (if active)
  - Setup command
  - Default values

The ShoreTel IP Phone models IP110 and IP115 do not support LLDP-MED.

Implementing IEEE 802.1x

Most ShoreTel IP phones support 802.1x network authentication. ShoreTel IP phones support the following aspects of 802.1x authentication:

- MD-5 challenge method only
- Multicast and unicast frames
- Devices attached to the second Ethernet port (PC port) using 802.1x PAE multicast frames
- EAPOL frames can be prioritized. EAPOL VLAN tags are not supported.
- Mandatory TIA-1057 LLDP-Med functionality for Class III communication device endpoints

ShoreTel IP phones that support 802.1x authentication are shipped with the feature enabled by default. The first time the phone connects to a network that has 802.1x enabled, the phone must present an ID and password for the user. The default secure user ID is the last six characters of the phone's MAC address; the password must be manually entered when the phone boots for the first time. The password is cached if authentication succeeds. If the authentication fails, the phone does not boot.

On networks where 802.1x authentication is not enabled, ShoreTel IP phones boot normally when they connect to the Ethernet switch.

If upgrading from a firmware version that supports 802.1x (3.3.x or 3.4.x), the previous settings (802.1x on/off, SID, password) are preserved. If upgrading from a firmware version that does not support 802.1x (2.2, 2.3, 3.1, 3.2), Logical Link Discovery Protocol (LLDP) is turned on by default, and a default SID of the last six characters of the MAC address is applied.

While 802.1x is enabled by default in ShoreTel 11 and higher, 802.1x might have been explicitly enabled in earlier releases through the ShoreTel IP phone parameter 802.1xEnable (a 1-character ASCII parameter). If 802.1x is enabled on the ShoreTel IP phone and disabled on the network switch, the ShoreTel IP phone never comes up.

You can modify the 802.1x setting through a parameter on ShoreTel IP phones:

- On ShoreTel 100-, 200-, 500-, and 600-Series IP phones, you can enable or disable 802.1x through the 802.1xEnable option, which you can access through MUTE **73887#** (SETUP#). Valid settings are as follows:
  - 802.1xEnable – 1 (802.1 authentication is enabled.)
  - 802.1xEnable – 0 (802.1 authentication is disabled. This is the default.)
- On ShoreTel 400-Series IP phones, you can enable or disable 802.1x through the **Use 802.1x** option available in the **Admin options > Ethernet** menu, which you can access through MUTE **73887#** (SETUP#). The default is "On" (enabled).

The ShoreTel IP Phone models IP110 and IP115 do not support 802.1x.

DHCP Settings

ShoreTel IP phones are pre-configured to use the network's DHCP server for addressing. In addition to its address and standard network addresses, the DHCP server's response also provides the following addresses for phone configuration:

- ShoreTel server address

  The ShoreTel server provides the IP phones with the latest application software and the configuration information that enables IP phones to be automatically added to the ShoreTel system. The ShoreTel server's address must be provided to the phone as a vendor-specific option. ShoreTel IP phones are pre-configured to look for the ShoreTel server's address to be specified as Vendor Specific DHCP Option 156. If this option is not available, the ShoreTel IP phones use Option 66. For information about configuring these DHCP options, see Configuring DHCP for ShoreTel IP Phones on page 55.

- SNTP server address

  The DHCP server should be configured to provide the address of your network's SNTP server to provide date and time information to the IP phones.

Note

If you previously used phones in an environment where automatic provisioning through DHCP was not used or the phones are from a vendor other than ShoreTel, the phones might not boot properly because incorrect configuration information is present in the phone. For information about clearing a phone's configuration, see Clearing a Phone's Configuration Settings on page 279.

Installing ShoreTel IP Phones

Installing ShoreTel IP phones involves plugging the phones into the network. The ShoreTel system automatically adds the phones to the network. For instructions on manually configuring phones, see Manually Configuring ShoreTel IP Phones on page 273.

Updating Firmware for IP Phones

After you install new IP phones, you should update the phone firmware.

ShoreTel 400-Series IP Phones

After ShoreTel 400-Series IP phones are added to the ShoreTel system, rebooting the phones updates configuration information but does not update the phone's firmware. To update phone firmware, use the Diagnostics & Monitoring system available through ShoreTel Director. For details on upgrading phone firmware, see the *ShoreTel Maintenance Guide*.

ShoreTel 100-, 200-, 500-, 600-, and 900-Series IP Phones

When these phones are initially connected to the network, they reboot and their firmware is updated automatically. You can initiate subsequent firmware updates by triggering a reboot through either the Diagnostics & Monitoring system or Quick Look, which are both available through ShoreTel Director. For details on upgrading phone firmware, see the *ShoreTel Maintenance Guide*.

The boot sequence for these phones is as follows:

1. DHCP on default VLAN. Reboot.
2. DHCP on voice VLAN. Reboot.
3. Connect to the Headquarters server for firmware code. Reboot.

Note

The Headquarters server uploads the latest phone firmware code to the phone. When the firmware code on the phone is an old version, the server uploads each successive firmware update until the firmware code on the phone is the current version. The phone reboots after each update. The update can take several minutes if the system makes many updates.

4. Connect to Media Gateway Control Protocol (MGCP).

Manually Configuring ShoreTel IP Phones

If you are not using a DHCP server to provide the IP address and configuration parameters to the phone, you need to manually set configuration parameters on the phone. You can enter the phone configuration menu at bootup or by entering a key sequence from the phone's keypad.

Manual Configuration at Bootup

Use the following procedures to enter the configuration menu while the phone is booting up.

On ShoreTel 100-, 200-, 500-, and 600-Series IP Phones

1. Connect the Ethernet cable to the data jack on the back of the IP phone or BB24.

Note

To access the BB24 setup screen, press the upper left and lower right buttons.

2. At the **Password=?** prompt, enter the default password **1234,** or the password provided by your system administrator, followed by #.

   You have four seconds to enter the password, after which the phone enters normal operation with its current settings.

Note

The default password is set in ShoreTel Director. For more information, see the *ShoreTel System Administration Guide*.

3. At the **Clear All Values** prompt, press # (No).
4. At each prompt, enter the appropriate value listed in Table 64 on page 274.
5. Press # to advance to the next setting or ***** to exit.
6. To accept changes, press **#**.

   The boot process begins after you finish entering new values or accepting existing values. The phone downloads the latest firmware from the ShoreTel server and in the process, reboots several times. When the phone displays the date and time, the boot and upgrade process is complete. See the *Maintenance Guide* for details about upgrading the phone's firmware.

Table 64: Configuration Values for ShoreTel 100-, 200-, 500-, and 600-Series IP Phones

Prompt	Value
DHCP –	Press * to toggle to the "Off" position, and then press #.
FTP –	Enter the IP address of your ShoreTel server, and then press #.
MGC –	Press #. (The phone obtains the address from configuration files on the ShoreTel server.)
SNTP –	Enter the IP address of your time server, and then press #.
802.1Q Tagging – Off	Press #. (Consult your network administrator before changing this value.)
VLAN ID –	Press #.
Country –	Enter the country code (see Table 15 on page 56).
Language –	Enter the language code (see Table 16 on page 57).
Save all Changes	Press #. (Yes)

On ShoreTel 400-Series IP Phones

1. Connect the Ethernet cable to the data jack on the back of the IP phone.
2. As the phone is booting, when prompted press any key to enter setup.
3. At the **Admin Password** prompt, enter the default password **1234** or the password provided by your system administrator.

Note

This password is configured through ShoreTel Director in the Administration > IP Phones > Options page. The parameter name is IP Phone Password. If the phone uses factory defaults, the phone has never been connected to a server, and you have not modified the IP Phone Password, use the default password, **1234**.

4. Do one of the following:

   - On the IP420, press #.
   - On the IP480, IP480g, and IP485g, press the **OK** soft key.

   The **Admin Options** menu opens.

5. Use the navigation key pad and the selector button to open the submenus necessary to configure parameters as follows:

   - If you are not using a DHCP server to provide an IP address, enter the following information:
     - Internet protocol > Use DHCP (Toggle to Off.)
     - Internet protocol > IPv4 address (Enter the static IP address of the phone.)
     - Internet protocol > Subnet mask (Enter the static IP subnet mask of the phone.)
     - Internet protocol > Gateway (Enter the static IP gateway.)
     - Internet protocol > SNTP server (Enter the IP address of the time server.)
   - If you are not using DHCP to provide configuration parameters, enter the following information:
     - Services> Config server (Enter the IP address of the ShoreTel configuration server.)

   For descriptions of these parameters, see Table 65 on page 276.

6. With the appropriate submenu highlighted, do one of the following:

   - On the IP420, press the selector button on the navigation key pad.
   - On the IP480, IP480g, and IP485g, press the **Edit** soft key.

7. To return to the previous menu, do one of the following:

   - On the IP420, scroll down to the **Back** option and press the selector button on the navigation key pad until you return to the top-level menu.
   - On the IP480, IP480g, and IP485g, press the **Back** soft key until you return to the top-level menu.

8. To apply the changes, do one of the following:

   - On the IP420, with **Exit** highlighted press the selector button on the navigation key pad.
   - On the IP480, IP480g, and IP485g, press the **Apply** soft key.

Tip

On IP480, IP480g, and IP485g phones, to exit the menu and apply changes, press and hold the Back soft key for 2 seconds.

The phone reboots and applies settings.

Table 65: Configuration Values for ShoreTel 400-Series IP Phones

Admin Options Menu Submenu	Option Name	Value to Enter
Internet Protocol	Use DHCP	Toggle to Off.
	IPv4 address	Enter the static IP address of the phone.
	Subnet mask	Enter the static IP subnet mask of the phone.
	Gateway	Enter the static IP gateway.
	SNTP server	Enter the IP address of the time server.
Services	Config server	Enter the IP address of the ShoreTel configuration server.

Manual Configuration from the Keypad

Use the following procedures to enter the configuration menu after the phone has booted.

On ShoreTel 100-, 200-, 500-, and 600-Series IP Phones

1. With the phone on hook, press the MUTE key followed by **73887# (SETUP#)**.
2. At the Password prompt, enter **1234,** or the password provided by your system administrator, followed by the # key.
3. Enter the values listed in Table 64 on page 274 when prompted. Press # to advance to the next settings or * to exit.

   The phone downloads the latest firmware from the ShoreTel server and, in the process, it reboots several times. When the phone displays the date and time, the boot and upgrade process is complete. See the *ShoreTel Maintenance Guide* for details about upgrading the phone's firmware.

On ShoreTel 400-Series IP Phones

1. With the phone on hook, press the MUTE key followed by **73887# (SETUP#)**.
2. At the **Admin Password** prompt, enter the default password **1234** or the password provided by your system administrator.

Note

This password is configured through ShoreTel Director in the Administration > IP Phones > Options page. The parameter name is IP Phone Password. If the phone uses factory defaults, the phone has never been connected to a server, and you have not modified the IP Phone Password, use the default password, **1234**.

3. Do one of the following:
   - On the IP420, press #.
   - On the IP480, IP480g, and IP485g, press the **OK** soft key.

The **Admin Options** menu opens.

4. Use the navigation key pad and the selector button to open the submenus necessary to configure parameters as follows:

   - If you are not using a DHCP server to provide an IP address, enter the following information:
     - Internet protocol > Use DHCP (Toggle to Off.)
     - Internet protocol > IPv4 address (Enter the static IP address of the phone.)
     - Internet protocol > Subnet mask (Enter the static IP subnet mask of the phone.)
     - Internet protocol > Gateway (Enter the static IP gateway.)
     - Internet protocol > SNTP server (Enter the IP address of the time server.)
   - If you are not using DHCP to provide configuration parameters, enter the following information:
     - Services> Config server (Enter the IP address of the ShoreTel configuration server.)

   For descriptions of these parameters, see Table 65 on page 276.

5. With the appropriate submenu highlighted, do one of the following:

   - On the IP420, press the selector button on the navigation key pad.
   - On the IP480, IP480g, and IP485g, press the **Edit** soft key.

6. To return to the previous menu, do one of the following:

   - On the IP420, scroll down to the **Back** option and press the selector button on the navigation key pad until you return to the top-level menu.
   - On the IP480, IP480g, and IP485g, press the **Back** soft key until you return to the top-level menu.

7. To apply the changes, do one of the following:

   - On the IP420, with **Exit** highlighted press the selector button on the navigation key pad.
   - On the IP480, IP480g, and IP485g, press the **Apply** soft key.

Tip

On IP480, IP480g, and IP485g phones, to exit the menu and apply changes, press and hold the Back soft key for 2 seconds.

The phone reboots and applies settings.

Displaying Settings for a ShoreTel IP Phone

You can display information about a ShoreTel IP phone by entering a key sequence on the phone's key pad.

On ShoreTel 100-, 200-, 500-, and 600-Series IP Phones

1. With the phone on hook, press the **MUTE** key followed by **4636# (INFO#)**.

   The phone displays the first one or two parameters, depending on the phone model.

2. Press # to advance the display or ***** to exit.

   The phone resumes normal operation after the last parameter has been displayed.

On ShoreTel 400-Series IP Phones

1. With the phone on hook, press the MUTE key followed by **4636#** (INFO#).

   The **Admin Options** menu opens.

2. Use the navigation key pad and the selector button to scroll through and open the submenus as necessary to see the phone's settings.

   For descriptions of the parameters, see the *ShoreTel Maintenance Guide*.

3. To close the Admin options menu, do one of the following:

   - On the IP420, with **Exit** highlighted press the selector button on the navigation key pad.
   - On the IP480, IP480g, and IP485g, press the **Exit** soft key.

Resetting a ShoreTel IP Phone

You can reset a phone by entering a key sequence on the phone's key pad.

On ShoreTel 100-, 200-, 500-, and 600-Series IP Phones

1. With the phone on hook, press the **MUTE** key followed by **73738# (RESET#)**.

   The phone reboots.

2. At the **Reset Phone?** prompt, press #.

   The phone reboots. The reboot process is complete when the phone displays the date and time.

On ShoreTel 400-Series IP Phones

1. With the phone on hook, press the MUTE key followed by **73738#** (**RESET#**).

   The phone displays the Reset phone screen.

2. Do one of the following:
   - On the IP420, with **Reset** highlighted, press the selector button on the navigation key pad.
   - On the IP 480, IP480g, and IP485g, press the **Reset** soft key.

The phone reboots and applies settings.

Clearing a Phone's Configuration Settings

You can clear a phone's configuration settings and return it to factory settings by entering a key sequence on the phone's key pad.

If a phone displays "No Service" after it boots, you can use this procedure to clear the settings.

Note

If you move ShoreTel 400-Series IP phones from one ShoreTel system to another, you need to clear each phone's configuration.

On ShoreTel 100-, 200-, 500-, and 600-Series IP Phones

1. With the phone on hook, press the **MUTE** key followed by **25327# (CLEAR#)**.
2. Press ***** to clear all values.

   The phone reboots. The reboot process is complete when the phone displays the date and time.

On ShoreTel 400-Series IP Phones

1. With the phone on hook, press the MUTE key followed by **25327#** (**CLEAR#**).

   The phone displays the Clear Configuration screen.
2. Do one of the following:
   - On the IP420, with **Clear & reboot** highlighted, press the selector button on the navigation key pad.
   - On the IP480, IP480g, and IP485g, press the **Clear** soft key.

   The phone reboots and applies settings.

CHAPTER

15

Desktop Requirements

This chapter describes the hardware and software requirements for installing ShoreTel client software, ShoreTel Communicator for Windows, on desktop and laptop computers. It contains the following information:

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- Recommendations 282
- Hardware Requirements 282
- Software Requirements 285
  - Operating Systems 285
  - .NET Framework 286
  - ShoreTel Communicator for Web Browser Requirements 286
  - Microsoft Outlook Integration 286

Overview

This chapter describes the hardware and software requirements for installing ShoreTel client software, ShoreTel Communicator for Windows, on desktop and laptop computers. The installation procedures are covered in Chapter 10, Server Requirements on page 173.

Recommendations

The following recommendations will assist you in planning and installing your desktop computers for the ShoreTel Communicator applications.

- Verify that each computer meets the minimum hardware and software requirements.
- Install the Client for the Microsoft Networking component.
- Close all applications before installing software.
- Users must have local administrative privileges to install the ShoreTel software.
- Microsoft Outlook must be configured in Corporate or Workgroup mode for Microsoft Outlook Integration to function properly. Internet Only mode is not supported.
- Users should be informed of which ShoreTel Communicator application they will be using.
- During a fresh install or upgrade to the ShoreTel client, Visual Studio Tools for Office (VSTO) pre-requisites need to be installed first. The VSTO pre-requisites will be installed automatically during the ShoreTel client installation.

Hardware Requirements

The requirements for running ShoreTel Communicator on the computers of end-users depend on the version of ShoreTel Communicator Client you want to install and the video call resolution. Table 66 provides information about the processor requirements for different configurations of ShoreTel Communicator. Table 67 provides information about the minimum memory requirements for different configurations of ShoreTel Communicator. Table 68 provides information about the requirements for installing different configurations of ShoreTel Communicator for end-users in a Microsoft Windows terminal server (WTS) environment.

Table 66: Client Hardware Requirement

ShoreTel Communicator Version	Windows Vista	Windows 7, Windows 8, Windows 8.1	Max Presence Load
Communicator with Personal Access with Presence Off	Pentium 3, 800 MHz	Pentium 4 - 1.6 GHz	No Presence supported
Communicator with Personal Access with Presence On	Pentium 4, 3.0 GHz with HT or Dual Core 1.6 GHz	Pentium 4, 3.0 GHz with HT or Dual Core 1.6 GHz	1 Event/Second
Communicator with Professional Access	Pentium 4, 3.0 GHz with HT or Dual Core 1.6 GHz	Pentium 4, 3.0 GHz with HT or Dual Core 1.6 GHz	1 Event/Second
Communicator with Agent, Supervisor, Operator Access (<40 extension presences)	Pentium 4, 3.0 GHz with HT or Dual Core 1.6GHz	Pentium 4 - 3.0 GHz with HT or Dual Core 1.6 GHz	1 Event/Second
Communicator with Agent, Supervisor, Operator Access (<500 extension presences)	Dual-Core 1.6 GHz	Dual Core 1.6 GHz	1 Event/Second
All Versions, VGA Video	Dual-Core 1.6 GHz	Dual-Core 1.6 GHz	1 Event/Second
All Versions, XGA Video	Core 2 Quad, 2.4 GHz	Core 2 Quad 2.4 GHz	1 Event/Second

Table 67: Hard Disk and Memory Requirements

ShoreTel Communicator Version	Hard Disk Space[1]		RAM[2]		Available RAM[2]	
	Vista	Win 7, Win 8, Win 8.1	Vista	Win 7, Win 8, Win 8.1	Vista	Win 7, Win 8, Win 8.1
Communicator with Personal Access (Presence On)	2 GB	2 GB	2 GB	2GB	150 MB	250 MB
Communicator with Personal Access (Presence Off)	2 GB	2 GB	2 GB	2 GB	100 MB	150 MB
Communicator with Professional Access	2 GB	2 GB	2 GB	2 GB	150 MB	250 MB
Communicator with Agent, Supervisor, Operator Access (<40 extension presences)	2 GB	2 GB	2 GB	2 GB	150 MB	250 MB

Table 67: Hard Disk and Memory Requirements(Continued)

ShoreTel Communicator Version	Hard Disk Space[1]		RAM[2]		Available RAM[2]	
	Vista	Win 7, Win 8, Win 8.1	Vista	Win 7, Win 8, Win 8.1	Vista	Win 7, Win 8, Win 8.1
Communicator with Agent, Supervisor, Operator Access (<500 extension presences)	2 GB	2 GB	2 GB	2 GB	150MB	250MB
All Versions, VGA Video	1 GB	2 GB	2 GB	2 GB	150MB	250MB
All Versions, XGA Video	3 GB	3 GB	2 GB	2 GB	150MB	250MB

Note

[1]Disk space requirement is for installation on a system without .NET Framework previously installed. Otherwise, Communicator requires less than 100 MB hard disk space.

[2]ShoreTel Communicator memory requirements are during normal operation. When running other applications on the PC in addition to Communicator, more memory might be required to maintain adequate performance.

Table 68: WTS Server Hardware

WTS Version	Max Number of Users per WTS	Max Presence/ Call Load [1]	RAM Memory required per client within the WTS	Minimum Processor [2]
W2008, 32-bit, SP2, Enterprise	50	2400	100 MB	Single DualCore E5410 @ 2.33 GHZ / 16GB RAM
W2008, 64-bit SP2 (non R2) (Standard and Enterprise)	100	5000 BHCC	200 MB	Single QuadCore E5410 @ 2.33 GHZ / 32 GB RAM
W2008, R2	100	5000 BHCC	150 MB	Dual QuadCore E5520 @ 2.26 GHZ / 32 GB RAM
W2008 R2 with XenApp-6 Platinum	100	5000 BHCC	175	Dual QuadCore E5520 @ 2.26 GHZ / 32 GB RAM

Note

- Presence events refers to the Presence status displayed in the Contacts viewer of ShoreTel Communicator.
- Please consider that other applications and environments, such as Microsoft Office, could also run within the same server. The CPU/RAM used must be dimensioned according to ALL applications running and not only ShoreTel. The above specifications were validated only for the ShoreTel user count and call load depicted in the table

Software Requirements

This section discusses the software requirements for installing the ShoreTel Communicator client software on computers end-users use.

Operating Systems

The following operating systems support ShoreTel Communicator client software:

- Windows Operating Systems
  - Windows Vista Business, 32-bit, SP2
  - Windows Vista Enterprise, 32-bit, SP2
  - Windows Vista Enterprise, 64-bit, SP2
  - Windows 7 Professional, 32-bit, SP1
  - Windows 7 Enterprise, 32-bit, SP1
  - Windows 7 Professional, 64-bit, SP1
  - Windows 7 Enterprise, 64-bit, SP1
  - Windows 8 (all versions, including 32 and 64-bit)
  - Windows 8.1 (all versions, including 32 and 64-bit)
  - Unicode support (Double Byte Character)
- Apple OS X 10.7.x, 10.8.x
- Windows Server (terminal license server)
  - Windows 2008 Server, 32-bit, SP2 (Enterprise)
  - Windows 2008 Server, 64-bit, SP2 (non R2)Standard and Enterprise
  - Windows 2008 Server, 64-bit, R2

  - Windows 2012 Server, Standard and DataCenter

- Citrix XenApp: For platform details on Windows Terminal Server and Citrix XenApp, see Appendix C, Installing Communicator on Citrix and Windows Servers.

.NET Framework

On Windows-based computers, ShoreTel Communicator requires the installation of .NET Framework version 4 or higher. When .Net Framework is not already installed on the target computer, the Communicator installer will automatically install or update the software if a copy is available in the Communicator installation files on the server or trigger a download from Microsoft before installing Communicator. The .Net Framework is not shipped with the product. The person doing the installation will be prompted to accept the end user license agreement from Microsoft to proceed with the .NET installation.

ShoreTel Communicator for Web Browser Requirements

ShoreTel Communicator for Web can be accessed and controlled via web browser. The following browser versions are supported:

- Safari 5.0 on Macintosh
- Microsoft Internet Explorer 9.0
- Firefox 5.0 on Windows and Mac OS
- Adobe Flash 9 or higher should also be installed

Microsoft Outlook Integration

This section discusses different ways ShoreTel Communicator integrates with Microsoft Outlook.

Integrating with E-mail

ShoreTel Communicator supports e-mail integration with the following products:

- Microsoft Outlook 2007, SP2
- Microsoft Outlook 2010 (32-bit and 64-bit)
- Microsoft Outlook 2013 (32-bit and 64-bit)

Additional Requirements for Microsoft Outlook Integration include:

- Microsoft Outlook must already be installed as the user's e-mail before installing Outlook integration features.
- Microsoft Outlook must be configured for workgroup mode rather than Internet-only mode before installing Microsoft Outlook integration features. This ensures it supports multiple mail service providers.

- Automatic Call Handling with the Microsoft Outlook Calendar requires an optional component of Microsoft Office called Collaborative Data Objects.
- The Collaboration Data Object must be installed in order for Microsoft Outlook calendar integration to work.

Integrating with Call Handling

ShoreTel can integrate with Microsoft Outlook 2007, 2010, and 2013 to allow Offline Call Handling Modes (CHM). Once configured, a user's CHM will automatically change, based on the user's Microsoft Outlook calendar even when Microsoft Outlook is not currently opened.

Microsoft Outlook 2007 Plug-in with Offline Call Handling Modes requires the installation of the following components on the client system:

- NET Framework 3.5
- Microsoft Outlook 2007 Primary Interop Assemblies
- Visual Studio Tools for Office Runtime 3

Microsoft Outlook 2010 Plug-in with Offline Call Handling Modes requires the installation of the following components on the client system:

- NET Framework 3.5
- Microsoft Outlook 2010 Primary Interop Assemblies
- Visual Studio Tools for Office Runtime 3

Microsoft Outlook 2013 Plug-in with Offline Call Handling Modes requires the installation of the following components on the client system:

- NET Framework 3.5
- Microsoft Outlook 2013 Primary Interop Assemblies
- Visual Studio Tools for Office Runtime 3

CHAPTER

16

Desktop Installation

This chapter describes the procedure for installing ShoreTel Communicator on PC and Mac computers. It contains the following information:

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- Recommendations 290
- Notifying Users via Email 290
- Installation Procedure 291
  - Silent Client Upgrade 291
  - Installation Requirements 291
  - Installation in a Large Deployment that Uses Active Directory 292
- Standard Integrated Software Distribution 294
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  - User Licensing 304

Overview

You can install ShoreTel Communicator or have users install ShoreTel Communicator, in which case the server can notify them with information on their extensions and how to install the ShoreTel Communicator.

Recommendations

The following information can help with the installation of the ShoreTel Communicator application on a desktop computer.

- Have the following information: the server name, user name, password, and extension number. This information must be available before the first-time use of the ShoreTel Communicator application.
- Close all applications before starting the ShoreTel software installation.
- With the Silent Client Install feature, the client software upgrade process on remote machines do not require administrative rights by the person installing or upgrading software on client machines. Administrators can upgrade the software on all client machines using Active Directory Group Policies regardless of the permissions associated with those machines or the users who log into those machines.
- Many of the changes are reliant on Microsoft Active Directory. Microsoft Outlook must be configured in “Corporate or Workgroup” mode for Outlook integration to function properly. “Internet Only” mode is not supported.

Notifying Users via Email

To simplify installation, the ShoreTel system provides an integrated software distribution feature. Using ShoreTel Director, the system administrator can send an e-mail message to each user configured with an e-mail address.

You can send all users, some users, or just one user an e-mail message using the Notify Users page (Figure 45).

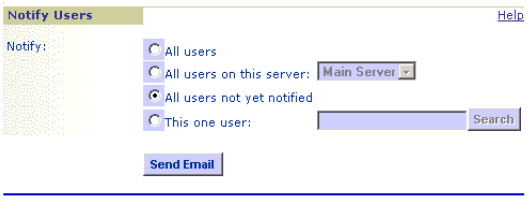

Figure 45: Notify Users page

Installation Procedure

This section provides the most typical steps associated with installing the ShoreTel Communicator application. There are two methods of installing ShoreTel Communicator software:

- Silent Client Upgrade
- Standard Integrated Software Distribution

Silent Client Upgrade

The Silent Client Upgrade allows the ShoreTel client software to be installed or upgraded on a client machine from a remote machines without the need for administrative rights. An administrator can easily upgrade the software on all client machines regardless of the permissions associated with those machines or the users who log into those machines.

Many of the changes are reliant on Microsoft Active Directory. The Microsoft Active Directory software handles the following tasks:

- Create a Group Policy Object to use to distribute the software package.
- Assign a package to a group of computers running Windows Vista, Windows 7, Windows 8, or Windows 8.1.
- Publish a package.
- Remove a package.

You will need to have the following files from the Client USB flash drive accessible with file permissions set to Share and File level Access by group <everyone>:

- Data1.cab
- Setup.exe
- ShoreTel Call Manger.msi

Enabling the new Remote Client Upgrade functionality requires performing a number of tasks using Microsoft Active Directory. For information on performing those tasks, refer to the following Microsoft Reference article:

- How To Use Group Policy to Remotely Install Software in Windows Server 2008 and Windows Server 2003, Microsoft Article ID 816102

ShoreTel recommends selecting the Prevent Users from Initiating Client Upgrades check box in the Edit System Parameters window. For details about other parameters, refer to the *ShoreTel System Administration Guide*.

Installation Requirements

This section provides information about the operating system and hardware requirements for installing ShoreTel Communicator for Windows on and client computers.

.NET Installation

Communicator requires the installation of version 4.0 (or higher) of .NET Framework. The Communicator installer automatically downloads the correct .NET Framework version if it is not present during the upgrade or install. Users are then prompted to accept the End User License Agreement from Microsoft to proceed with the .NET installation. Internet connectivity is required during the installation process.

64-bit Platform Support

ShoreTel Communicator for Windows supports Windows 2008 R2 running Windows Terminal Server, 64-bit. To install ShoreTel Communicator for Windows on 64-bit Windows 2008 Terminal Server:

1. Install .Net Framework for 64-bit Windows machines – Version 4.0 or higher.

Note

.Net Framework is not supplied with the ShoreTel installation software. This software is available from Internet sources or from your software vendor.

2. Install ShoreTel Communicator for Windows by using the installation wizard.

Installing ShoreTel Communicator for Windows on a 64-bit platform places files in the following folders:

- The default location is `C:\Program Files (x86)`
- The location of 32-bit client dll files is `C:\Windows\SysWow64`

Installation in a Large Deployment that Uses Active Directory

Some unique requirements exist for the installation of ShoreTel Communicator in a large deployment that uses Active Directory. This section outlines both the manual and the automated installation of ShoreTel Communicator in a large site with Active Directory. The decision for how to proceed depends on the following key factors:

- Whether manual (local) or remote installation is used.
- Presence on the server of .NET Framework version 4.0 or higher.
- Access to the World Wide Web (if .NET Framework 4.0 is not on the server).

The version of .NET Framework that is used should be the 32-bit version for a 32-bit server or the 64-bit version for a 64-bit server.

Manual Installation

Manual installation of .NET Framework can be in one of two scenarios. In one scenario, the Prerequisites folder contains .NET Framework 4.0 (or higher). In the other scenario, .NET Framework 4.0 does not exist at all on the ShoreTel server. If the required version of .NET Framework does not exist on the system, Web connectivity is required during installation.

Automated Setup

If the system administrator is using automated (remote) installation to set up ShoreTel Communicator in a large network that uses Active Directory, the administrator must push the following packages in the order listed below by using Microsoft Corporation's Group Policy Object (GPO) or another deployment tool:

1. Microsoft .NET Framework 4.0 (not located in the Prerequisites folder). Either .NET Framework exists on the system or the system must be connected to the Web (so that initiation of setup.exe causes a download of .NET Framework.)

2. Interop Assemblies (located in the Prerequisites folder) should contain Primary Interop Assemblies for 2007 and VSTO (Visual Studio Tools for Office). This resides in the Prerequisites folder.

   Communicator (CMWin), located in the Setup folder.

Pre-requisites for ShoreTel Communicator Installation in a Large Deployment

This section discusses large-scale ShoreTel Communicator deployments that use Active Directory. This section provides procedures manual and automated installations.

Manual Installation

This section contains instructions for manual installation in two scenarios. In one scenario, the Prerequisites folder contains .Net Framework 4.0. In the other scenario, .Net Framework 4.0 does not exist at all on the ShoreTel server.

Manual Setup with .Net Framework in Prerequisites

The ability to install ShoreTel software manually depends on the availability of .Net Framework 4.0. If the Prerequisites folder contains .Net Framework 4.0 and other, correct files, the system administrator can run *setup.exe* while the system is disconnected from the Internet. If the system does not already have .Net Framework, the system must have an operational connection to the Internet.

Manual Setup with .Net Framework Absent

If the Prerequisites folder does not contain .Net Framework 4.0, the system must have Internet connectivity because, when the system administrator runs setup.exe, the system automatically downloads .Net Framework 4.0.

Automated Setup

For Communicator in a large-scale deployment that includes Active Directory, the remedy is for system administrators to install individual items in the order listed below. The administrator must push the following packages in the order shown through GPO or any other deployment tool:

1. Microsoft .Net Framework 4.0 (not located in the Prerequisites folder). Either .Net Framework exists on the system or the system must be connected to the Web (so that initiation of setup.exe causes a download of .Net Framework.)

2. Interop Assemblies (in the Prerequisites folder) should contain Primary Interop Assemblies for 2007 and Visual Studio Tools for Office (VSTO). This resides in the Prerequisites folder.
3. Communicator (CMWin), located in the Setup folder.

Standard Integrated Software Distribution

Overview

ShoreTel system's integrated software distribution feature simplifies installation. Although the process presents a number of screens, there is a default installation that requires no input; you click through the screens until the installation completes.

Users receive an e-mail message from the ShoreTel system containing the information they need to install the ShoreTel Communicator application. The installation program is accessed using the URL listed in the e-mail notification. Notice that the e-mail notification includes the server name and the user name: Users will need this information when they start the ShoreTel Communicator application for the first time.

The software can also be installed from the ShoreTel Communicator CD.

Installing ShoreTel Communicator on a Windows PC

Note

Administrative rights on the client PC is required to install ShoreTel Communicator for Windows

1. Open the e-mail notification from the ShoreTel administrator containing the instructions for installing the ShoreTel client.
2. Click on the link to the ShoreTel software.

   From there, you can initiate the ShoreTel client installation.

Note

You can also reach the software by copying and pasting the address in the URL field of an open browser. An example link is below:

```
http://<server_IPaddress>/ShorewareResources/ClientInstall
```

The **ShoreTel Communicator Install** page shown in Figure 46 appears.

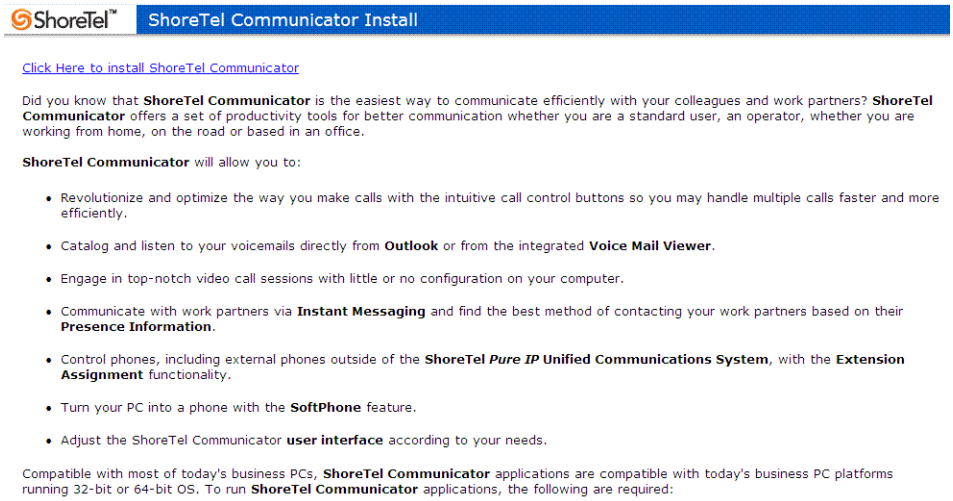

Figure 46: Client Install Page

3. After reviewing the information on this page, click the **Install** button.

   The InstallShield Wizard downloads the installation files (showing the progress of the download), “unpacks” the installation files, and configures the Windows Installer.

   The Welcome screen for the InstallShield Wizard appears.

4. To proceed, click **Next**.

   The ShoreTel End User License Agreement appears.

5. If you agree to the license terms, select the option **I accept the terms in the license agreement** and click **Next**.

   The Destination Folder screen appears.

6. If you want to install ShoreTel Communicator to a different folder, click **Change** and select a new folder.

7. Click **Next** to continue.

   The **Ready to Install** screen appears.

8. Click **Install** to continue.

   During the final installation process, a status screen appears that shows the progress of the installation. Installation may take a few minutes.

9. When installation is complete, click **Next**.

   Software installation is complete when the InstallShield Wizard Completed screen appears.

10. Click **Finish**.

    A shortcut icon to ShoreTel Communicator get added to your desktop.

After the computer reboots, the ShoreTel Communicator icon appears on the desktop.

Installing ShoreTel Communicator on a Mac

1. Open the e-mail notification from the ShoreTel administrator containing the instructions for installing the ShoreTel client, as shown in Figure 47.

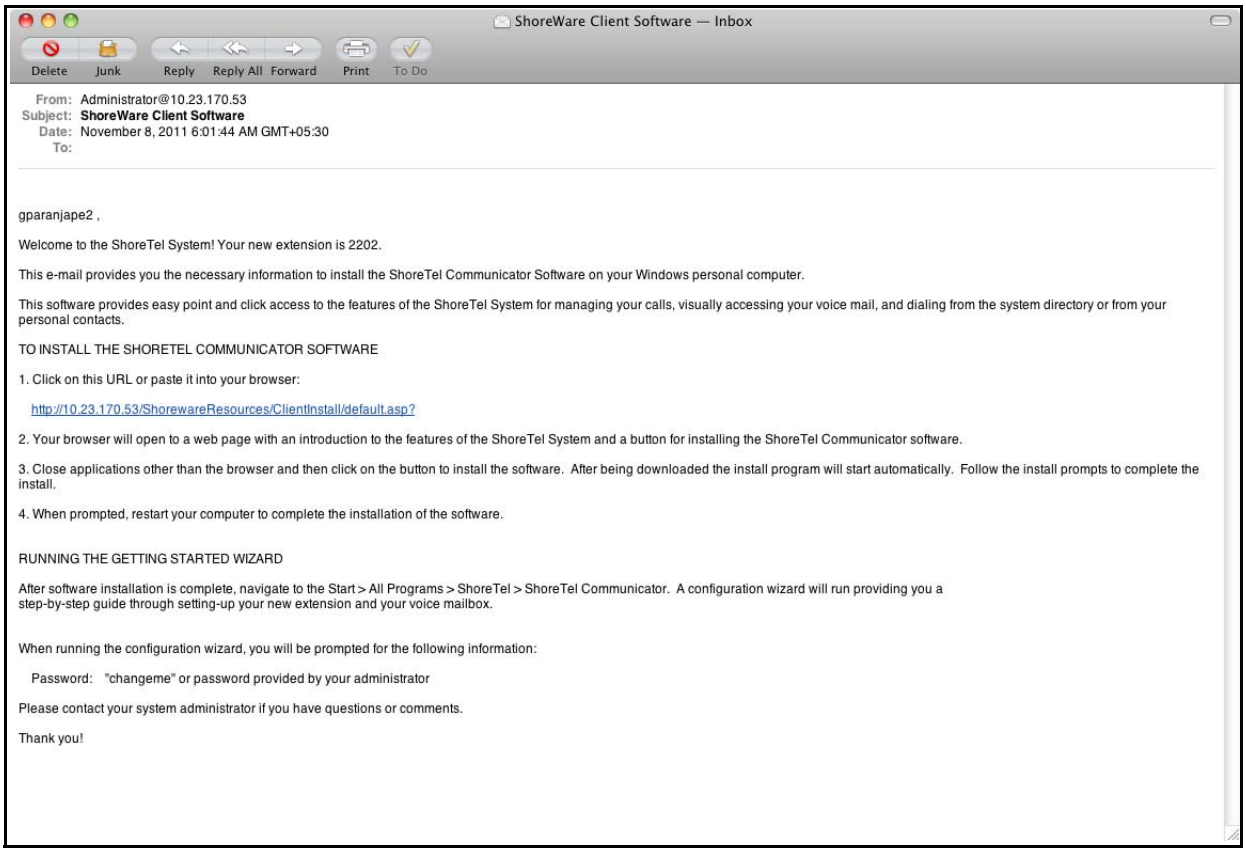

Figure 47: E-Mail Notification from ShoreTel Administrator

2. Click the link in the message.

   The ShoreTel Communicator Install window appears, as shown in Figure 48.

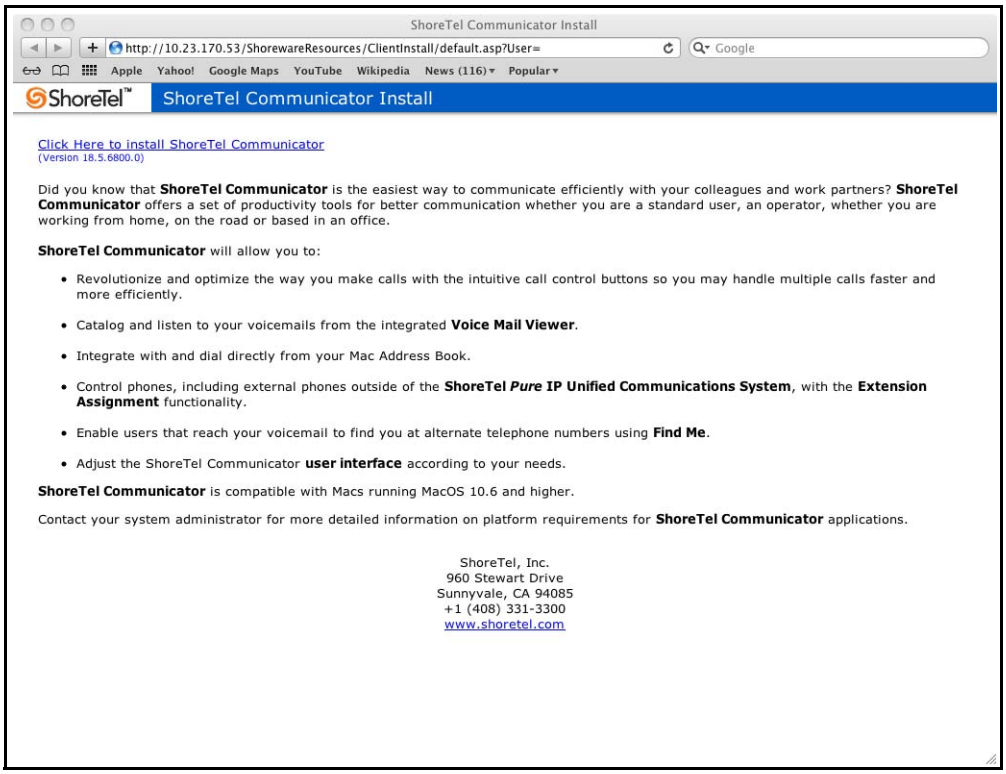

Figure 48: Click the Link

Note

You can also reach the software by copying and pasting the address in the URL field of an open browser. An example link is below:

`http://<server_IPaddress>/ShorewareResources/ClientInstall`

3. Click the link to download ShoreTel Communicator, as shown in Figure 49.

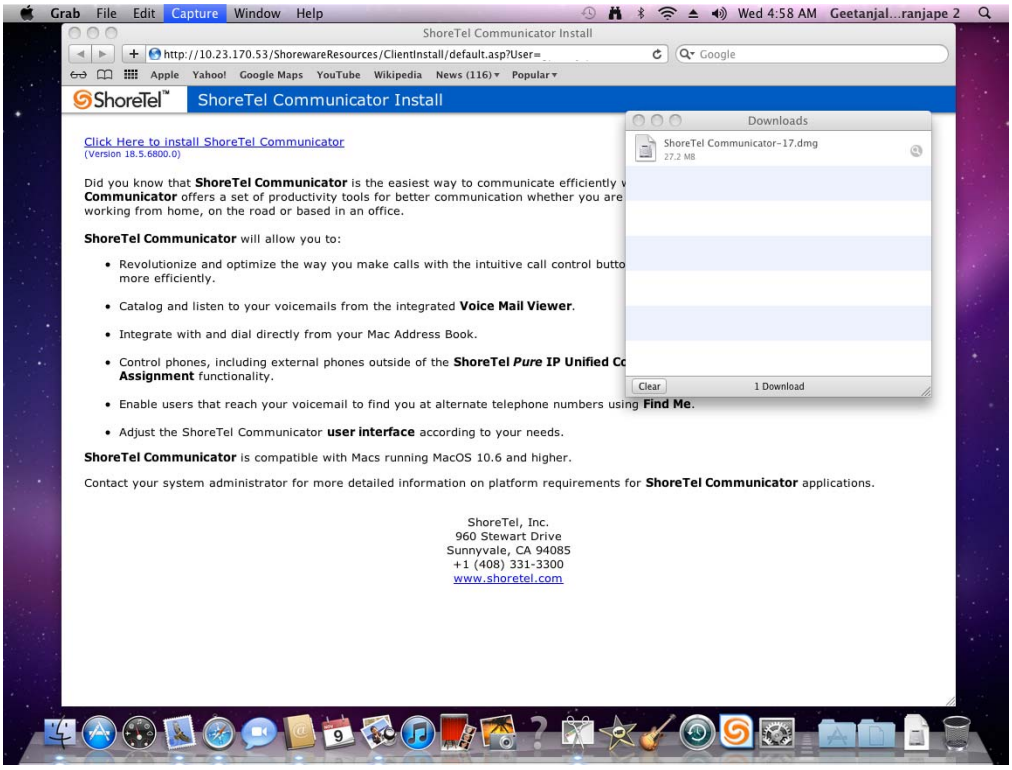

Figure 49: Download the Software

4. Install the software by dragging ShoreTel Communicator to the Applications folder, as shown in Figure 50.

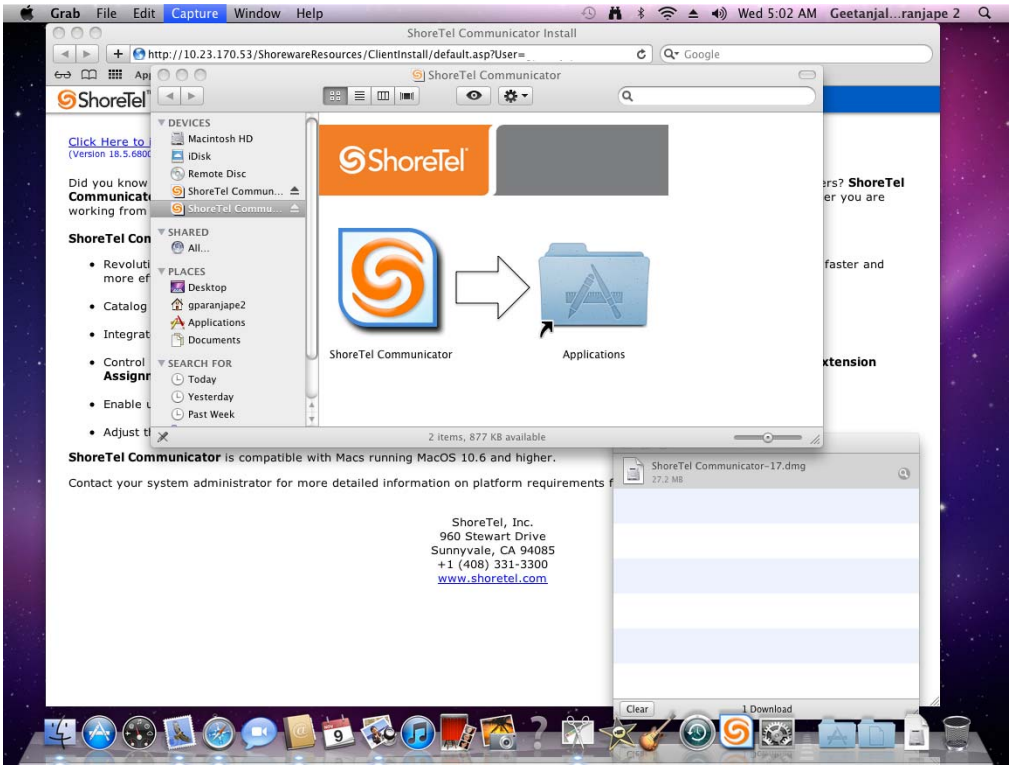

Figure 50: Install the Software

The system installs ShoreTel Communicator.

5. Log in to Communicator.

Note

If you do not have a user name and password, obtain them from your ShoreTel System Administrator.

6. ShoreTel Communicator opens on your desktop.

Starting the ShoreTel Communicator Application

The ShoreTel Communicator application can be started in one of three ways:

- Automatically upon system startup.
- From the Shortcut to ShoreTel Communicator icon on the desktop.
- From the **Start > Programs > ShoreTel** menu item.

The first time the ShoreTel Communicator application is started, a wizard appears prompting you to configure your ShoreTel Communicator server, voice mail box

If you have Microsoft Outlook installed on your computer, ShoreTel Communicator will offer to install Outlook integrated voice mail. Click **Yes** to have your voice mail delivered to your Microsoft Outlook Inbox. You will also be prompted to configure AutoStart.

At this point you have completed the most typical steps associated with installing the ShoreTel Communicator application. Additional procedures are described in the following sections.

Installing Outlook Integration

You can integrate Outlook to ShoreTel Communicator in three areas: voice mail, call handling, and memorized phone number management. You can install these integrated components from the Outlook tab of the ShoreTel System dialog box.

Note

When using Vista or Windows 7, users who do not have local administrative rights will not be able to install Communicator for Windows or Outlook voice Mail/Calendar Integration.

Voice Mail Integration

After you have installed voice mail integration, you have the option to:

- Use Outlook as the default voice mail client
- Attach voice mail to messages when moved
- Delete voice mail from messages when moved

Attach Voice Mail to Message when Moved

Check this option for your voice mail message to be saved in your Outlook folders for archival purposes. If you move a message to an Outlook folder when this option is in effect (and the Delete Voice Mail from Message when Moved option, described below, is not selected), a copy of the message is still stored on the voice mail server. If you delete the message in the voice mail interface, the Outlook copy is still available.

If you move a message without this option in effect and delete the message in the voice mail interface, the message information is still in Outlook, but the message itself is unavailable.

Delete Voice Mail from Message when Moved

Check this option to delete your voice mail messages from the ShoreTel System if you move a voice mail message to an Outlook folder. This is used to store messages in Outlook and free your voice mailbox for more messages.

Installing voice mail integration

1. In the ShoreTel Communicator tool bar, click the ShoreTel icon.

   A shortcut menu appears.

2. Click **Configure ShoreTel System**.

   The ShoreTel System dialog box appears.

3. Click the Outlook tab.

4. Click **Install**.

   In some cases, a warning appears requesting that you close running applications before continuing. Close the applications as requested.

Activating the Integration of Voice Mail with Microsoft Outlook

After a user has the ShoreTel Communicator application, an activation step is still necessary within ShoreTel Communicator. The steps in this section contain information that administrators give to users, or the users can find this information in one of the Communicator guides, such as *ShoreTel Communicator for Windows User Guide*.

No application program except ShoreTel Communicator should be running on a user's computer before the user begins the following steps:

1. Navigate to the Options and Preferences window (for example, through **Tools > Options** at the top of the Communicator interface).

2. Click **Outlook**. in the command navigation panel on the left side of this window.

3. Click the **Install** button to the right Voice Mail.

Note

If one or more applications are running when the administrator clicks **Install**, a request appears that tells the system administrator to all close running applications before continuing with the installation. If any application is running during the installation, the user must restart Outlook to make the changes apply.

Memorized Phone Number Management

ShoreTel Communicator Quick Dial has an option for importing Outlook contacts.

Setting the option under Memorized Phone Number Management

1. In the Memorized Phone Number Management section, click **Read phone numbers from Outlook on startu*p*** option.

2. If you want to exclude FAX numbers from the search, click **Don't include FAX numbers**.

3. If you want Outlook Contact to appear when you have an incoming call, click **Pop Outlook contacts on incoming call**.

4. Click **More Options** to select which Outlook contacts to import. The MAPI Import Options dialog box appears.

5. Click **Enable Disk Caching** if you want Outlook contacts to be available without delay when ShoreTel Communicator starts. When you have enabled disk caching, you can set when ShoreTel Communicator imports contacts. If disk caching is not enabled, ShoreTel Communicator imports contacts every time it starts.
6. Click the Import Configurator tab.
7. Click the locations where you want ShoreTel Communicator to search for contact information.

   To select individual folders, click Details and check the folders you want searched for contact information.
8. Click **OK**.
9. If you want to import contacts now, return to the Disk Cache Options tab and click **Read Contacts Now**.

   If you do not click this button, the Outlook contacts will be imported the next time you start ShoreTel Communicator.

   It will take some time for the ShoreTel Personal ShoreTel Communicator to load your Microsoft Outlook Contacts. Your Outlook Contacts will not be available until loading has been completed.

Configuring Instant Messaging

This section describes how to set up IM in the ShoreTel system and for individual users. For information about configuring users, refer to the *ShoreTel System Administration Guide*.

Note

The section also applies to users who are configured to use Microsoft Office Communications Server and Microsoft Lync.

Enabling Instant Messaging

To enable instant messaging, follow these steps:

1. Launch ShoreTel Director.
2. Click **Administrator > System Parameters > Others**.

   The System Parameters Edit Other Parameters page appears.
3. Scroll down to IM.
4. In the Domain Name field, enter the domain name used for your organization.
5. Select the **Enable Offline Message** check box if you want to allow users to leave messages for IM users who logged in that the logged off user can get when they log in.

Note

If you are using an SSL certificate, select the **Enable TLS** check box to allow users to encrypt IM messages using Transport Layer Security (TLS) protocol.

6. In the Sessions Timeout field, enter the duration, in minutes, that you want the system to keep an IM session open without an exchange before timing out.
7. Click **Save**.

Configuring the IM Class of Service

1. Launch ShoreTel Director.
2. Click **Administration > Users > Class of Service**.

   The Class of Service page appears.
3. In the Telephony Features Permissions section, select the feature class to which you want to add IM services.

   The Users page containing the profile of the user you selected appears.
4. From the IM Presence Invitation Handling drop-down menu, select one of the following options:
   - User defined: Allows the user to choose how to handle IM invitations.
   - Auto accept invitation: Forces IM invitations to be accepted automatically. The invitee still must invite the inviter.
   - Prompt to accept invitation: User is prompted when a new invitation is issued.
5. Click **Save**.

Configuring IM

1. Launch ShoreTel Director.
2. Click **Administration > Users > Individual Users**. The Individual Users page appears.
3. Select the user for whom you want to enable the service.

   The Users page containing the profile of the user you selected appears.
4. Scroll down to Instant Messaging Settings section near the bottom of the page.
5. In the Server/Appliance field, select the Service Appliance that you want the user to use for IM.
6. In the Presence Invitation Handling field, select one of the following options:
   - Select **Auto accept invitation** to have the system automatically accept a presence invitation for the user.

- Select **Prompt to accept invitation** to have the system issue a prompt to the user when another user sends a presence invitation.

Note

The Presence Invitation Handling field only appears when a Service Appliance is enabled for the user and the IM Presence Invitation Handling parameter in the Class of Service profile used for user group to which the user is associated with is configured to allow the user to make this selection.

Migrating IM and Presence Users to a Service Appliance

To move IM and Presence users from a legacy ShoreTel IM Server to a Service Appliance, follow these steps:

1. Launch ShoreTel Director.
2. Click **Administration > Users > Individual Users**.

   The Individual Users page appears.
3. Select the user that you want to move to the Service Appliance.

   The Users page appears.
4. Locate the Instant Messaging Settings section, and in the Server/Appliance field select the Service Appliance that you want the user to use for IM and Presence.
5. Click **Save**.
6. Notify the end-user to uninstall and then install Outlook calendar integration in ShoreTel Communicator for Windows if they are using Outlook calendar-integration. Refer to *ShoreTel Communicator for Windows User Guide* for instructions about how to configure Outlook calendar integration.

Upgrade

When the ShoreTel system is upgraded, users running older versions of ShoreTel Communicator or Call Manager may be informed that they must upgrade. Upgrades of the system may not require client upgrades. Refer to the online knowledge base on the ShoreCare web site to determine if a system upgrade requires client modifications.

User Licensing

ShoreTel offers three user license types:

- Extension and mailbox
- Extension-only
- Mailbox-only

These new choices allow users to request a phone extension license without having to purchase a mailbox at the same time. This additional flexibility may be helpful in situations where a fax machine, a modem, or a lobby phone is desired and a mailbox for voice mail was not needed. Similarly, users can purchase a mailbox without having to purchase a phone extension.

Earlier releases of the ShoreTel product offered Single Site and Multi-Site Enterprise license keys. In this release, the Single Site key is no longer available. For existing users, the Single Site key can still be used and will be renamed as a “Single Site Extension and Mailbox” license. Previous Multi-Site Enterprise keys become “Extension and Mailbox” licenses.

Purchasing User Licenses

Each user must be configured with one of those three license types. A license must be purchased for each user, based upon the needs of that user. To see if an installation is in compliance with the number of licenses purchased, all Extension-Only, Mailbox-Only, and Mailbox-and-Extension users are counted and compared against the sum of the licenses purchased.

- Extension and mailbox: Purchase of this license entitles the user to be assigned to both a physical extension and a ShoreTel mailbox.
- Extension-only: Purchase of this license entitles the user to be assigned to a physical extension, either via explicit assignment or via Extension Assignment.
- Mailbox-only: Purchase of this license allows the user to be assigned to a ShoreTel voice mail-box.

Language Licenses

ShoreTel supports multiple languages in addition to US English (which will remain the default language for new installations). One or more languages can be running at a site by purchasing a language license.

If only one language is needed at a single site, there is no need to purchase a language license.

For instructions on configuring the User Licenses or Language Licenses via Director, please refer to the ShoreTel System Administration Guide.

License Control

License Control adds enforcement and branding to the ShoreTel product and provides tighter enforcement (via MAC address-based node locking) on existing licensing. When an existing ShoreTel system is upgraded to the current software release, an enforcement scheme requires entry of a system key.

When launching ShoreTel Director, you are asked to enter either a Small Business Edition (SBE) or Enterprise Edition (EE) key (see below for details on the differences between these two). You can request a key online via Director. If an invalid key is entered or if the field is left empty, you will be allowed to log into the system for 45 days.

If no action is taken within the 45-day grace period, ShoreTel Director will be locked and you will be unable to make any configuration changes to the system (although the phones will continue to work).

This 45-day period allows for unplanned, ad hoc changes that may cause you to exceed license limits while providing time to comply with the license requirements by either removing unneeded configurations or by ordering additional licenses.

You will be forced to purchase one of two keys available:

- SBE key – required for Small Business Edition
  - This key is for smaller businesses.
  - Use of this key results in the display of SBE branding (on the initial login page above the navigation pane).
  - The SBE license allows a maximum of 50 users with an extension and mailbox, and the customer can add up to 50 users who have only a mailbox.

  For an SBE system, the following features are not available:

  - AMIS
  - SMDI
  - On-net Dialing
  - SBE does not support integration with another ShoreTel system or any 3rd party PBX.
- EE key – required for Enterprise Edition
  - This is for larger businesses with more than three sites.
  - The existing branding appears.
  - System behaves as it does today, except that number of sites is enforced via nagging.
  - Block adding an additional SBE or EE key.

For instructions on configuring licenses in ShoreTel Director or for information about Keyed and Self-Audited licenses, see the *ShoreTel System Administration Guide*.

CHAPTER

17

ShoreTel Integration with External Applications

To work with some external applications, the ShoreTel system may require additional set-up after system installation. This chapter identifies and describes how to set up the system to integrate with external applications.

This chapter includes the following topics:

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  - Important Considerations 309
- Uploading Public Contacts 309
  - Prerequisites 310
  - Running the Import Public Contacts Windows Batch File 313
  - Verifying Public Contacts are Uploaded 315
  - Using the Windows Task Scheduler to Upload Public Contacts 316
- Importing Personal Contacts 316
  - Important Considerations 316
  - Placing the CSV or XML File 317
  - Viewing Imported Contacts 317
  - CSV File Properties 319
  - XML File Properties 322
- Installing the ShoreTel Telephony Interface 326
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Overview

Using the ShoreTel ImportContacts.bat utility, you can import public contacts from the Public Folder on a Microsoft Exchange Server and upload them into the System Directory in ShoreTel Director for use by ShoreTel system users. Before running the utility, you must configure the settings for the batch file in a ShoreTel configuration file (ImportContactsconfig). When run, the ShoreTel batch utility performs the following procedures:

- Connects to your Microsoft Exchange Server (2007 or 2010) via the Exchange Web Services.
- Reads the contacts in the Exchange Public Folder.
- Copies the contacts into a comma-separated value (CSV) file. Be aware that the batch utility provides an option to ignore fields during CSV-file generation.
- Invokes the ShoreTel DBImport tool (dbimport.exe), which uses the contents of the CSV file to update the ShoreTel MYSQL user database. The tool adds, deletes, and modifies user account records based on the contents of the CSV file.

The imported and uploaded contacts are displayed in endpoints that can access the ShoreTel System Directory, such as Outlook, telephones, and ShoreTel Communicator. ShoreTel system users can dial the numbers of the imported and uploaded contacts, create buddies, and so on.

Important Considerations

When you upload public contacts from a Microsoft Exchange Server, be aware of the following considerations:

- Client hardware memory requirements can change if public contacts are imported and uploaded: Memory requirements can increase in relation to the number of contacts imported and uploaded.
- Contacts imported from a Microsoft Exchange Server and uploaded to the ShoreTel System Directory are never private and are fully visible in the ShoreTel Communicator Quick Dialer.
- Contacts cannot be imported from a Global Address List (GAL).

Uploading Public Contacts

Running the ShoreTel ImportContacts.bat utility updates the ShoreTel System Directory as follows:

- Contacts added to the Public Folder on a Microsoft Exchange Server are added to the ShoreTel System Directory.
- Contacts modified in the Public Folder on a Microsoft Exchange Server are modified in the ShoreTel System Directory.
- Contacts deleted from the Public Folder on a Microsoft Exchange Server are deleted from the ShoreTel System Directory.

To limit exposure, contacts imported from the Public Folder on a Microsoft Exchange Server and uploaded into the ShoreTel System Directory can be deleted from the System Directory using ShoreTel Director. See the *ShoreTel System Administration Guide* for information on using ShoreTel Director to manage the System Directory, including adding and deleting records.

Note

Contacts that you delete from the System Directory by using Director are deleted only from the System Directory; they are not deleted from the Public Folder on a Microsoft Exchange Server.

Contacts in the Public Folder can be imported and uploaded at any time, but it is usually best to run the batch utility during off-peak system hours.

You can also import and upload contacts by using the Windows Task Scheduler. For more information, see Using the Windows Task Scheduler to Upload Public Contacts on page 316.

Prerequisites

To upload public contacts, you system must comply with the following prerequisites:

- Your system must be running Microsoft Exchange Server 2007 or 2010.
- Your Microsoft Exchange Server must contain Public Folders.
- You must be familiar with Exchange server concepts and terminology and be proficient at managing an Exchange server. This document is not a tutorial on Exchange servers. For complete information on installing, configuring, and managing Exchange servers, see the Microsoft web site (http://www.microsoft.com/exchange).
- You must have System Administrator permissions to perform the following tasks:
  - Read Public Contacts from a Microsoft Exchange Server.
  - Edit the Import Contacts Configuration file.
  - Run the Public Contacts Windows Batch file.

Editing the Import Contacts Configuration File

Note

To perform this procedure, you must have system administrator permissions.

To edit the import contacts configuration file on the Headquarters server, follow this procedure:

1. Open a Command Prompt window (on your Headquarters server).
2. CD to the location of the Import Contacts Configuration file.

   On 32-bit systems:

```
C:\Program Files\Shoreline Communications\
   Shoreware Server\ImportContacts\ImportContactsconfig
```

On 64-bit systems:

```
C:\Program Files (x86)\Shoreline Communications\
   Shoreware Server\ImportContacts\ImportContactsconfig
```

The location of the file is shown in Figure 51 on page 311.

3. Open the Import Contacts Configuration file.

   An example Import Contacts Configuration File is shown in a browser in Figure 52.

   The example Import Contacts Configuration File is shown in Notepad in Figure 53.

4. Modify the parameters. The parameters are listed and described in Table 69 on page 312.

5. Save and close the Import Contacts Configuration file.

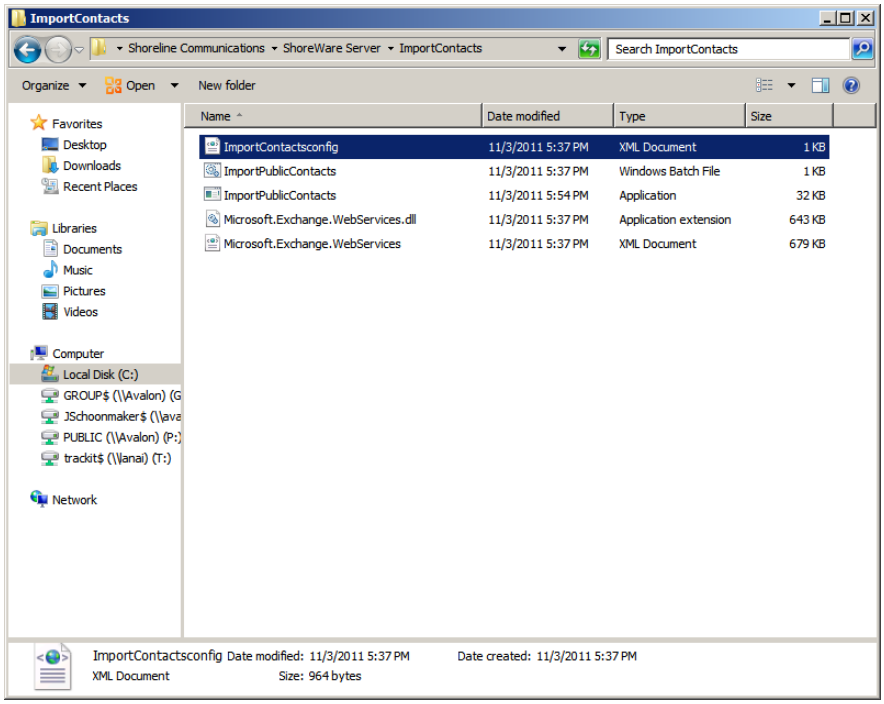

Figure 51: Import Contacts Configuration File Location

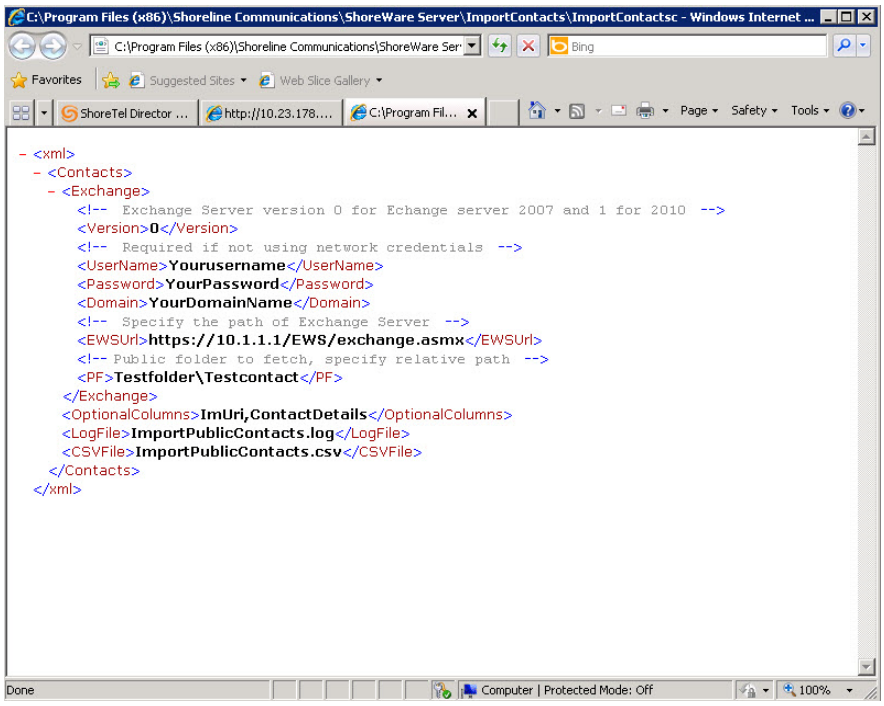

Figure 52: Example Contacts Configuration File in Browser

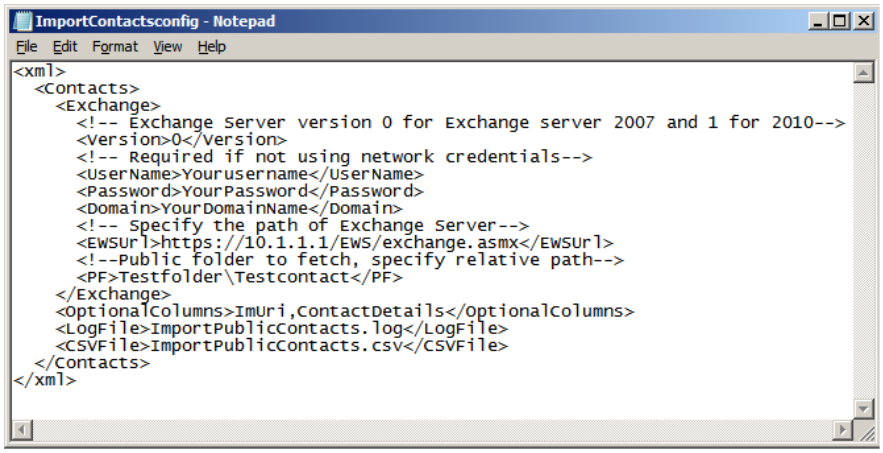

Figure 53: Example Contacts Configuration File in Notepad

Table 69: Import Contacts Configuration File Parameters

Parameter	Definition
Version	Exchange server version (0 or 1). ■ 0 = Exchange server 2007. ■ 1 = Exchange server 2010.
UserName	Your Exchange user name. Required only if you are not using Network Credentials.

Table 69: Import Contacts Configuration File Parameters (Continued)

Password	Your Exchange password. Required only if you are not using Network Credentials.
Domain	Name of your Exchange domain. Required only if you are not using Network Credentials.
EWSUrl	Exchange Web Service location. For example, https://10.XX.XXX.XX/EWS/exchange.asmx.
PF	Path to your company's Public Folder. Location where your company's public contacts are stored. ("Testfolder" and Testcontact" are placeholders in the example.)
OptionalColumns	Specifies information that is not imported and uploaded. For example, the home address or height of a contact.
LogFile	Specifies the log file name. The default location is C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\ImportContacts for 64 bit systems.
CSVFile	Specifies the CSV file name that is generated. The default location is C:\Program Files (x86)\Shoreline Communications\ShoreWare Server\ImportContacts for 64 bit systems.

Running the Import Public Contacts Windows Batch File

Note

To perform this procedure, you must have system administrator permissions.

To run the Import Public Contacts Windows batch file, follow these steps:

1. Open a Command Prompt window (on your Headquarters server).
2. CD to the location of the Import Public Contacts Windows Batch File:

   On 32-bit systems:

   ```
   C:\Program Files\Shoreline Communications\Shoreware Server\ImportContacts\
   ```

   On 64-bit systems:

   ```
   C:\Program Files (x86)\Shoreline Communications\Shoreware Server\ImportContacts\
   ```

   The location of the file is shown in Figure 54.

3. Run the Import Public Contacts Windows Batch File. The status of the procedure is shown in the example in Figure 55. The contacts are imported from the Public Folder on your Microsoft Exchange Server and uploaded to the ShoreTel System Directory for use by ShoreTel system users.

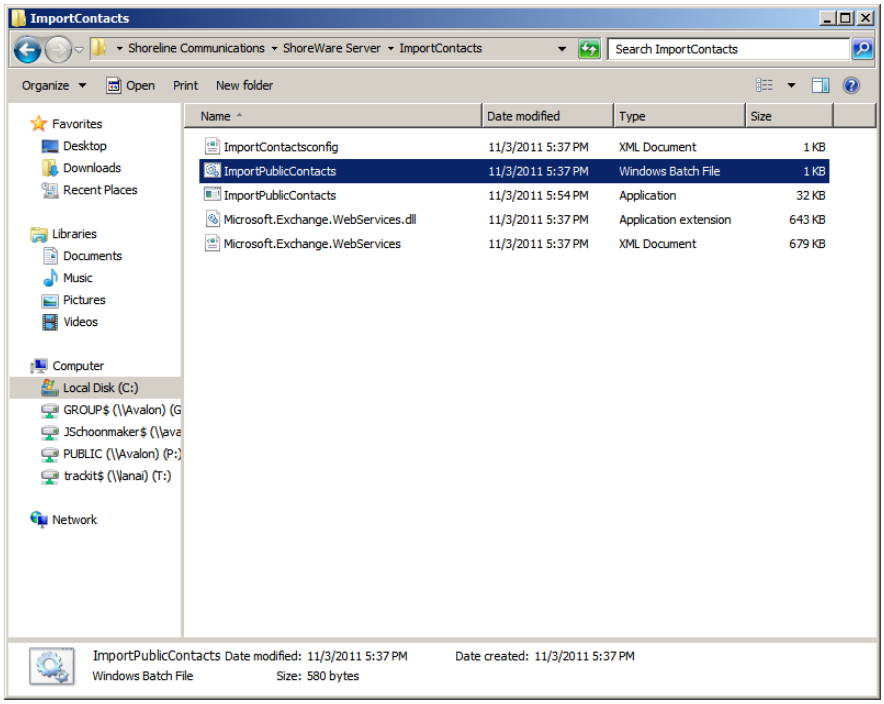

Figure 54: Import Public Contacts Windows Batch File Location

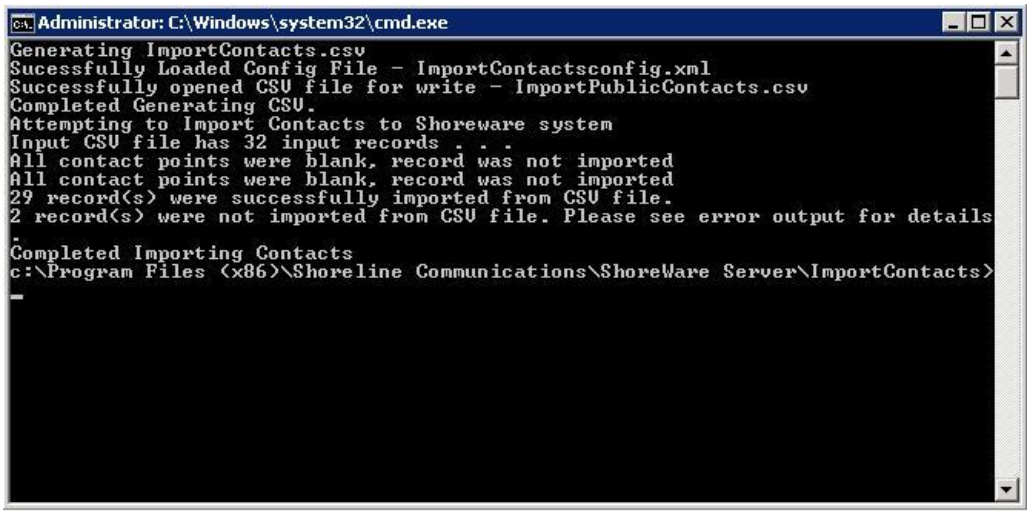

Figure 55: Example Import Public Contacts Windows Batch File Status

Verifying Public Contacts are Uploaded

Note

To perform this procedure, you must have system administrator permissions.

To run the Import Public Contacts Windows batch file, follow these steps:

1. Open ShoreTel Director.
2. Under **Administration**, click **System Directory**. The System Directory window appears, which displays the imported and uploaded contacts. An example System Directory screen is shown in Figure 56. If the Public Contacts are not displayed in the System Directory, they were not imported and uploaded.
3. To check for errors in the import and upload process, open and view a Log File (DBImport.err) on your Headquarters server.

   On 32-bit OS systems:

   ```
   C:\Program Files\Shoreline Communications\Shoreware
   Server\ImportContacts\DBImport.err
   ```

   On 64-bit OS systems:

   ```
   C:\Program Files (x86)\Shoreline Communications\Shoreware
   Server\ImportContacts\DBImport.err
   ```

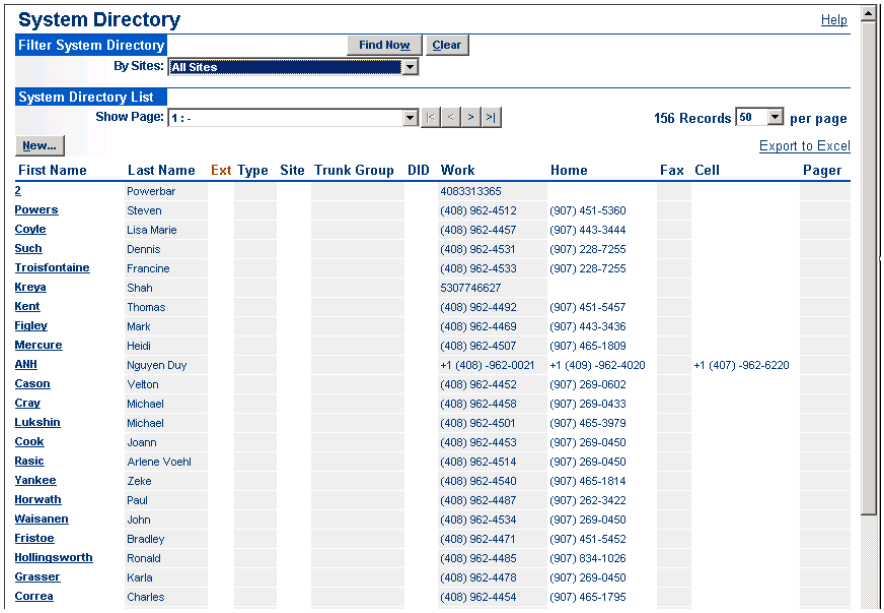

Figure 56: Example System Directory Screen

Using the Windows Task Scheduler to Upload Public Contacts

Note

To perform this procedure, you must have system administrator permissions.

Using the Windows Task Scheduler, you can also import public contacts from the Public Folder on a Microsoft Exchange Server and upload them into the System Directory in ShoreTel Director.

The Task Scheduler enables you to automatically run the Import Public Contacts Batch File on your ShoreTel Headquarters Server.

The Task Scheduler wizard opens the Import Public Contacts Batch File according to the schedule you choose. The tasks can be scheduled to execute at a specific time on a daily, weekly, or monthly schedule.

For more information on how to use the Task Scheduler on your Windows Server, see the Microsoft Corporation website.

Importing Personal Contacts

Using CSV or XML files, you can import personal contacts from ShoreTel Communicator into the ShoreTel System Directory.

The CSV and XML files contain lists of contacts and are formatted specifically for integration with ShoreTel Communicator. The CSV and XML files are not modified by the import process, nor are the contacts permanently added to the user's ShoreTel Communicator database.

ShoreTel Communicator caches CSV or XML file contents at startup and after each file change. The data is available in the Directory Viewer, Contacts Viewer, and QuickDialer. ShoreTel Communicator reports errors during the cache process to the user in log files. ShoreTel Communicator receives records from all properly formatted CSV and XML files in the target directory.

The number of Personal Contacts that can be imported is determined by the COST Max Personal Contacts setting in Director. The range is 10-100000. The default value is 500. Personal Contacts can be imported only if the "Allow Upload of Personal Contacts to the server" checkbox is enabled in the User Group COST setting. Imported Personal Contacts are stored on the server per user as a SQLite file.

Important Considerations

ShoreTel Communicator reads data files located in a directory specified by a registry key. The value in this registry is a string. The default value of this key is a string that points to the Contacts directory in the user profile directory, as shown below:

```
C:\Documents and Settings\username\Application Data\ ShoreWare Client\Contacts
```

The registry entry can point to a PC location or a server path. ShoreTel Communicator does not automatically create this key or assign a default value to it. This registry must be created and assigned to the location of the contact files before ShoreTel Communicator can import data records from the file.

For further information on editing the registry, contact ShoreTel TAC.

Note

Windows registry changes are effective immediately, and backups are not created automatically. Only experienced personnel should attempt registry changes.

Placing the CSV or XML File

Properly configured CSV and XML Files placed in the folder specified by the ContactImportLocation key are immediately cached to ShoreTel Communicator. Changes to these files are visible when the edited file is saved. When a file is removed from the folder, the contacts listed in that file remain in the Directory Viewer until ShoreTel Communicator is exited. Contacts removed from a file also remain in the Directory Viewer. When ShoreTel Communicator is started again, all records removed by contact deletion or file removal do not appear in the Directory Viewer.

Viewing Imported Contacts

Contacts imported from CSV or XML files appear in the Directory Viewer (Figure 57).

When contacts are grouped by data source, they appear under a heading that lists the Data Source. When contacts are grouped by company or are not grouped, the Data Source column indicates either the name of the originating file or the contents of the Name field in the originating file.

Details of contacts imported from the CSV or XML files are visible from the Directory Item Details panel. To access contact details, right click a contact and select View Directory Item Detail. The Directory Item Details panel (Figure 58) indicates the source of the file in the first data field and states that the record contents are not editable.

Imported CSV/XML file contacts are available in all QuickDialer controls. They appear in the list just like any other contact.

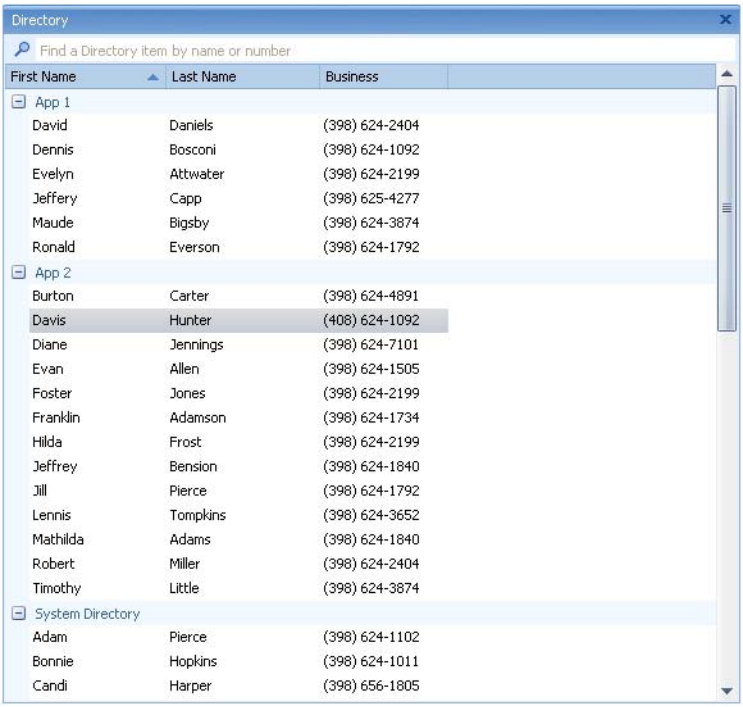

Figure 57: Directory Viewer containing Imported Records

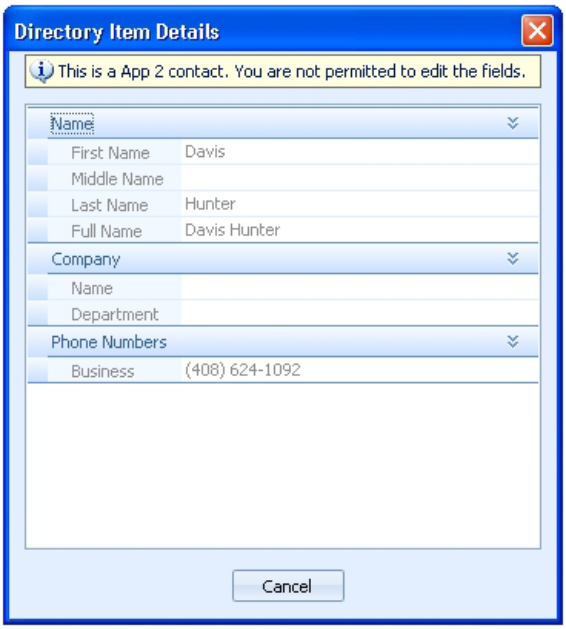

Figure 58: Directory Item Details

CSV File Properties

CSV files contains records, each of which consists of data fields. The composition of CSV file fields and records is described below.

CSV File Field Composition

Each field denotes one property for the file or for one contact. The field entries must conform to the following syntax rules:

- Data is of type strings and supports UTF-16 encoding.
- Fields that contain a double quote must be surrounded by double quotes. For example:

```
A “tiny” space -> “A ““tiny”” space””
“Joe” -> ““““Joe””””
“Red” Wagon -> ““““Red”” Wagon”
```

- Fields that contain commas must be surrounded by double quotes. For example:

```
“ShoreTel, Inc.”
```

- Fields that do not contain double quotes or commas with double quotes may be surrounded with double quotes.
- Data fields with no information translate into blank entries in ShoreTel Communicator.

CSV File Field Record Types

Each line in a CSV file corresponds to one data record. The end of a record is denoted by a Carriage Return and Line Feed. ShoreTel Communicator CSV integration files define three types of records:

- File Information Record
- Contact Header Record
- Contact Record

File Information Record

The File Information Record denotes the Source of the data and the Version of the file. Inclusion of this record in the CSV file is optional.

When it is included, the File Information Record must be the first record in the file.

- Source: This field is associated with all file records in ShoreTel Communicator and corresponds to the Data Source column in the Directory Viewer. Typically, this value is set to the original source of the file contents. When this field is not included, ShoreTel Communicator uses the CSV or XML file name as the Data Source contacts imported into the Directory Viewer.
- Version: This field displays the version of the contact information. When included, this field must be set to 2.0.

Source and Version variable declarations must conform to the following rules:

- Syntax for the Source variable is `Source=sourcetext`.
- Syntax for the Version variable is `Version=versionname`.

The Source and Version variables are optional.

File Information Record Example 1:

```
“Source=Lotus”,”Version=2.0”
```

File Information Record Example 2:

```
Source=Lotus, Version=2.0
```

Contact Header Record

The Contact Header Record is mandatory and lists the names of the heading files in the Viewer Directory. The Contact Header Record is located immediately after the File Information Record. If the file does not contain a File Information Record, the Contact Header Record is the first record in the file. Although field names correspond to Directory Viewer heading names, the field names are not always identical to the heading.

Valid field names for CSV import files are Contact ID, First name, Middle name, Last name, Company, Department, Business Phone, Business Phone 2, Home Phone, Home Phone 2, Mobile Phone, Pager, Business Fax, Email Address, Email2 Address, Email3 Address, IM Address, Categories.

Contact Header Record Example:

```
“Contact ID”,”First Name”,”Last Name”, “Business Phone”
```

Table 70: Contact Header Record Field Names

Field Name	Definition
Contact ID	This field uniquely identifies the contact record within the file. The Contact ID is a string with a maximum of 126 characters. ShoreTel Communicator does not display this field. All contact records require a Contact ID. If multiple contact records contain identical Contact IDs, the last such contact in the list is imported into ShoreTel Communicator and all other contacts with the same ID are ignored. ShoreTel Communicator does not display the contents of this field.
First Name	Directory Viewer displays contents under the First Name column.
Middle Name	Directory Viewer displays contents under the Middle Name column.
Last Name	Directory Viewer displays contents under the Last Name column.
Company	Directory Viewer displays contents under the Company column.
Department	Directory Viewer displays contents under the Department column.
Business Phone	Directory Viewer displays contents under the Business column.
Business Phone 2	Directory Viewer displays contents under the Business 2 column.
Home Phone	Directory Viewer displays contents under the Home column.

Table 70: Contact Header Record Field Names(Continued)

Home Phone 2	Directory Viewer displays contents under the Home 2 column.
Mobile Phone	Directory Viewer displays contents under the Mobile column.
Pager	Directory Viewer displays contents under the Pager column.
Business Fax	Directory Viewer displays contents under the Fax column.
Email Address	Directory Viewer displays contents under the Email column.
Email2 Address	Directory Viewer displays contents under the Email2 column.
Email3 Address	Directory Viewer displays contents under the Email3 column.
IM Address	Directory Viewer displays contents under the IM column.
Categories	Directory Viewer displays contents under the Categories column.

Contact Record

The file contains one record for each contact that is integrated into the Directory viewer. The order of data fields in each contact record must be identical to the fields in the Contact Header Record.

Contact Record Example 1:

```
“ID_100”,”Johnny”,”Fracas”, “398-212-0012”
```

Contact Record Example 2:

```
ID_100,Johnny,Fracas, 398-212-0012CSV Examples
```

CSV File Examples

CSV file with all fields surrounded by double quotes

```
“Source=Lotus”,”Version=2.0”
“Contact ID”, “First Name”, ”Middle Name”, “Last Name”, “Company”, “Department”,
“Business Fax”, “Business Phone”, “Home Phone”, “Mobile Phone”, “Pager”,
“Categories”, “Email Address”
“1234”,”Maude”,”June”,”Bigsby”,”Anycorp, Inc.”,””,,”(398) 777-8888”
“1235”,”David”,”””Doc”””,”Daniels”,”Anycorp, Inc.”,”Software Engineering”,”(398)
331-9999”,”(408) 331-3662”,”(650) 999-1212”,”(398) 218-9898”,”(398) 222-3434”,”New
Customer”,”Ddaniels@anycorp.com”
```

CSV file in which fields with commas and double quotes are surrounded by double quotes

```
Source=Lotus,Version=2.0
Contact ID,First Name,Middle Name,Last Name,Company,Department,Business
Fax,Business Phone,Home Phone,Mobile Phone,Pager,Categories,Email Address,IM
Address
1234,Maude,June,Bigsby,”Anycorp, Inc.”,,,(398) 777-8888,,,,,,
1235,David,”””Doc”””,Daniels,”Anycorp, Inc.”,Software Engineering,(398) 331-
9999,(398) 331-3652,(398) 929-1212,(398) 888-9898,(398) 222-3434, New Customer,
Ddaniels@anycorp.com,Ddaniels5000@yahoo.com
```

XML File Properties

XML files contain a structured set of elements. The file components and XML elements recognized by ShoreTel Communicator are described below.

XML File Name

The file name must have the extension .xml.

XML File Elements

The following elements are recognized by ShoreTel Communicator Contact XML files:

- Level 1 Elements
- Level 2 Elements
- Level 3 Elements

Level 1 Elements

Each file contains one Contacts element. The Contacts element specifies the source name and version number and contains one Contact element for each contact in the file.

Valid attributes: source, version.

Example:

<contacts source = “File 1” version = “2.0”> </contacts>

Level 2 Elements

The Contacts element contains one Contact element for each user defined by the XML file. Each contact element contains Level 3 elements that define the field contents for the user. Each Contact element must contain one ContactID element and one other Level 3 element

Level 3 Elements

Level 3 elements are contained with the Contact element and specify field contents for contacts imported to ShoreTel Communicator: contactID, name, company, department, categories, phone, email, and IM.

Table 71: Level 3 Elements

Element	Definition
contactID	This field uniquely identifies the contact record within the file. The Contact ID is a string with a maximum of 126 characters. ShoreTel Communicator does not display this field. All contact records require a Contact ID. If multiple contact records contain identical Contact IDs, the last such contact in the list is imported into ShoreTel Communicator and all other contacts with the same ID are ignored. Example: `<contactID>1234</contactID>`

Table 71: Level 3 Elements(Continued)

name	This element specifies the contact's name. Each contact element may contain only one name element. Valid attributes: first, middle, last. Example: `<name first="Sarah" middle="Jane" last="Clauser"/>`
company	Each contact element may contain only one company element. Valid attributes: value. Example: `<company name="Anycorp, Inc."/>`
department	Each contact element may contain only one department element. Valid attributes: value. Example: `<department value="Sales"/>`
categories	Each contact element may contain only one categories element. Valid attributes: value. Example: `<categories value="Austin"/>`

phone	This element specifies the contact's phone numbers. A contact element may contain multiple phone elements, subject to the rules outlined below.
	
	Valid attributes: type, name, value.
	
	■ Type: The type attribute must be equal to one of the following: Business, Home, Mobile, Pager, and Fax. An element may contain two phone elements with name equal to Business. An element may contain two phone elements with name equal to Home. An element may contain one phone element with name equal to Mobile. An element may contain one phone element with name equal to Pager. An element may contain one phone element with name equal to Fax.
	
	■ Name: The name attribute specifies the label of the ShoreTel Communicator Directory Viewer column heading. If a name value does correspond to a standard column heading label, ShoreTel Communicator creates a new heading.
	
	■ Value: The value attribute specifies the phone number that appears in the Directory Viewer data field.label of the ShoreTel Communicator Directory Viewer column heading. If a name value does correspond to a standard column heading label, ShoreTel Communicator creates a new heading.
	
	Example:
	
	`<phone type ="Business" name="Business 2" value= "+1 (398) 244-2489"/>`
	
	Example:
	
	`<phone type ="Pager" name="Pager" value= "+1 (398) 298-231"/>`
	
	If multiple Phone Type elements have the same name attribute, ShoreTel Communicator uses the first string and ignores all duplicate entries.

Table 71: Level 3 Elements(Continued)

email	This element specifies the contact's email addresses. A contact element may contain a maximum of three email elements, subject to the rules outlined below.
	
	Valid attributes: name, value.
	
	■ Name: The name attribute specifies the label of the ShoreTel Communicator Directory Viewer column heading. If a name value does correspond to a standard column heading label, ShoreTel Communicator creates a new heading.
	
	■ Value: The value attribute specifies the email address that appears in the Directory Viewer data field.label of the ShoreTel Communicator Directory Viewer column heading. If a name value does correspond to a standard column heading label, ShoreTel Communicator creates a new heading.
	
	Example:
	
	`<email name=”email 2” value= “apierce@anycorp.net”/>`
	
	Example:
	
	`<email name=”email” value= “adam.pierce521@yahoo.net”/>`

IM	This element specifies the contact's email addresses. A contact element may contain only one IM element. Valid attributes: name, value. ■ Name The name attribute specifies the label of the ShoreTel Communicator Directory Viewer column heading. If a name value does correspond to a standard column heading label, ShoreTel Communicator creates a new heading. ■ Value: The value attribute specifies the IM address that appears in the Directory Viewer data field.label of the ShoreTel Communicator Directory Viewer column heading. If a name value does correspond to a standard column heading label, ShoreTel Communicator creates a new heading.

XML File Example

ShoreTel Communicator Contact Integration XML file

```
<?xml version="2.0" encoding="utf-8"?>
<contacts source="Lotus" version="2.0">
  <contact>
    <name first="Sarah" middle="" last="Clauser"/>
    <company value="Anycorp, Inc."/>
    <department value="Finance"/>
    <contactID>1234</contactID>
    <phone type="Business" name="Business" value="+1 (398) 122-2558"/>
    <phone type="Business" name="Business 2" value="+1 (398) 122-2558"/>
    <email name="Email" value="Sclauser1021@anycorp.org"/>
    <email name="Email Address 2" value="sclauser@yahoo.com"/>
    <IM name="IM" value="sclauser1021@aol.com"/>
</contact>
<contact>
    <name first="Tammy" middle="" last="Masoon"/>
    <company value="Anycorp, Inc."/>
    <department value="Sales"/>
    <contactID>2234</contactID>
    <phone type="Home" name="Home" value="+1 (398) 962-2552"/>
    <phone type="Pager" name="Pager" value="+1 (398) 529-8670"/>
</contact>
<contact>
    <name first="Greg" middle="" last="Thilmonda"/>
    <company value="ShoreTel, Inc."/>
    <department value="Sales"/>
    <contactID>3234</contactID>
    <email name="Email" value="gthilmonda@anycorp.com"/>
</contact>
<contact>
    <name first="Patrick" last="Farrington"/>
    <contactID>4234</contactID>
    <phone type="Business" name="Business" value="+1 (398) 331-3642"/>
    <phone type="Mobile" name="Mobile" value="+1 (398) 666-5113"/>
    <phone type="Fax" name="Fax" value="+1 (398) 331-3642"/>
    <email name="Email" value="PFarrington@anycorp.com"/>
    <IM name="IM" value="PFarrington@aol.com"/>
  </contact>
</contacts>
```

Installing the ShoreTel Telephony Interface

The system installation wizard does not automatically install the ShoreTel Telephony Interface (STI) during installation.

If you are using third-party or supplementary ShoreTel applications that interact with the ShoreTel system, you may need to manually install the STI.

This section describes how to install the STI on Windows clients with third-party applications that integrate with ShoreTel Communicator for Windows.

For information on installing STI on Citrix servers, see Appendix C, Installing Communicator on Citrix and Windows Servers.

Prerequisites

Before you install the STI, perform the following prerequisite steps:

- Close all open programs, because a reboot will be required during the installation process.
- Ensure that ShoreTel Communicator for Windows is installed.
- Be sure you know the location of ShoreTel system software on your system.

Installing the STI

1. If it is not already installed, install (or upgrade) ShoreTel Communicator for Windows.
2. Launch Windows Explorer.
3. Enter the following URL:

   http://serverIP/shorewareresources/shoreteltelephonyinterface

   The ShoreTel Telephony Interface Install site appears.
4. Click the link to install the ShoreTel Telephony Interface (download and install the interface on the client computer).
5. Reboot the client computer.

Verifying that the Interface is Installed

1. Open Control Panel.
2. Click **Phone and Modem Options**.
3. Click **Advanced**.
4. Verify that **ShoreTel Remote TAPI Service Provider** is installed.

5. Select **ShoreTel Remote TAPI Service Provider**.
6. Click **Configure**. The ShoreTel Remote TSP dialog appears.
7. In **Provider Usage**, verify that the provider is enabled.
8. Launch ShoreTel Communicator for Windows.

The TAPI service registers the ID, password, and address of the user for transactions with the third-party application.

Installing the TSP Package

You must install the Telephony Service Provider (TSP) package on clients that require TAPI for third-party applications (for example, ShoreTel Professional Service applications).

This software can be found in the Third Party Support folder included with the Communicator software.

There are three ways to install the Third Party TSP package on client operating systems for third-party Applications:

- Running setup
- Using the Microsoft GPO Deployment tool
- Using the ShoreTel Professional Services application

The installation procedure for each method is described in the following sections.

Note

You must upgrade ShoreTel Communicator for Windows first before you upgrade the third-party TSP package.

Running Setup

1. Perform a fresh install or upgrade of Communicator for Windows.
2. Configure Communicator.
3. Install the Third Party TSP package.
4. Follow the default settings and finish the installation.
5. Reboot the client machine.

Communicator can now use Third Party applications.

Using the Microsoft GPO Deployment Tool

Using GPO, install (push) the TSP package to larger sites. GPO is Microsoft Corporation's Group Policy Object (GPO) deployment tool. It can be used to remotely install (push) software in Windows Server 2008. For more information about GPO, see the Microsoft support website, http://support.microsoft.com, and search for GPO.

Using the ShoreTel Professional Services Application

Use the Professional Services Application upgrade link, http://www.shoretel.com/services/applications. The link points to the Headquarters server for the correct location of the TSP package to install.

Installing Third-party TSP package in a Terminal Licensing Server Environment (Citrix and Windows)

1. Perform a fresh install or upgrade of Communicator for Windows.
2. Install the third Party TSP package.
3. On the Windows desktop, open the Control Panel.
4. Click **Phone and Modem**.
5. Click **My Location**.
6. Click **Advanced**.
7. Select **ShoreTel Remote TAPI Service Provider**.
8. Click **Remove**.
9. Click **OK**.
10. On the Windows desktop, open a command prompt window.
11. Navigate to the following location:

    ```
    \Program Files\ShoreTel\ShoreTel 3rd Party
    ```

12. Run the following command:

    ```
    TSPinstall -i StServer HQ servername (IP address)
    ```

13. On the Windows desktop, open the Control Panel.
14. Click **Phone and Modem > My Location > Advanced**.

    Verify that the ShoreTel Remote TAPI Service Provider is listed.

ShoreTel Communicator can now use Third Party applications.

CHAPTER

18

Legacy Integration

ShoreTel provides a way to convert a TDM-based voice network into the ShoreTel system. Integrating the ShoreTel system with an old PBX allows a customer with different systems to support phone and voice mail communication between systems. This chapter describes how to migrate your legacy system to the ShoreTel system. This chapter contains the following:

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Overview

An integrated voice network can provide the following streamlining for your system:

- Simplify communications for your users with an enterprise-wide coordinated dialing plan using extension dialing.
- Exchange voice mail messages between users on different sites using different voice mail systems. Standard commands such as compose, forward, and replay, extend the value of your different voice mail systems.
- Consolidate trunks with different traffic types.
- Reduce service costs by redirecting inter-site calls across your IP network.

Legacy PBX

A digital trunk tie line integrates the ShoreTel system with a legacy PBX. The connection is between the legacy system's PRI interface and the PRI interface of a ShoreTel Voice Switch located anywhere in your IP network.

There are four different types of activities that occur on the interface:

- Calls from ShoreTel users or applications to an extension located on the other system are routed across the tie trunk. When a call is placed, the trunk is accessed and the ShoreTel system sends the configured number of digits to the PBX identifying the called extension.
- Calls from users on the legacy system or from trunks, or other applications on the legacy PBX, are routed across this interface. When the legacy user places their call, the legacy system accesses the trunk and then sends the digits as DNIS.
- Outbound calls from users or applications on the ShoreTel system can be routed across the trunk to the legacy PBX. When a call is placed, the trunk access code or trunk configuration of the connection to the legacy PBX indicates the outbound call is to be placed to the PBX.
- Calls between the ShoreTel and legacy system's voice mail applications are carried across the trunk connecting the two systems. The voice mail systems make calls to configured destinations on the other system to send voice mail messages to users on the other system.

A tie trunk is not required to enable voice mail or AMIS integration. The two voice mail systems can communicate by dialing each other via the PSTN. In general, when a tie trunk is in place, AMIS calls should be routed via the trunk to reduce PSTN costs.

The connection between the two systems can be provided by either T1 trunks, PRI, or SIP interface. ShoreTel recommends that you use PRI or SIP to enable calling number information exchanges between the two systems.

Coordinated Dialing

Coordinated dialing allows users to dial between the systems using extension-to-extension dialing as well as enabling consolidation of inbound and outbound services. To effectively plan the integration, consider the following items:

- Expected call traffic between the two systems to provide sufficient trunking
- Current numbers of extensions and extension lengths at both systems
- Service plans to determine which PSTN services are provided at each voice system
- What type of legacy PBX equipment is integrated with the ShoreTel system

Trunk Requirements

The number of digital trunks required between the ShoreTel system and the legacy PBX depends on the expected traffic between the two systems. To determine the number of trunks, you need to estimate the number of calls per hour that are placed between the two systems. When estimating the call volume between the two systems, consider the following:

- The volume of direct calls between users on the two systems
- Traffic related to Automated Call Distributor (ADC) calls
- Outbound call volume (i.e. when outbound trunking to the PSTN is provided by one of the systems for all users, such as a PSTN trunk connected to the legacy PBX that provides long distance services for users on both the legacy and ShoreTel system)
- Inbound call volume (i.e. when inbound services are provided by one system to all users)

Additionally, you can rely on the estimated calls-per-hour number to determine the number of trunks to configure between the two systems.

For more information on trunk requirements, see Trunk Planning and Ordering on page 85.

Coordinated Dialing Plan

With legacy integration, users on both systems can dial one another using abbreviated or extension dialing. This includes dialing from applications on the systems, such as the ShoreTel voice mail application, and would also include forwarding a call to an assistant at an extension on the legacy PBX. To determine the coordinated dialing plan configuration, you must identify the current numbering of users on both systems:

- When the systems are located together, extensions can normally be assigned from a single numbering plan, or from a single DID number range provided by the local carrier. In this case, the extensions on the two systems are assigned such that there is no overlap using the desired extension length.
- When systems are at different locations, each system's numbering plan is often based on the DID range supplied by the local telephone company. In this case, overlap of the extension ranges can occur at the currently used extension length.

For example, consider the following situation:

- One location is assigned DID range 408-555-2000 through 2999
- The second location is assigned range 650-333-2500 through 2799
- The systems currently use four-digit dialing matching the trailing 4 digits of the DID numbers.

In this case, there are users on both systems currently assigned extension 2500. To provide a coordinated dialing plan across the systems, the extensions must be adjusted to make them unique system-wide. In the integration, four-digit extensions that overlap are made unique by increasing the extension length across the system. When the extension length is increased, the first digit becomes the "system" number and the remaining digits are the "extension." In the above example, the extension length would be increased to five-digit dialing, and at the first location would be extensions 52000 through 52999, while users at the second location would be assigned extensions 32500 through 32799.

The extensions on all systems that are integrated together should be configured to be the same length.

Be sure to document the planned integrated dialing plan prior to configuring the systems to streamline the configuration process. Information to take note of is provided in Table 72.

Table 72: Dial Plan template

	System One	System Two
Location		
DID Range		
Local Extensions (Prefix + Number)		
Remote Extensions (Prefix + Number)		

PSTN Services

The number of trunks, your integration plan, and the overall system design includes the provisioning of services across the network. PSTN services can be provided at both systems in the integration or consolidated together on one system.

Multi-Site Integration

When the systems are located at different sites, both systems should have local trunking for both inbound and outbound calls. Local inbound numbers make it easy for nearby customers to reach you, while local outbound trunks allow you to save on telephone charges by using local services at the site.

In this configuration, the trunk lines connecting the systems are used for the inter-site calling between extensions or applications on the two systems. The interfaces on the two systems are configured to dial out to the remote or off-system extensions, and to accept incoming calls using DNIS.

The ShoreTel voice switch that connects to the legacy PBX should be located at the site with the legacy PBX. This leverages the IP network to extend the calls to the other sites with the ShoreTel system.

Single Site Integration

When the systems are located at the same site, it is not required that both systems be connected to the PSTN. The systems can be configured to best match your requirements.

In a single site configuration, the PSTN connections for inbound calls can be connected to each system. In this environment, the trunks connecting the two systems are configured to dial out the remote or off-system extensions and to accept incoming calls using DNIS.

Alternatively, inbound services can be consolidated on either the ShoreTel system or the legacy PBX. In this environment, calls to users on the other systems are forwarded to the remote or off-system extensions through the trunk lines connecting the systems.

When all inbound trunks are consolidated on the ShoreTel system, the trunks are configured to support off-system extensions within the range of extensions on the other PBX.

When all inbound trunks are configured on the legacy PBX, the trunks on the ShoreTel system are configured to support inbound services with call routing to the extensions on the ShoreTel system.

When DID numbers are already in place on one of the PBX's which will be connected, ShoreTel recommends that the inbound DID service not be moved or split between the systems but configured to remain on the system where they are currently configured and have calls to users on the other system forward across the connecting trunks.

In the single site configuration, ShoreTel recommends that services for outbound calls be connected to the legacy PBX. In this configuration the trunk interfaces on the system are configured to support outbound local and long distance dialing while the interface on the PBX is configured to route the received outbound calls.

Consolidated Long Distance

Long distance calls can be consolidated into a single PSTN interface across both the ShoreTel system and the integrated legacy PBX. In this configuration, you gain the benefits of reduced long distance rates by consolidating all your enterprise's long distance calls into a single carrier. When it is required, the outbound long distance trunks are connected to the legacy PBX and the ShoreTel system is configured to route long distance calls outbound across the digital trunk connecting the systems.

Voice Mail Integration

The primary issue with voice mail integration is they are often proprietary and the interfaces defined to connect the same and disparate systems are very old, complex and difficult to implement. In fact, many voice systems from the same vendor are not connected. The interface with which most customers are familiar is AMIS. This is an analog interface that has been around for a long time, but is a real challenge to implement and can be very expensive from legacy voice mail providers. It is not uncommon to pay $10,000 per site for this capability. Another widely-used interface, Simplified Message Desk Interface (SMDI), was developed in the days when the PBX and voice mail systems were separate systems. It operates on a serial link between a PBX and voice mail system and allows them to work together. ShoreTel supports both AMIS and SMDI protocols for voice mail integration.

AMIS Protocol Support

The ShoreTel system sends and receives voice mail messages to and from legacy voice mail systems using AMIS protocol Version 1 - Specification February 1992. To send voice mail messages to remote AMIS sites, ShoreTel dials the access phone number for the remote system. Likewise, to receive voice messages from a remote system, the remote system must know the number to dial into the ShoreTel system. To reach the ShoreTel system, the remote system must be configured to dial any number that reaches an auto-attendant menu.

AMIS call support is enabled by default. Incoming AMIS voice mail is delivered in the same manner as other voice mail; however, users cannot send replies. To send outbound AMIS voice mail, you must define AMIS System profiles in ShoreTel Director.

ShoreTel negotiates the setup, handshaking, and teardown of AMIS system calls. Each voice mail requires a call over the trunk group defined for the AMIS delivery and call-back numbers.

Simplifying AMIS Systems and Increasing Usability

- Use the same extension length across your enterprise.
- Use off-system extensions to match remote users’ mail boxes with their extension numbers.

- Assign each system a System ID to identify the remote site location

For more information on AMIS systems, see the ShoreTel System Administration Guide.

SMDI Protocol Support

The ShoreTel product supports the SMDI protocol, enabling seamless integration of ShoreTel equipment with legacy phone systems and enabling a smooth migration toward an all-IP telephony solution.

A Little History

The SMDI protocol evolved at a time when voice mail services and PBX services were provided by separate physical devices. Over the years, manufacturers have managed to offer both PBX and voice mail services within a single device, and the need for SMDI has diminished. However, the protocol can still be useful in situations where newer equipment will be integrated into a network of older devices.

How It Works

SMDI enables the separate devices that provide PBX and voice mail services to share information over an out-of-band serial cable connection. The PBX shares information with the voice mail system about incoming calls. The following information is passed to the voice mail system:

- Who the call is from
- Where the call is going (i.e. user extension)
- The reason the call is going to voice mail instead of being answered

In response, the voice mail system returns a notification to the PBX that a message was left on the voice mail server. The PBX system then uses this information to alert the user by turning on the message waiting light on his or her phone.

Configurations of integrated equipment

With SMDI support, there are essentially two possible ways the ShoreTel and legacy equipment can be configured:

- External Voice Mail Configuration — The legacy system provides voice mail services while the ShoreTel system acts as the PBX.
- ShoreTel Voice Mail Configuration — The ShoreTel system provides voice mail services while the legacy system acts as the PBX.

Additional details

A group of analog trunks from the ShoreTel system is used to access the legacy voice mail system. The ShoreTel system is on the extension side of the trunks. The ShoreTel voice mail application manages the group of outgoing extensions. The ShoreTel server can provide digit translations if the legacy voice mail and ShoreTel system have different extension lengths.

Figure 59 shows the ShoreTel system providing PBX services and the legacy equipment providing voice mail services.

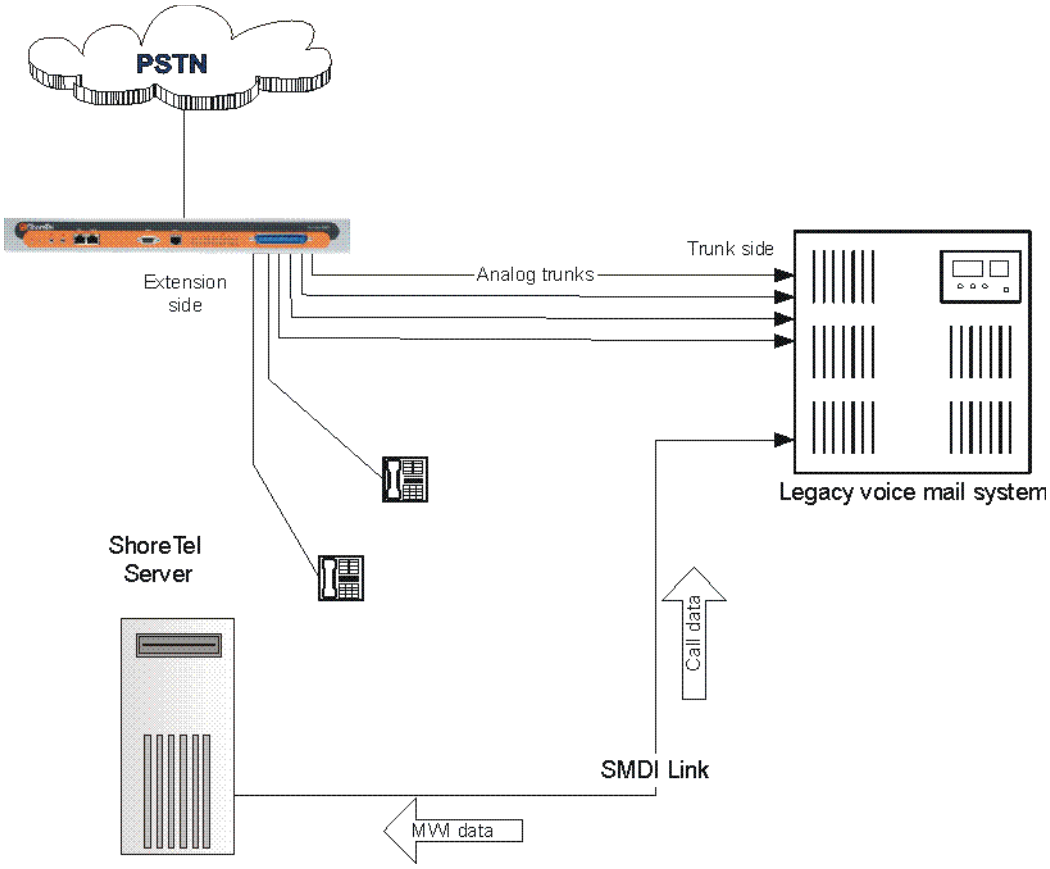

Figure 59: External Voice Mail with ShoreTel as PBX

Figure 60 shows the legacy system providing PBX services and the ShoreTel equipment providing voice mail services.

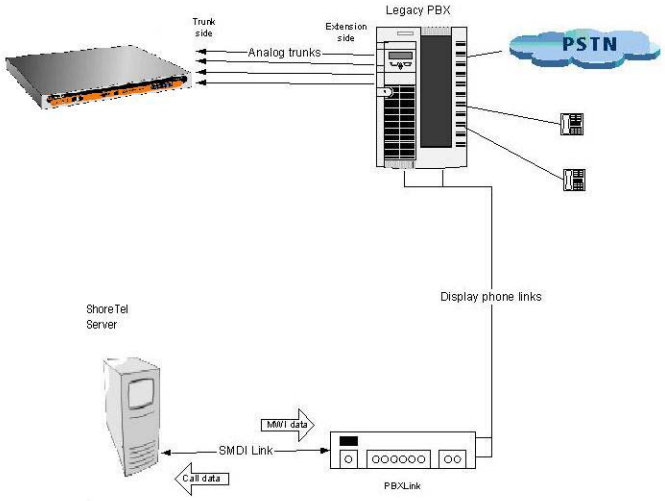

Figure 60: ShoreTel Voice Mail with legacy PBX

Details

- Figure 60 shows a ShoreTel Voice Switch connected to a legacy PBX through several analog trunks. These phone lines carry voice information from the PBX to the voice mail server. Signaling information is carried out-of-band on the separate serial line, which is shown near the bottom of the illustration.
- A ShoreTel voice mail server is connected through a serial cable to a PBX link device. The PBX link device provides the basic SMDI services that were not included in some of the older legacy PBX devices. This device must be purchased separately and configured per the manufacturer's instructions.
- The ShoreTel server and PBX link exchange information. The PBX link sends call data to the ShoreTel voice mail server, and the call data contains information related to the source and destination of the phone call, and provides information about why the call is going to voice mail — user did not answer, line was busy, and so on.
- The ShoreTel server, in return, sends MWI (Message Waiting Indicator) information that is used by the legacy PBX to turn on the message-waiting mechanism on a user's phone to let her know she has received a message.

Information Transferred via SMDI

The COM port is used to send call information between the ShoreTel system and the legacy voice mail system. The SMDI protocol transmits the following call information from the ShoreTel system to the legacy system:

- Message desk number: 1-999

- Logical Terminal number (terminal identifier): 1-9999
- Call type (All, Busy, Direct, No Answer, Unknown)
- Called party
- Calling party

The SMDI MWI protocol transmits the following information from the legacy voice mail system to the ShoreTel system:

- Message waiting indication control
- Extension
- On/Off indication

Configuring Legacy Voice Mail Integration Using SMDI

As mentioned before, there are two modes of operation with respect to integrating a ShoreTel system and a legacy system:

- External Voice Mail Configuration — In this configuration, the legacy system provides voice mail services while the ShoreTel system acts as PBX for users.
- ShoreTel Voice Mail Configuration — In this configuration, the ShoreTel system provides voice mail services while the legacy system acts as a PBX for users.

External voice mail configuration is discussed below, while the procedure for ShoreTel voice mail configuration is in Configuring ShoreTel Voice Mail Integration Using SMDI on page 346.

Integrating a Legacy Voice Mail System with ShoreTel

- Configure the server's COM port for SMDI connections to the legacy system.
- Configure interface options from ShoreTel Director.
- Create a user group for users with access to the integration extensions.

COM Port Setup

To establish the SMDI link between the ShoreTel server and the legacy voice mail system, connect one end of a DB-9 serial cable to the COM port on the ShoreTel server and the other end of the cable to a COM port on the legacy voice mail server.

The COM port settings on the ShoreTel server must match the settings of the COM port on the legacy voice mail server. Obtain the legacy voice mail COM port settings from the legacy voice mail server's administration guide or from your system integration manager. You need the following information:

- Baud rate
- Data bits

- Parity
- Stop bits
- Flow control

Configuring COM Port Communication

1. From the Start menu on the Windows server connected to the legacy voice mail server, select Settings, and then Control Panel.
2. In the Control Panel, open the Computer Management folder.
3. Open the Device Manager.
4. From the right pane in the window, expand the item Ports (COM & LTP).
5. Right-click the COM port used to connect the ShoreTel server and legacy voice mail system, and select **Properties** from the menu.

Note

Contact your server administrator if you need help in determining the correct COM port.

6. In the Properties window, enter the settings for the legacy voice mail server COM port.
7. Click **OK** to save the settings.
8. In ShoreTel Director, open the **Server** edit page.
9. Enter the COM port the server will use for SMDI communications in the COM Port (1-10) text box.
10. Click **Save**.

    The ShoreTel system will not read the COM port settings until you have saved the changes to the Server edit page or until the voice mail service is restarted.

Analog Trunk Port Setup

The ShoreTel system sends calls to the legacy voice mail server over analog trunks connecting the two systems. The extensions are on the ShoreTel side, and the legacy voice mail system is the trunk side. The ShoreTel system sends calls made to these extensions to the legacy voice mail system when voice mail is needed. Before the call is sent, the SMDI protocol sends information about the call to the legacy voice mail system via the SMDI serial link. This allows the legacy voice mail system to handle the call correctly.

Configuring the Extensions

- Create a list of the extensions and include the Logical Terminal Number for each extension.
- Configure the extensions with a new dial number (DN) type and marked as private users with no mail box.

- Assign a physical port to each extension in Director. Configure the extensions to forward to the Backup Auto Attendant on no answer or busy.

Configuring the ShoreTel Server

Follow these steps to set up communication between ShoreTel Director and the legacy voice mail server.

Setting up ShoreTel Director to Communicate with the Legacy Voice Mail Server

1. From ShoreTel Director, click **Servers** in the navigation frame.
2. Select the server connected to the legacy voice mail system.
3. In the Edit Server page under Simplified Message Desk Interface, change the settings as follows:
   a. Make sure that the ShoreTel as PBX box is selected.
   b. In the **COM Port** field, enter the port on the server that will be used for SMDI communication.
   c. In the **Message Desk Number** field, enter the Message Desk number. The range is 1-999, with a default of 1. This number identifies a specific voice mail system and must be set to the value the voice mail system expects. In configurations where a number of SMDI links are daisy chained together, this value is used to allow each system to known what data belongs to it. Since most systems use only one SMDI link, this parameter is normally set to 1.
   d. In the **Number of Digits** field, enter the extension length. The range is 2-32 digits. This value is used to determine how many digits the ShoreTel system sends in SMDI extension fields. This value needs to be set to the value the voice mail system expects. The most common values are either 7 or 10. If the system extension length is less than the number of SMDI digits then the extension number will be padded. For example, if the ShoreTel system needs to send extension 456 and the number of SMDI digits is set to 7, extension 0000456 is sent. If no padding is desired, the number of digits should be set to 2. In the above example with the number of SMDI digits set to 2 only 456 will be sent.
   e. In the **Translation Table** field, select a translation table. Translation tables are created in ShoreTel Director. If you are using a translation table, make sure the **Use for Call Data** and **Use for MWI Data** check boxes are selected. For more information on building translation tables, refer to the ShoreTel System Administration Guide.
   f. Click **Save**.

Digit Translation

If ShoreTel system extensions and legacy voice mail system extensions differ in length, you need to create digit translation tables that map the ShoreTel extensions to legacy system extensions. The digit translation tables must be added as a group of named tables from the Voice Mail section of ShoreTel Director. For more information, refer to the ShoreTel System Administration Guide.

Table 73 shows a digit translation table mapping shorter ShoreTel extensions to longer legacy system extensions. For example, ShoreTel extensions in the range of 5xx will be in the 65xx range on the PBX, and the original digit, 5, will be replaced by 65.

Table 73: Digit Translation Mapping

Extension Mapping		Digit Translation Table	
ShoreTel	Legacy	Original Digits	Replacement Digits
5xx	65xx	5	65
3xx	73xx	3	73
2xx	83xx	2	83

Table 74 shows a digit translation table mapping longer ShoreTel extensions to shorter legacy system extensions. For example, ShoreTel extensions in the range of 75xx will be in sent. to extensions in the 3xx range on the legacy voice mail system, and the original digits, 75, will be replaced by 3.

Table 74: Digit Translation Mapping

Extension Mapping		Digit Translation Table	
ShoreTel	Legacy	Original Digits	Replacement Digits
65	5xx	65	5
66xx	6xx	66	6
75xx	3xx	75	3

Figure 61 illustrates how digit translation functions between the ShoreTel server and legacy voice system.

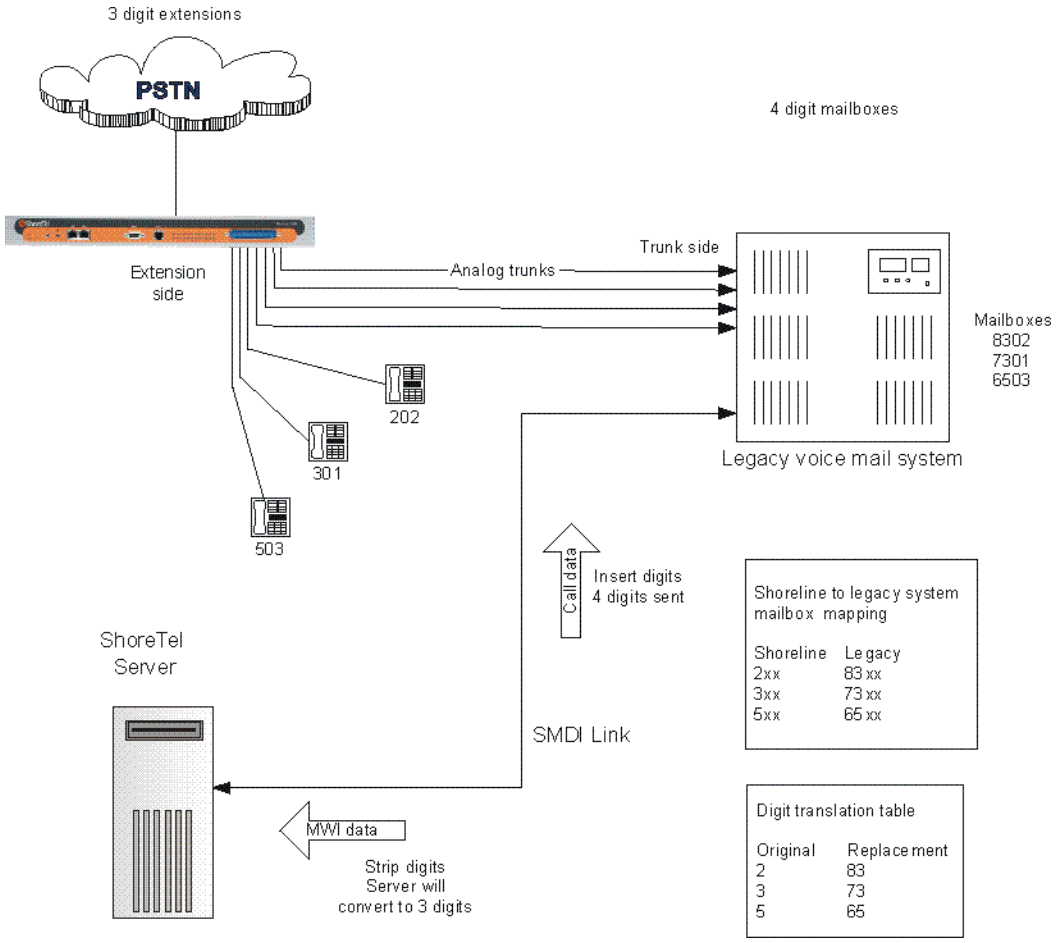

Figure 61: Mixed Extension Length SMDI Integration

Creating a Digit Translation Table

1. Launch ShoreTel Director and enter the user ID and password.
2. Click **Administration > System Parameters**.
3. Click **Digit Translation Tables**.
4. Click the **New** button.
5. Enter a name in the **Name** field and click **Save** to store your digit translation table.
6. Click the **New** button again to display the Digit Translation window, as shown in Figure 62.

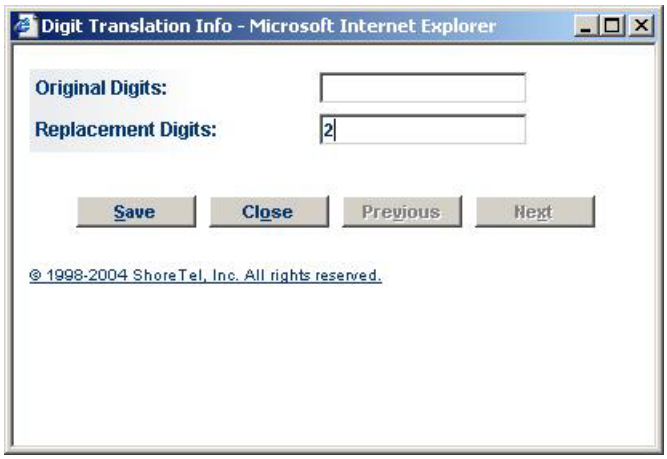

Figure 62: Leave Original Digits blank to add a digit to all legacy extensions

Next, you must select the digit translation mapping that you just created at the server.

7. Click the **Application Servers** link and click on the name of the ShoreTel server that will be handling the digit translation.

8. In the Simplified Message Desk Interface section of the Application Servers window, select **ShoreTel Voice Mail** from the Mode drop-down menu. The **Translation Table** drop-down menu appears.

9. Click on the arrow button and select the name of the digit translation table that you just created.

10. Select the **Use for Call Data** check box and **Use for MWI Data** check box by placing a check mark in each one as shown below. Doing so allows for the digit translation to occur under the following circumstances:

    - Data about a call is transferred between the legacy and ShoreTel systems.
    - Message Waiting Indicator information is transferred between the two systems to notify the legacy PBX that a message was left on the ShoreTel voice mail.

11. By default, the **Use Flash to Route Calls** check box is enabled. Leave this as is. Note that this check box only appears when **ShoreTel Voice Mail** is selected in the **Mode** drop-down menu in the Simplified Message Desk Interface section of the window. If selected, calls sent to the ShoreTel Auto Attendant from the SMDI trunk group are automatically transferred to the dialed extension using flash. If not selected, calls will be routed using other lines.

    The extension length must be the same on each of the systems for the Transfer Using Flash feature to work as no translation is applied.

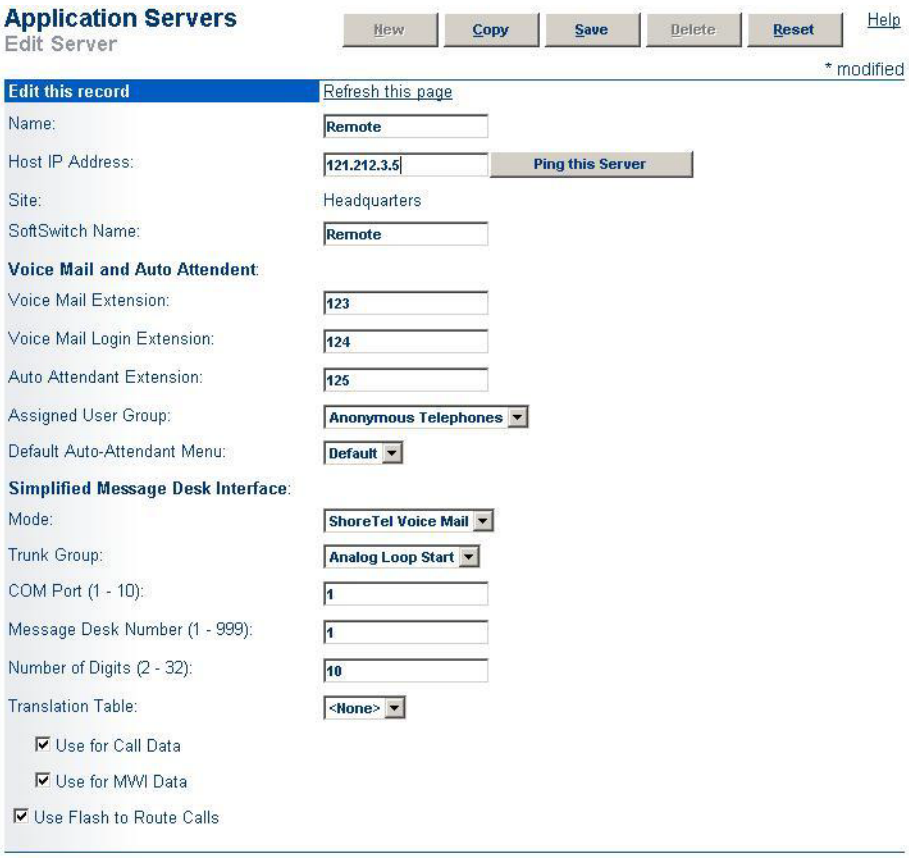

Figure 63: Enabling digit translation for MWI and call data, and flash routing

12. Click the **Save** button to store your changes.

Setting Up the User Group in ShoreTel Director

Follow these steps to set up a user group for those users who will have their voice mail re-directed to the legacy voice mail system.

1. Open ShoreTel Director.
2. From the navigation frame, click **Users > User Groups**.
3. Select an existing user group or create a new user group.
4. Change the **Simplified Message Desk Interface Mode** option to ShoreTel as PBX by selecting this setting from the drop-down menu.
5. Click **Save**.

Configuring ShoreTel Voice Mail Integration Using SMDI

As mentioned before, there are two modes of operation with respect to integrating a ShoreTel system and a legacy system:

- External Voice Mail Configuration — In this configuration, the legacy system provides voice mail services while the ShoreTel system acts as PBX for users.
- ShoreTel Voice Mail Configuration — In this configuration, the ShoreTel system provides voice mail services while the legacy system acts as a PBX for users.

External voice mail configuration is discussed in Configuring Legacy Voice Mail Integration Using SMDI on page 339. The procedure for ShoreTel voice mail configuration follows.

ShoreTel voice mail configuration consists of the following major tasks:

- Creating a Trunk Group
- Creating Trunks
- Configuring the ShoreTel Server for SMDI
- Creating a User Group
- Adding an Individual User
- Configuring the Serial Connection
- Configuring Digit Translation Tables
- PBX link

Creating a Trunk Group

One of the first tasks involved in configuring SMDI is to create a trunk group. The trunk group is used to manage the individual trunk lines between the ShoreTel Voice Switch and the legacy PBX. Instructions for creating the trunk group are provided below. For additional details on setting up trunk groups, refer to the ShoreTel System Administration Guide.

Complete the following steps to create a trunk group for SMDI trunks:

1. Launch ShoreTel Director and enter the user ID and password.
2. Click the **Administration** link to expand the list if it has not already been expanded.
3. Click the **Trunks** link to expand the list.
4. Click the **Trunk Groups** link to display the Trunk Groups window.
5. Select the trunk group site, and select **Analog Loop Start** for the type, and then click the **Go** link.
6. Enter a name for the trunk group in the **Name** field, as shown below.

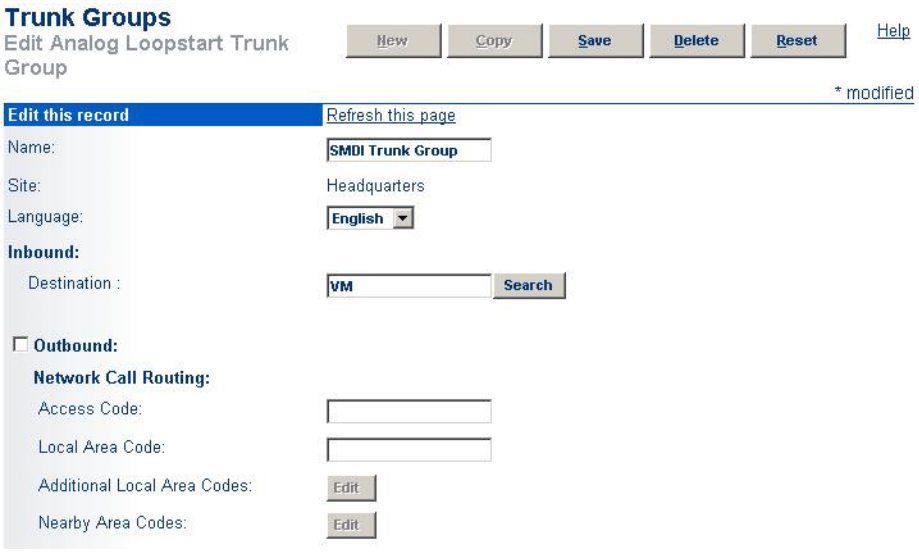

Figure 64: Creating a trunk group

7. Enter a voice mail extension in the **Inbound Destination** field to direct inbound calls to the ShoreTel Auto Attendant system.

8. Click the **Save** button to store your changes.

Creating Trunks

After creating the trunk group, the next step is to create one or more trunk lines representing each data connection between the ShoreTel Voice Switch and the legacy PBX. The lines between the PBX and ShoreTel voice mail must be trunk lines with ShoreTel being the trunk side and the PBX being the extension side. For example, calls leaving the PBX for the voice mail system will leave on extensions. The PBX-to-voice mail connection might also be a T1 trunk that uses a channel bank to provide extensions to the legacy PBX.

1. With ShoreTel Director still open, click the **Trunks** link to expand the list.

2. Click the **Individual Trunks** link.

3. Select the trunk line site — Headquarters or Remote — from the drop-down menu, and use the drop-down menu to find and select the name of the trunk group you just created.

4. Click the **Go** link to display the Edit Trunk window, similar to the one shown below.

Figure 65: Creating a trunk line

5. In the **Number** field, enter the Logical Terminal Number (LTN). This value can range from 1 to 9999. For many systems the extension number of the port is used.

   The LTN identifies the port the PBX will use to send the call to the ShoreTel voice mail system. It is very important that the LTN match what the PBX will send. You must check with your PBX vendor to determine what will be sent.

6. Click the **Save** button to store your changes.

Configuring the ShoreTel Server for SMDI

After creating the trunk lines, you will configure the ShoreTel voice mail server. Configuration involves setting up the various SMDI parameters:

1. With ShoreTel Director still open, click on the Application Servers link.
2. Click on the name of the server — Headquarters or Remote — that will be acting as the voice mail server for the legacy PBX.
3. In the Simplified Message Desk Interface section of the Application Servers window, click the drop-down menu and select **ShoreTel Voice Mail**. A new set of fields and menus related to SMDI appear.

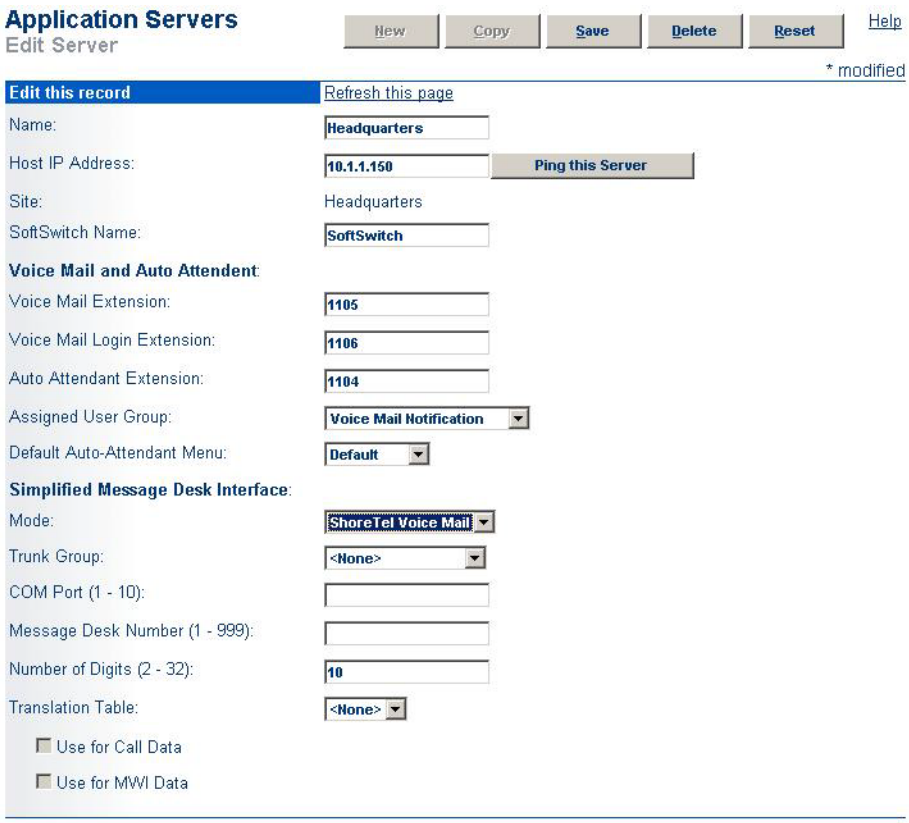

Figure 66: Configuring ShoreTel voice mail server

4. In the **Trunk Group** drop-down menu, select the name of the SMDI trunk group that you created earlier. This tells the server the name of the trunk group from which it should expect to receive voice mail calls.

5. In the **COM Port** field, enter the numerical value, which is between 1 and 10, that corresponds to the serial port of the ShoreTel server where you will be connecting the serial port. This serial port will be used to route out-of-band SMDI signaling information between the PBX link device and the ShoreTel server.

6. The **Message Desk Number**, which has a range of 1-999, is optional and can be set to the default value of 1. Check with the vendor for this value.

   The **Message Desk Number** is used to indicate a specific system in situations where a number of SMDI links have been daisy-chained together. This value allows each system to known which data belongs to it. In most case this parameter is set to 1, since only one system will be using the SMDI link.

7. The **Number of Digits** field, which has a range of 2-32, is optional.

   This value determines how many digits the ShoreTel system will send in SMDI extension fields. This value needs to be set to the value the voice mail system expects. The most common values are either 7 or 10. If the system extension length is less than the number of SMDI digits, then the extension number will be padded. For example, if the ShoreTel system needs to send extension

456 and the number of SMDI digits is set to 7, extension 0000456 will be sent. If no padding is desired the number of digits should be set to 2. In the above example with the number of SMDI digits set to 2 only 456 will be sent.

8. The translation table is optional and can be left as is for now. We will be returning to the related topic of digit translation tables later.

9. Click the **Save** button to store your changes.

Creating a User Group

After setting up the ShoreTel voice mail server for SMDI, the next step is to add users to the system. You will create a user group, and in this user group you will specify that all members will use ShoreTel Voice Mail. Once this is done, then you will modify user profiles at the individual level. For now, we will talk about creating the user group.

Complete the following steps to create a user group for users on the legacy PBX system:

1. With ShoreTel Director still open, click on the **Users** link to expand the list.

   a. Click the **User Groups** link.

   b. Click the **Add New** link to display the User Group**s** window.

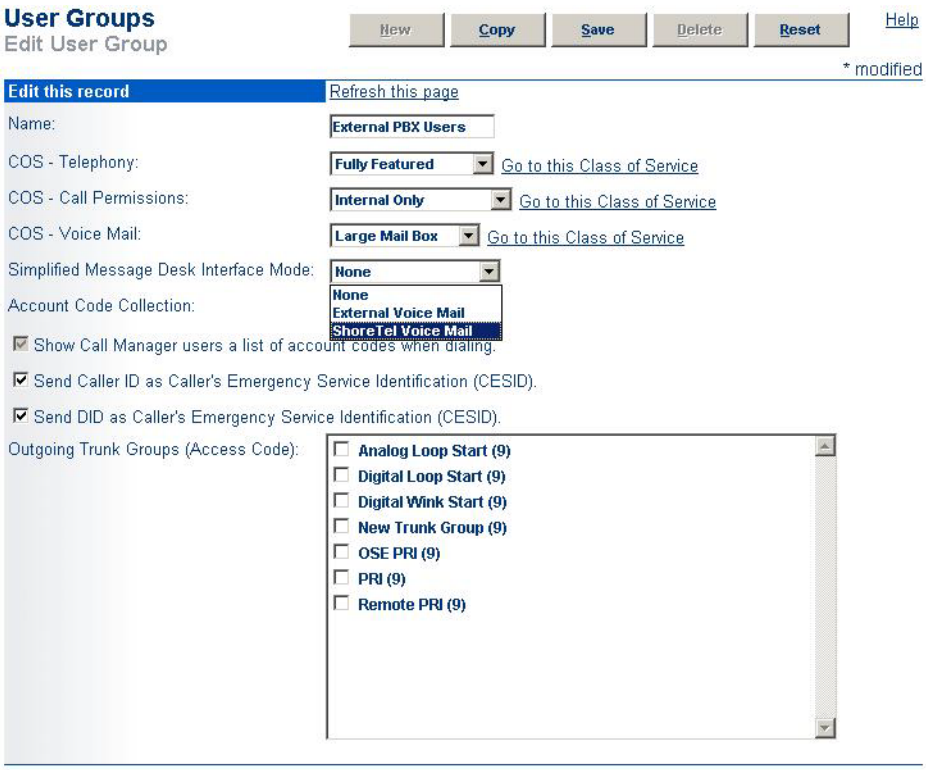

Figure 67: Creating a user group for legacy users

2. Enter a **Name** for the user group.

3. In the Simplified Message Desk Interface Mode drop-down window, select **ShoreTel Voice Mail** from the list.

4. Click the **Save** button to store your changes.

Adding an Individual User

After creating the user group, you can create user profiles for the legacy PBX users.

1. With ShoreTel Director still open, click the **Users** link to expand the list.

2. Click the **Individual Users** link.

3. In the **Add new user at site** field, select the server where you configured the ShoreTel voice mail for the PBX link device.

4. Click the **Go** link to display the **Edit User** window, shown below.

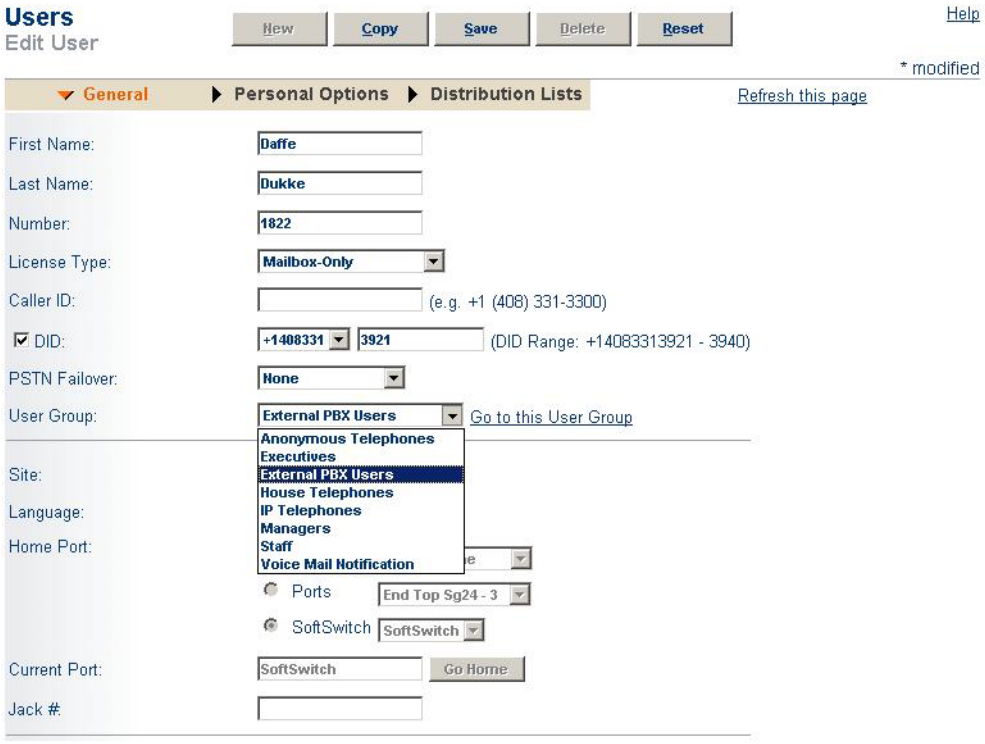

Figure 68: Creating a user record for a legacy user

5. Enter a name for the user in the **First Name** and **Last Name** fields.

6. In the **License Type** drop-down menu, click the arrow-button and select **Mailbox-Only.** The user is located on the legacy system and thus, he or she does not require a ShoreTel extension.

7. In the **User Group** drop-down menu, click on the arrow-button and find and select the name of the user group you just created.

8. Click the **Save** button to store your changes.

Configuring the Serial Connection

The ShoreTel voice mail system will only support one serial link per application server. To support another legacy PBX, you will need another ShoreTel distributed application server. A serial cable, such as a null modem, should be used to connect the legacy PBX to one of the COM ports of the ShoreTel server. Note that the ShoreTel system will extract the serial port settings, such as baud rate and parity bit values, from the Windows COM port settings. These settings can be verified by following the procedure below:

1. Right-click **My Computer**.
2. Select **Manage**.
3. Select **Device Manager**.
4. Left-click on **Ports (COM & LPT)**.
5. Right-click **Communications Port (COM1)** and select **Properties**.
6. Left-click on the **Port Settings** tab.
7. Verify that the settings match those suggested by the documentation that came with your legacy PBX device.

PBX

Table 75: Supported PBXs

Manufacturer	Model
Nortel	Meridian 1 Nortel Norstar
Avaya	System 75/85 Definity
Mitel	SX50 SX200 SX2000
Siemens	300S
NEC	NEAX

PBX link

A PBXLink device may be needed to provide SMDI services for a legacy PBX that does not offer support for SMDI. The PBXLink devices, manufactured by CTL, provide integration services to allow certain digital PBXs to interface seamlessly with a Voice Messaging System. The PBXLink connects to the PBX using a digital telephone line and to the Voice Messaging System using an RS-232 link. The PBXLink uses information appearing on the emulated digital set to determine the original source and

destination of the calls being forwarded to the voice mail system. This information is then communicated to the voice mail system on an RS-232 serial link using the industry standard Centrex SMDI protocol. The PBXLink is compatible with SMDI-compatible voice mail systems.

When using SMDI and ShoreTel voice mail configuration, the following features will not be supported:

- Extension Assignment
- Setting call handling mode
- Setting agent state

The following features will be supported:

- Recording greeting and name
- Setting TUI password
- Enable/disable envelope information
- Email voice message options
- Find Me
- Message functions including call back
- Message sending functions
- Workgroup
- ShoreTel voice mail
- Agents cannot be extensions in the legacy PBX
- System configuration
- Configuration parameters

System Requirements

The following are required on the ShoreTel system, or on the legacy PBX to enable the integration of the two systems:

- ShoreTel system
  - ShoreTel Voice Switch that supports a T1 circuit.
- Legacy PBX
  - T1 or PRI card for the PBX
  - Available card slot and capacity for the added trunks
  - Required software or licenses to support the desired trunk interface

If PRI is used in the integration interface, the legacy PBX must emulate the CO or support Network Side PRI.

Connection Cable

Special Considerations — Nortel PBX

When integrating with a Nortel Meridian PBX, a T1 connection must be used since the legacy system does not support Network Side PRI.

Special Considerations — Avaya/Lucent PBX

Universal Dial Plan (UDP) Must be Active — This capability enables transparent dialing between the Avaya/Lucent PBX and the ShoreTel system. If this is not active, users on the PBX will either have to dial a trunk access code to reach the users on the ShoreTel system, or configure forwarding from an extension in the legacy system to the ShoreTel extension using the trunk access code and the extension.

In some cases, this feature must be purchased separately from Avaya/Lucent.

Administration and Configuration

Tie Trunk Configuration

The following summary describes the administration and configuration of the digital trunk for connecting the ShoreTel system to the legacy system.

Services Summary

Before starting, a summary of the required configuration should be made based on the required services in the interface.

Table 76: Service Configuration Requirements

Desired Service	Required Configuration
Extension-to-Extension Calling	Enable inbound services on the trunk.
	Direct inbound calls using extension routing to the ShoreTel extensions.
	Enable off-system extensions.
	Define off-system extension range to match extensions on the remote PBX.
Inbound Trunks on Remote PBX	Enable inbound services on the trunk.
	Direct inbound calls using extension routing to the ShoreTel extensions.
	Outbound trunks on the remote PBX enable outbound services on the trunk.
	Configure any required access code for the trunk and the local area code for the trunks connected to the remote PBX.
	Configure the desired trunk services such as local, long distance, and so on.
	Configure the dialing format and any required digit sequences that are to be pre-pended to the dialed numbers. Users require trunk group access rights to use the trunk for outbound calls.
Consolidated Long Distance	Enable outbound services on the trunk.
	Configure any required access code for the trunk and the local area code for the trunks connected to the remote PBX.
	Configure trunk services, such as long distance and international.
	Configure the dialing format and any required digit sequences that are to be pre-pended to the dialed numbers. Users require trunk group access rights to use the trunk for outbound calls.

Trunk Configuration

The following steps describe how to configure the trunk for integrating the legacy PBX and the ShoreTel system. Some steps are optional depending on the types of services desired as summarized above.

Creating a New Trunk Group

1. In the ShoreTel Director, select Trunk Groups from the navigation frame to open the Trunk Groups list page.
2. Select the site where the trunk will be integrated and the type of trunk to configure — Digital Wink Start for T1 or PRI for PRI — and select **Go**. The new trunk group is created and the Trunk Group Edit page appears.
3. Click **Save** to store the trunk group configuration changes.

Configuring an Inbound Services with Extension Routing

1. In ShoreTel Director, open the Trunk Group edit page for the tie trunk.
2. Configure the number of digits received to match the number of digits sent by the remote PBX. This must match the extension length.
3. Enable **Extension Routing**. This directs all the received calls to the configured ShoreTel extension that matches the received DNIS digits.
4. Select a **Destination** to provide a back-up when the received digits do not match an extension in the ShoreTel system.
5. Click **Save** to save the trunk group configuration.

Configuring an Off-system Extensions

1. In ShoreTel Director, open the Trunk Group edit page for the tie trunk.
2. Select the **Edit** button by the off-system Extensions. The Off Systems Extension Range dialog is displayed.
3. Click **New** and define the extension ranges for the extension off the remote PBX.
4. Click **Save** to save the trunk group configuration.

Configuring an Outbound Call Routing via the Remote PBX

1. In ShoreTel Director, open the Trunk Group edit Page for the tie trunk.
2. Enable outbound services by selecting the **Outbound** check box.
3. Configure the access code and areas codes for the trunk to match the PSTN connection of the remote PBX.
4. Select the desired trunk services to match the services provided via the remote PBX.
5. Select the desired Trunk Digit Manipulations to match the tie trunk and the required dialing for the PSTN connection to your legacy PBX.

6. As needed, configure the local prefixes and pre-pend digits to match the tie trunk and the required dialing for the PSTN connection to your legacy PBX.

   For additional information on trunk configuration and information on configuration options, refer to the ShoreTel System Administration Guide.

CHAPTER

19

Cut-Over

This chapter provides the requirements and other information for implementing the cut-over from your existing telephone system to the ShoreTel system. The topics discussed in this chapter include the following:

- Cut-Over Requirements 360
- Cut-Over Worksheet 360
  - New Trunks 360
  - Cut-Over Coverage 360
- Cut-Over Implementation 360
  - Basic Cut-Over Checklist 361
  - Trunking Cut-Over 361
  - Cut-Over of Remaining Devices 362
  - Cut-Over Coverage 360

Cut-Over Requirements

As cut-over approaches, you should review and confirm your plan, assemble the cut-over tools, and line up resources to support the cut-over.

Cut-Over Worksheet

The cut-over worksheet is used by the installer during the cut-over to move all end-users from the old system to the new. It is extremely important that the cut-over worksheet be prepared before the cut-over begins. You can use the cut-over worksheet at the end of this chapter to document all new and existing connections. A soft copy of this form is available in a planning and installation workbook from ShoreTel. Make copies as necessary.

New Trunks

New trunks should be installed before cut-over. This allows time for them to be terminated, configured, and tested with the ShoreTel system.

Cut-Over Coverage

There are two aspects to cut-over coverage:

- The team involved with planning the ShoreTel system must be on site before, during, and after cut-over.
- Appropriate coverage must be scheduled to monitor the newly installed ShoreTel system for errors and last-minute configuration changes, and to help end-users with any questions they might have. ShoreTel recommends that you have support personnel on site before the first users arrive, to ensure that the system is functional and that telephone calls are processed properly.

Cut-Over Implementation

Once planning is completed, it is time to bring the ShoreTel system into service. Use the checklists in this section to implement the cut-over, starting with the top-level checklist below.

Table 77: Cutover Implementation Checklist

Description	Completed
Complete the tasks listed on the basic cut-over checklist.	
Cut-over and test all trunks.	
Cut-over and test the remaining devices (telephone, fax machines, modems, and so on).	
Confirm the cut-over coverage.	

Basic Cut-Over Checklist

Table 78: Basic Cut-Over Checklist

Description	Completed
Secure the telephone company's contact names, telephone numbers, and pager numbers for testing.	
Set up a command center to support cut-over activities.	
Ensure that copies of the floor plans and cut-over worksheets are available.	
Secure access to building and office areas that require ShoreTel voice switch telephones.	
Ensure that a telephone is installed next to the ShoreTel voice switch for testing.	
Ensure that music-on-hold is installed and tested.	
Record and test the auto-attendant greeting for on-hours and off-hours.	
Test all telephones.	
Test paging and night bell features, if applicable.	

Trunking Cut-Over

For existing trunking, use the cut-over worksheets to identify the trunks that are used from the old system (if applicable), and terminate them on the voice switches. Use a test telephone to dial in and out of each trunk, verify that it routes to the correct location, and listen closely to the voice quality.

When preparing new trunks for installation, use the following checklist.

Table 79: Trunking Cutover Checklist

Description	Completed
Identify the new trunks.	
Terminate the new trunks on the ShoreTel voice switches.	
Contact the telephone company's tester, and test each trunk (one at a time).	
Agree on the specific trunk that is being tested.	
Have the tester dial in on the new trunk.	
Answer the incoming call on a test telephone.	
Observe overall voice quality.	
Go through this checklist until all trunks are tested.	

When all of the trunks have been tested, have the telephone company's tester open the trunk group, and allow the callers to use the new trunks.

Cut-Over of Remaining Devices

Use the following checklist to test each new end-user device that is being installed.

Table 80: Remaining Devices Cutover List

Description	Completed
Place an internal call from the new device.	
Place an external call from the new device.	
If applicable, place a DID call.	
If the device is for a user with voice mail, leave a welcome message.	
Leave a user guide on the user's desk. This provides information about the ShoreTel system's commonly used features as well as general system information.	

Cut-Over Coverage

It is recommended that the cut-over team arrive on site before the beginning of the next business day after cut-over, to answer questions from end-users as they begin to use the ShoreTel system.

Cut-Over Worksheet

Table 81: Cutover Worksheet

Name	Extension	ShoreTel Port #	Patch Panel #	IDF #	Station Cable #

CHAPTER 20

Training

ShoreTel QuickStart is a virtual training program that is revolutionizing the way people learn to operate the ShoreTel system. QuickStart is an innovative, no-hassle approach to preparing system administrators, operators, and users for their ShoreTel implementation. It contains the following information:

Overview 366
Recommendations 366
Training Materials 366
End-User Training 366
Operator Training 367
Workgroup Training 367
System Administrator Training 368

Overview

ShoreTel is committed to ensuring that our customers have the tools and knowledge base they need to take full advantage of the new era of communication convergence. ShoreTel QuickStart fulfills that commitment.

All the courses available through ShoreTel QuickStart are provided online for your convenience. Some instruction modules include simple interactive tutorials that introduce you to basic features and configurations of your new ShoreTel system. More advanced technical training is available via live interactive web-based sessions or in-classroom instructor led training. In these advanced sessions you can learn about software configuration options and troubleshooting tips from an instructor providing valuable feedback for your specific issues.

For more information, please contact your ShoreTel-authorized partner.

Recommendations

The following recommendations will assist you with training:

- It is critical that all employees, workgroup agents/supervisors, and operators be familiar with ShoreTel services before the system is put in service.
- Be sure to consider training needs as your staff changes over time. You can return to ShoreTel QuickStart to train new employees on the use of the ShoreTel system.

Training Materials

The following training materials are available:

- User guides and self-paced online tutorials are available through the ShoreTel Communicator Help menu or from ShoreTel's online knowledge base.
- System administration training and end-user training are available through a ShoreTel-authorized partner or through ShoreTel, Inc.
- Additional training materials can be downloaded from ShoreTel.

End-User Training

ShoreTel offers online tutorials to familiarize end-users with the features and functionality of the ShoreTel Communicator client. The tutorials do not require registration, and users can take the course on their own schedule and timing. The on-line course emphasizes the common features and functions

in ShoreTel Communicator. Users learn how to install the client, answer calls, transfer calls, make conference calls, and access voice mail. A sound card and loudspeakers are helpful but not necessary for a user to take the course.

Operator Training

Operators, receptionists, and administrative assistants have special needs and responsibilities. In addition to the ShoreTel Communicator - Operator Access tutorial, ShoreTel offers an interactive online session in which such users can learn how to maximize the power of the ShoreTel system.

We encourage company operators, receptionists, or administrative personnel who support multiple managers to participate in a one-hour, live interactive web session that introduces the ShoreTel Communicator - Operator Access. The training covers these topics:

- Answering, transferring, and conferencing calls
- Accessing voice mail
- Using toolbar shortcuts
- Monitoring extensions
- Call routing
- Call handling modes

Class participants are able to experience a live ShoreTel system and ask questions of the instructor.

As a prerequisite for this class, ShoreTel asks that all class participants view the ShoreTel Communicator - Operator Access tutorial.

Operator training should be completed before your cut-over date.

Workgroup Training

Workgroups, such as those in a small call center, are empowered with special features and functionality. In addition to viewing the ShoreTel Communicator - Workgroup Access tutorial, you can learn more by signing up for ShoreTel's special online training sessions on this subject.

ShoreTel encourages those customers who will be using the ShoreTel Communicator - Workgroup Access to participate in a one-hour, live interactive web session introducing the ShoreTel Communicator - Workgroup Access. These sessions are available to ShoreTel customers on a request basis and concentrate on the workgroup configuration of the requesting company.

The training covers these topics:

- Answering, transferring, and conferencing calls
- Accessing voice mail
- Using toolbar shortcuts
- Monitoring agent extensions
- Monitoring calls in the queue
- Call routing and call distribution
- Call handling modes

Class participants are able to experience a live ShoreTel system and ask questions of the instructor. Contact your ShoreTel-authorized partner or visit the ShoreTel QuickStart web center for more information regarding course content and registration.

As a prerequisite for this class, ShoreTel asks that all class members view the ShoreTel Communicator - Workgroup Access tutorial.

Workgroup training should be completed before your cut-over date.

System Administrator Training

ShoreTel welcomes system administrators to review course content and register for an interactive training session on the ShoreTel Director software. This training complements the documentation available for the system and gives system administrators the opportunity to interact with a ShoreTel system expert.

ShoreTel's system administration training is designed for IT professionals who will be responsible for the configuration and ongoing support of the ShoreTel system. The training covers these topics:

- Getting started
- Setting up single-site and multisite environments
- Configuring ShoreTel Voice Switches
- Trunks
- Users
- Voice mail
- Automated attendant menus
- Workgroups
- Maintenance

The class, which is led by an online instructor, lasts about four hours. Participants are able to interact with a ShoreTel system and ask questions of the instructor. Contact your ShoreTel-authorized partner or visit the ShoreTel QuickStart web center for more information regarding course content and registration.

Please register for system administration training at least three weeks before your proposed cut-over date.

APPENDIX A

International Planning and Installation

This chapter provides information about voice switches, operating systems, and features that are supported when the ShoreTel system operates outside the United States of America. The topics in this appendix include:

- Software and Feature Support 370
- Language Packs 370
  - Language Options 370
- Analog Telephones, Tones, Cadences, and Impedances 372
- Dialing Plan Considerations 373
  - Single-Extension Plan 373
  - Trunk Access Codes 373
  - Operator Digit 373
  - Emergency Numbers 373
  - DID Numbers 374
- Carrier Codes 374

Software and Feature Support

For information about our worldwide support for software and features, contact a ShoreTel Sales Partner or refer to the ShoreTel Country Availability Web page at:

```
http://www.shoretel.com/international/
```

Language Packs

Language packs determine the language in the following parts of the system:

- Voice prompts (Voice mail, Auto Attendant, system announcements)
- Telephone User Interface (telephone display and ShoreTel Communicator interface)
- Online help for ShoreTel Communicator

Language pack availability affects the behavior of the system in the following areas:

- Site
- Trunk
- Workgroup
- Auto Attendant
- Voice Mail
- User
- ShoreTel Communicator

Language Options

The following pages allow you to program language options:

- Edit Site: The Edit Site page, shown in Figure 69, specifies the language pack used by the Backup Auto-Attendant (BAA) or by any ShoreTel 400-Series IP phones that do not have a user assigned.

  To access the Edit Site page, select **Administration > Site** from the main menu, then click on the name of the desired site.

Figure 69: Language set at Site level

- Edit Workgroup: The Edit Workgroup page, shown in Figure 70, specifies the language that the system uses for playing prompts to inbound callers.

  To access the Edit Workgroup page, select **Administration > Workgroups** from the main menu, then click on the name of the desired site.

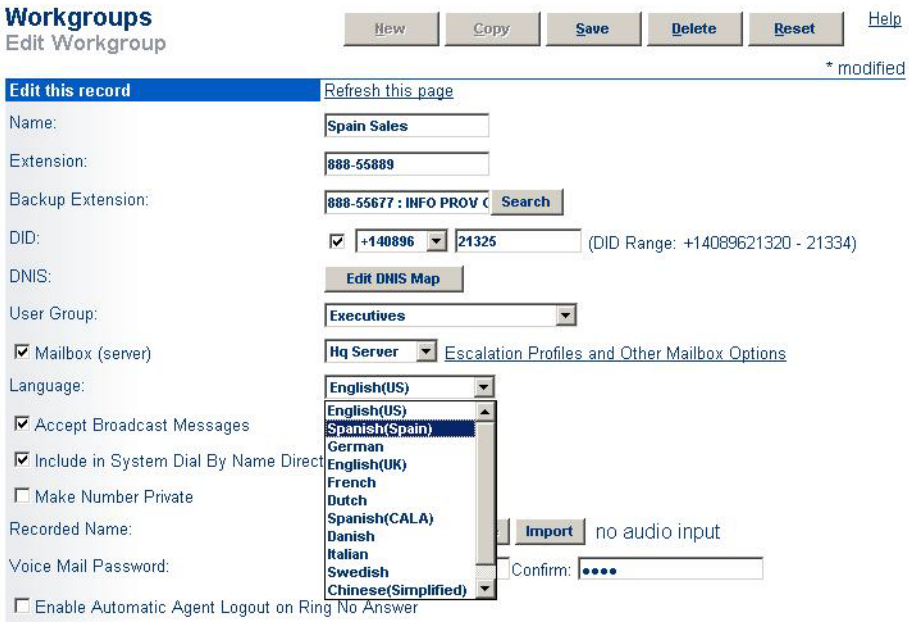

Figure 70: Language set at Workgroup level

- Edit Trunk Group: The Edit Trunk Group page, shown in Figure 71, specifies the language prompts are played to incoming callers.

  To access the Edit Trunk Group page, select **Administration > Trunks > Trunk Groups** from the main menu, then click on the name of the desired trunk group.

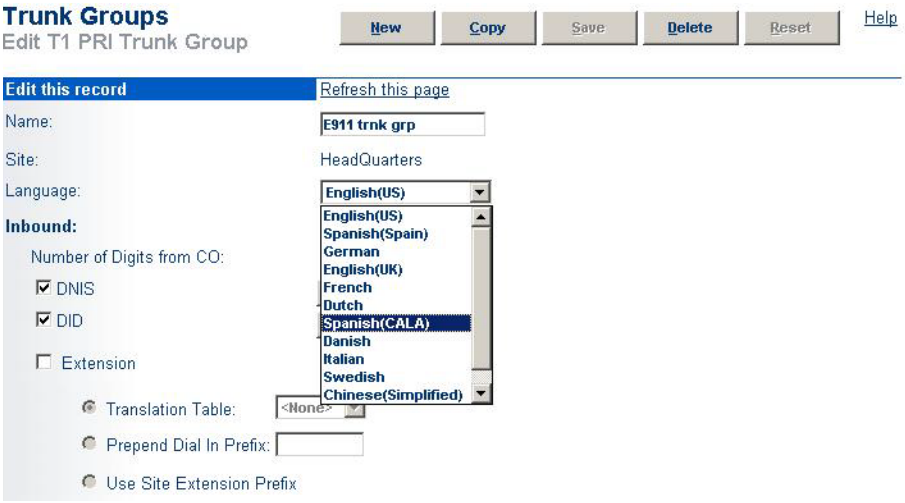

Figure 71: Language set at Trunk Group level

- Edit User: The Edit User page, shown in Figure 72, specifies the language prompts used for the user's telephone interface and voicemail prompts.

  To access the Edit User page, select **Administration > Users > Individual Users** from the main menu, then click on the name of the desired user.

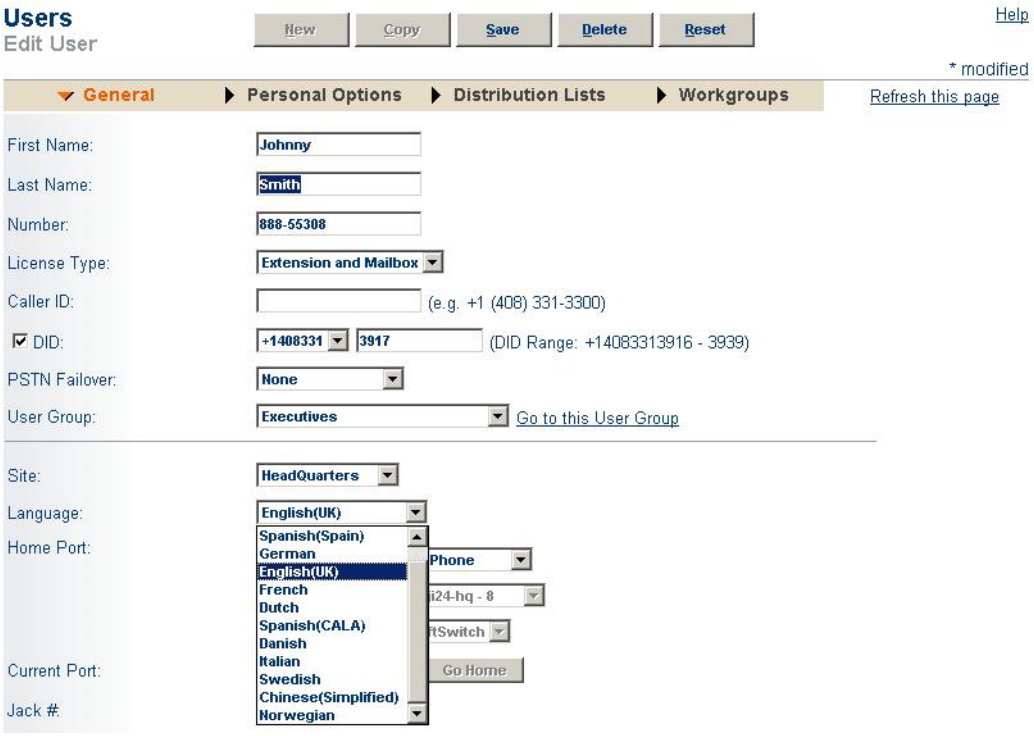

Figure 72: Language set at User level

In language priority, a workgroup language overrides the language associated with a trunk, which in turn overrides the language associated with an individual user.

Analog Telephones, Tones, Cadences, and Impedances

For all supported countries, standard analog telephones are available on a per-country basis. The main difference between telephones in different countries is the line impedance. The ShoreTel Distributed Call Control software will provide the appropriate impedance required for each supported country. Tones, cadences, and impedance requirements are matched on a per-country basis.

Dialing Plan Considerations

When planning a global voice network, remember that the ShoreTel system is a single image system and that you must consider all countries and locations when designing the international dialing plan. The ShoreTel system can match the dialing plan requirements of the local service provider for the supported countries.

Single-Extension Plan

Across the global voice network, all extensions must be unique and cannot overlap.

Trunk Access Codes

Across the global voice network, when you configure trunk access codes, that portion of the dialing plan will be reserved so you will be sacrificing one digit. Typically in the US, customers use 9 as a trunk access code. Internationally, those in the EMEA, for instance, often use 0 as a trunk access code. The following are some things to consider when you create a trunk access code:

- Using two different trunk access codes will limit users to only being able to access certain trunk groups.
- If you use a single trunk access code, some users will need to be retrained.
- Alternatively, 8 could be defined for the trunk access code globally.

ShoreTel recommends proper identification from the beginning. The trunk access code should not be changed later.

Operator Digit

The leading digit of 0 is typically reserved for dialing the operator in the US. The operator digit is configurable. Similarly, EMEA customers are accustomed to dialing 9 to reach the operator.

ShoreTel recommends choosing a single digit for the trunk access code and selecting a different single digit for the operator.

Emergency Numbers

The ShoreTel system allows dialing of emergency numbers with and without trunk access codes. For this reason, you should architect the dialing plan for this feature.

- 911 is used in the US.
- 112 is used in Europe and other countries.
- Check for other countries and regions for local requirements.

Thus, extensions should not begin with 0, 1, or 9 to make use of this feature.

Each site can have a maximum of ten emergency numbers to accommodate locations where multiple emergency service numbers are required.

For more information about emergency numbers, see the appendix in the *ShoreTel System Administration Guide* about emergency 911 operations.

DID Numbers

DID numbers are related to the trunk group in which they are associated. You should strive to match the last digits of the DID number to the user's extension number.

Carrier Codes

Certain countries provide an option for requiring one or two numbers that the ShoreTel user must press after the trunk access code (usually a 9 or an 8) and before an area code or another nation's country code. The purpose of this option is to get the lowest-cost route for long-distance or international calls. When the user presses this code, the call goes out a trunk to a carrier that the system administrator has specified. If the user makes a long-distance or international call without this code, the ShoreTel system selects the trunk.

This section defines the carrier codes that certain countries use and lists the numbers that the user presses to utilize the associated trunks. The two definitions that readers need for this description are as follows:

Carrier code: This number specifies a carrier. The system administrator assigns this code to a trunk group so that calls go to that carrier when the user prepends the country code to a phone number. System administrators in applicable countries must know the code for the carriers they want to give preferential business. The user does not see this carrier code.

Country code: This country code is a nation-wide number that a user presses to direct long-distance or international calls to the carrier that the carrier code specifies. This country code is not the number that callers from outside a country use to reach the country. For example, the country code that callers outside of Singapore use to reach that country is 65, but from inside Singapore, the country code that a caller presses to direct an international call to a specific carrier is 01.

Using the Singapore example: if a trunk access code is 9 and the ShoreTel user with international calling permission initiates a call to India, the number sequence is as follows:

9 01 91 <telephone number>

As of the current release, six countries use this code function. Table 82 lists the carrier code and application for the countries that use them.

Table 82: Carrier Code by Country

Code	Country and Application
55	Brazil, all calls
1	Hong Kong, international calls
2	South Korea, international calls
01	Singapore, international calls
2	Taiwan, international calls
1	Thailand, international calls

APPENDIX B

Regulatory and Safety Information

This chapter provides detailed information regarding compliance of the ShoreTel system with the international regulatory bodies. The chapter also addresses safety as it relates to installation, operation, and regular use of the ShoreTel system. The topics discussed in this appendix include:

Agency Approvals 378
EMC Compliance Statements (SG-8/12/24 and T1) 379
United States 379
European Union 379
Canada 380
Restricted Access Location 380
WEEE Information 380
Safety 380
Important Safety Instructions 380
Electrical Safety 381

Agency Approvals

Table 83: Agency Approvals

Category	Regulatory Compliance / Agency Approval
EMC	EN 55022 Class A (SG-12, SG-8, SG-24, SG-T1)
	EN 55022 Class B/Class A (SG-E1)
	FCC Part 15 Class A (SG-12, SG-8, SG-24, SG-T1)
	EN 55024:1998 including amendments A1:2001 and A2:2003 (SG-24, SG-E1)
Electrical Safety	FCC Part 68 for SG-24, SG-T1
	IEC 60950:1999 3rd ed. SG-8, SG-12, SG-24, SG-T1, SG-E1
	EN60950:2000 SG-8, SG-24, SG-T1, SG-E1
	AS/NZ 60950:2000 SG-8, SG-24, SG-T1, SG-E1
	UL60950 3rd ed. 2000 SG-8, SG-12, SG-24, SG-T1, SG-E1
	ACA TS001-1997: SG-8, SG-24, SG-T1, SG-E1
	FCC Part 68: SG-8, SG-12, SG-24
Telecom	ETSI TS 103 021-1 V1.1 (2003-08) SG-8, SG-12, SG-24
	ETSI TS 103 021-2 V1.2 (2003-09) SG-8, SG-12, SG-24

Table 83: Agency Approvals(Continued)

Category	Regulatory Compliance / Agency Approval
	ETSI TS 103 021-3 V1.2 (2003-09) SG-8, SG-12, SG-24
	ETSI TBR4 Nov. 1995 SG-E1
	ETSI TBR4/A1 Dec. 1997 SG-E1
	ETSI TS 102 119 V.1.1.1 Aug. 2001 SG-E1
	Bellcore GR-499-CORE, issue 2, Dec. 1998 SG-T1
Telecom Homologation	NZ PTC 220/06/016 through PTC 220/06/023 SG-8, SG-12, SG-24, SG-T1, SG-E1 and IP 560 Phones

EMC Compliance Statements (SG-8/12/24 and T1)

United States

This equipment has been tested and found to comply with the limits for Class A digital devices, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications to this equipment not expressly approved by the party responsible for compliance to FCC part 15 could void the user's authority to operate the equipment.

European Union

This is a Class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

Canada

This Class A digital apparatus complies with Canadian ICES-003. Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Restricted Access Location

This product is intended to be installed only in a RESTRICTED ACCESS LOCATION. A RESTRICTED ACCESS LOCATION is defined as an area where access can be gained only by SERVICE PERSONNEL who have been instructed about the reasons for the restrictions applied to the location and about any precautions that must be taken. RESTRICTED ACCESS LOCATIONS can be accessed only through the use of a tool or lock and key or other means of security, and are controlled by the authority responsible for the location. SERVICE PERSONNEL are defined as persons having appropriate technical training and experience necessary to be aware of hazards to which they are exposed in performing a task and of measures to minimize the danger to themselves or other persons.

WEEE Information

In accordance with the requirements of council directive 2002/96/EC on Waste of Electrical and Electronic Equipment (WEEE), ensure that at end-of-life you separate this product from other waste and scrap and deliver to the WEEE collection system in your country for recycling.

Safety

The following information is included in this publication for the use and safety of installation and maintenance personnel.

WARNING!

This equipment uses a three-conductor power cord with safety grounding conductor. Ensure that this is connected to an AC outlet with provision for grounding. Ensure the permanent earthing protector is connected as directed in the installation instructions. Consult a licensed electrician if necessary.

Important Safety Instructions

- Read all of the instructions before attempting to operate the equipment and before connecting the power supply.
- Always follow basic safety precautions to reduce the risk of fire, electrical shock, and injury to persons.
- To prevent fire or shock hazard, do not expose the unit to rain, moisture, or install this product near water. Never spill liquid of any kind on this product.

- Never push objects of any kind into this product through openings, as they may touch dangerous voltage points or short out parts, which could result in the risk of fire or electrical shock.
- Do not open the cabinet, as there are high voltage components inside. Refer servicing to qualified service personnel.
- Do not attach the power supply cord to building surfaces. Do not allow anything to rest on the power cord or allow the cord to be abused by persons walking on it.
- To protect this equipment from overheating, do not block the openings in the housing that are provided for ventilation.

Electrical Safety

WARNING!

Do not take chances with your life. Follow these guidelines carefully

- Observe all safety regulations and read the warnings, cautions, and notes posted on the equipment.
- Never assume that the power is turned off. Always check to ensure that a circuit does not have power.
- Connect all power before installing changes in systems or wiring.
- Use caution when installing or modifying telephone lines. Never install telephone wiring during an electrical storm.
- Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
- Telephone connections to the unit should be made with number 26 AWG wire in order to minimize risk of fire.

APPENDIX C

Installing Communicator on Citrix and Windows Servers

This appendix describes how to install ShoreTel Communicator for Windows on Citrix and Windows servers. It contains the following information:

Note

In Windows Server 2008 and Windows Server 2008 R2, Windows Terminal Services is known as Remote Terminal Services.

Overview 384
XenApp Support Considerations 384
Citrix XenApp Environment Best Practices 384
Citrix XenApp Restrictions 385
Windows Server Support Considerations 385
Windows Server Restrictions 385
Installing ShoreTel Communicator on WTS or Citrix XenApp 385
Preliminary Steps for Upgrading ShoreTel Communicator on 64-bit Platforms 386
Installing Communicator on a Terminal Server 386
Using Third-Party Applications with ShoreTel Communicator on a Citrix or Terminal Server 387
Installing the Microsoft Office 2007/2010/2013 Outlook Add-in 387
Installing ShoreTel Telephony Interface (STI) on a Citrix or Terminal Server ... 388

Overview

You can install ShoreTel Communicator for Windows on Citrix XenApp and Windows Terminal Servers to provide ShoreTel Communicator functionality to Terminal Services clients.

ShoreTel Communicator for Windows on Citrix XenApp supports desktop and published modes in standard environments, but does not support isolation environments.

For information on Citrix XenApp and Windows Terminal Services, refer to the documentation from the manufacturer.

The topics discussed in this appendix include:

- XenApp Support Considerations on page 384
- Windows Server Support Considerations on page 385
- Installing ShoreTel Communicator on WTS or Citrix XenApp on page 385
- Using Third-Party Applications with ShoreTel Communicator on a Citrix or Terminal Server on page 387

XenApp Support Considerations

This section provides information about best practices and restrictions when installing ShoreTel Communicator for Windows in a Citrix XenApp environment.

Citrix XenApp Environment Best Practices

ShoreTel recommends the following best practice guidelines for computers running ShoreTel on XenApp servers:

- Use only Citrix-ready anti-virus software on XenApp servers.
- Run XenApp and ShoreTel servers on a Citrix-qualified server platform.
- Perform frequent defragmentation of the XenApp server disk.
- Co-locate the Citrix/WTS server with the Headquarters server or the DVS servicing the ShoreTel Communicator clients.

Note

To prevent the user from receiving a warning message about enhanced security, ShoreTel recommends that you disable Enhanced Security on the Microsoft server running Citrix XenApp or Windows Terminal Services.

Citrix XenApp Restrictions

ShoreTel Communicator for Windows does not support the following XenApp operations:

- Streaming mode
- Application Isolation Environment (AIE)
- Virtual deployment
- XenDesktop

The following ShoreTel Communicator for Windows features are not supported in the Citrix XenApp environment:

- SoftPhone
- Video
- Docking in Seamless Mode (Docked Top, Docked Bottom, Docked Left, Docked Right)
- Presenter for Java must be used because ShoreTel does not support Presenter for Windows (ShoreTel Conferencing)

Windows Server Support Considerations

This section provides information about restrictions when installing ShoreTel Communicator for Windows in a Windows Server environment.

Windows Server Restrictions

The following ShoreTel Communicator for Windows features are not supported in the Windows Server environment:

- SoftPhone
- Video

Installing ShoreTel Communicator on WTS or Citrix XenApp

ShoreTel supports ShoreTel Communicator on the following platforms:

- Windows Server 2008 32-bit and 64 bit
- Windows Server 2008 R2

- Windows Server 2012 Standard and Data Center
- XenApp 6.0 on Windows Server 2008 R2
- XenApp 6.5 on Windows Server 2008 R2

Preliminary Steps for Upgrading ShoreTel Communicator on 64-bit Platforms

ShoreTel Communicator for Windows requires .NET Framework version 3.5 or higher on 64-bit Windows Terminal Services platforms.

ShoreTel does not ship the .NET Framework as part of the software package.

The first time the .NET Framework is required, Communicator prompts you to download and save it to a file on the ShoreTel server.

Note

If the .NET Framework is not installed on the target terminal server and the .NET Framework file in the ShoreTel folder is empty, the target terminal server must be able to access the Internet so that the .NET Framework can be downloaded during the Communicator installation process.

Installing Communicator on a Terminal Server

Note

Administrative rights on the terminal server are required in order to install ShoreTel Communicator for Windows.

1. Open a browser on the terminal server.
2. Enter the following URL:

   http://<*ShoreTel_server_name*>/ShoreWareresources/clientinstall

   ShoreTel_server_name is the name or IP address of the ShoreTel Headquarters server or DVS that manages the client software on the ShoreTel server.

   The ShoreTel Communicator Install page for Windows computers appears. Refer to Figure 73 for an example.
3. Review the information on this page, then click **Click Here to Install ShoreTel Communicator**.

   The download process starts, and the InstallShield Wizard is launched.
4. Follow the prompts to install Communicator.

Note

On 64-bit systems, the installation process places files in this folder by default:

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare Client
```

On 32-bit systems, the installation process places files in this folder by default:

```
C:\Program Files\Shoreline Communications\ShoreWare Client
```

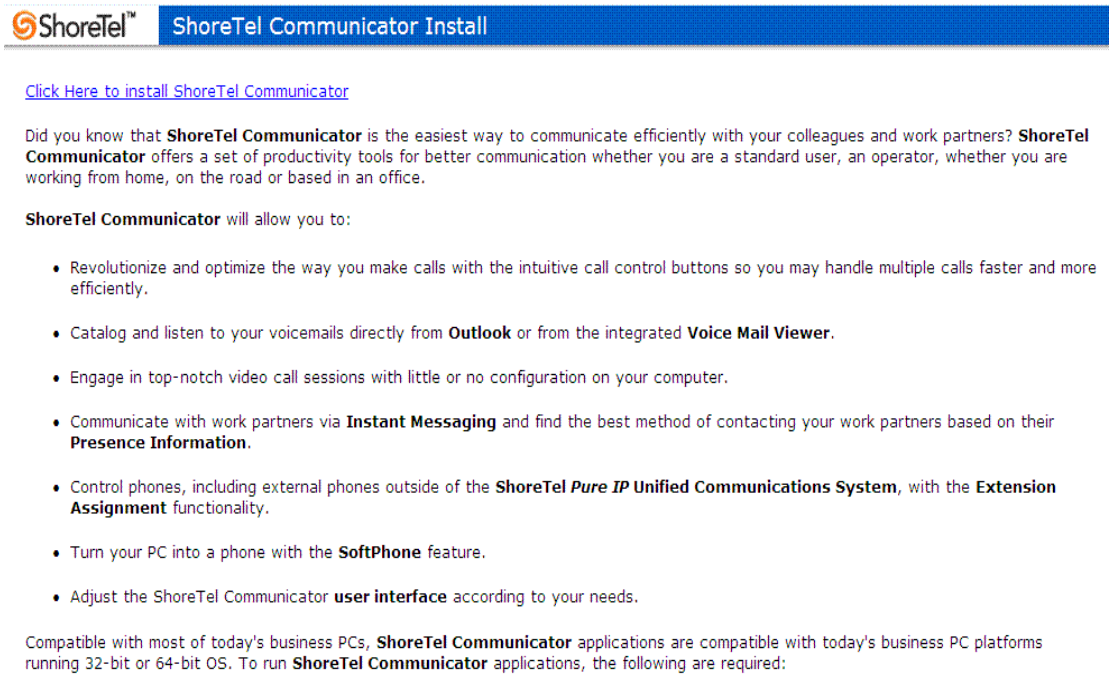

Figure 73: ShoreTel Communicator Install Page for Windows

Using Third-Party Applications with ShoreTel Communicator on a Citrix or Terminal Server

Third-party applications can interact with ShoreTel Communicator for Windows on a Citrix/Terminal Server only if the terminal server is running the ShoreTel Telephony Interface (STI).

This section describes how to set up the Citrix/Terminal Server to use third-party applications with ShoreTel Communicator for Windows.

Installing the Microsoft Office 2007/2010/2013 Outlook Add-in

WTS/Citrix XenApp supports the Microsoft Office 2007/2010/2013 Outlook add-in for ShoreTel Communicator.

This feature supports contact import, voice mail, conference scheduling, call handling mode, and Outlook presence.

Note

You must install Microsoft Outlook prior to installing ShoreTel Communicator.

1. Log on to the Citrix XenApp server for the desired individual user.

Note

ShoreTel supports Citrix XenApp 6.0 and 6.5. For more information, refer to Installing ShoreTel Communicator on WTS or Citrix XenApp on page 385.

2. Start Communicator.
3. To install the Microsoft Office 2007/2010/2013 Outlook add-in for ShoreTel Communicator, open **Tools > Options > Outlook**, and click **Install** for the options you want to install. For more information about installing the add-in, refer to the *ShoreTel Communicator for Windows User Guide*.

Installing ShoreTel Telephony Interface (STI) on a Citrix or Terminal Server

1. Install or upgrade ShoreTel Communicator.
2. Install ShoreTel Telephony Interface:
   a. Launch Windows Explorer.
   b. Enter the following URL:

      http://serverIP/shorewareresources/shoreteltelephonyinterface

      The ShoreTel Telephony Interface Install site appears.
   c. Click the link to install the ShoreTel Telephony Interface. Download and install the interface on the Citrix/Terminal Server.
3. Reboot the terminal server.
4. Launch the Control Panel.
5. Select **Phone and Modem Options**.

   The Phone and Modem Options dialog appears.

Note

If this is the first time this option is activated, another dialog box is opened first, requiring outbound dialing information.

6. Click **Advanced**.
7. Remove all ShoreTel providers.
8. Click **OK**.

   The changes are saved and the dialog closes.
9. On the terminal server, click **Start > Run**.
10. Type cmd, then click **OK**.

    The Command Prompt appears, as shown in Figure 74.
11. Navigate to the directory where the ShoreTel Telephony Interface is installed: `\Program Files\ShoreTel\ShoreTel 3rd Party`.
12. At the prompt, type the following:

    ```
    TSPinstall -i StServer HQ servername
    ```

    HQ servername is the hostname or IP address of your ShoreTel Headquarters server.

    The TSPinstall utility is launched.
13. Close the cmd prompt and reboot the server.
14. Verify that multiple lines are provided for the ShoreTel Telephony Interface:
    a. On the terminal server, navigate to the Phone and Modem Options **Advanced** tab.
    b. In the Provider list, select the ShoreTel provider, then click **Configure**.

       The ShoreTel Remote TSP dialog appears, as shown in Figure 75.

       If the ShoreTel Remote TAPI Service Provider is connected to the ShoreTel Server, the fields are populated automatically.

       If an error message is posted in **Provider Status** and **Server Name** and **Login** are blank, the ShoreTel Remote TAPI Service Provider must be removed.

       Complete the following steps to remove the provider:

       1. Go to the Control Panel and open Phone and Modem Options Advanced.
       2. Click **ShoreTel Remote TAPI Service Provider**.
       3. Click **Remove**.

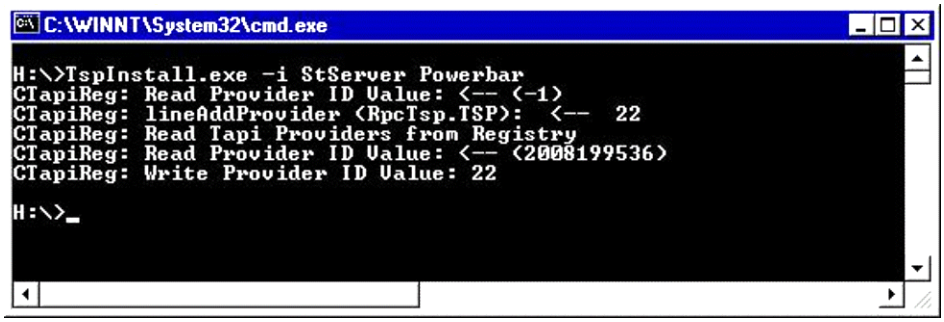

Figure 74: TSPInstall Command Line

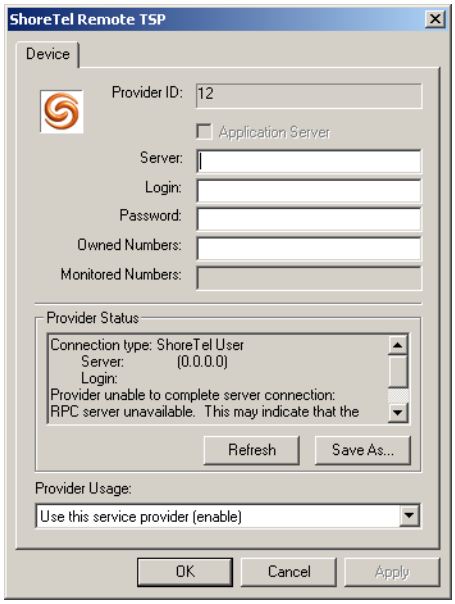

Figure 75: ShoreTel Remote TSP Dialog Box

APPENDIX D

Session Initiation Protocol

This chapter provides information about the Session Initiation Protocol (SIP). You should refer to this chapter for help in planning a SIP deployment on your ShoreTel system.

Note

For SIP configuration steps and other SIP details, see the “Session Initiation Protocol (SIP)” chapter in the *ShoreTel System Administration Guide*.

The topics discussed in this appendix include:

Overview 392
General SIP Comments 392
Conferencing 392
DTMF 393
Foreign Language Support 393
General Feature Limitations 393
Additional Configuration Considerations 394

Overview

The protocol, which works at the application layer, allows users to initiate interactive sessions between any network devices that support the protocol. SIP is capable of initiating or terminating Internet telephony calls and other multimedia applications such as video or gaming.

The protocol is based on a client-server model. With support for redirection services, networked users can initiate a call or receive a call, regardless of their physical location.

In its networking negotiations SIP takes into account the following pieces of information:

- The address of the end system
- The physical media
- The call recipient's acceptance to the invitation

The protocol then configures the parameters for the session and handles the call setup and tear-down.

SIP allows two discrete ShoreTel systems to be integrated with any IP connection, without the need for physical tie trunking. (Note that care should be taken to make sure that the extension numbering plans in the two systems do not overlap, and that if they do overlap, translation tables need to be used to resolve conflicts.)

In the current release of the ShoreTel system, the SIP trunks and SIP tie-trunks support the SIP capabilities. Like other trunk, the SIP trunk assignments are switches, so that SIP calls into and out of the ShoreTel system traverse these SIP trunks. However, up to five SIP trunks can be associated with one analog switch port, meaning that there will be no physical channel/port associated with each SIP trunk. The SIP trunk is a logical trunk end point which only handles call control responsibilities. The media flows directly between the end-point SIP devices (i.e. call initiator and the call terminator), freeing the switch from the burden of controlling media flow.

General SIP Comments

Conferencing

- Ports for MakeMe conferences must be available on the initiating side of a 3-way conference call involving a SIP end-point.
- On ShoreTel IP800 models or third-party SIP phones, MakeMe conference ports are needed even for 3-way conferences. Note that configuration of any Make Me conferencing support in ShoreTel Director requires at least 4 available conference ports.
- ShoreTel SIP trunks support from 4-way up to a maximum of 6-way conferences. This conferencing relies on ShoreTel's MakeMe capability. End-users can set up MakeMe conference calls by using their ShoreTel Communicator. Like extensions with support of Media Gateway Control Protocol (MGCP), SIP extensions require permissions and a minimum of 4 MakeMe ports to set up MakeMe conference call.

- An individual SIP trunk must be provisioned for each call to the SIP device (including conference-in or transferred calls). Thus, static SIP trunks must be provisioned with additional trunks in line with the highest anticipated number of such calls.

DTMF

ShoreTel supports RFC2833 (DTMF) for users calling over SIP trunks regardless of the negotiated voice codec.

ShoreTel can be configured to use SIP INFO for DTMF signaling in environments where out-of-band DTMF is needed but RFC 2833 is not applicable. SIP INFO for DTMF signaling is available on only SIP trunks.

Foreign Language Support

In addition to English, ShoreTel support other languages (for Caller Name, Called Name, User Name, and so on) over SIP tie trunks and service provider trunks. Some third-party devices might not be able to display all of a languages' characters.

General Feature Limitations

- A music on hold (MOH) switch supports 15 streams of MOH, but some of these can be used to fan out MOH to other trunk switches. If some MOH streams go to other switches, the actual number of MOH streams on SIP trunks is less than 15.
- Three-way conference on a SIP trunk call uses Make Me conference ports. A minimum of 3 Make Me ports must be configured to support 3-way conferencing.
- A SIP trunk can be a member of a 3-party conference but cannot initiate a 3-way conference (unless the SIP device merges the media streams itself).
- ShoreTel SIP supports basic transfers (blind transfers) and attended transfers (consultative transfers).
- In the current release, the following features are supported by SIP only if the trunk has a SIP trunk profile with hairpinning and the trunk is on a half-width switch:
- Silent Coach
- Silent Monitor
- Barge-In
- Call recording
- Silence detection on trunk-to-trunk transfers is not supported because it requires a physical trunk.
- Extension Assignment is limited using SIP trunks. Either DTMF over INFO must be used, or in—the absence of such support—the features that use DTMF are not supported (including "Accept call by pressing 1.")
- Fax (and modem) redirection on SIP trunks is supported if T.38 is used.

Additional Configuration Considerations

- Overlapping number plans are not allowed between two systems tied with SIP trunks unless digit translation is used.
- When translating digits between two ShoreTel systems tied with SIP trunks, even system extensions like VM, AA should be properly translated.
- Multiple trunks (SIP and non-SIP trunks) can be created or deleted at one time.

APPENDIX E

Reverse Proxy Servers for ShoreTel Communicator on iPhone

ShoreTel Communicator for iPhone can communicate with the ShoreTel UC system via the cellular data network or WIFI. A VPN connection must be used unless the system uses a configured reverse proxy server. Topics discussed in this appendix include:

Overview 396
Reverse Proxy Settings 396
Example Reverse Proxy Configuration on a Linux Server 398
Example Reverse Proxy Configuration on a Microsoft Windows Server 402
- Check List 402
- About the Security Certificate 403
- Example Script 405
- Checklist 409

Overview

The data transmitted through the server is not encrypted by default. An option to configure secure communication using SSL is available, and requires an additional reverse proxy server. A VPN connection is not required in this configuration.

To fully set up a reverse proxy you need an Apache server version 2.2 or higher, and an SSL certificate from a root certificate authority. The system supports a self-signed certificate, however, the users will receive a warning each time the application is launched. This is not recommended for production deployments

Reverse Proxy Settings

Each ShoreTel user is associated with a ShoreTel HQ or DVS Server defined by the user's association to a site in Director. The server handles ShoreTel Communicator requests to perform telephony, voicemail, and other actions. In a reverse proxy configuration, a user must use the proxy configuration which will connect the user directly to his server.

In the case where the user re-assigns his extension to a phone associated to a server different from the server associated with the proxy definition, Communicator for iPhone will not display call history.

The reverse proxy maps public IPs/ports on specific paths with internal IPs/ports and paths. The data received by the Reverse Proxy is routed to the internal ShoreTel Services.

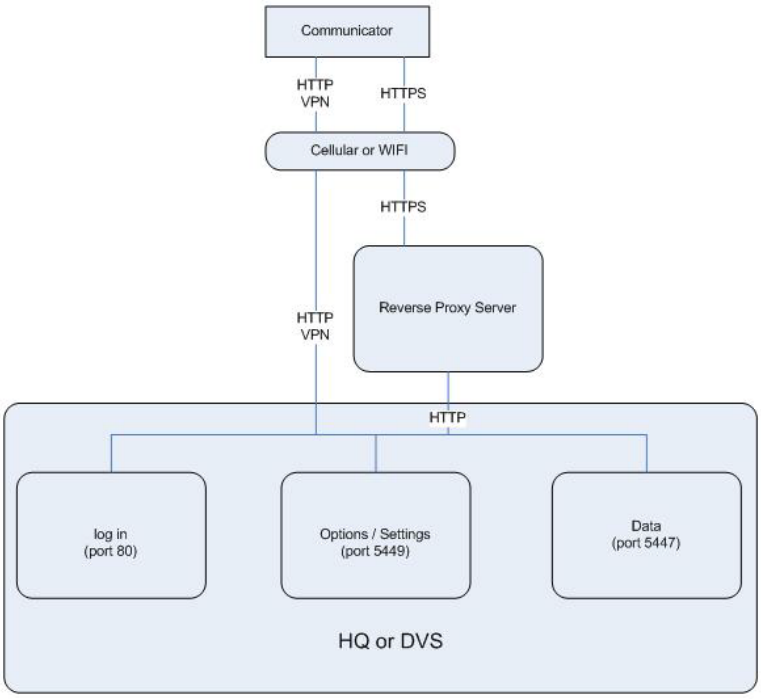

Figure 76: Reverse Proxy Data Routing with ShoreTel

Each user must provision ShoreTel Communicator for iPhone with the appropriate reverse proxy IP address/port.

For example:

- User 1 is on HQ at 10.0.0.1
- User 2 is on DVS at 10.0.0.2
- Reverse proxy is 10.0.0.64 (64.0.0.1 internally) using ports 5500 and 5501.

Reverse proxy for User 1 is on HQ could be configured by the administrator:

- 10.0.0.64:5500/authenticate mapped to 10.0.0.1:80
- 10.0.0.64:5500/cas mapped to 10.0.0.1:5447
- 10.0.0.64:5500/director2 mapped to 10.0.0.1:5449

Reverse proxy for User 2 is on DVS could be configured by the administrator:

- 10.0.0.64:5501/authenticate mapped to 10.0.0.2:80
- 10.0.0.64:5501/cas mapped to 10.0.0.2:5447
- 10.0.0.64:5501/director2 mapped to 10.0.0.2:5449

When setting up an account in ShoreTel Communicator, User 1 must use the reverse proxy connection: 10.0.0.64 port: 5500 and User 2 must use the reverse proxy connection: 10.0.0.64 port: 5501.

A single reverse proxy server can be configured to provide services for multiple ShoreTel Services.

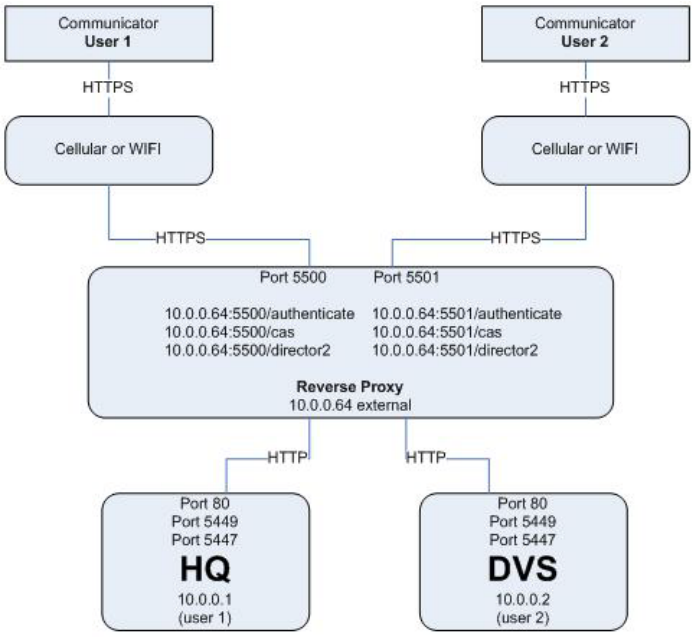

Figure 77: Reverse Proxy and Multiple Services

In all cases, the IT administrator must make sure that the reverse proxy can be accessed internally and externally.

Note

The reverse proxy configuration uses SSL. A valid SSL certificate signed by a root certificate authority, such as Verisign, must be installed on the reverse proxy server for communication over SSL to be secure.

Example Reverse Proxy Configuration on a Linux Server

The following script example illustrates how to configure a Linux server to provide reverse proxy for Apache 2.2 on port 5500 for connection to the HQ server at 10.0.0.1.

1. Modify httpd.conf to specify proxy port to be used for HTTP+SSL:

```
# Listen: Allows you to bind Apache to specific IP addresses and/or
# ports, instead of the default. See also the <VirtualHost>
# directive.

# Change this to Listen on specific IP addresses as shown below to
# prevent Apache from glomming onto all bound IP addresses.#

Listen 5500
```

2. Verify in httpd.conf that the following modules are enabled (uncommented):

```
LoadModule proxy_module modules/mod_proxy.so
LoadModule proxy_http_module modules/mod_proxy_http.so
LoadModule rewrite_module modules/mod_rewrite.so
LoadModule ssl_module modules/mod_ssl.so
```

3. Edit conf\extra\ httpd-vhosts.conf:

```
#
# Use name-based virtual hosting.
#

NameVirtualHost *:5500

<VirtualHost *:5500>

    # necessary for rewriting
```

```
RewriteEngine on

# uncomment the logging for problem trace only
# RewriteLog “logs/ciproxy.localhost-rewrite.log”
# RewriteLogLevel 3

# NOTE the rewrite rules have a proxy redirect
RewriteRule ^/theme/(.+)$ /director2/theme/$1 [P]
RewriteRule ^/yui_2.7.0/(.+)$ /director2/yui_2.7.0/$1 [P]
RewriteRule ^/js/(.+)$ /director2/js/$1 [P]

ProxyPass /authenticate/ http://10.0.0.1/
ProxyPassReverse /authenticate/ http://10.0.0.1/

ProxyPass /cas/ http://10.0.0.1:5447/
ProxyPassReverse /cas/ http://10.0.0.1:5447/

ProxyPass /director2/ http://10.0.0.1:5449/
ProxyPassReverse /director2/ http://10.0.0.1:5449/

# These are Optional
ErrorLog “logs/ciproxy.localhost-error.log”
CustomLog “logs/ciproxy.localhost-access.log” combined

#   SSL Engine Switch:
#   Enable/Disable SSL AND PROXYING OF SSL for this virtual host.
SSLEngine on
SSLProxyEngine on

#   SSL Cipher Suite:
#   List the ciphers that the client is permitted to negotiate.
#   See the mod_ssl documentation for a complete list.
SSLCipherSuite ALL:!ADH:!EXPORT56:RC4+RSA:+HIGH:+MEDIUM:+LOW:+SSLv2:+EXP:+eNULL

#   Server Certificate:
#   Point SSLCertificateFile at a PEM encoded certificate.  If
#   the certificate is encrypted, then you will be prompted for a
#   pass phrase.  Note that a kill -HUP will prompt again.  Keep
#   in mind that if you have both an RSA and a DSA certificate you
#   can configure both in parallel (to also allow the use of DSA
#   ciphers, etc.)
#SSLCertificateFile “conf/ssl.crt/server-dsa.crt”
SSLCertificateFile “conf/ssl.crt/server.crt”

#   Server Private Key:
#   If the key is not combined with the certificate, use this
#   directive to point at the key file.  Keep in mind that if
#   you've both a RSA and a DSA private key you can configure
#   both in parallel (to also allow the use of DSA ciphers, etc.)
#SSLCertificateKeyFile “conf/ssl.key/server-dsa.key”
SSLCertificateKeyFile “conf/ssl.key/server.key”
```

```
#   Server Certificate Chain:
#   Point SSLCertificateChainFile at a file containing the
#   concatenation of PEM encoded CA certificates which form the
#   certificate chain for the server certificate. Alternatively
#   the referenced file can be the same as SSLCertificateFile
#   when the CA certificates are directly appended to the server
#   certificate for convenience.
#SSLCertificateChainFile “conf/ssl.crt/server-ca.crt”

#   Certificate Authority (CA):
#   Set the CA certificate verification path where to find CA
#   certificates for client authentication or alternatively one
#   huge file containing all of them (file must be PEM encoded)
#   Note: Inside SSLCACertificatePath you need hash symlinks
#         to point to the certificate files. Use the provided
#         Makefile to update the hash symlinks after changes.
#SSLCACertificatePath “conf/ssl.crt”
#SSLCACertificateFile “conf/ssl.crt/ca-bundle.crt”

#   Certificate Revocation Lists (CRL):
#   Set the CA revocation path where to find CA CRLs for client
#   authentication or alternatively one huge file containing all
#   of them (file must be PEM encoded)
#   Note: Inside SSLCARevocationPath you need hash symlinks
#         to point to the certificate files. Use the provided
#         Makefile to update the hash symlinks after changes.
#SSLCARevocationPath “conf/ssl.crl”
#SSLCARevocationFile “conf/ssl.crl/ca-bundle.crl”

#   Client Authentication (Type):
#   Client certificate verification type and depth.  Types are
#   none, optional, require and optional_no_ca.  Depth is a
#   number which specifies how deeply to verify the certificate
#   issuer chain before deciding the certificate is not valid.
#SSLVerifyClient require
#SSLVerifyDepth  10

#   Access Control:
#   With SSLRequire you can do per-directory access control based
#   on arbitrary complex boolean expressions containing server
#   variable checks and other lookup directives.  The syntax is a
#   mixture between C and Perl.  See the mod_ssl documentation
#   for more details.
#<Location />
#SSLRequire (    %{SSL_CIPHER} !~ m/^(EXP|NULL)/ \
#            and %{SSL_CLIENT_S_DN_O} eq “Snake Oil, Ltd.” \
#            and %{SSL_CLIENT_S_DN_OU} in {“Staff”, “CA”, “Dev”} \
#            and %{TIME_WDAY} >= 1 and %{TIME_WDAY} <= 5 \
#            and %{TIME_HOUR} >= 8 and %{TIME_HOUR} <= 20       ) \
#           or %{REMOTE_ADDR} =~ m/^192\.76\.162\.[0-9]+$/
#</Location>
```

```
#   SSL Engine Options:
#   Set various options for the SSL engine.
#   o FakeBasicAuth:
#     Translate the client X.509 into a Basic Authorisation.  This means that
#     the standard Auth/DBMAuth methods can be used for access control.  The
#     user name is the `one line' version of the client's X.509 certificate.
#     Note that no password is obtained from the user. Every entry in the user
#     file needs this password: `xxj31ZMTZzkVA'.
#   o ExportCertData:
#     This exports two additional environment variables: SSL_CLIENT_CERT and
#     SSL_SERVER_CERT. These contain the PEM-encoded certificates of the
#     server (always existing) and the client (only existing when client
#     authentication is used). This can be used to import the certificates
#     into CGI scripts.
#   o StdEnvVars:
#     This exports the standard SSL/TLS related `SSL_*' environment variables.
#     Per default this exportation is switched off for performance reasons,
#     because the extraction step is an expensive operation and is usually
#     useless for serving static content. So one usually enables the
#     exportation for CGI and SSI requests only.
#   o StrictRequire:
#     This denies access when “SSLRequireSSL” or “SSLRequire” applied even
#     under a “Satisfy any” situation, i.e. when it applies access is denied
#     and no other module can change it.
#   o OptRenegotiate:
#     This enables optimized SSL connection renegotiation handling when SSL
#     directives are used in per-directory context.
#SSLOptions +FakeBasicAuth +ExportCertData +StrictRequire
<FilesMatch “\.(cgi|shtml|pl|asp|php)$”>
    SSLOptions +StdEnvVars
</FilesMatch>
<Directory “C:/xampp/cgi-bin”>
    SSLOptions +StdEnvVars
</Directory>

#   SSL Protocol Adjustments:
#   The safe and default but still SSL/TLS standard compliant shutdown
#   approach is that mod_ssl sends the close notify alert but doesn't wait for
#   the close notify alert from client. When you need a different shutdown
#   approach you can use one of the following variables:
#   o ssl-unclean-shutdown:
#     This forces an unclean shutdown when the connection is closed, i.e. no
#     SSL close notify alert is send or allowed to received.  This violates
#     the SSL/TLS standard but is needed for some brain-dead browsers. Use
#     this when you receive I/O errors because of the standard approach where
#     mod_ssl sends the close notify alert.
#   o ssl-accurate-shutdown:
#     This forces an accurate shutdown when the connection is closed, i.e. a
#     SSL close notify alert is send and mod_ssl waits for the close notify
#     alert of the client. This is 100% SSL/TLS standard compliant, but in
#     practice often causes hanging connections with brain-dead browsers. Use
#     this only for browsers where you know that their SSL implementation
```

```
    #     works correctly.
    #   Notice: Most problems of broken clients are also related to the HTTP
    #   keep-alive facility, so you usually additionally want to disable
    #   keep-alive for those clients, too. Use variable “nokeepalive” for this.
    #   Similarly, one has to force some clients to use HTTP/1.0 to workaround
    #   their broken HTTP/1.1 implementation. Use variables “downgrade-1.0” and
    #   “force-response-1.0” for this.
    BrowserMatch “.*MSIE.*” nokeepalive ssl-unclean-shutdown downgrade-1.0 force-
response-1.0

    #   Per-Server Logging:
    #   The home of a custom SSL log file. Use this when you want a
    #   compact non-error SSL logfile on a virtual host basis.
    #    CustomLog “logs/ssl_request.log” “%t %h %{SSL_PROTOCOL}x %{SSL_CIPHER}x
\”%r\” %b”

</VirtualHost>
```

Example Reverse Proxy Configuration on a Microsoft Windows Server

This section provides information about setting up an Apache reverse proxy for the ShoreTel system. An example script setting up Apache 2.2 for reverse proxy operation on a Windows server is used. The example is created for the ShoreTel HQ server which uses port 5500 to connect to the reverse proxy server. The HQ server is assigned IP address 10.0.0.1.

Check List

- Identify the machine name you will be using for the proxy server.

  This is the name that the certificate authority will use to create your SSL and your end users will use to setup their iPhones.

  Do not include hyphens or underscore in this name.

- Contact ISP or Name Server to create the DNS record that points to the external IP given to the proxy server.

  If you cannot ping the address from the Internet, then you will not be able to get to the internal address.

- Order your SSL from the certificate authority.
- You should ha a certificate file and a private file.
- Install Apache 2.2 on the server that you have prepared to be you proxy server.

- Copy the Httpd-vhosts.conf fild from the %Apache Software Foundation\Apache2.2\conf\extra folder and place it in the %\Apache Software foundation\Apache2.2\conf folder.

  This will be where the system will look for the required config files.

- Copy the certificate files that you get from the certificate authority to the % \Apache Software Foundation\Apache2.2\conf folder.

Follow the instructions given to prepare the httpd.conf and the httpd-vhosts.conf files.

About the Security Certificate

To use Apache for the reverse proxy, you must use an SSL certificate for Apache. You can order an SSL certificate from a root certificate authority. If the certificate authority does not provide a certificate for Apache, you can convert a Windows certificate to the Apache format. Apache SSL certificates have a different format than the Microsoft Windows SSL certificate.

Note

The certificate you purchase must match the machine name that you want the proxy to be. We highly recommend that you change the machine name to something that reflects this machine as your proxy because it will also be the name that your users enter on their iPhone for the server name. For example, the machine name might be proxy.yourdomain.com or gateway.yourdomain.com where proxy or gateway reflect the same exact name on the certificate that you order. You must also contact your name server provider so that you can ping the machine name from the internet.

Before you create a script, make sure that your SSL certificates conform to the Apache format. If you are ordering an SSL certificate for this application, ask for the Apache format.

Note

You must also contact your name server provider so that you can ping the Apache server from the Internet.Network propagation of a machine names can take some time, upwards of three hours for some ISP providers. Please remember this when contacting your ISP.

This section provides information about the Windows and Apache certificate formats and describes how to convert the Windows format to Apache format.

Identifying Windows SSL Certificates

SSL certificates for Windows usually use one of the following formats:

- PCKS#12/PFX file format with a .pfx or .p12 extension.
- PCKS#7/PFX (or P7B) file format with a .p7b or .p7c extension.

PCKS#12/PFX is a binary formats that imbeds the certificate, intermediate certificates, and the private key into one encrypted file.

Identifying Apache SSL Certificates

SSL certificates for Apache usually use the PEM format and have one of the following extensions:

- .pem
- .crt
- .cer
- .key

This format is a Base64 encoded ASCIIfile.

Converting a PFX Certificate to a PEM Certificate

This section describes a process you can use to convert the format an SSL certificate for Windows uses to a format the Apache server can use. For more information about converting formats, refer to OpenSSL user guide.

Converting the format an SSL certificate for Windows uses to a format that Apache can use, do the following:

1. On the Apache server, open the command line in Windows.
2. Navigate to the OpenSSL installation, which is typically located in

   `C:\Apache Software Found\Apache2.2\bin`
3. At the command line, type:

   `openssl pkcs12 -in filename.pfx -nocerts -out key.pem`

   Press **Enter**. This exports the private key file from the pfx file.
4. At the command line, type

   `openssl pkcs12 -in filename.pfx -clcerts -out key.pem`

   Press **Enter**. This exports the certificate file from the pfx file.
5. At the command line, type:

   `openssl rsa -in key.pem -out server.key`

   Press **Enter**. This removes the passphrase from the private key so that Apache does not prompt you for a password when it is starting.
6. In each of the exported files, change the extension from .pem to .crt.(??)

Example Script

This section describes how to configure the Windows server. The certificate files used in this example include following:

- Server.crt — This is the actual certificate.
- NetworkSolutions_CA.crt — This is the intermediate certificate provided by NetworkSolutions. This certificate is optional and not all certificate providers provide this certificate.
- Server.key — This is the private key.

These file names apply to the example and may be different than those used in your environment. Also, your setup may not have an intermediate certificate.

1. Modify httpd.conf to specify proxy port to be used for HTTP+SSL:

```
#
# Listen: Allows you to bind Apache to specific IP addresses and/or
# ports, instead of the default. See also the <VirtualHost>
# directive.
#
# Change this to Listen on specific IP addresses as shown below to
# prevent Apache from glomming onto all bound IP addresses.
#
Listen 5500
```

2. Verify in httpd.conf that the following modules are enabled (uncommented):

```
LoadModule proxy_module modules/mod_proxy.so
LoadModule proxy_http_module modules/mod_proxy_http.so
LoadModule rewrite_module modules/mod_rewrite.so
LoadModule ssl_module modules/mod_ssl.so
```

3. Verify that the following line is also enabled (uncommented)

   `Include conf/httpd-vhosts.conf`

4. Edit `conf/httpd_vhosts.conf`:

```
Listen 5500

# Use name-based virtual hosting.
#
```

```
NameVirtualHost *:5500

<VirtualHost *:5500>

    RewriteEngine on
    RewriteLog "logs/devnosproxy.localhost-rewrite.log"
    RewriteLogLevel 3
    RewriteRule ^/theme/(.+)$ /director2/theme/$1 [P]
    RewriteRule ^/yui_2.7.0/(.+)$ /director2/yui_2.7.0/$1 [P]
    RewriteRule ^/js/(.+)$ /director2/js/$1 [P]

    ProxyPass /authenticate/ http://10.0.0.1/
    ProxyPassReverse /authenticate/ http://10.0.0.1/

    ProxyPass /cas/ http://10.0.0.1:5447/
    ProxyPassReverse /cas/ http://10.0.0.1:5447/

    ProxyPass /director2/ http://10.0.0.1:5449/
    ProxyPassReverse /director2/ http://10.0.0.1:5449/

    ErrorLog "logs/devnosproxy.localhost-error.log"
    CustomLog "logs/devnosproxy.localhost-access.log" combined

    #   SSL Engine Switch:
    #   Enable/Disable SSL for this virtual host.
    SSLEngine on

    #   SSL Cipher Suite:
    #   List the ciphers that the client is permitted to negotiate.
    #   See the mod_ssl documentation for a complete list.
    SSLCipherSuite ALL:!ADH:!EXPORT56:RC4+RSA:+HIGH:+MEDIUM:+LOW:+SSLv2:+EXP:+eNULL

    #   Server Certificate:
    #   Point SSLCertificateFile at a PEM encoded certificate.  If
    #   the certificate is encrypted, then you will be prompted for a
    #   pass phrase.  Note that a kill -HUP will prompt again.  Keep
    #   in mind that if you have both an RSA and a DSA certificate you
    #   can configure both in parallel (to also allow the use of DSA
    #   ciphers, etc.)
SSLCertificateFile "C:/Apache Software Foundation/Apache2.2/conf/server.crt"
    #SSLCertificateFile "C:/Apache Software Foundation/Apache2.2/conf/server-
dsa.crt"

    #   Server Private Key:
    #   If the key is not combined with the certificate, use this
    #   directive to point at the key file.  Keep in mind that if
    #   you've both a RSA and a DSA private key you can configure
    #   both in parallel (to also allow the use of DSA ciphers, etc.)
SSLCertificateFile "C:/Apache Software Foundation/Apache2.2/conf/server.key"
    #SSLCertificateKeyFile "C:/Apache Software Foundation/Apache2.2/conf/server-
dsa.key"
```

```
    #   Server Certificate Chain:
    #   Point SSLCertificateChainFile at a file containing the
    #   concatenation of PEM encoded CA certificates which form the
    #   certificate chain for the server certificate. Alternatively
    #   the referenced file can be the same as SSLCertificateFile
    #   when the CA certificates are directly appended to the server
    #   certificate for convenience.
    #   SSLCertificateChainFile "C:/Apache Software Foundation/Apache2.2/conf/servr-
ca.crt

    SSLCertificateChainFile "C:/Apache Software Foundation/Apache2.2/conf/
NetworkSolutions_CA.crt"

    #   Certificate Authority (CA):
    #   Set the CA certificate verification path where to find CA
    #   certificates for client authentication or alternatively one
    #   huge file containing all of them (file must be PEM encoded)
    #   Note: Inside SSLCACertificatePath you need hash symlinks
    #         to point to the certificate files. Use the provided
    #         Makefile to update the hash symlinks after changes.
    #SSLCACertificatePath "C:/Apache Software Foundation/Apache2.2/conf/ssl.crt"
    #SSLCACertificateFile "C:/Apache Software Foundation/Apache2.2/conf/ssl.crt/ca-
bundle.crt"

    #   Certificate Revocation Lists (CRL):
    #   Set the CA revocation path where to find CA CRLs for client
    #   authentication or alternatively one huge file containing all
    #   of them (file must be PEM encoded)
    #   Note: Inside SSLCARevocationPath you need hash symlinks
    #         to point to the certificate files. Use the provided
    #         Makefile to update the hash symlinks after changes.
    #SSLCARevocationPath "C:/Apache Software Foundation/Apache2.2/conf/ssl.crl"
    #SSLCARevocationFile "C:/Apache Software Foundation/Apache2.2/conf/ssl.crl/ca-
bundle.crl"

    #   Client Authentication (Type):
    #   Client certificate verification type and depth.  Types are
    #   none, optional, require and optional_no_ca.  Depth is a
    #   number which specifies how deeply to verify the certificate
    #   issuer chain before deciding the certificate is not valid.
    #SSLVerifyClient require
    #SSLVerifyDepth  10

    #   Access Control:
    #   With SSLRequire you can do per-directory access control based
    #   on arbitrary complex boolean expressions containing server
    #   variable checks and other lookup directives.  The syntax is a
    #   mixture between C and Perl.  See the mod_ssl documentation
    #   for more details.
    #<Location />
    #SSLRequire (    %{SSL_CIPHER} !~ m/^(EXP|NULL)/ \
    #            and %{SSL_CLIENT_S_DN_O} eq "Snake Oil, Ltd." \
```

```
#            and %{SSL_CLIENT_S_DN_OU} in {"Staff", "CA", "Dev"} \
#            and %{TIME_WDAY} >= 1 and %{TIME_WDAY} <= 5 \
#            and %{TIME_HOUR} >= 8 and %{TIME_HOUR} <= 20       ) \
#           or %{REMOTE_ADDR} =~ m/^192\.76\.162\.[0-9]+$/
#</Location>

#   SSL Engine Options:
#   Set various options for the SSL engine.
#   o FakeBasicAuth:
#     Translate the client X.509 into a Basic Authorisation.  This means that
#     the standard Auth/DBMAuth methods can be used for access control.  The
#     user name is the `one line' version of the client's X.509 certificate.
#     Note that no password is obtained from the user. Every entry in the user
#     file needs this password: `xxj31ZMTZzkVA'.
#   o ExportCertData:
#     This exports two additional environment variables: SSL_CLIENT_CERT and
#     SSL_SERVER_CERT. These contain the PEM-encoded certificates of the
#     server (always existing) and the client (only existing when client
#     authentication is used). This can be used to import the certificates
#     into CGI scripts.
#   o StdEnvVars:
#     This exports the standard SSL/TLS related `SSL_*' environment variables.
#     Per default this exportation is switched off for performance reasons,
#     because the extraction step is an expensive operation and is usually
#     useless for serving static content. So one usually enables the
#     exportation for CGI and SSI requests only.
#   o StrictRequire:
#     This denies access when "SSLRequireSSL" or "SSLRequire" applied even
#     under a "Satisfy any" situation, i.e. when it applies access is denied
#     and no other module can change it.
#   o OptRenegotiate:
#     This enables optimized SSL connection renegotiation handling when SSL
#     directives are used in per-directory context.
#SSLOptions +FakeBasicAuth +ExportCertData +StrictRequire
<FilesMatch "\.(cgi|shtml|pl|asp|php)$">
    SSLOptions +StdEnvVars
</FilesMatch>
<Directory "C:/Apache Software Foundation/Apache2.2/conf/cgi-bin">
    SSLOptions +StdEnvVars
</Directory>

#   SSL Protocol Adjustments:
#   The safe and default but still SSL/TLS standard compliant shutdown
#   approach is that mod_ssl sends the close notify alert but doesn't wait for
#   the close notify alert from client. When you need a different shutdown
#   approach you can use one of the following variables:
#   o ssl-unclean-shutdown:
#     This forces an unclean shutdown when the connection is closed, i.e. no
#     SSL close notify alert is send or allowed to received.  This violates
#     the SSL/TLS standard but is needed for some brain-dead browsers. Use
#     this when you receive I/O errors because of the standard approach where
#     mod_ssl sends the close notify alert.
```

```
    #   o ssl-accurate-shutdown:
    #     This forces an accurate shutdown when the connection is closed, i.e. a
    #     SSL close notify alert is send and mod_ssl waits for the close notify
    #     alert of the client. This is 100% SSL/TLS standard compliant, but in
    #     practice often causes hanging connections with brain-dead browsers. Use
    #     this only for browsers where you know that their SSL implementation
    #     works correctly.
    #   Notice: Most problems of broken clients are also related to the HTTP
    #   keep-alive facility, so you usually additionally want to disable
    #   keep-alive for those clients, too. Use variable "nokeepalive" for this.
    #   Similarly, one has to force some clients to use HTTP/1.0 to workaround
    #   their broken HTTP/1.1 implementation. Use variables "downgrade-1.0" and
    #   "force-response-1.0" for this.
    BrowserMatch ".*MSIE.*" \
        nokeepalive ssl-unclean-shutdown\
        downgrade-1.0 force-response-1.0

    #   Per-Server Logging:
    #   The home of a custom SSL log file. Use this when you want a
    #   compact non-error SSL logfile on a virtual host basis.
    CustomLog "C:/Apache Software Foundation/Apache2.2/logs/ssl_request.log"\
         "%t %h %{SSL_PROTOCOL}x %{SSL_CIPHER}x \"%r\" %b"

</VirtualHost>
```

Checklist

- Identify the machine name you will be using for the proxy server.
- Remember this is the name that will be used by your end users when they setup their iPhones and the certificate authority to create your SSL. Do not include under-scores or hyphens.
- Contact ISP or Name Server to create the DNS record that points to the external IP given to the Proxy Server.
- If you cannot ping the address from the internet then you will not be able to get to the internal address.
- Order your SSL from the Certificate Authority.
- You should have a certificate and a private key file.
- Install Apache 2.2 on the server that you have prepared to be your Proxy Server.
- Copy the httpd-vhosts.conf file from the `%\Apache Software Foundation\Apache2.2\conf\extra` folder and place it in the `%\Apache Software Foundation\Apache2.2\conf` folder this will be where the system will look for the required config files.
- Copy the certificate files that you get from your certificate authority to the `%\Apache Software Foundation\Apache2.2\conf` folder as well.

- Follow the instructions given to prepare the httpd.conf and the httpd-vhosts.conf files.
- Test.

APPENDIX F

ShoreTel Voice Switches

This appendix describes the ShoreTel voice switches. It contains the following information:

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ShoreTel Voicemail Model Voice Switches 414
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IPBX-T1 and IPBX-E1 Voice Switch 490

Overview

Switch model numbers are located on the rear panel, as shown in Figure 78.

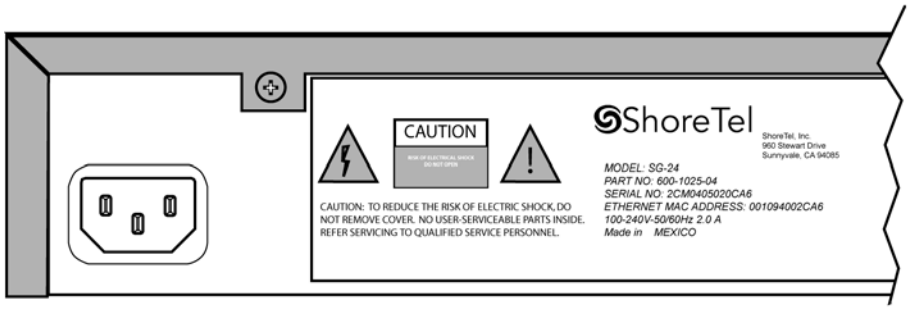

Figure 78: Switch Model Number Label

Switch Models

The classification of ShoreTel Voice Switch models is in three switch families that depend on the chassis type of the switch:

- 1-U Half Width Switches
- 1-U Full Width Switches
- IPBX Switches

The following is a brief description of each switch family.

ShoreTel 1-U Half Width Voice Switches

The ShoreTel 1-U Half Width Switch family is the most recent ShoreTel switch design. 1-U Half Width have a smaller footprint, use less power, and have lower heat dissipation requirements than earlier ShoreTel switches. These switches offer higher granularity in the number of IP users supported, allowing customers to precisely program the switch to satisfy their requirements.

The switches can be stacked or mounted in a standard 19-inch rack. Rack mounting 1-U Half Width Switches requires the ShoreTel Dual Tray. One or two switches are inserted into the Dual Tray, which is then mounted into the 19-inch rack. Two switches are mounted side by side Rack mounting the switches require the ShoreTel Dual Tray

ShoreTel 1-U Half Width Voice Switch models include:

- ShoreTel 30 (SG 30)

- ShoreTel 30BRI (SG 30BRI)
- ShoreTel 50 (SG 50)
- ShoreTel 90 (SG 90)
- ShoreTel 90BRI (SG 90BRI)
- ShoreTel 220T1 (SG 220T1)
- ShoreTel 220T1A (SG 220T1A)
- ShoreTel T1k (SG T1k)
- ShoreTel 220E1 (SG 220E1)
- ShoreTel E1k (SG E1k)

ShoreTel Voicemail Model Voice Switches

Voicemail Model Switches are ShoreTel switches that provide voicemail services and access to auto attendant menus for extensions hosted by the switch. Voicemail Model (V Model) switches provide local access to voicemail while being controlled by a Distributed server at a different location.

The switches can be stacked or mounted in a standard 19-inch rack. Rack mounting 1-U Half Width Switches requires the ShoreTel Dual Tray. One or two switches are inserted into the Dual Tray, which is then mounted into the 19-inch rack. Two switches are mounted side by side Rack mounting the switches require the ShoreTel Dual Tray

ShoreTel V Model Switch models include:

- ShoreTel 90V (SG 90V)
- ShoreTel 50V (SG 50V)
- ShoreTel 90BRIV (SG 90BRIV)

Capacity

Number of V Model switches allowed per system

A ShoreTel system supports a maximum of 100 V Model Switches. There are no restrictions concerning the allocation of switches among the sites defined by the system.

Simultaneous Voicemail Calls per V Model switches

Voicemail Model Switches support the following number of simultaneous voicemail calls.

- SG50V – Maximum of 5 Voicemail calls per switch
  - G711 calls: 5
  - G729 calls: 2

- SG90V – Maximum of 9 Voicemail calls per switch
  - G711 calls: 9
  - G729 calls: 4
- SG90BRIV – Maximum of 9 Voicemail calls per switch
  - G711 calls: 9
  - G729 calls: 4

Call Load

Voicemail Model Switches call load capacity is as follows:

- 5400 BHCC when supporting 90 MGCP IP Phones or 90 SIP Trunks
- 3600 BHCC when supporting 90 SIP IP Phones or 90 SIP Trunks

Compact Flash Memory

Voicemail Model switches store voicemail and Auto Attendant files on compact flash. Flash card capacity for V Model Switches is:

- SG50V: 1 Gb
- SG90V: 2 Gb
- SG90BRIV: 2 Gb

Media Support

Voicemail Model Switches support the following media streams:

- G711
  - Music on Hold (MOH): 15 calls
  - Backup Auto Attendant (BAA): 50 calls
- G729
  - Music on Hold (MOH): none
  - Backup Auto Attendant (BAA): none

SIP support

Voicemail Model Switches support the following SIP media streams:

- G711 Ringback tone (Hunt Groups and Work Group calls): 50 media streams
- G729 Ringback tone (Hunt Groups and Work Group calls): no support

ShoreTel 1-U Full Width Voice Switches

The ShoreTel 1-U Full Width Switch family includes three models that support analog, IP, SIP, T1, and E1 voice data streams. Full width switch models can be stacked or mounted directly into a standard 19-inch equipment rack. These switches are all 1 RU and have an RJ21X connector for connection to analog phones and trunks. They also feature redundant Ethernet LAN connections for greater availability and reliability.

ShoreTel 1-U Full Width Voice Switch models include:

- ShoreTel 120 (SG 120) – also referred to as ShoreTel 120/24 (SG 120/24)
- ShoreTel 60 (SG 60) – also referred to as ShoreTel 60/12 (SG 60/12)
- ShoreTel 40 (SG 48) – also referred to as ShoreTel 40/8 (SG 40/8)
- ShoreTel T1 (SG T1)
- ShoreTel E1 (SG E1)
- ShoreTel 24A (SG 24A)

ShoreTel IPBX Voice Switches

The ShoreTel IPBX Switch family is the earliest ShoreTel switch design. Although ShoreTel no long markets IPBX switches, existing switches are supported and can be used in a ShoreTel network configuration. IPBX switches are full width and varying heights, depending on the switch model.

ShoreTel IPBX Voice Switch models include:

- ShoreTel 24 (IPBX 24) Voice Switch (2 RU)
- ShoreTel T1 (IPBX T1) Voice Switch (1.5 RU)
- ShoreTel E1 (IPBX E1) Voice Switch (1.5 RU)

Specifications – SG 1-U Half-Width Switches

ShoreTel 90 Voice Switch

The following sections describe ShoreTel 90 resource capacity, LED behavior, and connectors. The ShoreTel 90 is not supported in installations outside the U.S. and Canada. Figure 79 displays the ShoreTel 90 front plate.

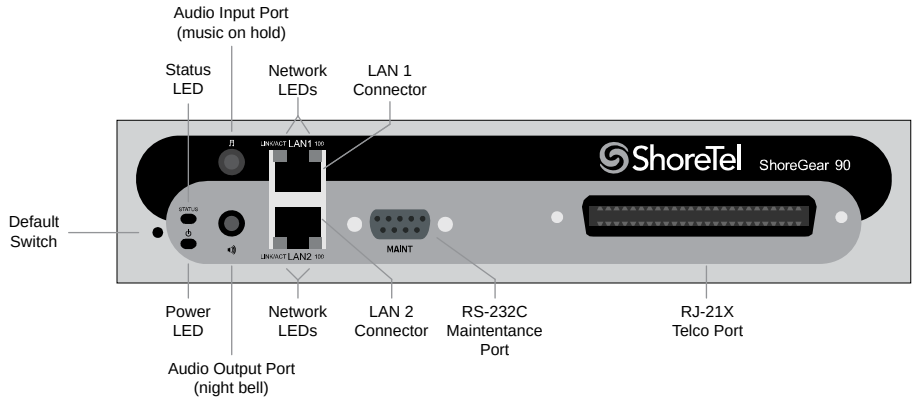

Figure 79: ShoreTel 90 Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 1-8: Eight Loop Start Trunks
  - Ports 9-12: Four Extensions or DID Trunks. A single command configures all ports as either Extensions or DID trunks.
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
- Make Me Conference Resources: 12 ports
  - Ports 1-12
- Maximum IP Phone Resources: 90 devices
  - Analog Port Reallocation: 60
  - Built-in Resources: 30

LED Descriptions

Power LED

The ShoreTel 90 has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing:
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure. Replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.

- 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
- 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
- 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
- 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 90 network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 90 has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast, at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow, the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast, at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

ShoreTel 90 Connectors

The ShoreTel 90 voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
  - Backup Operator: Extension Port 12

ShoreTel 90 RJ-21X Telephone and Trunk Connector

Table 84 lists the RJ-21X Ring and Tip pin numbers for the SG 90.

Table 84: ShoreTel 90 RJ-21X Telephone and Trunk Connector

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Trunk	1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
2	Trunk	3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown

Table 84: ShoreTel 90 RJ-21X Telephone and Trunk Connector (Continued)

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
3	Trunk	5	Slate/White	30	White/Slate
–		6	Blue/Red	31	Red/Blue
4	Trunk	7	Orange/Red	32	Red/Orange
–		8	Green/Red	33	Red/Green
5	Trunk	9	Brown/Red	34	Red/Brown
–		10	Slate/Red	35	Red/Slate
6	Trunk	11	Blue/Black	36	Black/Blue
–		12	Orange/Black	37	Black/Orange
7	Trunk	13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
8	Trunk	15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
9	Extension - DID	17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
10	Extension - DID	19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
11	Extension - DID	21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
12	Extension - DID	23	Green/Violet	48	Violet/Green
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 90BRI Voice Switch

The following sections describe ShoreTel 90BRI resource capacity, LED behavior, and connectors. Figure 80 displays the ShoreTel 90BRI front plate.

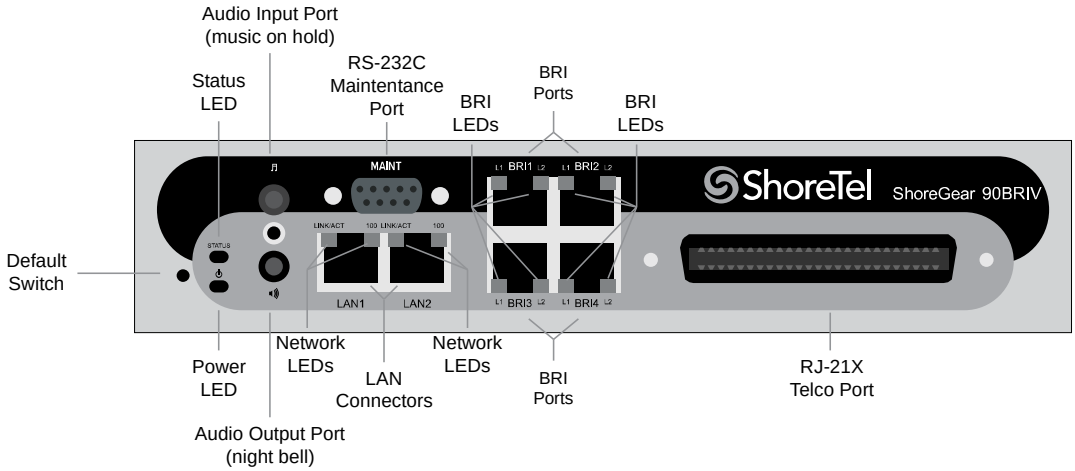

Figure 80: ShoreTel 90BRI Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 9-12: Extensions
- Digital Circuit Resources
  - Four BRI Spans, each comprising two channels: Eight channels maximum
- Make Me Conference Resource: None
- Maximum IP Phone Resources: 90 devices
  - Analog Port Reallocation: 20
  - Digital Channel Reallocation: 40
  - Built-in Resources: 30

LED Descriptions

Power LED

The ShoreTel 90BRI has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing:
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.

- 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
- 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
- 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
- 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 90BRI network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 90BRI has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast (100 msec on/off), at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow (1 sec. on/off), the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast (100 msec on/off), at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

BRI LED

Each BRI connector has two LEDs to indicate port activity. The color and blink pattern of the LED indicate the port function:

- LED 1: Off, LED 2 Off – Port not configured in Director
- LED 1: Yellow, LED 2 Off – Port inactive or not connected
- LED 1: Off, LED 2 Off – Layer 1 active. Layer 2 not established
- LED 1: Off, LED 2 Green – Layer 1 active. Layer 2 active.
- LED 1: Off, LED 2 Green flashing – Call in progress (Layer 1, Layer 2, and Layer 3 active).

ShoreTel 90BRI Connectors

The ShoreTel 90BRI voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
- 4 RJ-45 T1 telco port

ShoreTel 90BRI RJ-21X Telephone and Trunk Connector

Table 85 lists the RJ-21X Ring and Tip pin numbers for the SG 90BRI.

Table 85: ShoreTel 90BRI RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
–		1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
–		3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown
–		5	Slate/White	30	White/Slate
–		6	Blue/Red	31	Red/Blue
–		7	Orange/Red	32	Red/Orange
–		8	Green/Red	33	Red/Green
–		9	Brown/Red	34	Red/Brown
–		10	Slate/Red	35	Red/Slate
–		11	Blue/Black	36	Black/Blue
–		12	Orange/Black	37	Black/Orange
–		13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
–		15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
9	Extension	17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
10	Extension	19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
11	Extension	21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
12	Extension	23	Green/Violet	48	Violet/Green
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 50 Voice Switch

The following sections describe ShoreTel 50 resource capacity, LED behavior, and connectors. The ShoreTel 50 is not supported in installations outside the U.S. and Canada. Figure 81 displays the ShoreTel 50 front plate.

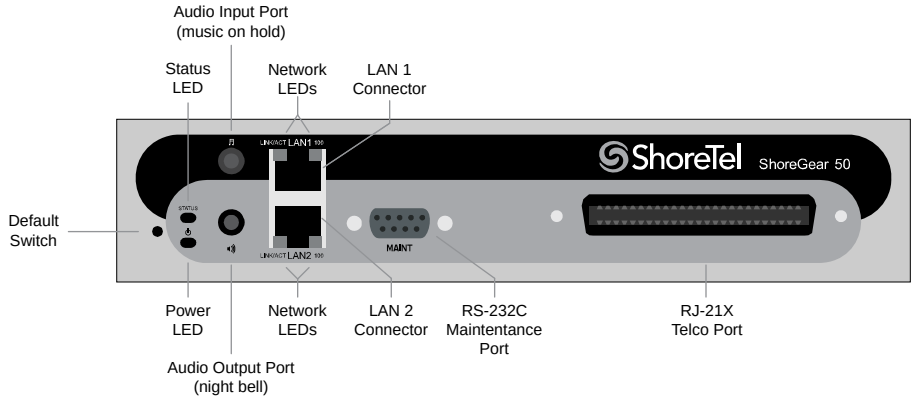

Figure 81: ShoreTel 50 Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 1-4: Four Loop Start Trunks
  - Ports 11-12: Two Extensions or DID Trunks. A single command configures all ports as either Extensions or DID trunks.
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
- Make Me Conference Resources: six ports
  - Ports 1-4, 11-12
- Maximum IP Phone Resources: 50 devices
  - Analog Port Reallocation: 30
  - Built-in Resources: 20

LED Descriptions

Power LED

The ShoreTel 50 has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.

- Flashing:
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes —The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 50 network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M

- When green, the switch is connected to a 100BaseT network.
- When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 50 has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast, at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow, the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast, at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

ShoreTel 50 Connectors

The ShoreTel 50 voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
  - Backup Operator: Extension Port 12

ShoreTel 50 RJ-21X Telephone and Trunk Connector

Table 86 lists the RJ-21X Ring and Tip pin numbers for the SG 50.

Table 86: ShoreTel 50 RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Trunk	1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
2	Trunk	3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown
3	Trunk	5	Slate/White	30	White/Slate
–		6	Blue/Red	31	Red/Blue
4	Trunk	7	Orange/Red	32	Red/Orange
–		8	Green/Red	33	Red/Green
–		9	Brown/Red	34	Red/Brown
–		10	Slate/Red	35	Red/Slate
–		11	Blue/Black	36	Black/Blue
–		12	Orange/Black	37	Black/Orange
–		13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
–		15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
9	Extension - DID	17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
10	Extension - DID	19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
11	Extension - DID	21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
12	Extension - DID	23	Green/Violet	48	Violet/Green
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 30 Voice Switch

The following sections describe ShoreTel 30 resource capacity, LED behavior, and connectors. The ShoreTel 30 is not supported in installations outside the U.S. and Canada. Figure 82 displays the ShoreTel 30 front plate.

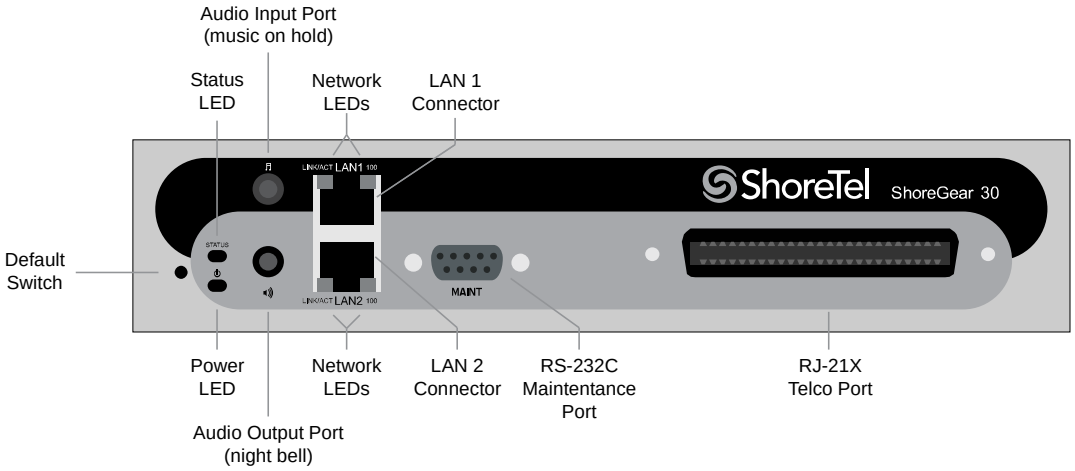

Figure 82: ShoreTel 30 Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 1-2: Two Loop Start Trunks
  - Ports 11-12: Two Extensions or DID Trunks. A single command configures all ports as either Extensions or DID trunks.
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
- Make Me Conference Resources: none
- Maximum IP Phone Resources: none
  - Analog Port Reallocation: 20
  - Built-in Resources: 10

LED Descriptions

Power LED

The ShoreTel 30 has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.

- Flashing:
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure. Replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 30 network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 30 has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast, at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow, the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast, at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

ShoreTel 30 Connectors

The ShoreTel 30 voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
  - Backup Operator: Extension Port 12

ShoreTel 30 RJ-21X Telephone and Trunk Connector

Table 87 lists the RJ-21X Ring and Tip pin numbers for the SG 30.

Table 87: ShoreTel 30 RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Trunk	1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
2	Trunk	3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown
–		5	Slate/White	30	White/Slate
–		6	Blue/Red	31	Red/Blue
–		7	Orange/Red	32	Red/Orange
–		8	Green/Red	33	Red/Green
–		9	Brown/Red	34	Red/Brown
–		10	Slate/Red	35	Red/Slate
–		11	Blue/Black	36	Black/Blue
–		12	Orange/Black	37	Black/Orange
–		13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
–		15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
–		17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
–		19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
11	Extension - DID	21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
12	Extension - DID	23	Green/Violet	48	Violet/Green
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 30BRI Voice Switch

The following sections describe ShoreTel 30BRI resource capacity, LED behavior, and connectors. Figure 83 displays the ShoreTel 30BRI front plate.

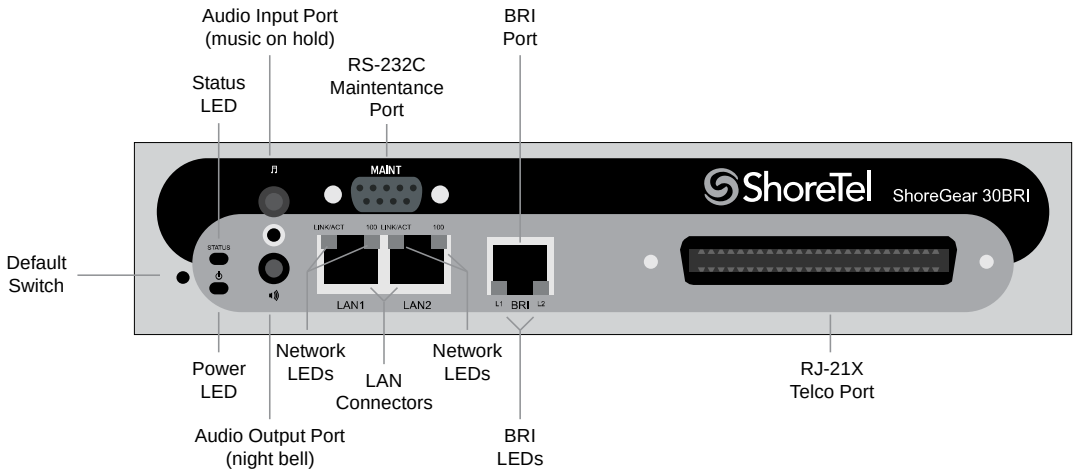

Figure 83: ShoreTel 30BRI Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 11-12: Extensions
- Digital Circuit Resources
  - One BRI Span comprising two channels: two channels maximum
- Make Me Conference Resource: None
- Maximum IP Phone Resources: 30 devices
  - Analog Port Reallocation: 10
  - Digital Channel Reallocation: 10
  - Built-in Resources: 10

LED Descriptions

Power LED

The ShoreTel 30BRI has one power LED, which indicates the following:

- On: The switch is operating normally.

- Off: The switch has no power.
- Flashing:
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 30BRI network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 30BRI has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast (100 msec on/off), at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow (1 sec. on/off), the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast (100 msec on/off), at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

BRI LED

Each BRI connector has two LEDs to indicate port activity. The color and blink pattern of the LED indicate the port function:

- LED 1: Off, LED 2 Off – Port not configured in Director
- LED 1: Yellow, LED 2 Off – Port inactive or not connected
- LED 1: Off, LED 2 Off – Layer 1 active. Layer 2 not established
- LED 1: Off, LED 2 Green – Layer 1 active. Layer 2 active.
- LED 1: Off, LED 2 Green flashing – Call in progress (Layer 1, Layer 2, and Layer 3 active).

ShoreTel 30BRI Connectors

The ShoreTel 30BRI voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface

- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
- 4 RJ-45 T1 telco port

ShoreTel 30BRI RJ-21X Telephone and Trunk Connector

Table 88 lists the RJ-21X Ring and Tip pin numbers for the SG 30BRI.

Table 88: ShoreTel 30BRI RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
–		1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
–		3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown
–		5	Slate/White	30	White/Slate
–		6	Blue/Red	31	Red/Blue
–		7	Orange/Red	32	Red/Orange
–		8	Green/Red	33	Red/Green
–		9	Brown/Red	34	Red/Brown
–		10	Slate/Red	35	Red/Slate
–		11	Blue/Black	36	Black/Blue
–		12	Orange/Black	37	Black/Orange
–		13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
–		15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
9	Extension	17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
10	Extension	19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
11	Extension	21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
12	Extension	23	Green/Violet	48	Violet/Green
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 220T1 Voice Switch

The following sections describe ShoreTel 220T1 resource capacity, LED behavior, and connectors. The ShoreTel 220T1 is not supported in installations outside the U.S. and Canada. Figure 84 displays the ShoreTel 220T1 front plate.

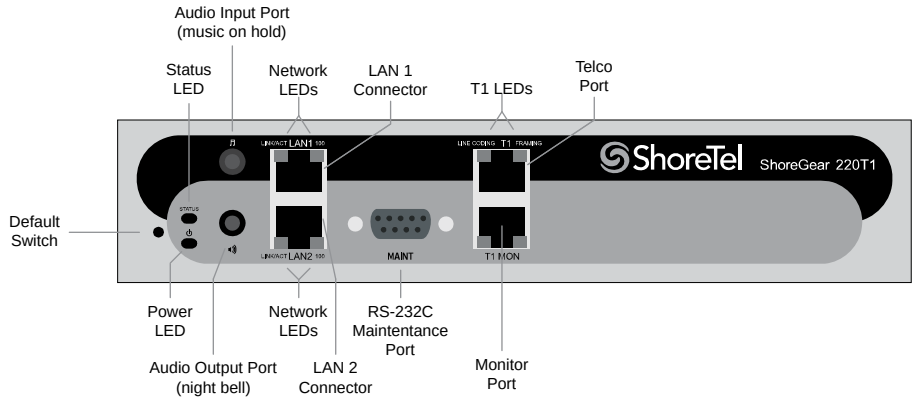

Figure 84: ShoreTel 220T1 Front Plate

Switch Capacity

- Digital Circuit Resources: 24 channels maximum
  - One T1 circuit, 24 channels per circuit: 24 channels maximum
- Make Me Conference Resource: None
- Maximum IP Phone Resources: 220
  - Digital Channel Reallocation: 120
  - Built-in Resources: 100

LED Descriptions

Power LED

The ShoreTel 220T1 has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.

- 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
- 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
- 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
- 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 220T1 network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 220T1 has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast, at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow, the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast, at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

Monitor and Telco LEDs

The Monitor and Telco LEDs indicate line coding, network framing, and loopback status. These LEDs are color coded—green, yellow, and red. The Monitor and Telco LED descriptions follow.

Telco and Monitor LED alarms and errors are logged as switch events in ShoreTel Director's event log.

- Line Coding: This LED indicates line coding status, as follows:
  - When green, the line coding signal is good.
  - When yellow, bipolar violations (BPV) are being received at one second intervals.
  - When red, a loss of signal (LOS) has occurred.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.
- Framing: This LED indicates network framing status, as follows:
  - When green, the T1/E1 signal is in frame; the signal is synchronized.
  - When yellow, a yellow alarm has been received from the Central Office.
  - When flashing yellow, the frame-bit error rate has exceeded its limits. A small number of frame-bit errors (>1 per million) have occurred; this state will take up to 10 minutes to clear.
  - When flashing fast yellow, a series of frame-bit errors (>1 per 1000) have occurred.
  - When red, the T1/E1 signal is out-of-frame (OOF). The received signal cannot be framed to the Extended Superframe (ESF) or D4 format.
  - When flashing red, loopback is active (local or CO).

- When off, the switch has no power.

ShoreTel 220T1 Connectors

The ShoreTel 220T1 voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-45 T1 telco port
- 1 RJ-45 T1 monitor port for connecting test equipment

ShoreTel 220T1A Voice Switch

The following sections describe ShoreTel 220T1A resource capacity, LED behavior, and connectors. The ShoreTel 220T1A is not supported in installations outside the U.S. and Canada. Figure 85 displays the ShoreTel 220T1A front plate.

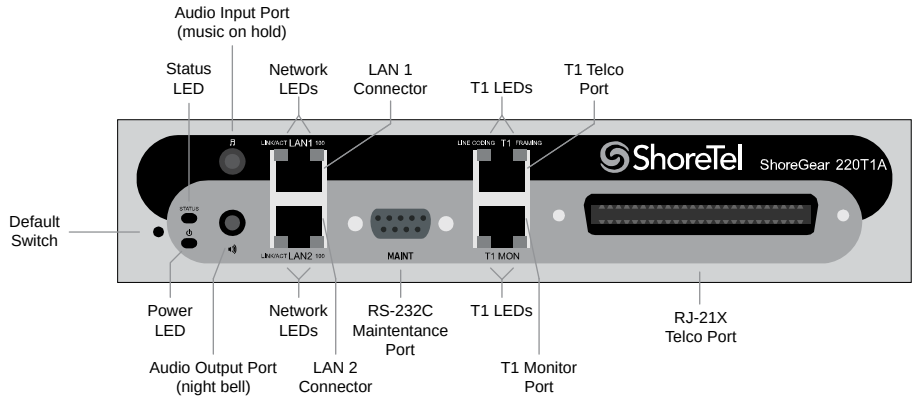

Figure 85: ShoreTel 220T1A Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 1-2: Two Loop Start Trunks
  - Ports 9-12: Four Extensions or DID Trunks. A single command configures all ports as either Extensions or DID trunks.
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12

- Digital Circuit Resources: 24 channels maximum
  - One T1 circuit, 24 channels per circuit
- Make Me Conference Resource: Six ports
  - Ports 1-2, 9-12
- Maximum IP Phone Resources: 220 devices
  - Analog Channel Reallocation: 30
  - Digital Channel Reallocation: 120
  - Built-in Resources: 70

LED Descriptions

Power LED

The ShoreTel 220T1A has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 220T1A network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 220T1A has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast (100 msec on/off), at least one port is handling an active call.
- Status LED (Yellow)
    - When on steady, no ports are handling active calls and at least one port is out of service.
    - When flashing slow (1 sec. on/off), the switch is not connected (or has lost connection) to a ShoreTel server.
    - When flashing fast (100 msec on/off), at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

Monitor and Telco LEDs

The Monitor and Telco LEDs indicate line coding, network framing, and loopback status. These LEDs are color coded—green, yellow, and red. The Monitor and Telco LED descriptions follow.

Telco and Monitor LED alarms and errors are logged as switch events in ShoreTel Director's event log.

- Line Coding: This LED indicates line coding status, as follows:
  - When green, the line coding signal is good.
  - When yellow, bipolar violations (BPV) are received at one second intervals.
  - When red, a loss of signal (LOS) has occurred.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.
- Framing: This LED indicates network framing status, as follows:
  - When green, the T1/E1 signal is in frame; the signal is synchronized.
  - When yellow, a yellow alarm has been received from the Central Office.
  - When flashing yellow, the frame-bit error rate has exceeded its limits.
  - When flashing slow yellow, a small number of frame-bit errors (>1 per million) have occurred; this state will take up to 10 minutes to clear.
  - When flashing fast yellow, a series of frame-bit errors (> 1 per 1000) have occurred.
  - When red, the T1/E1 signal is out-of-frame (OOF). The received signal cannot be framed to the Extended Superframe (ESF) or D4 format.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.

ShoreTel 220T1A Connectors

The ShoreTel 220T1A voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-45 T1 telco port
- 1 RJ-45 T1 monitor port for connecting test equipment

ShoreTel 220T1A RJ-21X Telephone and Trunk Connector

Table 89 lists the RJ-21X Ring and Tip pin numbers for the SG 220T1AI.

Table 89: ShoreTel 220T1A RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Trunk	1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
2	Trunk	3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown
–		5	Slate/White	30	White/Slate
–		6	Blue/Red	31	Red/Blue
–		7	Orange/Red	32	Red/Orange
–		8	Green/Red	33	Red/Green
–		9	Brown/Red	34	Red/Brown
–		10	Slate/Red	35	Red/Slate
–		11	Blue/Black	36	Black/Blue
–		12	Orange/Black	37	Black/Orange
–		13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
–		15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
9	Extension	17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
10	Extension	19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
11	Extension	21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
12	Extension	23	Green/Violet	48	Violet/Green
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel-220E1 Voice Switch

The following sections describe ShoreTel-220E1 resource capacity, LED behavior, and connectors. Figure 86 displays the ShoreTel-220E1 front plate.

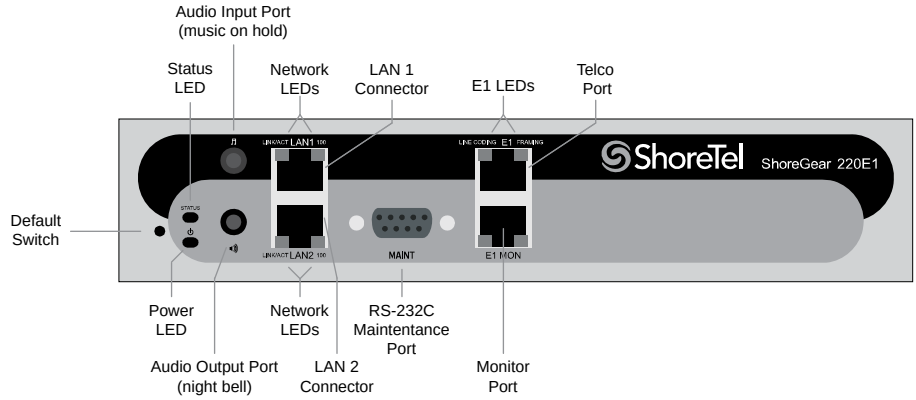

Figure 86: ShoreTel-220E1 Front Plate

Switch Capacity

- Digital Circuit Resources: 30 channels maximum
  - One E1 circuit, 30 channels per circuit
- Make Me Conference Resource: none
- Maximum IP Phone Resources: 220
  - Digital Channel Reallocation: 150
  - Built-in Resources: 70

LED Descriptions

Power LED

The ShoreTel-220E1 has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.

- 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
- 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel-220E1 network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel-220E1 has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast, at least one port is handling an active call.

- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow, the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast, at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

Monitor and Telco LEDs

The Monitor and Telco LEDs indicate line coding, network framing, and loopback status. These LEDs are color coded—green, yellow, and red. The Monitor and Telco LED descriptions follow.

Telco and Monitor LED alarms and errors are logged as switch events in ShoreTel Director's event log.

- Line Coding: This LED indicates line coding status, as follows:
  - When green, the line coding signal is good.
  - When yellow, bipolar violations (BPV) are being received at one second intervals.
  - When red, a loss of signal (LOS) has occurred.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.
- Framing: This LED indicates network framing status, as follows:
  - When green, the T1/E1 signal is in frame; the signal is synchronized.
  - When yellow, a yellow alarm has been received from the Central Office.
  - When flashing yellow, the frame-bit error rate has exceeded its limits.
  - When flashing slow yellow, a small number of frame-bit errors (10e-6) have occurred; this state will take up to 10 minutes to clear.
  - When flashing fast yellow, a series of frame-bit errors (10e-3) have occurred.
  - When red, the T1/E1 signal is out-of-frame (OOF). The received signal cannot be framed to the Extended Superframe (ESF) or D4 format.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.

ShoreTel-220E1 Connectors

The ShoreTel-220E1 voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)

- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-45 T1 telco port
- 1 RJ-45 T1 monitor port for connecting test equipment

ShoreTel T1k Voice Switch

The following sections describe ShoreTel T1k resource capacity, LED behavior, and connectors. The ShoreTel T1k is not supported in installations outside the U.S. and Canada. Figure 87 displays the ShoreTel T1k front plate.

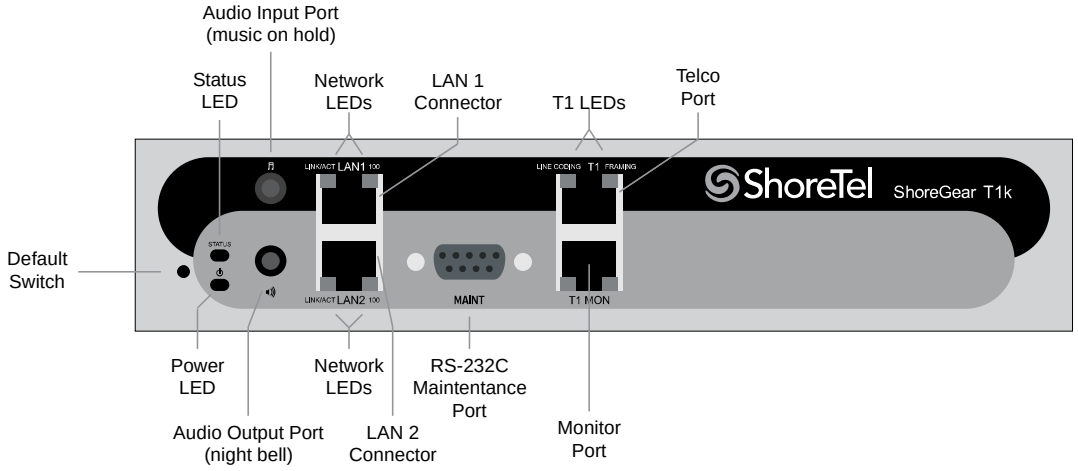

Figure 87: ShoreTel T1k Front Plate

Switch Capacity

- Digital Circuit Resources: 24 channels maximum
  - One T1 circuit, 24 channels per circuit
- Make Me Conference Resource: None
- Maximum IP Phone Resources: None

LED Descriptions

Power LED

The ShoreTel T1k has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel T1k network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:

- When flashing, network activity is detected.
- When on (not flashing), the switch is connected to an Ethernet network.
- When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel T1k has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast, at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow, the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast, at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

Monitor and Telco LEDs

The Monitor and Telco LEDs indicate line coding, network framing, and loopback status. These LEDs are color coded—green, yellow, and red. The Monitor and Telco LED descriptions follow.

Telco and Monitor LED alarms and errors are logged as switch events in ShoreTel Director's event log.

- Line Coding: This LED indicates line coding status, as follows:
  - When green, the line coding signal is good.
  - When yellow, bipolar violations (BPV) are being received at one second intervals.
  - When red, a loss of signal (LOS) has occurred.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.

- Framing: This LED indicates network framing status, as follows:
  - When green, the T1/E1 signal is in frame; the signal is synchronized.
  - When yellow, a yellow alarm has been received from the Central Office.
  - When flashing yellow, the frame-bit error rate has exceeded its limits. A small number of frame-bit errors (>1 per million) have occurred; this state will take up to 10 minutes to clear.
  - When flashing fast yellow, a series of frame-bit errors (>1 per 1000) have occurred.
  - When red, the T1/E1 signal is out-of-frame (OOF). The received signal cannot be framed to the Extended Superframe (ESF) or D4 format.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.

ShoreTel T1k Connectors

The ShoreTel T1k voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-45 T1 telco port
- 1 RJ-45 T1 monitor port for connecting test equipment

ShoreTel E1k Voice Switch

The following sections describe ShoreTel E1k resource capacity, LED behavior, and connectors. The ShoreTel E1k is not supported in installations outside the U.S. and Canada. Figure 88 displays the ShoreTel E1k front plate.

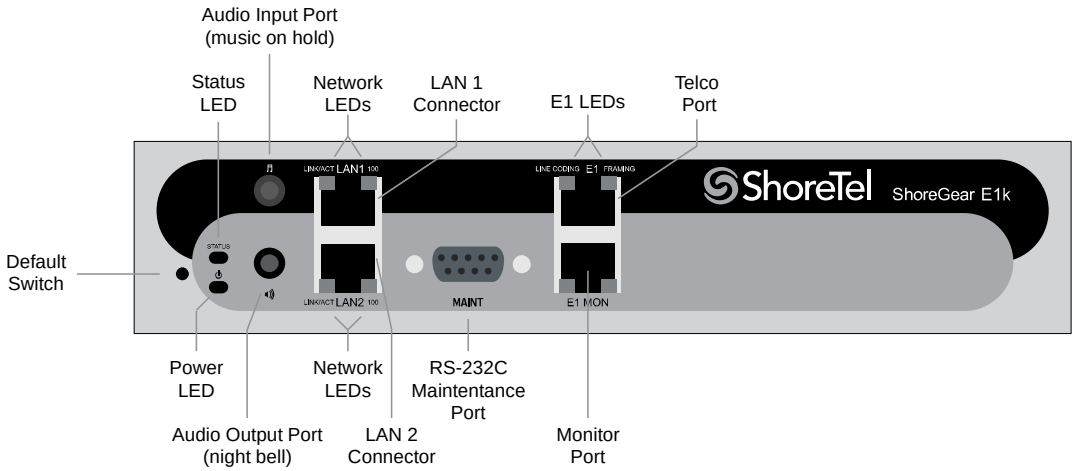

Figure 88: ShoreTel E1k Front Plate

Switch Capacity

- Digital Circuit Resources: 30 channels maximum
  - One E1 circuit, 30 channels per circuit
- Make Me Conference Resource: None
- Maximum IP Phone Resources: None

LED Descriptions

Power LED

The ShoreTel E1k has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.

- 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
- 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel E1k network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel E1k has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast, at least one port is handling an active call.

- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow, the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast, at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

Monitor and Telco LEDs

The Monitor and Telco LEDs indicate line coding, network framing, and loopback status. These LEDs are color coded—green, yellow, and red. The Monitor and Telco LED descriptions follow.

Telco and Monitor LED alarms and errors are logged as switch events in ShoreTel Director's event log.

- Line Coding: This LED indicates line coding status, as follows:
  - When green, the line coding signal is good.
  - When yellow, bipolar violations (BPV) are being received at one second intervals.
  - When red, a loss of signal (LOS) has occurred.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.
- **F**raming: This LED indicates network framing status, as follows:
  - When green, the E1 signal is in frame; the signal is synchronized.
  - When yellow, a yellow alarm has been received from the Central Office.
  - When flashing yellow, the frame-bit error rate has exceeded its limits. A small number of frame-bit errors (>1 per million) have occurred; this state will take up to 10 minutes to clear.
  - When flashing fast yellow, a series of frame-bit errors (>1 per 1000) have occurred.
  - When red, the T1/E1 signal is out-of-frame (OOF). The received signal cannot be framed to the Extended Superframe (ESF) or D4 format.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.

ShoreTel E1k Connectors

The ShoreTel E1k voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)

- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-45 T1 telco port
- 1 RJ-45 T1 monitor port for connecting test equipment

Specifications – SG Voice Model Switches

ShoreTel 90V Voice Switch

The following sections describe ShoreTel 90V resource capacity, LED behavior, and connectors. The ShoreTel 90V is not supported in installations outside the U.S. and Canada. Figure 89 displays the ShoreTel 90V front plate.

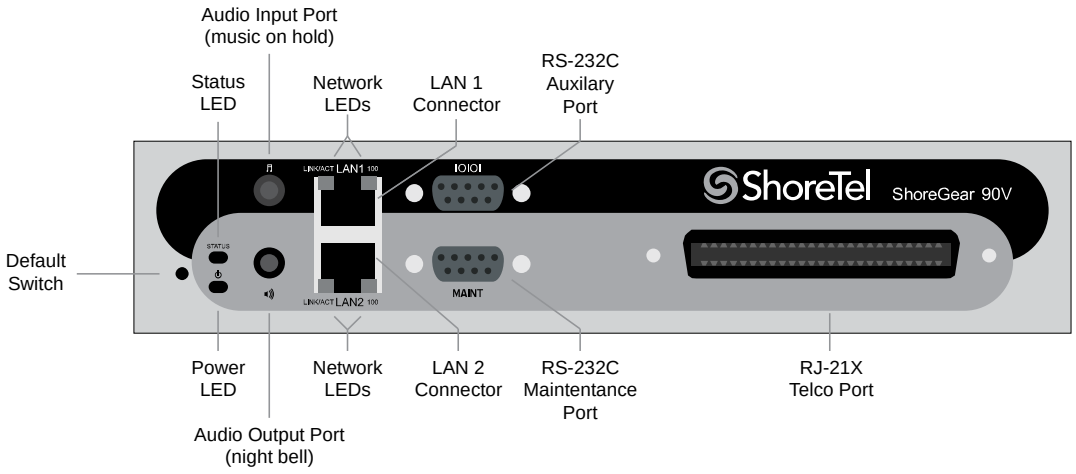

Figure 89: ShoreTel 90V Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 1-8: Eight Loop Start Trunks
  - Ports 9-12: Four Extensions or DID Trunks. A single command configures all ports as either Extensions or DID trunks.
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
- Make Me Conference Resources: 12 ports
  - Ports 1-12

- Maximum IP Phone Resources: 90 devices
  - Analog Port Reallocation: 60
  - Built-in Resources: 30

LED Descriptions

Power LED

The ShoreTel 90V has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing:
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure. Replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 90V network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 90V has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast, at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow, the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast, at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

ShoreTel 90V Connectors

The ShoreTel 90V voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface

- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
  - Backup Operator: Extension Port 12

ShoreTel 90V RJ-21X Telephone and Trunk Connector

Table 90 lists the RJ-21X Ring and Tip pin numbers for the ShoreTel 90V.

Table 90: ShoreTel 90V RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Trunk	1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
2	Trunk	3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown
3	Trunk	5	Slate/White	30	White/Slate
–		6	Blue/Red	31	Red/Blue
4	Trunk	7	Orange/Red	32	Red/Orange
–		8	Green/Red	33	Red/Green
5	Trunk	9	Brown/Red	34	Red/Brown
–		10	Slate/Red	35	Red/Slate
6	Trunk	11	Blue/Black	36	Black/Blue
–		12	Orange/Black	37	Black/Orange
7	Trunk	13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
8	Trunk	15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
9	Extension - DID	17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
10	Extension - DID	19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
11	Extension - DID	21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
12	Extension - DID	23	Green/Violet	48	Violet/Green

Table 90: ShoreTel 90V RJ-21X Telephone and Trunk Connector Pins(Continued)

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 90BRIV Voice Switch

The following sections describe ShoreTel 90BRIV resource capacity, LED behavior, and connectors. Figure 90 displays the ShoreTel 90BRIV front plate.

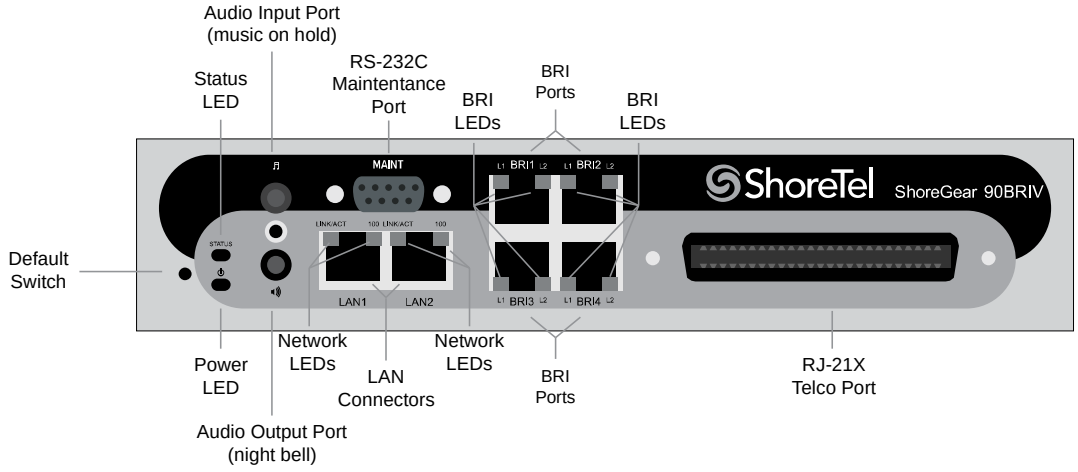

Figure 90: ShoreTel 90BRIV Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 9-12: Extensions
- Digital Circuit Resources
  - Four BRI Spans, each comprising two channels: Eight channels maximum
- Make Me Conference Resource: None
- Maximum IP Phone Resources: 90 devices
  - Analog Port Reallocation: 20
  - Digital Channel Reallocation: 40
  - Built-in Resources: 30

LED Descriptions

Power LED

The ShoreTel 90BRIV has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes—Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 90BRIV network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.

- When on (not flashing), the switch is connected to an Ethernet network.
- When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 90BRIV has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast (100 msec on/off), at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow (1 sec. on/off), the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast (100 msec on/off), at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

BRI LED

Each BRI connector has two LEDs to indicate port activity. The color and blink pattern of the LED indicate the port function:

- LED 1: Off, LED 2 Off – Port not configured in Director
- LED 1: Yellow, LED 2 Off – Port inactive or not connected
- LED 1: Off, LED 2 Off – Layer 1 active. Layer 2 not established
- LED 1: Off, LED 2 Green – Layer 1 active. Layer 2 active.
- LED 1: Off, LED 2 Green flashing – Call in progress (Layer 1, Layer 2, and Layer 3 active).

ShoreTel 90BRIV Connectors

The ShoreTel 90BRIV voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
- 4 RJ-45 T1 telco port

ShoreTel 90BRIV RJ-21X Telephone and Trunk Connector

Table 91 lists the RJ-21X Ring and Tip pin numbers for the SG 90BRIV.

Table 91: ShoreTel 90BRIV RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
–		1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
–		3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown
–		5	Slate/White	30	White/Slate
–		6	Blue/Red	31	Red/Blue
–		7	Orange/Red	32	Red/Orange
–		8	Green/Red	33	Red/Green
–		9	Brown/Red	34	Red/Brown
–		10	Slate/Red	35	Red/Slate
–		11	Blue/Black	36	Black/Blue
–		12	Orange/Black	37	Black/Orange
–		13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
–		15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
9	Extension	17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
10	Extension	19	Brown/Yellow	44	Yellow/Brown

Table 91: ShoreTel 90BRIV RJ-21X Telephone and Trunk Connector Pins(Continued)

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
–		20	Slate/Yellow	45	Yellow/Slate
11	Extension	21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
12	Extension	23	Green/Violet	48	Violet/Green
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 50V Voice Switch

The following sections describe ShoreTel 50V resource capacity, LED behavior, and connectors. The ShoreTel 50V is not supported in installations outside the U.S. and Canada. Figure 91 displays the ShoreTel 50V front plate.

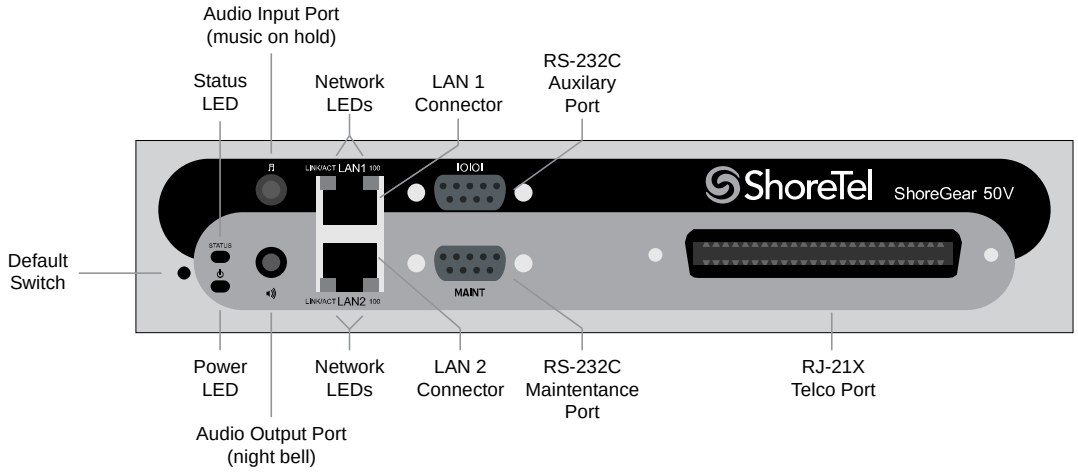

Figure 91: ShoreTel 50V Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 1-4: Four Loop Start Trunks
  - Ports 11-12: Two Extensions or DID Trunks. A single command configures all ports as either Extensions or DID trunks.
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
- Make Me Conference Resources: six ports

- Ports 1-4, 11-12

- Maximum IP Phone Resources: 50 devices
  - Analog Port Reallocation: 30
  - Built-in Resources: 20

LED Descriptions

Power LED

The ShoreTel 50V has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsk/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsk/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The ShoreTel 50V network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), the switch is connected to an Ethernet network.
  - When off, the switch cannot detect an Ethernet network.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Status LED

The ShoreTel 50V has one status LED to provide general information about the ports. The color and blink pattern of the LED indicate the port function:

- Status LED (Green)
  - When on steady, no ports are handling active calls.
  - When flashing fast, at least one port is handling an active call.
- Status LED (Yellow)
  - When on steady, no ports are handling active calls and at least one port is out of service.
  - When flashing slow, the switch is not connected (or has lost connection) to a ShoreTel server.
  - When flashing fast, at least one port is handling an active call and at least one port is out of service.
- Off: No ports are assigned.

ShoreTel 50V Connectors

The ShoreTel 50V voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)

- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
  - Power Failure Transfer Unit: Trunk Port 1 to Extension Port 12
  - Backup Operator: Extension Port 12

ShoreTel 50V RJ-21X Telephone and Trunk Connector

Table 92 lists the RJ-21X Ring and Tip pin numbers for the SG 50V.

Table 92: ShoreTel 50V RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Trunk	1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
2	Trunk	3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown
3	Trunk	5	Slate/White	30	White/Slate
–		6	Blue/Red	31	Red/Blue
4	Trunk	7	Orange/Red	32	Red/Orange
–		8	Green/Red	33	Red/Green
–		9	Brown/Red	34	Red/Brown
–		10	Slate/Red	35	Red/Slate
–		11	Blue/Black	36	Black/Blue
–		12	Orange/Black	37	Black/Orange
–		13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
–		15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
9	Extension - DID	17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
10	Extension - DID	19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
11	Extension - DID	21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
12	Extension - DID	23	Green/Violet	48	Violet/Green

Table 92: ShoreTel 50V RJ-21X Telephone and Trunk Connector Pins(Continued)

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

Specification – SG 1U Full Width Switches

ShoreTel 120 Voice Switch

The following sections describe ShoreTel 120 resource capacity, LED behavior, and connectors. The ShoreTel 120 is not supported in installations outside the U.S. and Canada. Figure 92 displays the ShoreTel 120 front plate.

The ShoreTel 120 is often referred to as the ShoreTel 120/24 (SG 120/24).

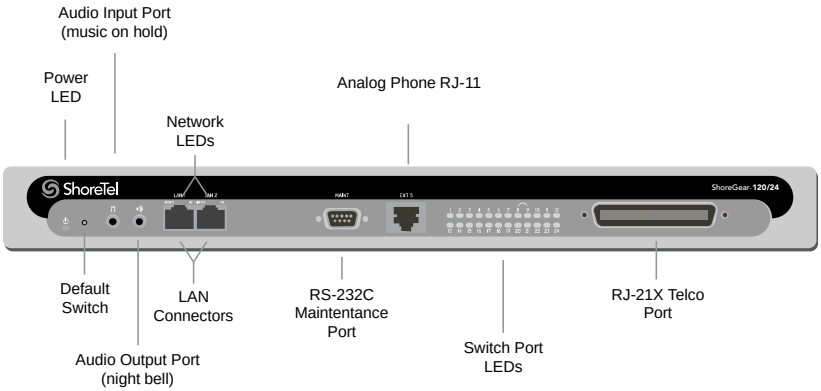

Figure 92: ShoreTel 120 Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 1-8: Eight Loop Start Trunks, DID Trunks, or Extensions
  - Ports 9-24: Sixteen Extensions.
  - Power Failure Transfer Unit: Trunk Port 8 to Extension Port 9
- Make Me Conference Resource: 24 Ports
  - Ports 1-24

- Maximum IP Phone Resources: 120 devices
  - Analog Port Reallocation: 120

LED Descriptions

Power LED

The ShoreTel 120 has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsa/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsa/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Switch Port LEDs

The ShoreTel 120 has 24 telephone/trunk port LEDs. The color of the LED indicates the port function:

- Green when the port is a telephone port.
- Yellow when the port is a trunk port.
- Off indicates the port is reserved for IP phones, for conferencing, or is not configured.

The following describes the switch port LED behavior and meaning:

- Telephone Port LEDs (Green)
  - When on steady, the port is configured as a telephone port and the telephone is idle.
  - When flashing with ring cadence, the telephone is ringing.
  - When flashing slowly, the telephone is off hook.
  - When flashing fast, the port is in use (call in progress).
- Trunk Port LED (Yellow)
  - When on steady, the port is configured as a trunk port and the trunk is idle.
  - When flashing slowly, the trunk is off hook.
  - When flashing fast, the trunk is in use (call in progress).
- Port LED Alternating Green/Yellow: The port is out of service. The LED periodically alternates green/yellow or yellow/green. The color of the LED between alternating colors indicates the port type: green for phone and yellow for trunk.
- Off (IP phone): When the LED is off, the port is reserved for IP phones, for conferencing, or is not configured.

Network LEDs

The network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), heavy network activity is detected.
  - When off, the switch has no power.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

ShoreTel 120 Connectors

The ShoreTel 120 voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-11 connector for connecting an analog phone (extension 9)
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
  - Power Failure Transfer Unit: Trunk Port 8 to Extension Port 9
  - Backup Operator: Extension Port 9

ShoreTel 120 RJ-21X Telephone and Trunk Connector

Table 93 lists the RJ-21X Ring and Tip pin numbers for the SG 120I.

Table 93: ShoreTel 120 RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Trunk, DID, Extension	1	Blue/White	26	White/Blue
2	Trunk, DID, Extension	2	Orange/White	27	White/Orange
3	Trunk, DID, Extension	3	Green/White	28	White/Green
4	Trunk, DID, Extension	4	Brown/White	29	White/Brown
5	Trunk, DID, Extension	5	Slate/White	30	White/Slate
6	Trunk, DID, Extension	6	Blue/Red	31	Red/Blue
7	Trunk, DID, Extension	7	Orange/Red	32	Red/Orange
8	Trunk, DID, Extension	8	Green/Red	33	Red/Green
9	Extension	9	Brown/Red	34	Red/Brown
10	Extension	10	Slate/Red	35	Red/Slate
11	Extension	11	Blue/Black	36	Black/Blue
12	Extension	12	Orange/Black	37	Black/Orange
13	Extension	13	Green/Black	38	Black/Green
14	Extension	14	Brown/Black	39	Black/Brown
15	Extension	15	Slate/Black	40	Black/Slate
16	Extension	16	Blue/Yellow	41	Yellow/Blue

Table 93: ShoreTel 120 RJ-21X Telephone and Trunk Connector Pins(Continued)

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
17	Extension	17	Orange/Yellow	42	Yellow/Orange
18	Extension	18	Green/Yellow	43	Yellow/Green
19	Extension	19	Brown/Yellow	44	Yellow/Brown
20	Extension	20	Slate/Yellow	45	Yellow/Slate
21	Extension	21	Blue/Violet	46	Violet/Blue
22	Extension	22	Orange/Violet	47	Violet/Orange
23	Extension	23	Green/Violet	48	Violet/Green
24	Extension	24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 24A Voice Switch

The following sections describe ShoreTel 24A resource capacity, LED behavior, and connectors. The ShoreTel 24A is not supported in installations outside the U.S. and Canada. Figure 93 displays the ShoreTel 24A front plate.

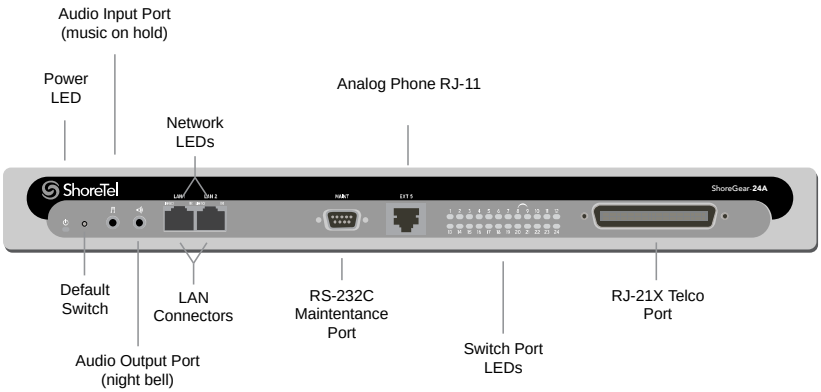

Figure 93: ShoreTel 24A Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 1-24: Twenty four extensions
- Make Me Conference Resource: 24 Ports
  - Ports 1-24

- Maximum IP Phone Resources: None

LED Descriptions

Power LED

The ShoreTel 24A has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsa/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsa/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Switch Port LEDs

The ShoreTel 24A has 24 telephone/trunk port LEDs. The color of the LED indicates the port function:

- Green when the port is a telephone port.
- Yellow when the port is a trunk port.
- Off indicates the port is reserved for IP phones, for conferencing, or is not configured.

The following describes the switch port LED behavior and meaning:

- Telephone Port LEDs (Green)

- When on steady, the port is configured as a telephone port and the telephone is idle.
- When flashing with ring cadence, the telephone is ringing.
- When flashing slowly, the telephone is off hook.
- When flashing fast, the port is in use (call in progress).

- Trunk Port LED (Yellow):
  - When on steady, the port is configured as a trunk port and the trunk is idle.
  - When flashing slowly, the trunk is off hook.
  - When flashing fast, the trunk is in use (call in progress).
- Port LED Alternating Green/Yellow: The port is out of service. The LED periodically alternates green/yellow or yellow/green. The color of the LED between alternating colors indicates the port type: green for phone and yellow for trunk.
- Off (IP phone): When the LED is off, the port is reserved for IP phones, for conferencing, or is not configured.

Network LEDs

The network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), heavy network activity is detected.
  - When off, the switch has no power.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

ShoreTel 24A Connectors

The ShoreTel 24A voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-11 connector for connecting an analog phone (extension 9)
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports

ShoreTel 24A RJ-21X Telephone and Trunk Connector

Table 94 lists the RJ-21X Ring and Tip pin numbers for the SG 24AI.

Table 94: ShoreTel 24A RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Extension	1	Blue/White	26	White/Blue
2	Extension	2	Orange/White	27	White/Orange
3	Extension	3	Green/White	28	White/Green
4	Extension	4	Brown/White	29	White/Brown
5	Extension	5	Slate/White	30	White/Slate
6	Extension	6	Blue/Red	31	Red/Blue
7	Extension	7	Orange/Red	32	Red/Orange
8	Extension	8	Green/Red	33	Red/Green
9	Extension	9	Brown/Red	34	Red/Brown
10	Extension	10	Slate/Red	35	Red/Slate
11	Extension	11	Blue/Black	36	Black/Blue
12	Extension	12	Orange/Black	37	Black/Orange
13	Extension	13	Green/Black	38	Black/Green
14	Extension	14	Brown/Black	39	Black/Brown
15	Extension	15	Slate/Black	40	Black/Slate
16	Extension	16	Blue/Yellow	41	Yellow/Blue
17	Extension	17	Orange/Yellow	42	Yellow/Orange
18	Extension	18	Green/Yellow	43	Yellow/Green
19	Extension	19	Brown/Yellow	44	Yellow/Brown

Table 94: ShoreTel 24A RJ-21X Telephone and Trunk Connector Pins(Continued)

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
20	Extension	20	Slate/Yellow	45	Yellow/Slate
21	Extension	21	Blue/Violet	46	Violet/Blue
22	Extension	22	Orange/Violet	47	Violet/Orange
23	Extension	23	Green/Violet	48	Violet/Green
24	Extension	24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 60 Voice Switch

The following sections describe ShoreTel 60 resource capacity, LED behavior, and connectors. The ShoreTel 60 is not supported in installations outside the U.S. and Canada. Figure 94 displays the ShoreTel 60 front plate.

The ShoreTel 60 is often referred to as the ShoreTel 60/12 (SG 60/12).

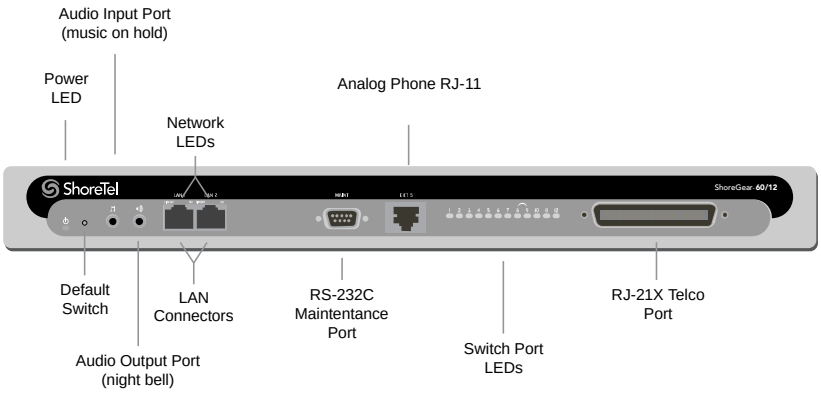

Figure 94: ShoreTel 60 Front Plat

Switch Capacity

- Analog Circuit Resources
  - Ports 1-8: Eight Loop Start Trunks, DID Trunks, or Extensions
  - Ports 9-12: Four Extensions.
  - Backup Operator: Extension Port 9
  - Power Failure Transfer Unit: Trunk Port 8 to Extension Port 9
- Make Me Conference Resource: 12 ports

- Ports 1-12
- Maximum IP Phone Resources: 60 devices
  - Analog Port Reallocation: 60

LED Descriptions

Power LED

The ShoreTel 60 has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsa/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsa/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Switch Port LEDs

The ShoreTel 60 has 12 telephone/trunk port LEDs. The color of the LED indicates the port function:

- Green when the port is a telephone port.
- Yellow when the port is a trunk port.
- Off indicates the port is reserved for IP phones, for conferencing, or is not configured.

The following describes the switch port LED behavior and meaning:

- Telephone Port LEDs (Green)
  - When on steady, the port is configured as a telephone port and the telephone is idle.
  - When flashing with ring cadence, the telephone is ringing.
  - When flashing slowly, the telephone is off hook.
  - When flashing fast, the port is in use (call in progress).
- Trunk Port LED (Yellow)
  - When on steady, the port is configured as a trunk port and the trunk is idle.
  - When flashing slowly, the trunk is off hook.
  - When flashing fast, the trunk is in use (call in progress).
- Port LED Alternating Green/Yellow: The port is out of service. The LED periodically alternates green/yellow or yellow/green. The LED color between alternating colors indicates the port type: green for phone and yellow for trunk.
- Off (IP phone): When the LED is off, the port is reserved for IP phones, for conferencing, or is not configured.

Network LEDs

The network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), heavy network activity is detected.
  - When off, the switch has no power.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

ShoreTel 60 Connectors

ShoreTel 60 voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-11 connector for connecting an analog phone (extension 9)
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
  - Power Failure Transfer Unit: Trunk Port 8 to Extension Port 9
  - Backup Operator: Extension Port 9

ShoreTel 60 RJ-21X Telephone and Trunk Connector

Table 95 lists the RJ-21X Ring and Tip pin numbers for the SG 60.

Table 95: ShoreTel 60 RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Trunk, DID, Extension	1	Blue/White	26	White/Blue
2	Trunk, DID, Extension	2	Orange/White	27	White/Orange
3	Trunk, DID, Extension	3	Green/White	28	White/Green
4	Trunk, DID, Extension	4	Brown/White	29	White/Brown
5	Trunk, DID, Extension	5	Slate/White	30	White/Slate
6	Trunk, DID, Extension	6	Blue/Red	31	Red/Blue
7	Trunk, DID, Extension	7	Orange/Red	32	Red/Orange
8	Trunk, DID, Extension	8	Green/Red	33	Red/Green
9	Extension	9	Brown/Red	34	Red/Brown
10	Extension	10	Slate/Red	35	Red/Slate
11	Extension	11	Blue/Black	36	Black/Blue
12	Extension	12	Orange/Black	37	Black/Orange
–		13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
–		15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue

Table 95: ShoreTel 60 RJ-21X Telephone and Trunk Connector Pins(Continued)

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
–		17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
–		19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
–		21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
–		23	Green/Violet	48	Violet/Green
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel 40 Voice Switch

The following sections describe ShoreTel 40 resource capacity, LED behavior, and connectors. The ShoreTel 40 is not supported in installations outside the U.S. and Canada. Figure 95 displays the ShoreTel 40 front plate.

The ShoreTel 40 is often referred to as the ShoreTel 40/8 (SG 40/8).

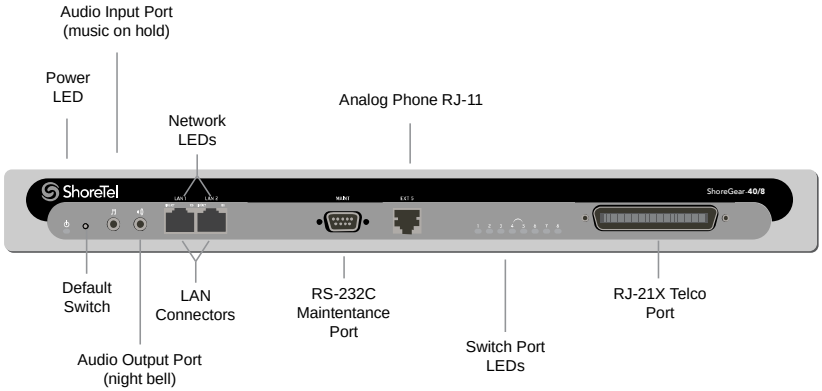

Figure 95: ShoreTel 40 Front Plate

Switch Capacity

- Analog Circuit Resources
  - Ports 1-2: Two Loop Start Trunks, DID Trunks, or Extensions
  - Ports 3-4: Two Loop Start Trunks.

  - Ports 5-8: Four Extensions
  - Power Failure Transfer Unit: Trunk Port 4 to Extension Port 5
- Make Me Conference Resource: eight ports
  - Ports 1-8
- Maximum IP Phone Resources: 40 devices
  - Analog Port Reallocation: 40

LED Descriptions

Power LED

The ShoreTel 40 has one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/tsa/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/tsa/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Switch Port LEDs

The ShoreTel 40 has 8 telephone/trunk port LEDs. The color of the LED indicates the port function:

- Green when the port is a telephone port.
- Yellow when the port is a trunk port.
- Off indicates the port is reserved for IP phones, for conferencing, or is not configured.

The following describes the switch port LED behavior and meaning.

- Telephone Port LEDs (Green)
  - When on steady, the port is configured as a telephone port and the telephone is idle.
  - When flashing with ring cadence, the telephone is ringing.
  - When flashing slowly, the telephone is off hook.
  - When flashing fast, the port is in use (call in progress).
- Trunk Port LED (Yellow)
  - When on steady, the port is configured as a trunk port and the trunk is idle.
  - When flashing slowly, the trunk is off hook.
  - When flashing fast, the trunk is in use (call in progress).
- Port LED Alternating Green/Yellow: The port is out of service. The LED periodically alternates green/yellow or yellow/green. The color of the LED between alternating colors indicates the port type: green for phone and yellow for trunk.
- Off (IP phone): When the LED is off, the port is reserved for IP phones, for conferencing, or is not configured.

Network LEDs

The network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity.

When both LAN connectors are connected into a redundant network configuration, one network port is active while the other is in standby mode. If one LAN connection fails, the switch activates the other port.

The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), heavy network activity is detected.
  - When off, network activity is not detected.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

ShoreTel 40 Connectors

The ShoreTel 40 voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-11 connector for connecting an analog phone (extension 9)
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports
  - Power Failure Transfer Unit: Trunk Port 4 to Extension Port 5
  - Backup Operator: Extension Port 5

ShoreTel 40 RJ-21X Telephone and Trunk Connector

Table 96 lists the RJ-21X Ring and Tip pin numbers for the SG 40I.

Table 96: ShoreTel 40 RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
–		1	Blue/White	26	White/Blue
–		2	Orange/White	27	White/Orange
–		3	Green/White	28	White/Green
–		4	Brown/White	29	White/Brown
1	Trunk, DID, Extension	5	Slate/White	30	White/Slate
2	Trunk, DID, Extension	6	Blue/Red	31	Red/Blue
3	Trunk	7	Orange/Red	32	Red/Orange
4	Trunk	8	Green/Red	33	Red/Green
5	Extension	9	Brown/Red	34	Red/Brown
6	Extension	10	Slate/Red	35	Red/Slate

Table 96: ShoreTel 40 RJ-21X Telephone and Trunk Connector Pins(Continued)

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
7	Extension	11	Blue/Black	36	Black/Blue
8	Extension	12	Orange/Black	37	Black/Orange
–		13	Green/Black	38	Black/Green
–		14	Brown/Black	39	Black/Brown
–		15	Slate/Black	40	Black/Slate
–		16	Blue/Yellow	41	Yellow/Blue
–		17	Orange/Yellow	42	Yellow/Orange
–		18	Green/Yellow	43	Yellow/Green
–		19	Brown/Yellow	44	Yellow/Brown
–		20	Slate/Yellow	45	Yellow/Slate
–		21	Blue/Violet	46	Violet/Blue
–		22	Orange/Violet	47	Violet/Orange
–		23	Green/Violet	48	Violet/Green
–		24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

ShoreTel-T1 and ShoreTel E1 Voice Switches

The following sections describe ShoreTel-T1 and ShoreTel E1 resource capacity, LED behavior, and connectors. The ShoreTel-T1 is not supported in installations outside the U.S. and Canada. Figure 96 displays the ShoreTel-T1 front plate. The ShoreTel E1 front plate is identical to the ShoreTel-T1 except for the E1 labeling.

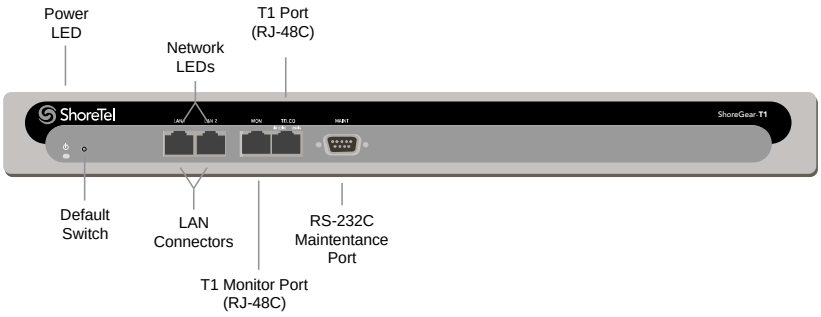

Figure 96: ShoreTel-T1 Front Plate

The ShoreTel-T1 provides higher-density trunking to the central office using CAS or PRI signaling. The ShoreTel-T1 can also be used as a gateway to legacy PBX systems.

The ShoreTel E1 provides higher-density trunking to the central office using PRI signaling. The ShoreTel E1 can also be used as a gateway to legacy PBX systems.

Switch Capacity

- Digital Circuit Resources
  - SG T1 – One T1 circuit, 24 channels per circuit: 24 channels maximum.
  - SG E1 – One T1 circuit, 30 channels per circuit: 30 channels maximum.
- Make Me Conference Resources: None
- Maximum IP Phone Resources: None

LED Descriptions

Power LED

The ShoreTel-T1 and ShoreTel E1 voice switches have one power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory may be corrupted. Go to the Quick Look page to make sure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

The network LEDs (LAN1 and LAN2) indicate the speed at which the switch is communicating with the network and whether there is network activity. The network LED descriptions are as follows:

- Link/Activity: When lit, this LED indicates that the switch is connected to an Ethernet network. This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), heavy network activity is detected.
  - When off, network activity is not detected.

This LED is not directly related to any switch's individual network activity. For example, if three switches are connected to the same hub and one switch's Traffic LED shows activity, the other switches will indicate the same activity.

- 100M
  - When green, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.

Monitor and Telco LEDs

The Monitor and Telco LEDs indicate line coding, network framing, and loopback status. These LEDs are color coded—green, yellow, and red. The Monitor and Telco LED descriptions follow.

Telco and Monitor LED alarms and errors are logged as switch events in ShoreTel Director's event log.

- Line Coding: This LED indicates line coding status, as follows:
  - When green, the line coding signal is good.
  - When yellow, bipolar violations (BPV) are being received at one second intervals.
  - When red, a loss of signal (LOS) has occurred.
  - When flashing red, loopback is active (local or CO).
  - When off, the switch has no power.
- Framing: This LED indicates network framing status, as follows:
  - When green, the T1/E1 signal is in frame; the signal is synchronized.
  - When yellow, a yellow alarm has been received from the Central Office.
  - When flashing yellow, the frame-bit error rate has exceeded its limits.
  - When flashing slow yellow, a small number of frame-bit errors (>1 per million) have occurred; this state will take up to 10 minutes to clear.
  - When flashing fast yellow, a series of frame-bit errors (>1 per 1000) have occurred.

- When red, the T1/E1 signal is out-of-frame (OOF). The received signal cannot be framed to the Extended Superframe (ESF) or D4 format.
- When flashing red, loopback is active (local or CO).
- When off, the switch has no power.

ShoreTel-T1 and ShoreTel E1 Connectors

The ShoreTel-T1 and ShoreTel E1 voice switches contain the following components:

- 1 DB-9 female connector for maintenance
- 2 RJ-45 connectors for the LAN interface
- 1 RJ-45 T1 telco port
- 1 RJ-45 T1 monitor port for connecting test equipment

Specification – IPBX Switches

IPBX-24 Voice Switch

The IPBX-24 (Figure 97) supports 24 analog ports in a combination of no more then 8 standard trunk ports and 16 analog telephone ports, up to 24. The IPBX-24 interfaces to standard analog trunks using loop start or wink start signaling, as well as to standard analog telephones, including CLASS feature phones with Caller ID Name and Number, and Message Waiting.

The IPBX-24 can support up to 120 ShoreTel IP Phones (5 phones on each IP phone port). The IPBX-24 ports are configured for IP through the Edit ShoreGear 24 page.

If you are installing IP phones in your system, you must assign sufficient IPBX-24 ports to IP phone support before attempting to install and configure IP phones.

The IPBX-24 does not support analog trunks outside the U.S. and Canada. The IPBX-24 does not support Caller ID, Message Waiting, Fax, and modems outside the U.S. and Canada.

The IPBX-24 LEDs and connectors are defined below.

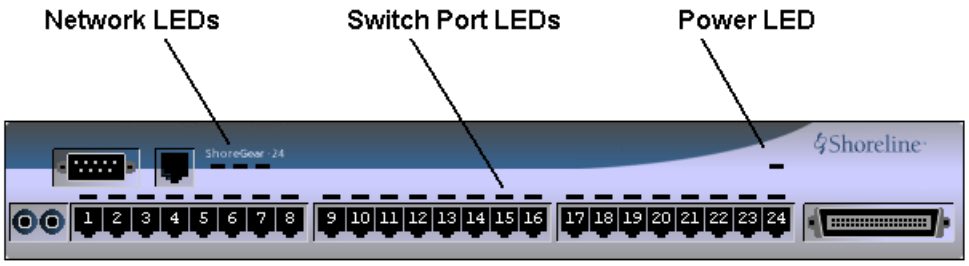

Figure 97: IPBX-24 Front Plate

LED Descriptions

Power LED

The IPBX-24 has one green power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory might be corrupted. Go to the Quick Look page to ensure that the system is running properly.
  - 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
  - 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds. You can use BOOTP or DHCP to tell the switch where the files are. If you are using BOOTP, set the BOOTP server to the IP address of the ShoreTel server, and set the boot file to `/ts24/vxworks`. If you are using a DHCP server that supports options 66 and 67, set option 66 to the ShoreTel server's IP address, and set option 67 to `/ts24/vxworks`.
  - 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Switch Port LEDs

The IPBX-24 has 24 telephone/trunk port LEDs. The color of the LED indicates the port function:

- Green when the port is a telephone port.
- Yellow when the port is a trunk port.
- Off indicates the port is reserved for IP phones, for conferencing, or is not configured.

The following describes the switch port LED behavior and meaning:

- Telephone Port LEDs (Green)
  - When on steady, the port is configured as a telephone port and the telephone is idle.

- When flashing with ring cadence, the telephone is ringing.
- When flashing slowly, the telephone is off hook.
- When flashing fast, the port is in use (call in progress).

- Trunk Port LED (Yellow)
  - When on steady, the port is configured as a trunk port and the trunk is idle.
  - When flashing slowly, the trunk is off hook.
  - When flashing fast, the trunk is in use (call in progress).
- Port LED (Red): When on, the port is out of service.
- IP Phone (Off): When the LED is off, the port is reserved for IP phones, for conferencing, or is not configured.

Network LEDs

The network LEDs indicate the speed at which the switch is communicating with the network and whether there is network activity.

The network LED descriptions are as follows:

- Link: When lit, the switch is connected to an Ethernet network.
- 100M
  - When lit, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.
- Traffic: This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), heavy network activity is detected.
  - When off, network activity is not detected.

This LED is not directly related to any particular switch's individual network activity. For example, if you have three switches that are connected to the same hub, and one switch's Traffic LED shows activity, the other switches will indicate the same.

IPBX-24 Connectors

The IPBX-24 voice switch contains the following components:

- 1 3.5 mm mono connector for audio input (music on hold)
- 1 3.5 mm mono connector for audio output (overhead paging and night bell)
- 1 DB-9 female connector for maintenance

- 1 RJ-45 connector for the LAN interface
- 24 RJ-11 connectors for the trunk and telephone ports:
  - 8 universal telephone/trunk ports (Ports 1 through 8)
  - 16 telephone ports (Ports 9 through 24)
  - Power fail transfer (between Ports 8 and 9)
- 1 RJ-21X male connector for mass termination of the telephone/trunk ports

IPBX-24 RJ-21X Telephone and Trunk Connector

Table 97 lists the RJ-21X Ring and Tip pin numbers for the IPBX-24I.

Table 97: IPBX-24 RJ-21X Telephone and Trunk Connector Pins

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
1	Trunk, DID, Extension	1	Blue/White	26	White/Blue
2	Trunk, DID, Extension	2	Orange/White	27	White/Orange
3	Trunk, DID, Extension	3	Green/White	28	White/Green
4	Trunk, DID, Extension	4	Brown/White	29	White/Brown
5	Trunk, DID, Extension	5	Slate/White	30	White/Slate
6	Trunk, DID, Extension	6	Blue/Red	31	Red/Blue
7	Trunk, DID, Extension	7	Orange/Red	32	Red/Orange
8	Trunk, DID, Extension	8	Green/Red	33	Red/Green
9	Extension	9	Brown/Red	34	Red/Brown
10	Extension	10	Slate/Red	35	Red/Slate
11	Extension	11	Blue/Black	36	Black/Blue
12	Extension	12	Orange/Black	37	Black/Orange
13	Extension	13	Green/Black	38	Black/Green
14	Extension	14	Brown/Black	39	Black/Brown
15	Extension	15	Slate/Black	40	Black/Slate
16	Extension	16	Blue/Yellow	41	Yellow/Blue
17	Extension	17	Orange/Yellow	42	Yellow/Orange
18	Extension	18	Green/Yellow	43	Yellow/Green
19	Extension	19	Brown/Yellow	44	Yellow/Brown
20	Extension	20	Slate/Yellow	45	Yellow/Slate
21	Extension	21	Blue/Violet	46	Violet/Blue

Table 97: IPBX-24 RJ-21X Telephone and Trunk Connector Pins(Continued)

Port	Type	Ring		Tip	
		Pin #	Cable Color	Pin #	Cable Color
22	Extension	22	Orange/Violet	47	Violet/Orange
23	Extension	23	Green/Violet	48	Violet/Green
24	Extension	24	Brown/Violet	49	Violet/Brown
–		25	Slate/Violet	50	Violet/Slate

IPBX-T1 and IPBX-E1 Voice Switch

The IPBX-T1 (Figure 98) provides higher-density trunking to the central office using T1 or PRI signaling. The IPBX-E1 provides higher-density trunking using E1 PRI signaling.

The IPBX-T1 and IPBX-E1 LEDs and connectors are defined below.

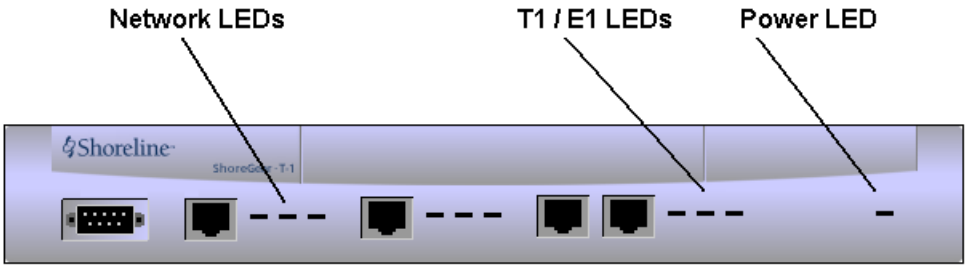

Figure 98: ShoreTel T1 and ShoreTel E1 Front Panel

LED Descriptions

Power LED

The IPBX-T1 and IPBX-E1 have one red power LED, which indicates the following:

- On: The switch is operating normally.
- Off: The switch has no power.
- Flashing
  - 2 flashes — The switch failed its internal self-test. This indicates a hardware failure; replace the unit and submit a Return Material Authorization (RMA) to ShoreTel, Inc.
  - 3 flashes — Booting via FTP. Flash memory may be corrupted. Go to the Quick Look page to make sure that the system is running properly.

- 4 flashes — The IP address is unavailable. DHCP and BOOTP did not respond to the IP address request, and the IP address is not available in nonvolatile memory to continue boot process. The switch will automatically reboot in five seconds and try again. Check the BOOTP/DHCP server and the network configuration to ensure that the voice switch is receiving a valid IP address.
- 5 flashes — The operating system is not available. The switch is booting from FTP but cannot find the boot files. It automatically reboots in five seconds.
- 6 flashes — Using a previously stored IP address. A BOOTP/DHCP transaction was attempted, but the BOOTP/DHCP server did not respond. The switch continues to use the IP address stored in nonvolatile memory until it receives a valid response. If the switch receives a response that provides a different IP address, it reboots using the new IP address. If the switch receives a response that matches the IP address stored in nonvolatile memory, it continues operation, and the power LED stops flashing. If the problem persists, check the BOOTP/DHCP server and network configuration.

Network LEDs

Network LEDs indicate the speed at which the switch is communicating with the network and when there is network activity. The network LED descriptions follow:

- Link: This LED indicates that the switch is connected to an Ethernet network.
- 100M
  - When lit, the switch is connected to a 100BaseT network.
  - When off, the switch is connected to a 10BaseT network.
- Traffic: This LED indicates network activity, as follows:
  - When flashing, network activity is detected.
  - When on (not flashing), heavy network activity is detected.
  - When off, network activity is not detected.

This LED is not directly related to any particular switch's individual network activity. For example, if you have three switches connected to the same hub, and one switch's Traffic LED shows activity, the other switches will indicate the same.

T1 and E1 LEDs

The T1 and E1 LEDs indicate line coding, network framing, and loopback status. These LEDs are color coded—green, yellow, and red. T1 and E1 LED alarms and errors are logged as switch events in ShoreTel Director's event log.

- Line Coding: This LED indicates line coding status, as follows:
  - When green, the line coding signal is good.
  - When yellow, bipolar violations (BPV) are detected one second intervals.
  - When red, a loss of signal (LOS) has occurred.

- When off, the switch has no power.

- Framing: This LED indicates network framing status, as follows:
  - When green, the T1/E1 signal is in frame; the signal is synchronized.
  - When yellow, a yellow alarm has been received from the CO.
  - When flashing yellow, the frame-bit error rate has exceeded its limits.
  - When flashing slow yellow, frame-bit errors (>1 per million) have occurred; this state will take up to 10 minutes to clear.
  - When flashing fast yellow, frame-bit errors (>1 per 1000) have occurred.
  - When red, the T1/E1 signal is out-of-frame (OOF). The received signal cannot be framed to the Extended Superframe (ESF) or D4 format.
  - When off, the switch has no power.
- Loopback: This LED indicates loopback status for testing, as follows:
  - When yellow, loopback is enabled. This may be set from within ShoreTel Director or from the CO.
  - When off, loopback is disabled.

IPBX-T1 and IPBX-E1 Connectors

The IPBX-T1 and IPBX-E1 voice switches contain the following components:

- 1 DB-9 female connector for maintenance
- 1 RJ-45 connector for the LAN interface
- 1 RJ-48C connector for T1 or E1 monitoring
- 1 RJ-48C connector for the T1 or E1 interface

APPENDIX G

Glossary

A

Administrator	The office manager or IS professional responsible for installing and configuring the system.
All Trunks Busy	The situation in which a user tries to make an outside call through a telephone system and receives a “fast” busy signal (twice as many as normal in the same amount of time), indicating that no trunks are available to handle the call.
API	Application programming interface; software that an application program uses to request and carry out lower-level services performed by the computer’s or telephone system’s operating system. For Windows, the API also helps applications manage windows, menus, icons, and other graphical user interface elements.
Automated Attendant	A device that answers callers with a recording and allows callers to route themselves to an extension; also called an auto-attendant.

B

BOOTP	Boot Protocol, a standard protocol for assigning networking information to client workstations over the network; similar to but less sophisticated than DHCP.

C

Call Control	The dynamic, transactional servicing of calls, usually via a graphical user interface with call information. For example, an attendant can use a GUI application to transfer calls based on CallerID information.
Call Handling	The predetermined, pre-configured features for servicing incoming calls in order to obtain certain expected results. Examples of call handling features include call forwarding on busy, call forwarding on no answer, and do not disturb.
Call Handling Mode	A set of telephony and call handling features that are enabled depending on the business conditions of the user (for example, in the office or out of the office). Call handling modes, which are enabled manually by the user, include features such as call forwarding on busy, call forwarding on no answer, and the selection of the voice mail greeting to use for a particular mode.
Call History	The visual records in ShoreTel Desktop, documenting all incoming and outgoing calls to the user's extension.
Call Notification	A set of features that inform the user of the arrival of a new call, such as ringing the telephone or playing a sound on the workstation speakers.
Call Routing	A methodology of delivering calls to destinations based on a situation or system status. Call routing can also refer to the automatic delivery of an incoming call to a particular extension, such as in DID or dedicated CO lines.
Call Stack	The list of calls in ShoreTel Desktop associated with an extension, including active calls and calls that have been put on hold or are being managed in some other way by the user.
Call Waiting	Usually for single-line telephones, a feature that lets a second call arrive to the line by delivering a call-waiting tone to the user and a ring-back to the caller.
Call-Waiting Tone	The tone that is presented to a user with call waiting when a second call arrives.
Caller	For documentation purposes, an outside caller — a person calling the telephone system from outside. See also **End User.**
CallerID	A technique for transmitting the calling party's telephone number and (optionally) name to equipment enabled to handle this feature; also called CLI in Europe.
Centrex	A name for advanced telephone services provided by the local telephone company. It usually requires a connection to a special telephone system but provides services such as voice mail and call forwarding.

CLASS	Custom Local Area Signalling Services, a family of telephone services offered from local telephone companies, usually for a monthly fee; includes features such as CallerID, Call Waiting, call return, repeat dialing, call rejection, call trace, priority ringing, and selective call forwarding.
Class of Service	Abbreviated as CoS or COS; a set of features and privileges associated with a particular user or extension, used for grouping similar users together.
CO	Central Office; the building where the telephone company's telephone switching equipment that services the local area is located.
CO Line	See Trunk.
Conference	Three or more parties joined together in a single call, such that each party can hear and be heard by the others.

D

DHCP	Dynamic Host Configuration Protocol, a protocol for downloading network information (such as IP addresses) to client workstations.
DID	Direct Inward Dial, a signaling mechanism used by telephone companies to indicate to a customer's PBX what telephone number was dialed by the calling party. It can be used with analog lines but is used mostly with digital (that is, T-1) connections.
DTMF	Dual-Tone Multi-Frequency, a technique of providing two tones for each button on a telephone to signal dialing digits; also known as Touch Tone.

E

End User	For documentation purposes, a person using the telephone system from the inside, such as from an extension or a call control application, as opposed to a caller who dials in from outside the system; often shortened to "user." See also **Caller**.
Erlang Formula	A mathematical way of predicting a randomly arriving workload (such as telephone calls) based on known information (such as average call duration). Although traditionally used in telephone traffic engineering to determine the required number of trunks, Erlang formulas have applications in call center staffing as well.
External Call	A telephone call directed to or from outside the telephone system, and over the Public Switched Telephone Network (PSTN).

F

FSK	Frequency Shift Key, a modulation technique used with low-speed modems; also used with CallerID and message-waiting lamp indicators.
FXO	Foreign Exchange Office. An FXO interface connects to the public switched telephone network (PSTN) central office and is the interface offered on a standard telephone. An FXO interface is used for trunks, tie lines, or connections to a PSTN CO or PBX that does not support E&M signaling (when local telecommunications authority permits).
FXS	Foreign Exchange Station. An FXS interface supplies ring, voltage and dial tone for basic telephone equipment, keysets, and PBXs. The FXO interface is useful for off-premises station applications.

G

Greeting	The voice recording sent to the caller when a call is answered by voice mail or by the auto-attendant; usually a single file, and not the concatenation of smaller phrases.
GUI	In ShoreTel documentation, the graphical user interface presented to the user as part of the software application that runs on the user's workstation.

H

Handled Call	A call answered by an employee or a device, such as an auto-attendant or voice mail, as opposed to being blocked or abandoned.
Hang Up	The act of putting the telephone receiver back on the hook to indicate to the telephone system that the user is done with the call.
Hold	As in "on hold"; the situation in which a caller is placed in the user's call management stack for later handling.

I

Internal Call	A telephone call dialed between internal extensions.

J

Java	The platform-independent programming language developed by Sun Microsystems for providing complete programs, including animated graphics.

L

Line	See **Trunk**.
Loop Start	One of the mechanisms used to signal the telephone system that the calling party wants to make a call. Loop start is a completion of the circuit using a set load between the two wires (tip and ring).

M

Message Notification	A set of features that inform the user that a new message has arrived in his or her voice mailbox, such as lighting the call-waiting lamp, paging the user, or dialing a telephone number.
Music-on-Hold (MOH)	Background music heard when callers are put on hold, letting them know they are still connected. Most telephone systems have the ability to connect to any sound-producing device (for example, a radio, a cassette player, or a CD player). ShoreTel also supports file-based MOH.

O

On Hook/Off Hook	The state of the telephone as being either on the hook (hung up) or off the hook and seizing the line.
Operator	The person who monitors the telephone system and transfers calls to the appropriate extensions.
Outside Caller	See **Caller**.

P

PBX	Private Branch Exchange; a term used by telephone companies to indicate equipment that is located on the customer's premises and that can route telephone calls.
Permissions	Privileges granted to each user with respect to what data, features, menus, or calling options may be used. Permissions are under the control of the system administrator.
Physical Extension	A common internal extension with an assigned physical port and telephone.
Prompt	For an auto-attendant menu, the result of playing (concatenating) a series of phrases together.
PSTN	Public Switched Telephone Network; another name for the public telephone network.

R

Remote Caller	See **Caller**.
Ringback Tone	The audible signal given to the caller by the telephone company (or telephone system) to indicate that the remote telephone is ringing.
RJ-11	Registered Jack number 11; one of the series of registered jacks and cabling developed originally by AT&T to standardize the cabling between the telephone and the telephone company lines.

S

Service Provider Interface (SPI)	An interface between the operating system and the telephone hardware.
Status Bar	A text and mini-graphics area, usually at the bottom of a software application window, that is normally used for showing the status of the application or other pertinent information.
Stutter Tone	An intermittent dial tone provided by the telephone system (as opposed to the usual constant dial tone); sometimes used to indicate to the user that there are messages in his or her voice mailbox or that a feature (such as call forwarding) is enabled.

T

T-1	A digital transmission link with a capacity of 1.554 Mbps (1,544,000 bits per second). A T-1 trunk can normally handle 24 voice conversations, each digitized at 64 Kbps. T-1 lines are used for connecting networks across remote distances.
Telco	An abbreviation for telephone company.
Telephony Application Programming Interface (TAPI)	A telephony software interface included in Microsoft Windows 95, 98, and NT; the operating system that lets applications incorporate telephony control.
Tip and Ring	Telephony jargon for the two wires from the telephone system to the telephone set; also indicates polarity
Trunk	Sometimes used synonymously with line or CO line. Traditionally, a trunk from the telephone company connects to a PBX only, and not to a telephone, whereas a line from the telephone company connects to a telephone. For documentation purposes, either term can be used when referring to voice connections from the telephone company.
Trunk Hunt Group	A term sometimes used to indicate a group of telephone lines configured by the telephone company to rotate incoming calls among all the lines in search of the next available one. In this way, a company can give out one main number, and all calls to that number will hunt for the next available line or trunk.
TUI	Telephone User Interface; a set of defined keystrokes on the telephone keypad that are used to execute commands to either the telephony switch, voice mail, or the automated attendant.

W

Workstation	A personal computer (PC) or similar computer.