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# ShoreTel 13 Planning and Installation Guide

Part Number: 800-1549-02



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# Preface

This preface provides information about the objectives, organization, and conventions of the *ShoreTel 13 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 13 Planning and Installation Guide* (this guide) is in the documentation folder on the ShoreTel DVD. 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 13 Planning and Installation Guide* can be used in conjunction with the ShoreCare<sup>®</sup> project management tool.

## Software Documentation

The *ShoreTel 13 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 Server Appliances, refer to the *Service Appliance 100 Planning, Installation, and Administration Guide* for complete installation and configuration information. Both guides can be found in the documentation folder on the DVD.

The following release notes can be found in the documentation folder on the associated DVD and may also be accessed from ShoreTel Director:

• ShoreTel Release Notes provide information about new releases, new features, installation, and upgrading for the ShoreTel server.

## Hardware Documentation

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

- ShoreGear Voice Switch Quick Install Guide
- ShoreTel Service Appliance 100 Planning, Installation and Administration 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 command within the ShoreTel Communicator application.

- Analog Phone Quick Reference, which is available in the telephone user interface
- IP Phone Quick Reference, which is available in the telephone user interface

### **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 DVD 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 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 "International Planning and Installation" on page 289.

# **1.1** 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.

	Task	Date Completed
q	Download and modify the Microsoft Project installation schedule included in Resources	
q	Complete Call Flow Analysis	
q	Inventory and determine trunk requirements	
q	Order new trunk lines	
q	Trunk installation date	
q	Inventory your existing telephone equipment	
q	Order new phones and/or headsets	
q	Review your need for a ShoreTel Server Appliance	
q	Order a ShoreTel Server Appliance	
q	Review the need for a ShoreTel Enterprise Contact Center Solution	
q	Order a ShoreTel Enterprise Contact Center Solution	
q	Order ShoreTel voice switches	
q	ShoreTel shipping date	



# Phase 2: Environmental and Infrastructure Analysis and Upgrade

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

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

# Phase 3: Resource Scheduling and Tracking

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

# Phase 4: System Load and Configuration

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

## **Phase 5: Installation Readiness Review**

# Phase 6: Cut-Over

	Tack	Date Completed
	105K	Completed
q	Participate in the Phase 6 conference call	
q	Complete your Cutover Review Checklist	
q	Send web-based training modules to end users	
q	Send TUI guides to end users	
q	Verify that operators are trained	
q	Verify that workgroups are trained	
q	Verify that all phones have been placed and extensions tested	
q	Verify that existing trunk lines have been swapped and tested	
q	Verify that end users have been sent the ShoreTel client notification	
q	Cut-over to the ShoreTel system	
q	Complete your Post Cut-over Survey	
q	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. The topics are:

- "Recommendations" on page 23
- "Network Assessment" on page 23
- "Determine System Topology" on page 24
- "Determine Number of ShoreTel Voice Switches" on page 27
- "WAN Connections" on page 27
- "Failover" on page 28

# 2.1 **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.

# 2.2 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
- x for Wi-Fi.

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

# 2.3 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 servicelevel information.

See "Network Requirements and Preparation" on page 29, for detailed information on planning your network for the ShoreTel system.

### 2.3.1 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.

### 2.3.2 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.

### 2.3.3 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 processand 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 "Installing Communicator on Citrix and Windows Terminal Servers" on page 299.

### 2.3.4 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 "IP Phone Installation" on page 219.

### 2.3.5 Telephone Requirements

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

- Step 1 Count the telephone users in the current environment. Include conference room telephones, lobby telephones, and telephones that multiple users share.
- Step 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.
- Step 3 Count the number of ports that fax machines and modems will use.

Step 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.

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.

Step 5 Consider the needs for additional telephone ports for third-party systems, including server appliances and overhead paging systems.

See "Telephone Planning and Ordering" on page 149, for more information about selecting telephones.

Step 6 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 the ShoreTel Service Appliance 100. 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 the ShoreTel Service Appliance 100. A license allows one data-compatible endpoint to participate in a conference

### 2.3.6 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 149, 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 <u>www.erlang.com</u>, 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%).

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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.

# 2.4 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. "ShoreTel Voice Switches" on page 323 provides more information about all of the ShoreTel voice switches.

See "International Planning and Installation" on page 289 for information about the ShoreTel Voice Switches and features that we support outside the U.S.

# 2.5 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

# 2.6 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.



# Chapter 3

# Network Requirements and Preparation

Use the information in this chapter to determine specific network requirements for the ShoreTel system. After determining the network requirements, you will be ready to configure your network appropriately. The topics discussed include:

- "Overview" on page 29
- "Understanding the Requirements for Toll-Quality Voice" on page 30
- "WAN Technology Choices" on page 52
- "IP Address Assignment" on page 54
- "Configuring DHCP for ShoreTel IP Phones" on page 55
- "Configuring Automatic VLAN Assignment through DHCP" on page 58
- "Time Services" on page 59
- "Virtual Private Network (VPN)" on page 60
- "Firewalls" on page 62
- "Media Encryption" on page 64
- "Session Initiation Protocol (SIP)" on page 65
- "Example Network Topologies" on page 65
- "Computing Admission Control Bandwidth" on page 67

## 3.1 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.

Since 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

# **3.2 Understanding the 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.

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)
- Layer 4 UDP 5004

### 3.2.1 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.



### **3.2.2** Bandwidth Requirements

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

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

#### 3.2.2.1 Voice Encoding

Within a site, linear broadband encoding is recommended since bandwidth in the LAN is inexpensive and readily available. Between sites, G.729a is recommended because it uses the least amount of bandwidth. The linear codec provides slightly higher voice quality than G.711, but 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 will 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 3-1 provides bandwidth information for different codecs.

		Effective Sample		Supported
Codec	Sample Rate	Size	Data Rate	ShoreTel Endpoints
L16/1600 (Linear	16 KHz	16 bits	256 Kbps	IP 110/115/212/
Broadband)				230/230g/265/560/
				560g/655
L16/8000 (Linear)	8 KHz	16 bits	128 Kbps	All
PCMU (G.711 μ-	8 KHz	8 bits	64 Kbps	All
law)				
PCMA (G.711 A-	8 KHz	8 bits	64 Kbps	All
law)				
G.722 (ADPCM)	8 KHz	4 bits	32 Kbps	All
G.729a	8 KHz	1 bit	8 Kbps	All
AAC_LC	32 KHz			
BV-32	16KHz		32 Kbps	
BV-16	8KHz		16 Kbps	
DV-14	8KHz			
T.38				

Table 3-1Supported Codecs

#### **3.2.2.2** ShoreTel TCP and UDP Port Usage

Table 3-2 and Table 3-3 provide information about the ports ShoreTel devices and applications use to communicate with other ShoreTel devices and applications.

Originating		Destination Device			
Device	Traffic Type	Switch	IP Phone	Communicator	Softphone
Switch	Call Control	Location Service UDP 5440	MGCP UDP 2427		MGCP UDP 2427
		Call Control UDP 5441			
		Bandwidth Manager UDP 5443			
		Admission Control UDP 5445			
	Media Stream	RTP UDP 5004 (dynamic: 1024- 65535)	RTP UDP 5004 (dynamic: 1024-65535)		
SA-100 Appliance	Call Control	Location Service UDP 5440			
		Call Control UDP 5441			
		Bandwidth Manager UDP 5443			
		Admission Control UDP 5445			
		HTTP Web share TCP 80		Instant Messaging XMPP TCP5222	
		TCP 443		Presenter TCP 443 TCP 80	
	Conference Bridge Integration			HTTP- Configuration Control TCP 80	
	Media Stream	RTP UDP 5004 Configurable dynamic default: 10000- 10550)	RTP UDP 5004 Configurable dynamic default: 10000-10550)		RTP for SIP UDP 1024- 65535
SA-100	Media Stream V Switch only				NTP UDP 123

Table 3-2	Port Usage Part 1
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Originating		Destination Device			
Device	Traffic Type	Switch	IP Phone	Communicator	Softphone
IP Phone	Call Control	MGCP UDP 2727			
	Media Stream	RTP UDP 5004 if dynamic 10000- 10550	RTP UDP 5004 [if dynamic 10000-10550 BB to Phone		UDP 5004 RTP if dynamic: 10000-10550
Communicator	Video		001 3334	CMCP server TCP 5464 CMCP client TCP 5465	
	Media Stream	Dynamic configurable default 1000- 10550			
SoftPhone	Call Control	MGCP UDP 2727			
	Media Stream	RTP UDP 5004 if dynamic 1000- 10550	RTP UDP 5004 if dynamic 10000-10550		RTP UDP 5004 if dynamic 10000-10550
DVM Server	Call Control	RPC - NCC TCP 1024-65535		Remote TAPI TCP 1024-65535	
		MGCP - Media proxy UDP 2427			
		Location Service UDP 5440 Call Control UDP 5441			
		Bandwidth Manager UDP 5443			
		Admission Control UDP 5445			

Table 3-2Port Usage Part 1 (Continued)

Originating		Destination Device			
Device	Traffic Type	Switch	IP Phone	Communicator	Softphone
DVM Server	Media Stream	RTP UDP 5004 [if dynamic 1024- 65535]	RTP UDP 5004 [if dynamic 1024- 65535]		
	RPC Connection Negotiation	Port Mapper RPC TCP 111 UDP 111			RTP UDP 5004 [if dynamic 1024-65535]
	Configuration Control	Firmware download TCP 1024-65535			
HQ/Director Server	Call Control Media Stream	RPC - NCC TCP 1024-65535 MGCP - Media proxy UDP 2427 Location Service UDP 5440 Call Control UDP 5441 Bandwidth Manager UDP 5443 Admission Control UDP 5445 RTP UDP 5004 [if dynamic 1024-	RTP UDP 5004 [if dynamic	TCP 1024-65535 Remote TAPI	
	RPC Connection Negotiation Configuration Control	Port Mapper RPC TCP 111 UDP 111 Firmware download	1024-65535]		RTP UDP 5004
HQ/Director	Maintenance	TCP 1024-65535 Diagnostic ipbxctl	ТСР 5555		[if dynamic 1024-65535]
Server		TCP 5555	Diagnostic		

Table 3-2Port Usage Part 1 (Continued)



Originating		Destination Device			
Device	Traffic Type	Switch	IP Phone	Communicator	Softphone
Other	Call Control	SIP UDP 5060			
	Media Stream	RTP - for SIP UDP 1024-65535			RTP UDP 5004 [if dynamic 1024-65535]
	Configuration Control	DHCP Client UDP 68	DHCP Client UDP 68		
	Maintenance	Telnet TCP 23	Telnet TCP 23		
		SNMP UDP 161			

Table 3-2 I off Osage I art I (Continued	Table 3-2	Port Usage Part 1	(Continued)
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Table 3-3	
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		Destination Device				
Originating Device	Traffic Type	Service Appliance 100	DVM Server	HQ/Director Server	Other	
Switch	Call Control	Location Service UDP 5440 Call Control UDP 5441 DRS UDP 5442 Bandwidth Manager UDP 5443 Admission Control UDP 5445	RPC - NCC TCP 1024-65535 MGCP - Media proxy UDP 2727	RPC - NCC TCP 1024-65535 MGCP - Media proxy UDP 2727	SIP UDP 5060	
	Call Control: Softswitch		Location Service UDP 5440	Location Service UDP 5440		

		Destination Device				
Originating Device	Traffic Type	Service Appliance 100	DVM Server	HQ/Director Server	Other	
Switch	Call Control: Softswitch		Call Control UDP 5441	Call Control UDP 5441		
			DRS UDP 5442	DRS UDP 5442		
			Bandwidth Manager UDP 5443	Bandwidth Manager UDP 5443		
			Admission Control UDP 5445	Admission Control UDP 5445		
			DRS keepalive UDP 5446	DRS keepalive UDP 5446		
	Call Control: TMS RPC		NCC Event port TCP 5457	NCC Event port TCP 5457		
			SUNRPC Broadcast UDP 5458	SUNRPC Broadcast UDP 5458		
			MSRPC TCP/UDP 5500- 5600	MSRPC TCP/UDP 5500- 5600		

Table 3-3Port Usage Part 2 (Continued)


		Destination Dev			
Originating Device	Driginating S Device Traffic Type		DVM Server	HQ/Director Server	Other
Switch	Media Stream RTP UDP 5004 Configurable dynamic default: 10000-10550)		RTP Static UDP 5004 RTP Configurable dynamic default: 10000- 10550)	RTP Static UDP 5004 RTP Configurable dynamic default: 10000- 10550)	RTP - for SIP UDP 1024- 65535
RPC Connection Negotiation Configuration Control Database V Switch only Transport V Switch only Maintenance		Port Mapper RPC TCP 111 UDP 111	Port Mapper RPC TCP 111 UDP 111		
		FTP CTL - Boot files TCP 21	FTP CTL - Switch Boot TCP 21	DHCP Server UDP 67	
			FTP DATA - Boot files TCP 20	FTP DATA - Switch Boot TCP 20	
	Database V Switch only		MYSQL TCP 4306	MYSQL TCP 4306	
			MYSQL Config TCP 4308	MYSQL Config TCP 4308	
	Transport V Switch only		CDS TCP 5432	CDS TCP 5432	
	Maintenance				SNMP TRAP UDP 162

Table 3-3Port Usage Part 2 (Continued)

		Destination Device				
Originating Device	Originating Device Traffic Type		DVM Server	HQ/Director Server	Other	
Service Appliance 100	rvice ppliance 100 Call Control UDP 5440 Call Control UDP 5441 Bandwidth Manager UDP 5443 Admission Control UDP 5445		Softswitch Location Service UDP 5440 Call Control UDP 5441 DRS UDP 5442 Bandwidth Manager UDP 5443 Admission Control UDP 5445 DRS Keepalive UDP 5446	Softswitch Location Service UDP 5440 Call Control UDP 5441 DRS UDP 5442 Bandwidth Manager UDP 5443 Admission Control UDP 5445 DRS Keepalive UDP 5446		
Call Control: TMS RPC Configuration Control Database Transport		NCC Event port TCP 5457 SUNRPC Broadcast UDP 5458 MSRPC TCP/UDP 5500- 5600	NCC Event port TCP 5457 SUNRPC Broadcast UDP 5458 MSRPC TCP/UDP 5500- 5600			
	Configuration Control		FTP CTL - Boot files TCP 21 FTP DATA -Boot files TCP 20 MYSOL	FTP CTL - Boot files TCP 21 FTP DATA -Boot files TCP 20 MYSOL		
			TCP 4306 MYSQL Config TCP 4308	MYSQL Config TCP 4306 MYSQL Config TCP 4308 MYSQL CDR TCP 4309		
	Transport		CDS TCP 5432	CDS TCP 5432		

Table 3-3Port Usage Part 2 (Continued)



		Destination Dev			
Originating Device	Traffic Type	Service Appliance 100	DVM Server	HQ/Director Server	Other
Service Appliance 100	Media Stream	RTP UDP 5004 Configurable dynamic default: 10000-10550)	RTP Static UDP 5004 RTP Configurable dynamic default: 10000- 10550)	RTP Static UDP 5004RTP for SIP EndpointsDleRTP Configurable dynamic default: 10000- 10550)BTP for SIP Endpoints UDP 1024- 65535	
	Collaboration Management (CMCA)	(Web Share) Ping Sync UDP/TCP 5450			Ping Sync/ UDP 5450 (CMCA) to other SA- 100 TCP 5450
	Instant Messaging	UDP 5451 UDP 5463 TCP/UDP 5466	Any HTTP TCP 80 Web-proxy, session manager TCP 5449, 5469	Any HTTP TCP 80 Web-proxy, session manager TCP 5449, 5469	
	IM XMPP				TCP/UDP 5466 message forwarding
	STTS -NCC			TCP 5467	
	STTS - Media			TCP 5468	
					NTP UDP 123
					DHCP Server UDP 67
					SMTP Trap UDP162
					SMTP TCP 125
					DNS TCP/UDP 53

Table 3-3Port Usage Part 2 (Continued)

		Destination Device			
Originating		Service		HQ/Director	
Device	Traffic Type	Appliance 100	DVM Server	Server	Other
IP Phone	Call Control				
	Media Stream		RTP UDP 5004 if dynamic 10000-10550	RTP UDP 5004 if dynamic 10000-10550	
			FTP TCP 21	FTP TCP 21	
	Configuration Control		FTP CTL - Config TCP 21	FTP CTL - Config TCP 21	DHCP Server
			FTP DATA - Config TCP 20	FTP DATA - Config TCP 20	SNTP UDP 123
			ICMP PING	ICMP - PING	
				UDP 5004	
				RTP [if dynamic 1024-65535]	
Communicator	Call Control		MS RPC - Remote TAPI TCP/UDP 5500- 5600	MS RPC - Remote TAPI TCP/UDP 5500- 5600	
			Remote TAPI Event TCP 1024-65535	Remote TAPI Event TCP 1024-65535	
	Configuration Control		CSIS TCP 5440 CAS TCP 5447	Web client, Online help TCP 80 HTTP CSIS	
			Web-proxy Momt	TCP 5440	
			API TCP 5449, 5469	CAS TCP 5447	
				Web-proxy, Mgmt API TCP 5449, 5469	
	RPC		Port Mapper	Port Mapper	
	Connection Negotiation		RPC TCP 135 MS	RPC TCP 135 MS	

Table 3-3Port Usage Part 2 (Continued)



		Destination Device			
Originating Device Traffic Type		Service Appliance 100	DVM Server	HQ/Director Server	Other
Communicator	nunicator Web		Web-proxy, WCMWeb-proxy, WCoptions page/options page/Mgmt APIMgmt APITCP 5449, 5469TCP 5449, 5469Session MgmtSession MgmtAD/non-AD loginAD/non-AD loginauth & Webauth & WebcontentTCP 80TCP 80TCP 80CASCASTCP 5447TCP5447		
	Mobile		MCM Server TCP 80	MCM Server TCP 80	
	Instant Messaging	XMPP TCP 5222			
	Conference Bridge Integration	HTTP Configuration Control TCP 80 Presenter			
		TCP 443 TCP 80			
SoftPhone	Media Stream	RTP UDP 5004 if dynamic 10000-10550	RTP UDP 5004 if dynamic 10000- 10550	RTP UDP 5004 if dynamic 10000- 10550	
	Configuration Control			HTTP TCP 80	

Table 3-3Port Usage Part 2 (Continued)

		Destination Device				
Originating Device	Traffic Type	Service Appliance 100	DVM Server	HQ/Director Server	Other	
DVM Server	Call Control		MS RPC - DTAS/ TMS TCP 1024-65535 Call data TCP 5441 Location Service UDP 5440 Call Control UDP 5441 Bandwidth Manager UDP 5443 Admission Control UDP 5445 DRS keepalive	MS RPC - DTAS/ TMS TCP 1024-65535 MS RPC - DB access TCP 1024-65535 Call data TCP 5441 Location Service UDP 5440 Call Control UDP 5441 Bandwidth Manager UDP 5443		
			UDP 5446	Admission Control UDP 5445 DRS keepalive UDP 5446		
	Media Stream					
	RPC Connection Negotiation		Port Mapper MS RPC TCP 135	Port Mapper RPC TCP 111 UDP 111 MS RPC TCP 135		
	Maintenance				RPC - Quicklook TCP 1024- 65535	
	Distributed Voice Mail		SMTP - Voice Mail transport TCP 25	SMTP - Voice Mail transport TCP 25		
	Voice Mail Notification				SMTP TCP 25	

Table 3-3Port Usage Part 2 (Continued)

		Destination Dev	ce		
Originating		Service		HQ/Director	
Device	Traffic Type	Appliance 100	DVM Server	Server	Other
HQ/Director Server	Call Control		MS RPC - DTAS/ TMS TCP 1024-65535		
			MS RPC - DB Notify TCP 1024-65535		
			Call data TCP 5441		
			Location Service UDP 5440		
			Call Control UDP 5441		
			Bandwidth Manager UDP 5443		
			Admission Control UDP 5445		
			DRS keepalive UDP 5446		
	Media Stream				
	RPC Connection Negotiation		Port Mapper RPC TCP 111 UDP 111 MS RPC TCP 135		
	Maintenance		RPC - Quicklook TCP 1024-65535		
	Distributed Voice Mail		SMTP - Voice Mail transport TCP 25		
	Voice Mail Notification				SMTP TCP 25

		Destination Device				
Originating Device	Traffic Type	Service Appliance 100	DVM Server	HQ/Director Server	Other	
HQ/Director Server	CDR				CDR archive on remote server TCP 3306 -	
Other	Configuration Control			HTTP - Director TCP 80		
	Maintenance		HTTP - Quicklook TCP 80			

Table 3-3Port Usage Part 2 (Continued)

#### **3.2.2.3** Bandwidth in the LAN

For LAN calls using the voice switches, 10 msecs of voice samples are encapsulated in a Real Time Protocol (RTP) packet before being transmitted onto the LAN. For IP phones and SoftPhones, 20 msecs of voice samples are encapsulated in an RTP packet before being transmitted onto the network.

The protocol overhead consists of 12 bytes for the RTP header, 8 bytes for the UDP header, 20 bytes for the IP header, and 26 bytes for the Ethernet framing. When ADPCM voice encoding is used, an additional 4 bytes are added to the voice data for decoding purposes. This yields an effective LAN bandwidth as shown in Table 3-4.

	Linear Broadband	Linear	G.711	ADPCM (G.722)	G.729a	G.729a
Voice data (10 msec)	320	160	80	40+4 <sup>a</sup>	20 (20 msec) <sup>b</sup>	30 (30 msec)
RTP header	12	12	12	12	12	12
UDP header	8	8	8	8	8	8
IP header	20	20	20	20	20	20
Ethernet header and framing <sup>c</sup>	26	26	26	26	26	26
Total bytes per packet <sup>d</sup>	386	226	146	110	86 (20 msec)	96 (30 msec)
Bandwidth for voice only <sup>e</sup>	256 Kbps	128 Kbps	64 Kbps	32 Kbps	8 Kbps	8 Kbps
Bandwidth with overhead	309 Kbps	181 Kbps	117 Kbps	88 Kbps	34 Kbps	34 Kbps

Table 3-4 LAN Bandwidth—Bytes

a. When ADPCM using voice encoding, four bytes are added to the voice data for decoding purposes.

b. G.729a is supported in 10-msec, 20-msec, and 30-msec packets.



- c. Ethernet framing = 14 bytes of Ethernet header, a 4-byte checksum, and 8 bytes of additional framing.
- d. Voice data bytes per packet = (# bits/sample) x (8 samples/msec) x (10 msecs/packet) / (8 bits/byte).
- e. Bandwidth = (# bytes/10 msecs) x (8 bits/byte).

For calls between analog telephones, voice bandwidth is used only on the connection between the voice switches. For calls involving IP telephones, the bandwidth is required between the IP phones at the user's desktop. This means that for IP telephones, network planning must include provisioning capacity to each IP phone.

#### **3.2.2.4** Bandwidth in the WAN

Increasing the number of voice samples per packet decreases the bandwidth required (since the percentage of signaling overhead is reduced); however, it also increases the latency of the voice call, which can result in poorer voice quality. Consequently, the ShoreTel system uses 10-msec voice packets on the LAN, where bandwidth is readily available, and 20-msec voice packets on the WAN, where bandwidth conservation is more important. WAN calls are calls made between ShoreTel system sites.

For WAN calls, routers with RTP Header Compression (cRTP) reduce the 40 bytes in the IP + UDP + RTP header to 4 bytes. If you want to use cRTP, make sure the router's implementation of cRTP does not increase the latency or jitter of the voice traffic, since this can have a negative impact on voice quality. If the router does increase latency or jitter with cRTP, add this to your overall expected latency and make sure you still have sufficient performance for acceptable voice quality.

Table 3-5 shows the resulting effective WAN bandwidth. It does not include the overhead associated with the underlying WAN network protocol, such as HDLC, frame relay, ATM, and VPN; however, the ShoreTel admission control software computes bandwidth requirements according to the data in this table and assumes a PPP header-size for computations.

	Linear Broadband	Linear	G.711	ADPCM	G.729a	G.729a
Voice data (20 msec)	640	320	160	80+4 <sup>a</sup>	20	30
RTP header	12	12	12	12	12	12
UDP header	8	8	8	8	8	8
IP header	20	20	20	20	20	20
PPP header	5	5	5	5	5	5
Total bytes per packet <sup>b</sup>	685	365	205	129	65	75

Table 3-5	WAN Bandwidth—Bytes
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Table 3-5	WAN Bandwidth—Bytes

	Linear Broadband	Linear	G.711	ADPCM	G.729a	G.729a
Bandwidth for voice only <sup>c</sup>	256 Kbps	128 Kbps	64 Kbps	32 Kbps	8 Kbps	8 Kbps
Bandwidth including overhead	284 Kbps	146 Kbps	82 Kbps	52 Kbps	26 Kbps	26 Kbps
Bandwidth after cRTP	260 Kbps	132 Kbps	68 Kbps	37 Kbps	12 Kbps	12 Kbps

a. When ADPCM voice encoding is used, an additional 4 bytes are added to the voice data for decoding purposes.

b. Voice data bytes per packet = (# bits/sample) x (8 samples/msec) x (20 msecs/packet) / (8 bits/byte)

c. Bandwidth = (# bytes/20 msecs) x (8 bits/byte)

## 3.2.3 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. This one-way delay, from "mouth-to-ear," must not exceed 100 msecs for toll-quality voice, or 150 msecs for acceptable-quality voice. 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 latency introduced by the ShoreTel system can be understood as follows: When a person talks, the voice is sampled by the ShoreTel voice switch, generating a latency of 5 msecs. If the call does not traverse ShoreTel voice switches and is handled completely internally by the switch, the latency is generated by the basic internal pipeline of the switch. In this case, the switch samples the voice, processes it, combines it with other voice streams (switchboard), and then converts it back to audio for output to the phone in 5-msec packets, for a total latency of about 17 msecs.

When the call transfers between voice switches, the voice is packetized in larger packets—10msec for LAN and 20-msec for WAN — to reduce network overhead. The larger packets take more time to accumulate and convert to RTP before being sent out. On the receive side, the incoming packets are decoded and placed in the queue for the switchboard. For a 10-msec packet, this additional send/receive time is approximately 15 msecs, and for a 20-msec packet it is about 25 msecs.

For IP phones, the latency is 20 ms in the LAN and 30ms in the WAN.

When the codec is G.729a, the encoding process takes an additional 10 msecs and the decoding process can take an additional 10 msecs.

See Table 3-6 for specific information about latency on the ShoreTel system.



Configuration	Overhead	Encoding	Frame Size -5	Jitter Buffer <sup>a</sup>	Decoding	Total (+/- 5 msec) <sup>b</sup>
Switch	17	0	0	Varies	0	17
LAN	17	5	5	Varies	5	32 + Jitter Buffer
WAN	17	5	15	Varies	5	42 + Jitter Buffer
G.729a (LAN and WAN)	17	15	15	Varies	15	62 + Jitter Buffer

Table 3-6Latency

a. The jitter buffer varies, depending on network conditions. See below for more information.

b. If a call comes in on a trunk through either T1/E1 or analog loop-start, the total latency is increased by the delay in the PSTN. You must add this latency to the total latency. Latency for the PSTN varies; however, it is probably a minimum of 10 msecs (for local), and it could be as high as hundreds of msecs (for long international calls).

## 3.2.4 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 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 msecs 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 msecs to compensate for increased jitter and decreases in size in reaction to less jitter. The maximum value of the jitter buffer is set by ShoreTel Director and ranges from 20 to 300 msecs, with a default of 50 msecs.

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 IP phones that are configured into the ShoreTel system, the jitter buffer is not configurable. The minimum jitter buffer is 10 msecs, and the maximum is 80 msecs.

Maximum values greater than 100 should rarely be necessary. If needed, this could indicate a problem in your network that should be addressed in another way.

## 3.2.5 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, the ShoreTel voice switches have a feature called lost packet concealment. When there is no voice sample to be played, the last sample available 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.

#### 3.2.5.1 Summary of the Network Requirements

Table 3-7 summarizes the network requirements for bandwidth, latency, jitter, and packet loss.

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Parameter	Requirement
Bandwidth (WAN)	With ADPCM and no RTP Header Compression: 52 Kbps per call
	With G.729a and no RTP Header Compression: 26 Kbps per call
	With G.711 and no RTP Header Compression: 82 Kbps per call
	If your network uses VPN, bandwidth use is affected.
Latency and jitter for toll	< 100 msecs total
quality	100 msecs less 42 msecs allocated for the ShoreTel system yields a 58 msec budget for the network.
	When G.729a encoding is used, 100 msecs less 62 msecs allocation for the ShoreTel system yields a 38 msec budget for the network.
Latency and jitter for	< 150 msecs total
acceptable quality	150 msecs less 42 msecs allocated for the ShoreTel system yields a 108 msec budget for the network.
	When G.729a encoding is used, 150 msecs less 62 msecs allocated for the ShoreTel system yields an 88 msec budget for the network.
Packet loss	< 1% for voice calls, and no packet loss for fax and modem calls

#### 3.2.5.2 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 will 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.

## 3.2.6 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.

#### 3.2.6.1 Local Area Network

To manage bandwidth in the local area network (intra-site) and meet the requirements for tollquality 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 will automatically prioritize voice traffic ahead of any data traffic coming from daisy-chained personal computers (for example, large files transfers and e-mail).

On the local area network, there are several methods to prioritize voice packets, including:

- IP Precedence = 5 (configurable, recommendation is 5)
- DiffServ/ToS = EF (configurable, recommendation is EF)
- UDP (Destination port) = 5004 (when not using SIP)

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 choose to prioritize Differentiated Service Code Point (DSCP) since 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 your 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.

PCs connected through IP phones will lose their connection to the network if the IP phone loses power.

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.

#### 3.2.6.2 Virtual LANs

An alternative method to prioritize voice over data is to create a separate virtual LAN strictly for your voice traffic. The ShoreTel IP phone as well as the ShoreTel 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.

#### 3.2.6.3 Wide Area Network

To manage bandwidth in the wide area network, prioritize your voice traffic ahead of your data traffic. The voice packets on the ShoreTel system always travel on UDP port 5004, so you simply prioritize this UDP port within your routers with priority queueing. 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 routers needs to be configured to prioritize voice ahead of data using one of the two tagging methods, DiffServ/ToS or UDP 5004.

ShoreTel customers typically choose to prioritize UDP 5004 to avoid costly network upgrades since older routers and more Ethernet switches support this function. Additionally, configuring UDP 5004 for prioritization is easy to set up.

#### 3.2.6.4 Client Bandwidth

ShoreTel Communicators communicate with the ShoreTel server for call information and control, configuration changes, and advanced services such as extension monitoring. Table 3-8 provides an estimate of the client bandwidth used for each of the ShoreTel Communicator applications.

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

Table 3-8Typical ShoreTel Communicator Bandwidth Use

## 3.2.7 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.

## **3.2.8** Admission Control in the Wide Area Network

To ensure that your voice traffic does not overwhelm the 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 connection to phone.

## 3.2.9 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.



## 3.2.10 Traffic Shaping to Reduce Bottlenecks

Given that more applications are 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.

## 3.2.11 Echo Cancellation

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 since 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 the 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, the user may hear himself or herself 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 msecs after being sent.

## 3.2.12 Resultant Voice Quality

As stated earlier, the ShoreTel system has been recognized for excellent voice quality. This is a result of the excellent hardware and software design that minimizes latency and dynamically adapts to the effects of jitter, packet loss, and echo introduced by the network.

There are two subjective testing methods that are used to evaluate voice quality. A method called Mean Opinion Score (MOS) is an open test in which a variety of listeners judge the quality of a voice sample on a scale of 1 (low) to 5 (high). There is general industry agreement on the theoretical maximum MOS value on a per codec basis that can be achieved as shown in Table 3-9.

Table 3-9Theoretical MOS Maximum Scores

Codec	Data Rate (Kbps)	MOS
Linear	128	4.5

Codec	Data Rate (Kbps)	MOS
G.711	64	4.1
ADPCM (G.722)	32	3.85
G.729a	8	3.85

Table 3-9Theoretical MOS Maximum Scores

Both the MOS test method and an interactive test method were used by Microm. The interactive test focused on the conversational quality of the call. The results are shown in Table 3-10. The ShoreTel MOS scores are higher than the industry-standard values. This is likely a result of the subjective nature of the head-to-head test, which scores a relative ranking rather than an absolute ranking.

Codec	Data Rate (Kbps)	MOS	Interactive
Linear	128	Not tested	Not tested
G.711	64	4.46-4.87	4.66
ADPCM	32	3.96-4.05	4.33
G.729a	8	Not tested	Not tested

Table 3-10ShoreTel MOS and Interactive Test Results

## 3.3 WAN Technology Choices

## 3.3.1 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 are available from different service providers to provide IP connectivity between locations, as shown in Table 3-11.

Technology	Upstream Bandwidth Kbps	Downstream Bandwidth Kbps	Calls with ADPCM <sup>a</sup>
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

Table 3-11IP Connectivity Chart



Technology	Upstream Bandwidth Kbps	Downstream Bandwidth Kbps	Calls with ADPCM <sup>a</sup>
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

Table 3-11	IP Connectivity Chart
------------	-----------------------

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

#### 3.3.2 Leased T1

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

## 3.3.3 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.

## 3.3.4 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.

## 3.3.5 IDSL

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

## 3.3.6 ADSL

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

#### 3.3.7 Cable Modems

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

## 3.3.8 ISDN BRI

## 3.3.9 Dial-Up Modems

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

## 3.4 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. See Appendix F in this guide for all switch models or refer to the ShoreTel quick install guide for a specific ShoreTel Voice Switch model for information about the location of the maintenance port on the switch.

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, we recommend 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 telephone must have a unique IP address. You can configure the IP telephone through DHCP or manually on the telephone.



• Telephones 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.

## **3.5 Configuring DHCP for ShoreTel IP Phones**

The ShoreTel server provides the latest application software and configuration information to the 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.

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. Model numbers of ShoreTel IP Phones that support DHCP option 156 are ShoreTel IP Phone models IP110/115/212k/230/230g/265/560/560g/655.

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 3-12.

If the customer's 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 3-13 is the list of language numbers. (As Table 3-13 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 that say a requested service is unavailable.

To set up DHCP option 156 for ShoreTel IP Phone models IP110/115/212k/230/230g/265/560/ 560g/655 on a Microsoft DHCP server:

- Step 1 Open DHCP Manager on the Microsoft DHCP server.
- Step 2 Right-click the DHCP server, and then select Set pre-defined options.
- Step 3 Click Add.
- Step 4 Set Name to IP Phone Boot Server.
- Step 5 Set Data Type to String.
- Step 6 Set Code to 156 and add a description, if desired.
- Step 7 Navigate to the *scope* options and add option 156.
- Step 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 HQ server.
- *n* in country=*n* corresponds to the country number in Table 3-12.
- *n* in language=*n* corresponds to the language number in Table 3-13.

Table 3-12Country Numbers for 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
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



Number	Country
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 3-12Country Numbers for Option 156 (Continued)

Table 3-13	Language ]	Numbers by	Country f	for Option 156
	6 6			1

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

Number	Language (Country)
14	Japan
15	South Korea
17	Taiwan (Mandarin)
18	Portugal
22	Bulgaria
23	Australia, Fiji

Table 3-13Language Numbers by Country for Option 156 (Continued)

Step 9 Connect an Ethernet cable to the data jack on the back of the IP phone.

The IP phone downloads the latest bootROM and firmware from the ShoreTel server. During the whole configuration process, an IP phone reboots more than once. When the phone displays the date and time, the boot and upgrade processes have finished.

# **3.6 Configuring Automatic VLAN Assignment through DHCP**

You can configure an IP phone to automatically determine its VLAN id via DHCP. When the phone boots for the first time, it will acquire an IP address via DHCP similar to any other network device. However, the DHCP response will also specify (using a proprietary DHCP option), the VLAN id for the phone to use. Then, the phone will release the IP address originally assigned to it and will reboot. After reboot, all packets are tagged with the VLAN id specified in the original DHCP response.

The following phones are unaffected by this features: AP100 and AP110.

The Automatic VLAN Assignment feature is not configured through ShoreTel Director. Configuration changes are performed at the DHCP server. Parameters related to Automatic VLAN Assignment (along with their supporting text) have been italicized in the procedure that follows to make them easier to spot.

To configure Automatic VLAN Assignment via DHCP on a Microsoft DHCP server:

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

ftpservers=ip address, Layer2Tagging=N, VlanId=X

*FtpServers always needs to be set to a ShoreTel server and is a pre-existing parameter.* 



Layer2Tagging is a new parameter.

- Purpose: enable/disable 802.1Q, default is disabled
- Format: Layer2Tagging=N

where N=0 is disable, N=1 is enable

VlanId is a new parameter.

- Purpose: VLAN id when 802.1Q is enabled, default is zero
- Format: VlanId=X

where X is a VLAN id between 0 and 4094 E.g., the following would enable VLAN tagging using a VLAN id of 10: FtpServers=192.168.0.13,Layer2Tagging=1,VlanId=10

## **3.7** 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 that the NIST Internet Time Service (ITS) supports. See Table 3-14.

In addition, you must configure the DHCP server to provide the correct GMT offset to the ShoreTel IP Phones at each site. See "Associating a User Group with Unassigned IP Phones" section on page 225 for more information.

Name	IP Address	Location
time-a.nist.gov	129.6.15.28	NIST, Gaithersburg, Maryland
time-b.nist.gov	129.6.15.29	NIST, Gaithersburg, Maryland
time- a.timefreq.bldrdoc.gov	132.163.4.101	NIST, Boulder, Colorado
time- b.timefreq.bldrdoc.gov	132.163.4.102	NIST, Boulder, Colorado
time- c.timefreq.bldrdoc.gov	132.163.4.103	NIST, Boulder, Colorado
utcnist.colorado.edu	128.138.140.44	University of Colorado, Boulder
time.nist.gov	192.43.244.18	NCAR, Boulder, Colorado
time-nw.nist.gov	131.107.1.10	Microsoft, Redmond, Washington
nist1.symmetricom.com	69.25.96.13	Symmetricom, San Jose, California
nist1-dc.glassey.com	216.200.93.8	Abovenet, Virginia
nist1-ny.glassey.com	208.184.49.9	Abovenet, New York City

Table 3-14 NTP Time Servers

Name	IP Address	Location
nist1-sj.glassey.com	207.126.98.204	Abovenet, San Jose, California
nist1.aol-ca.truetime.com	207.200.81.113	TrueTime, AOL facility, Sunnyvale, California
nist1.aol- va.truetime.com	64.236.96.53	TrueTime, AOL facility, Virginia

Table 3-14NTP Time Servers (Continued)

## **3.8** Virtual Private Network (VPN)

With the increasing desire to leverage the public Internet, and the concern about security, IP VPNs (Internet Protocol Virtual Private Networks) are becoming 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 being adopted by companies of all sizes as a result 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 at the office including all network applications. A sample VPN configuration is shown in Figure 3-1.



Figure 3-1 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.

## 3.8.1 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.

## 3.8.2 Encryption

See "Media Encryption" section on page 64 for more information about ShoreTel's proprietary media encryption methods.

Encryption is the marking, transforming, and reformatting of messages to protect them from disclosure and maintain confidentiality. The two main considerations with encryption are the algorithm, such as Triple Pass DES (112 bits), RCA (128 bits), and Triple DES (168 bits), and the management of the distribution of encryption keys (IKE and PKI). These more recent keys, which support more than 100 bits, have been a major driver in the success of IP VPNs. They make it extremely difficult to hack into enterprise computer systems without an investment of millions of dollars in equipment.

Encryption starts with a key exchange that must be conducted securely. The IKE (ISAKMP/ Oakley) protocol has been considered the most robust and secure key exchange protocol in the industry to date. It is also a de facto standard for service providers and product vendors requiring the highest level of security for their VPN solutions. PKI (Public Key Infrastructure), new to the key management scene, is currently thought to be the long-term solution to simplifying the management of VPNs. The industry is still evaluating and testing PKI, with some initial deployments beginning to occur.

#### **3.8.3** 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 is 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.

## 3.8.4 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.

## 3.9 Firewalls

A firewall is the first major purchase and the foundation of network security (Figure 3-2). 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 that is deemed to be "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 employees Internet access. In an e-business site, it allows outside access to the web server while preventing unauthorized access or attacks.





Figure 3-2 Firewalls

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.

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.

## 3.10 Media Encryption

In addition to using a VPN or a firewall, another method of enhancing the security on your network is to enable the ShoreTel media encryption feature. 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.

The ShoreTel encryption algorithm utilizes dynamically generated keys to encrypt the RTP data for the media stream. The payload inside the RTP packets is encrypted by the sending party, and the transmission is decrypted by the receiving party. The ShoreTel algorithm was selected due to its reliability, simplicity and its efficiency – it places very little burden on the switch's CPU even during maximum loads.

## 3.10.1 Details:

- TCP/IP and UDP packet headers are not encrypted.
- Only calls inside a ShoreTel network will be encrypted. Once the call passes through TDM or analog trunks or via SIP, the encryption is stripped away and the conversation is no longer encrypted.
- The encryption algorithm handles the key exchange between the sending and receiving parties at the time of call setup. If the call starts off without encryption, and encryption is enabled during the middle of a call, the call will remain unencrypted.
- There is no difference in the user experience for encrypted and unencrypted calls. Encryption is essentially transparent, and the user will not know if the call is being encrypted or not.
- Encryption is not supported on the SoftSwitch, so calls to voice mail or auto attendant are not encrypted.

## 3.10.2 Supported Platforms

The media encryption feature is supported on the hardware shown in Table 3-15.

Platform Type	Model	
Switches	ShoreTel 1U Half-width voice switches	
	ShoreTel 1U Full-width voice switches	
IP Phones	IP110	
	IP115	
	IP212k	
	IP230	
	IP265	
	IP560	
	IP560g	
	IP565g	
	IP655	

 Table 3-15
 Platforms Supporting Media Encryption

For instructions on enabling media encryption, refer to the section on Call Control Options in the *ShoreTel 13 System Administration Guide*.

## **3.11** 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 points:

- If 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 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 (in contrast with ShoreTel's proprietary protocol, which always uses port 5004). Thus, if you are using SIP, you must deselect the "Always Use Port 5004 for RTP" check box on the Call Control Options page in Director so that it is not fixed at 5004.

## 3.12 Example Network Topologies

## 3.12.1 Single-Site Implementation

Figure 3-3 is an example of a simple, single-site implementation.



Figure 3-3 Single Site

## 3.12.2 Multisite Implementation

Figure 3-4 is an example of a multisite implementation with various WAN technology choices.



Figure 3-4 MultiSite Options



## 3.13 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 inter-site voice encoding must be set to G.729a and the ShoreTel voice switches at each end of the call must be G.729a-capable.

## 3.13.1 WAN Bandwidth per Call (Full Duplex) Without cRTP

Table 3-16 defines the bandwidth, including IP overhead, that is used for each voice call between sites when RTP Header Compression (cRTP) is not being 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.

Bandwidth in Kbps per Number of Calls	Linear	G711	ADPCM	G 729a
1		0.711	50	0.7294
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

Table 3-16Bandwidth Without cRTP

Bandwidth in Kbps				
Calls	Linear	G.711	ADPCM	G.729a
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
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

Table 3-16	Bandwidth	Without cRTP	(Continued)
1able 3-10	Danuwium	without CKTT	(Commueu)

## 3.13.2 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 3-17 defines the bandwidth used between sites when cRTP is being 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.



Bandwidth in Kbps per Number of Calls	Linear	G711	ADPCM	G729a
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
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 intra-site 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" section on page 50.

## 3.13.3 Setting Admission Control

The Admission Control Bandwidth parameters are set in the Site edit page of ShoreTel Director. For information on setting this parameter, see the chapter on configuring sites in the *ShoreTel 13 System Administration Guide*.



## Chapter 4

# **Routing Calls**

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. The topics discussed include:

- "Recommendations" on page 71
- "Hunt Groups" on page 72
- "Direct All Calls to an Auto-Attendant" on page 72
- "Direct All Calls to a Live Operator" on page 74
- "Direct All Calls to Extensions" on page 78
- "Blended Call Routing" on page 79
- "Analyze Outbound Call Routing" on page 82

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 23,

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*.

## 4.1 **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 (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.

## 4.2 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.

## 4.3 Direct All Calls to an Auto-Attendant

You can direct all inbound calls to the automated 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. See Figure 4-1 for an illustration of auto-attendant call flow.




Figure 4-1 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.

#### 4.3.1 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.

#### 4.3.1.1 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 83, for more information.

#### 4.3.2 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.

#### 4.3.3 Example of Auto-Attendant Call Routing

In the call flow example shown in Figure 4-1 on page 73, all calls are received by the autoattendant. The calling party can choose to be directed to:

• 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.

# 4.4 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. Shore Tel 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 either 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 (see the *ShoreTel 13: Administration Guide* for details on 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, to access the application note on paging on ShoreTel's web site at www.shoretel.com.

#### 4.4.1 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 83, for more information.

#### 4.4.2 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.

### 4.4.3 Example Using Hunt Groups

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.

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.
- 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 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, see the "Hunt Groups" section on page 138.

### 4.4.4 Example of Operator Call Routing

In the example call flow shown in Figure 4-2, all calls are received by the operator, who then transfers the calls to the appropriate destination.





Figure 4-2 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 (Figure 4-1 on page 73). 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).

# 4.5 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 autoattendant for Dial by Number, Dial by Name, and zero out to an operator.

## 4.5.1 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 83, for more information.

## 4.5.2 After-Hours Call Routing

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

## 4.5.3 Example of Direct Inward Dial Call Routing

In the illustration shown in Figure 4-3, all calls are received by workgroups or by individuals.





Figure 4-3 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 automated attendant.

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

# 4.6 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.

#### 4.6.1 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 83, for more information.

#### 4.6.2 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.

## 4.6.3 Example of Blended Call Routing

In the example shown in Figure 4-4, a mix of inbound call routing is used.





Figure 4-4 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 autoattendant 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.

# 4.7 Analyze Outbound Call Routing

In general, you should have trunks at every site that support both outbound and inbound calling. Here are some general comments 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)" section on page 84.
- 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. Please see the appendix on emergency 911 operations in the *ShoreTel 13: 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 83, and "Dialing Plan" on page 99.



# Chapter 5

# **Trunk Planning and Ordering**

This chapter explains the features and functionality of trunks on the ShoreTel system, so you can plan and order your service. The topics discussed include:

- "Recommendations" on page 83
- "Reviewing and Selecting Trunk Types" on page 83
- "Understanding Trunk Features" on page 89
- "Performing Traffic Calculations" on page 93
- "Ordering Telephone Service" on page 93

## 5.1 **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 (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.

## 5.2 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 5-1 shows which trunk types are supported on individual ShoreTel Voice Switches. The next section provides more detailed information about the various trunk features.

Voice Switch	Analog Loop- Start (North. Amer.)	Analog Loop- Start EMEA	Digital Loop- Start	Analo g 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
ShoreTel E1	No	No	No	No	No	No	Yes	No	No
ShoreTel T1	No	No	Yes	No	Yes	Yes	No	No	No

Table 5-1Supported Trunk Types

## 5.2.1 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:

- 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 13 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 (on hook) caller ID support is based on SIN 227 and SIN 242 standards in the UK.

## 5.2.2 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 13 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.

### 5.2.3 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:

- 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

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

#### 5.2.4 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:

- 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>\*



## 5.2.5 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:

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

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

- 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>\*

#### 5.2.6 BRI Trunks

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

PRI trunks support:

- 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.

#### 5.2.7 T1 PRI Trunks

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

PRI trunks support:

- 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

- 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.

### 5.2.8 E1 PRI Trunks

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

E1 PRI trunks support:

- 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 289.

#### 5.2.9 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:

- 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 off. 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.

## 5.3 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 5-2 shows each trunk type and the associated 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 <sup>a</sup>	Yes <sup>a</sup>	Yes	Yes	Yes	Yes
Caller ID Name	Yes	No	Yes	No	No	Yes <sup>b</sup>	Yes	Yes	Yes
• Direct Inward Dial (DID)	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes

Table 5-2Trunk 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
• Dialed Number Identification Service (DNIS)	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
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 <sup>c</sup>	No	Yes <sup>c</sup>	N/A	No	Yes	No	Yes	No

Table 5-2Trunk Features (Continued)

a. Via Automatic Number Identification (ANI).

b. Caller ID Name is supported for NI-2 configured trunks.

c. \*67 and \*82 codes do not work if the CO requires a pause between the code and the dialed number.

Legend to Table 5-2

- 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.

### 5.3.1 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.

### 5.3.2 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.

### 5.3.3 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>\*.

### 5.3.4 Direct Inward Dial (DID)

Direct Inward Dial (DID) allows extensions (users, menus, workgroups, route points, etc.) on the system 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—that is:

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

#### 5.3.5 Dialed Number Identification Service (DNIS)

Dialed Number Identification Service (DNIS) allows extensions (users, menus, workgroups, route points, etc.) on the system to be accessed directly, without the need of 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—that is:

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

## 5.3.6 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 (\*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 13 System Administration Guide*.

## 5.3.7 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.

### 5.3.8 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.

# 5.4 **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, see "Planning and System Design" on page 23.

# 5.5 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 DVD 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 289, 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 cutover 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 13 System Administration Guide* for information on how to configure your system for emergency calls.

## 5.5.1 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 Trunk	is is	
Customer Name: Today's Date: Cut-over Date: Cut-over Time:		
Vendor Make: Model: FCC Registration Number: Ringer Equivalence:	ShoreTel, Inc. ShoreGear 4ABUSA-26003-MF-E 0.5B	
Ana log Loop Start Tranks Quantity of Trunks: Protocol: Signalling: Caller ID: Caller ID: Caller ID Format: Caller ID Delivery:	Loop Start DTMF Yes / No MDMF Blocked / Unblocked	
Ana log Wink Trunks Quantity of Trunks: Protocol: Signalling: Automatic Number Identification (AND): Direct Inward Dial (DID): Quanity of Numbers (Block) Number of Digits: Dialed Number Identication Service (DNIS): Quanity of Numbers: Number of Digits:	Wink Start DTMF Yes / No Yes / No 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 Yes / No 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	Example: 100, 200
Comments		

Figure 5-1 Telephone Service Order Form—Analog Trunks

#### 5.5.2 T1 Service

Use the T1 Telephone Service Order form (Figure 5-2) 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.

Customer Name: Today's Date: Cut-over Date: Cut-over Time: Vendor Make: Shore Tel, Inc. Model: Shore Gear FCC Registration Number: 4ABUSA-26003-MIFE Ringer Equivalence: 0.5B Disite Lloca Start Tranks
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         Disitel Loop Start Tranks
Cut-over Date: Cut-over Time: Vendor Make: Shore Tel, Inc. Model: Shore Gear FCC Registration Number: 4ABUSA-26003-MF-E Ringer Equivalence: 0.5B
Cut-over Time: Vendor Make: Shore Tel, Inc. Model: Shore Gear FCC Registration Number: 4ABUSA-26003-MF-E Ringer Equivalence: 0.5B Disite Lloca Start Tranks
Vendor Make: ShoreTel, Inc. Model: ShoreGear FCC Registration Number: 4ABUSA-26003-MF-E Ringer Equivalence: 0.5B Dirith Loop Start Tranks
Make: Shore Tel, Inc. Model: Shore Gear FCC Registration Number: 4ABUSA-26003-MFE Ringer Equivalence: 0.5B
Model: ShoreGear FCC Registration Number: 4ABUSA-26003-MF-E Ringer Equivalence: 0.5B
FCC Registration Number: 4ABUSA-26003-MFE Ringer Equivalence: 0.5B
Ringer Equivalence: 0.5B
Dir ifa II. oon Start Trunks
DENTLOOP SUIT THERE
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
Dig ital 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 5-2 Telephone Service Order Form—T1 Trunks

## 5.5.3 T1 PRI Service

Use the T1 PRI Telephone Service Order form (Figure 5-3) 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:	Shore Tel, Inc.	
Model: FCC Registration Number: Ringer Equivalence:	ShoreGear 4ABUSA-26003-MF-E 0.5B	
PRI Trunks Quantity of Trunks:	_	
Protocol: Central Office Type: Signalling:	PRI 4ESS / 5ESS / DMS-100 / NI-2 DTMF	
Framing Format: Line Code:	ESF/D4 B8ZS/AMI	
Service: Caller ID: Caller ID Delivery: Direct Inward Dial (DID):	Inbound / Outbound / Both Yes / No Blocked / Unblocked Yes / No	
Quanity of Numbers (Block) Number of Digits: Dialed Number Identication Service (DNIS):	3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 Yes /No	Example: 100, 200
Quanty of Numbers: Number of Digits:	3 - 4 - 5 - 6 - 7 - 8 - 9 - 10	
Comments		

Figure 5-3 Telephone Server Order Form—PRI Trunks

## 5.5.4 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.

#### 5.5.5 E1 PRI Service

See "International Planning and Installation" on page 289, 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. The information in this chapter is useful for administrators of larger, multisite installations. The topics include:

- "Overview" on page 99
- "Define Digit Collection" on page 99
- "Define Digit Manipulation" on page 105
- "On-Net Dialing" on page 107
- "Quick Reference of Star Codes" on page 113

## 6.1 **Overview**

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.

In this chapter you will learn how to define what happens at each of these steps. Once you are familiar with these concepts, we will introduce you to On-Net Dialing, a feature that allows users to divide phone numbers into two separately-managed parts for a more flexible dialing plan.

# 6.2 Define Digit Collection

When someone picks up a telephone in a ShoreTel system and begins dialing a telephone number, the voice switch software examines each digit in the number and determines whether digit collection should continue or be terminated.

### 6.2.1 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 6-1 shows the Dialing Plan edit page.

System Parameters Edit Dialing Plan	<u>Save</u> <u>R</u> eset
Edit this record	Refresh this page
Number of Extension Digits:	4 Increase Extension Length
Dialing Plan:	
Digit:	Reservation:
0:	Trunk Access Codes (1 Digit)
1:	Extensions
2:	Extensions
3:	Extensions
4:	Extensions
5:	Extensions
6:	Extensions
7:	Extensions
8:	Extensions
9:	Trunk Access Codes (1 Digit)
#:	Voice Mail Login
*:	Feature Activation

Figure 6-1 Dialing Plan Edit Page

#### 6.2.1.1 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 "911" (911, 911x, or 911xx).

#### 6.2.1.2 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.

Digit	Rule
0 - The digit configured in the dialing plan as the operator digit.	Digit collection is stopped and the call is routed to the site operator.
#	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.
	<ul> <li>valid on-system extensions – the call is routed to a trunk.</li> <li>invalid extensions – the call is routed to the Backup Automated Attendant.</li> </ul>
	Rule does not apply to trunk access codes.

Table 6-1	Digit Collection Rules
-----------	------------------------

#### 6.2.1.3 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. See the appendix on emergency 911 operations in the *ShoreTel 13 System Administration Guide* for information on how to configure your system for emergency calls.

To define digit collection for internal numbers:

• In ShoreTel Director, go to the Dialing Plan edit page under System Parameters and edit the dialing plan parameters. See the *ShoreTel 13 System Administration Guide* for a description of the parameters on this page.

#### 6.2.1.4 Changing Extension Length

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

To change the extension length:

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

After applying your edits, you cannot decrease an extension length. For example, once it is increased to 4, the minimum is 4.

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

## 6.2.2 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.

#### 6.2.2.1 Configuring 7-Digit Local Dialing

The Local Area Code on the Site edit page, shown in Figure 6-2, 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.



Sites Edit Site	New Copy Save Delete Reset
	* modified
Edit this record	Refresh this page
Name:	Headquarters
Country:	United States of America -
Parent:	Top of Tree
Use Parent As Proxy	
Local Area Code:	408
Additional Local Area Codes:	Edit
Emergency Call Back Number (CESID):	(e.g. +1 (408) 331-3300)
Time Zone:	(GMT-08:00) Pacific Time (US & Canada); Tijuana, Pacific Standard Time
NightBell Extension:	
Night Bell Switch:	None 💽 Edit Night Bell Call Handling
Paging Extension:	
Paging Switch:	None •
Operator Extension:	4515 - Greta Garbo Search
FAX Redirect Extension:	4803 - Support Center Search
Emergency Number:	911
Admission Control Bandwidth:	1440 kbps
<u>Edit IP Phone Address Map</u>	

Figure 6-2 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.

To define 7-digit dialing:

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

See the *ShoreTel 13 System Administration Guide* for more information about the Site edit page.

#### 6.2.2.2 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 (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.

To define 10-digit dialing:

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

The Additional Local Area Codes dialog box, shown in Figure 6-3, appears.

Additional Local Area Codes Web Page Dialog Dial phone numbers with the following area codes as local:	X
972 New Remove	
OK Cancel	
http://powerbar/shore 🌉 Local intranet	

Figure 6-3 Additional Local Area Codes Dialog Box

See the *ShoreTel 13 System Administration Guide* for more information about the Additional Local Area Codes field on the Site edit page.

#### 6.2.2.3 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 since some service providers do not support permissive dialing. See "Define Digit Manipulation" section on page 105.

#### 6.2.2.4 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.

#### 6.2.2.5 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 (#).

#### 6.2.2.6 n11 Dialing

The ShoreTel system supports "n11" dialing, including 411 (information) and 611 (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.

#### 6.2.2.7 911 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.



Please see the appendix on emergency 911 operations in the *ShoreTel 13 System Administration Guide* for information on how to configure your system for emergency calls.

#### 6.2.2.8 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.

#### 6.2.2.9 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.

#### 6.2.2.10 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.

#### 6.2.2.11 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.

# 6.3 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 (local, long distance, ERC, international), digit manipulation can occur. If the number is unroutable (n11, ECS, operator, and vertical service code numbers) digit manipulation (other than the dial-out prefix) is not applied.

To specify trunk digit manipulation:

Step 1 Open the Trunk Digit Manipulation page, shown in Figure 6-4.

Trunk Digit Manipulation:						
Remove leading 1 from 1+10	0					
Hint: Required for some long distance service providers.						
Remove leading 1 for Local Area Codes (for all prefixes unless a specific local prefix list is provided below)						
Hint: Required for some local se	ervice providers with overlay area codes.					
🗹 Dial 7 digits for Local Area C	Im Dial 7 digits for Local Area Code (for all prefixes unless a specific local prefix list is provided below)					
Hint: Local prefixes required for	some local service providers with mixed 7D and 1+10D in the same home area.					
Local Prefixes:	None Go to Local Prefixes List					
Prepend this Dial Out Prefix:						
Off System Extensions:	Edit					

Figure 6-4 Digit Manipulation on the Trunk Group Edit Page

Step 2 Select the options and specify numbers as needed, using Table 6-2 as a guide.

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.

Table 6-2Digit Manipulation Options



Option	Description	Example
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.
Vertical Service Codes	If a Vertical Service Code was dialed, digit manipulation rules do not apply.	Not applicable.
	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.	
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.	Not applicable.
	Digit manipulation, including the Dial Out Prefix, will not be applied to these calls.	

Table 6-2Digit Manipulation Options (Continued)

# 6.4 **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 intersite 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.



How It Works

Figure 6-5 Abbreviated Four-digit Dialing with Extension Prefix

As Figure 6-5 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 (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 "cookie cutter" 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 You can preserve the existing dialing plans when adding ShoreTel equipment to a deployment with legacy equipment by assigning 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.

# 6.4.1 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 subsections that follow provide details on each of these tasks.

- NOTE ShoreTel's Small Business Edition does not support On-Net Dialing.
- NOTE Enabling On-Net Dialing is an irreversible process. It permanently changes the database. Therefore, plan carefully before proceeding with the configuration.

#### 6.4.1.1 Planning and Configuring the Dialing Plan

Assigning extension prefixes to a specific digit must be done all at once. Once the dialing plan window (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.

To configure the dialing plan via Director, follow the procedure below:

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

Edit Dialing Plan	Save Reset
Edit this record	Refresh this page
Number of Extension Digits:	4 Increase Extension Length
Dialing Plan:	2
Digit:	Reservation:
0:	Operator 💌
1:	Extensions
2:	Extensions
3:	Extensions
4:	Extensions
5:	Extensions
6:	Extensions
7:	Extension Prefix (3 Digit)
8:	Extension Prefix (5 Digit) Extension Prefix (6 Digit)
9:	Extension Prefix (7 Digit)
#	Not Used
*:	Trunk Access Codes (1 Digit) Trunk Access Codes (2 Digit)

Figure 6-6 Configuring dialing plan

- Step 4 Click on the drop-down menu to the right of the desired digit and select the number of digits you would like the extension prefix (i.e. 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.
- Step 5 Repeat this process for any other extension prefixes, unused extensions, or trunk access codes.
- Step 6 Click Save to store your changes. The Configure Extension Prefix Warning dialog box (similar to the one shown below) appears with a list of each of the sites in your system.



Configure Extension	Prefix Warning! Web Page Dialog	×
Warning! This pro extension prefix for ea continue, or press "Ca	ccess is irreversible. Please enter ch site and press "OK" button to ancel" button to abort the action. Save Cancel	
Site Extension Prefi	x List	
Dallas:	818	
Headquarters:	818	
New York:	616	
Remote1:	313	
San Francisco:	313	
Remote1: San Francisco: 1998-2005 ShoreTel, Inc.	313 313 All rights reserved.	_

Figure 6-7 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 (user extensions, menus, workgroups, distribution lists) are affected by changes to the extension prefix.

Step 7 Click the Save button to store your changes.

#### 6.4.1.2 Adding Sites

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

- Step 1 Launch ShoreTel Director and enter the user ID and password.
- Step 2 Click on the Administration link to expand the list (if it has not already been expanded).
- Step 3 Click on the Sites link.
- Step 4 Click on the "Add a new site" in drop-down menu and select the country where the site will be added.
- Step 5 Click the Go link to display a window similar to the one shown below.

Sites Edit Site	New Copy Save Delete Reset	<u>Help</u>
	* m	odified
Edit this record	Refresh this page	
Name:	New York	
Country:	United States of America	
Language:	English	
Parent:	San Francisco 💌	
□ Use Parent As Proxy		
Local Area Code:	212	
Additional Local Area Codes:	Edit	
Caller's Emergency Service Identification (CESID):	1 (212) 616-9111 (e.g. +1 (408) 331-3300)	
Time Zone:	(GMT-05:00) Eastern Time (US & Canada), Eastern Standard Time	-

Figure 6-8 Add a new site

Step 6 Enter the name of the site, along with all other relevant information, in the appropriate fields. (Refer to the "ShoreTel Sites" chapter in the *ShoreTel 13 System Administration Guide* for additional information on con-figuring this window.)

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

- Step 7 Click Save to store your changes.
- Step 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. By clicking on the name of the site, you will see an Extension Prefix field. The field should be populated with the value entered in the Extension Prefix Warning window, as shown in the window below:

Sites	New	Сору	<u>S</u> ave	Delete	Reset	<u>Help</u>
						* modified
Edit this record	Refresh this pag	<u>je</u>				
Name:	New York					
Country:	United States of	America 💌				
Language:	English 💌					
Parent:	Remote	•				
Use Parent As Proxy						
Extension Prefix:	616					
Local Area Code:	212					
Additional Local Area Codes:	Edit					
Caller's Emergency Service Identification (CESID):	1 (212) 616-9191	(e.g. +	-1 (408) 331-3	300)		
Time Zone:	(GMT-05:00) Eas	tern Time (US	& Canada), Ea	stern Standard	Time	•

Figure 6-9 Extension Prefix field now populated



#### 6.4.1.3 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 is due to cookies in the system populating the new user's extension with old and 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.

# 6.5 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 (i.e. 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.

## 6.5.1 Common Star Codes

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.
Changing Call Handling Mode and Forwarding	VoiceMail + password + # + 72
Changing Extension Assignment	VoiceMail + password + # + 731
Unassign Extension Assignment	VoiceMail + password + # + 732
Assign Extension to External Number	VoiceMail + password + # + 733

# 6.5.2 Extension Assignment Star Codes

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.

# 6.5.3 Trunk Star Codes

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:

- "Overview" on page 115
- "Define Network Call Routing" on page 115

# 7.1 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.

# 7.2 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.

### 7.2.1 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.

To define call permissions:

Step 1 Open the *Call Permissions* edit page (Figure 7-1).

Class of Service Edit Call Permissions	New         Copy         Save         Delete         Reset         Help
Edit this record	Refresh this page
Name:	Long Distance Calling
Scope:	<ul> <li>○ Internal Only</li> <li>○ Local Only</li> <li>ⓒ National Long Distance</li> <li>○ National Mobile</li> <li>○ International Long Distance</li> <li>○ All Calls</li> </ul>
Restrictions:	(e.g. +1900,+1xxx976)
Permissions:	(e.g. 1/311)

Figure 7-1 Call Permissions Edit Page

- Step 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.
- Step 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.

Follow these 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 (311, 411, etc.) 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.

# 7.2.2 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, see the *ShoreTel 13: 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:

- 1. Checks call permissions for the caller's user group to determine if an account code must be collected.
- 2. 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 (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.

Refer to the chapter on Call Control in the *ShoreTel 13: System Administration Guide* for more information about account codes and account code wildcards.

# 7.2.3 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 7-2.

Trunk Services:
🔽 Local
☑ Long Distance
✓ International
☑ n11 (e.g. 411, 611, except 911 which is specified below)
<b>I</b> 911
▼ Easy Recognizable Codes (ERC) (e.g. 800, 888, 900)
Explicit Carrier Selection (e.g. 1010xxx)
☑ Operator Assisted (e.g. 0+)
Caller ID not blocked by default

Figure 7-2 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. (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 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.

To define trunk services:

- Step 1 Open the Trunk Services dialog box on the Trunk Group edit page.
- Step 2 Select the services that will be available for the selected trunk.

See the *ShoreTel 13: System Administration Guide* for more information about the Trunk Group edit page.



To define admission control:

- Step 1 Open the Site edit page.
- Step 2 Enter the proper amount in the Admission Control Bandwidth field.

See the *ShoreTel 13: System Administration Guide* for more information about the *Site* edit page and for instructions about computing Admission Control Bandwidth.

### 7.2.4 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.

#### 7.2.4.1 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.

To make the routing decision, the algorithm poses the following questions. For the number dialed, is there:

- 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?

To specify parameters for the routing decision:

Step 1 Open the Network Call Routing page on the Trunk Group edit page, shown in Figure 7-3

Network Call Routing:	
Access Code:	9
Local Area Code:	408
Additional Local Area Codes:	Edit
Nearby Area Codes:	Edit

Figure 7-3 Network Call Routing on the Trunk Group Edit Page

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

See the *ShoreTel 13: 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 applications and services of the ShoreTel system to assist you in planning your system configuration, and to determine the equipment you need for completing deployment. The topics discussed include:

- "Account Code Collection Service" on page 121
- "Planning Fax Handling" on page 127
- "Private Numbers" on page 134
- "Automated Attendant" on page 135
- "Call Handling Delegation" on page 136
- "ShoreTel Communicator for Windows" on page 136
- "ShoreTel Communicator for Mac" on page 136
- "ShoreTel Communicator for Web" on page 136
- "Bridged Call Appearances" on page 137
- "Hunt Groups" on page 138
- "Pickup Groups" on page 140
- "Workgroups" on page 142
- "Enterprise Telephony Features" on page 144
- "ShoreTel Enterprise Contact Center Solution" on page 147

# 8.1 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.

### 8.1.1 Account Codes

Account Code Collection Service supports up to 50,000 account codes of 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 8-1 gives example account codes and how the Account Code Collection Service interprets the code.

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

 Table 8-1
 Account Code Interpretation Example

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

### 8.1.2 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.

# 8.1.3 Distributed Voice Mail

ShoreTel has Distributed Voice Mail to provide 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 pickup 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:

- 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 (can also include a voice mail attachment in WAV format).
- A pager (a pager model that allows message notification).
- An extension (if the extension 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."

### 8.1.4 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. (See the section on configuring users in the *ShoreTel 13 System Administration Guide* for more information.)

### 8.1.5 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.

### 8.1.6 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. Thusly, users are not caught off-guard by an unexpected (and unwanted) "mailbox full" notification.

For more information, refer to the section on configuring users in the *ShoreTel 13 System Administration Guide*.



## 8.1.7 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.

To simplify AMIS systems, and increase 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 13 System Administration Guide*.

### 8.1.8 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 (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, see "SMDI Protocol Support" on page 258.

# 8.1.9 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 (6 seconds).

The voice mail system does not automatically notify callers of the Find Me call handling option. Shore Tel users can elect to tell callers of the Find Me option in their recorded greeting (i.e. 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.



### 8.1.10 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 13 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 (for example, 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.

### 8.1.11 Time Stamps

The time stamp of the message is relative to the time on the server where the message is taken. For example:

- 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.

# 8.2 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

Figure 8-1 shows how to plan your fax options.



Planning Fax Service

Figure 8-1 Planning Fax Service

How you configure your fax service with ShoreTel Director depends on which method of fax call handling you have chosen. The following provides a basic outline of the steps involved:

If you plan to use the main number for voice and fax calls, and the main number goes to an auto-attendant:

- Step 1 Configure the fax extension through the User edit page of ShoreTel Director. Make sure that fax redirection is disabled for fax extension "users."
- Step 2 Enter a fax extension you created in Step 1 in the FAX Redirect Extension field from the Site edit page.

If you plan to use the main number for voice and fax calls, and the main number goes to an operator:

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

If your users have their own faxes or fax service:

- Step 1 Configure the fax extensions through the User edit page of ShoreTel Director.
- Step 2 Assign a range of direct fax numbers.



Step 3 From the Trunk Group edit page (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:

- Step 1 Configure the fax extensions through the User edit page of ShoreTel Director.
- Step 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, see the ShoreTel 13 System Administration Guide.

#### 8.2.1 Using a Fax Server

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

- 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 allows you to:

- 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

#### 8.2.1.1 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 machine typically require 19.2 Kbps, ShoreTel recommends that you use G.711 voice encoding for fax calls. For more information on fax requirements, see the "ShoreTel IP Phones" on page 151.

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

#### 8.2.1.2 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 his or her e-mail address.

Once configured, incoming fax calls are received at the user's phone extension. The fax server listens for the fax tone, takes over the call (assuming 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 8-2 shows the flow for a fax call.



Figure 8-2 Fax server integration call flow

#### 8.2.1.3 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.

#### 8.2.1.4 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

To configure the Fax Server Integration feature:

- Step 1 Configure a fax server per the manufacturer's instructions.
- Step 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.

- Step 3 Launch ShoreTel Director.
- Step 4 Click on the Administration > Users > Individual Users.
- Step 5 Click Add a New User. The Edit User window appears, as shown in Figure 8-3. (Arrows in the illustration point to fields that must be configured. Refer to the bulleted list below the illustration for details.)

<b>Users</b> Edit User	Kew         Copy         Save         Delete         Reset	<u>Hel</u>
🔻 General	Personal Options     Distribution Lists     Workgroups	Refresh this page
First Name:	Fax1	
Last Name:	Marketing	
Number:	114	
License Type:	Extension-Only	
Caller ID:	(e.g. +1 (408) 331-3300)	
DID:	+1 V (DID Range: +14083451000 - 4083451000)	
PSTN Failover:	None 🗸	
User Group:	House Telephones 🛛 🔽 Go to this User Group	
Site:	Headquarters 💌	
Language:	English(US) 🗸	
Home Port:	O IP Phones Any IP Phone	
	💿 Ports 🛛 🔽 💌	
	O SoftSwitch SoftSwitch	
Current Port:	Omy fuji-8 - 1 Go Home	
Jack #		
Mailbox on Server:	Headquarters Second Escalation Profiles and Other Mailbox Options	
Accept Broadcast Me	issages 🔫	
☑ Include in System Dia	al By Name Directory 🛛 🔫 🛶 🛶	
Make Number Private		
Fax Support:	Fax Machine 👻	

Figure 8-3 Creating a user account for the fax server

Step 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.
- Step 7 Click the Save button to store your changes.

- Step 8 Click the Personal Options tab and enter "1" in the Current call stack size field.
- Step 9 Click Save to store your changes.

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

- Step 10 In Director, select the user account representing the fax server connection.
- Step 11 Click the Personal Options tab.
- Step 12 Click the Standard link under Edit Call Handling Modes.
- Step 13 Under Call Forward Condition, select the No Answer/Busy radio button as shown in Figure 8-4.

Standard Mode	Save Reset	Help
Tax T marketing		* modified
Edit this record	Refresh this page	
Call Forward Condition:	C Always      No Answer/Busy	Never
Always Destination:	Extension: 21101 - Voice Mail	Search
	C External:	(e.g. 9+1 (408) 331-3300)
Busy Destination:	• Extension: 21101 - Fax Port2	Search
	C External:	(e.g. 9+1 (408) 331-3300)
No Answer Destination:	• Extension: 21101 - Fax Port2	Search
	C External:	(e.g. 9+1 (408) 331-3300)
No Answer Number of Rings:	3	
🔽 Enable Calling Message Notific	cation	
Personal Assistant:	Search	
Call Handling Note:		
Enable Find Me		

Figure 8-4 Configuring Call handling mode for Busy/No Answer failover

Step 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.

Step 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.)

- Step 16 Under the Administration link, click Sites.
- Step 17 Click on the site where the switch and fax server are located (i.e. either Headquarters or Remote). The Edit Site page appears as shown in Figure 8-5.



Sites Edit Site	New Copy Save	<u>D</u> elete <u>R</u> eset
Edit this record	Refresh this page	
Name:	Headquarters	
Country:	United States of America 💌	
Language:	English 💌	
Parent:	Top of Tree	
☐ Use Parent As Proxy		
Local Area Code:	408	
Additional Local Area Codes:	Edit	
Caller's Emergency Service Identification (CESID):	+1 (408) 331-3300 (e.g. +1 (408) 331-3300	נכ)
Time Zone:	(GMT-08:00) Pacific Time (US & Canada); Tijuana	ı, Pacific Standard Time
NightBell Extension:	21567	
Night Bell Switch:	HQ-Fuji 🗾 Edit Night Bell Call Handling	
Paging Extension:	21678	
Paging Switch:	HQ-Fuji 💌	
Operator Extension:	22115 - Gregorio Lavilla Search	
FAX Redirect Extension:	21100 - Fax Port1 Search	

Figure 8-5 Configuring Fax Redirect extension for primary fax server port

Step 18 Under FAX Redirect Extension (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.

- Step 19 Click the Users link and then the Individual Users link.
- Step 20 Click on the name of a user who will be using the enhanced Fax Server Integration feature.
- Step 21 The Edit User window appears as shown in Figure 8-6.

Users Edit User	Hew Copy Save Delete Reset	<u>Help</u>
Ear Oser		* modified
🔻 General	Personal Options Distribution Lists Workgroups	Refresh this page
First Name:	Geoffrey	
Last Name:	Giraffe	
Number:	251	
License Type:	Extension and Mailbox 💌	
Caller ID:	(e.g. +1 (408) 331-3300)	
DID:		
PSTN Failover:	None	
User Group:	Executives Go to this User Group	
Site:	Headquarters 💌	
Language:	English 💌	
Home Port:	IP Phones Any IP Phone	
	C Ports Fuji24 - 1	
	C SoftSwitch SoftSwitch	
Current Port:	Any IP Phone Go Home	
Jack #		
Mailbox on Server:	Headquarters  Voice Mail Delivery and Notifications	
Accept Broadcast Mes	ssages	
☑ Include in System Dia	I By Name Directory	
🗖 Make Number Private		
Allow Use of Soft Phor	ne	
Fax Support:		
C None		
Redirect Inbound Fate	ax Calls to Site Fax Extension	
C This Extension Is C	onnected to a Fax Server	

Figure 8-6 Enabling Fax Redirect For a User

Step 22 Select Redirect Inbound Fax Calls to Site Fax Extension for the Fax Support radio button.

Step 23 Click the Save button to store your changes.

# 8.3 **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.



The following conditions apply to 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.

# 8.4 Automated 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.

Some useful applications for the auto-attendant menus are:

- Answering the main number
- Routing calls to workgroups (for example, sales, support, and so on)
- · Providing automated directions
- Providing a way for users to log into voice mail (we recommend 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:

- Do not create 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 (we recommend "0").
- Remember to provide an option to return to the previous menu (we recommend the "\*" button).

• Try to keep prompts short, quick, and efficient.

Users can record AA 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 AA menus, allowing him or her to delegate the task to more appropriate team members. For details on enabling this feature, please see the *ShoreTel 13 System Administration Guide*.

# 8.5 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, see the *ShoreTel 13 System Administration Guide*.

# 8.6 ShoreTel Communicator for Windows

ShoreTel Communicator for Windows is the Windows-based client application that runs on the computer of users. 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 conferencing, ShoreTel Presenter is automatically installed with ShoreTel Communicator.

For a list of all the capabilities and other details about ShoreTel Communicator, see *ShoreTel Communicator for Windows Guide* or other platform-specific Communicator guide. The configuration details are in the *ShoreTel 13 System Administration Guide*.

# 8.7 ShoreTel Communicator for Mac

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

# 8.8 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 in Communicator for Windows. Examples of tasks a Communicator user can perform are:

• 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.

# 8.8.1 Accessing ShoreTel Communicator for Web from within Your Network

- Step 1 Open a browser.
- Step 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.

Step 3 Press Enter.

Step 4 If prompted, enter your client ID and password.

Step 5 The ShoreTel Communicator page appears in your browser.

# 8.9 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 (see the *ShoreTel 13 System Administration Guide* for details).

Custom buttons can be programmed on 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 random manner desired by the system administrator.

### 8.9.1 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 may 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, please refer to the *ShoreTel 13 System Administration Guide*.

# 8.10 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 are lost. The hunt group can be used as the backup destination for a workgroup, so that some basic hunting can be done 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 (i.e., 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 section about setting call control options in the *ShoreTel 13 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.

### 8.10.1 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.



### 8.10.2 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 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).

### 8.10.3 Hunt Group Applications

Hunt groups provide solutions to a several call routing scenarios.

#### 8.10.3.1 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.

#### 8.10.3.2 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, 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.

#### 8.10.3.3 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.

#### 8.10.3.4 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.

# 8.11 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 hypothetical users (e.g. 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 (e.g. 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 rings (x1002) 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 in order to answer his own call.

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

Pickup groups can include the following types of extensions:

- 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.

# 8.12 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 of 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.

# 8.12.1 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.

# 8.12.2 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.

#### 8.12.2.1 Barge In and Silent Monitor Telephony COS Configuration

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

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—Radio button choices are:

- 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.

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—Radio button choices are:

- Accept None: If selected, users within this COS may not receive barge-in's from anyone.
- Accept All: 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-Radio button choices are:

- 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-Radio button choices are:

- 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.

# 8.13 Enterprise Telephony Features

### 8.13.1 Music on Hold

ShoreTel can provide music on hold (MOH) at a site through the audio input port on the ShoreTel Voice Switches that support MOH. A site needs only one MOH source. See Appendix F to see the switches that support MOH.

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 will not receive MOH when they are on an internal call. See the *ShoreTel 13 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 will be connected to that source when placed on hold, and the device at the other end of the trunk will connect directly to the MOH switch.


- The existing rules for MOH will also apply to MOH for SIP Trunks:
  - MOH will not be 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.

## 8.13.2 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.

## 8.13.3 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 (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 13 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 13 System Administration Guide* for more information about establishing and managing paging groups.

## 8.13.4 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.

## 8.13.5 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 (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 (for example, 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.

#### 8.13.5.1 Intercom Telephony COS Configuration

Each telephony class-of-service permissions 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.

# 8.13.6 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 13 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, (although 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 (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.

# 8.14 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 13 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 on the types of telephones supported by the ShoreTel system and what to consider when planning phones for your system. The topics discussed include:

- "Recommendations" on page 149
- "Application Considerations" on page 149
- "ShoreTel IP Phones" on page 151
- "Analog Phone Requirements" on page 157
- "Fax Machines and Modems" on page 159
- "Fax Machines and Modems" on page 159

# 9.1 **Recommendations**

The following recommendations will 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 will need to 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 there is an available outlet at each location.

# 9.2 Application Considerations

This section describes considerations for a business to consider before ordering telephones.

# 9.2.1 Operators, Receptionists, and Call Center Agents

Employees who typically answer and transfer large numbers of calls should have a comfortable headset. Also, they can use the Handsfree Mode feature to turn off audible dial tone. With these supports, employees can use ShoreTel Communicator to answer and transfer calls rapidly without the need to touch the telephone. Many employees is this type of job role stop using their telephone and just use Communicator and their headset.

If an operator is using one of the ShoreTel IP Phone multiline models, the Automatic Off-Hook Preference feature allows the user to select which audio path (speakerphone or headset) is automatically activated when a call is placed or when an incoming phone call is received. The featured can be configured from Director, ShoreTel Communicator, or from the IP phone.

Operators may also benefit from the programmable buttons feature, which allows users to assign functions to the custom keys on the multiline phones, and on the BB24 device. The programmable buttons feature allows a user to assign the extension monitoring feature to one of the custom buttons. The Programmable Toolbars feature allows a system administrator to program common functions and operations to buttons in a user's ShoreTel Communicator window so that an operator can perform many common tasks (e.g. answer call, transfer call, invoke URL, etc.) at the click of a button.

Some operators will benefit from a cordless telephone or a cordless headset, which gives them greater mobility.

# 9.2.2 Receptionists

Receptionists are typically satisfied with a standard desk telephone that supports Caller ID and Message Waiting with a speakerphone and mute button.

# 9.2.3 General Users

Typically, most users will be satisfied with a standard desk telephone that has a speakerphone and mute button, 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 available on preprogrammed buttons, and they can be deployed in areas where there are no computers to run the ShoreTel Communicator -Personal Access.

# 9.2.4 Conference Rooms

Most conference rooms need a speakerphone. Because conference rooms do not have a ShoreTel Communicator client in the room, a ShoreTel IP phone can support conference rooms discussions. The ShoreTel IP phone provides single-button access to features such as transferring and conferencing calls. ShoreTel designed the IP 655 to fulfill the needs of meetings in small to medium-size conference rooms.

# 9.2.5 Lobby Phones

A cost-effective wall-mount, slim-line, or desk telephone is adequate for most lobby phones, hall phones, and the like. The IP110/115 models offer a cost-effective telephone that is ideal for use in lobbies, lounges, or other common areas.

# 9.2.6 Multi-line Phones

ShoreTel offers extension monitoring from an IP phone. With this feature, an administrative assistant or workgroup supervisor can monitor up to five system extensions. The extension monitor feature can be enabled for ShoreTel IP phones from the User edit pages of ShoreTel Director. For more information, see the *ShoreTel 13 System Administration Guide*.

## 9.2.7 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.



# 9.3 ShoreTel IP Phones

This section describes the different models of ShoreTel IP Phones. The subsection for each phone models lists the features of the phone to help network planners decide which phones to buy for the different uses within the customer's business. The ShoreTel Voice Switches control the ShoreTel IP Phones.

The ShoreTel IP Phone multiline models offer user-programmable buttons so that users can assign common operations to the buttons on their phones. These phones also support the Automatic Off-Hook Preference feature. This feature lets the user select the audio output when the user initiates or receives a call. The audio output can be the handset, built-in loudspeaker, or headset.

Similarly, the multiline<sup>1</sup> models support the Plantronics CS50 wireless headset. Users can answer or end calls by pressing the activation button on this headset when they hear their phone ring. The 565g model offers support for use with some Bluetooth wireless headsets.

The ShoreTel IP Phone BB24 ("button box") is a unit that plugs into a phone and adds 24 extension buttons to a phone. Additionally, it has an Ethernet switch port, allowing connection of a PC or the connection of an additional BB24 or IP Phone.

All ShoreTel IP Phone models can use custom ring tones. The system administrator can load a pair of internal and external ring tones in WAV file format onto each phone. Each user can have a unique ring tone. For instructions on how to load ringtones, refer to the "Configuring IP Phones" chapter in the *ShoreTel 13 System Administration Guide*.

# 9.3.1 ShoreTel IP Phone 110

The ShoreTel IP Phone 110 phone is a phone for general use. Its features include:

- Single-line display for caller information
- Six function keys (Conference, Hold, Intercom, Redial, Transfer, Voice Mail)
- Ethernet Switch port for connecting a PC to the back of the phone
- Support for basic media encryption for calls inside a ShoreTel network
- Ability to load custom ring tones in WAV file format

# 9.3.2 ShoreTel IP Phone 115

The ShoreTel IP Phone 115 phone is based on the IP110 model with the addition of an external microphone to support speakerphone functionality.

Its features include:

- External microphone to support speakerphone
- Single-line display for caller information
- Six function keys (Conference, Hold, Intercom, Redial, Transfer, Voice Mail)
- Ethernet Switch port for connecting a PC to the back of the phone
- Support for basic media encryption for calls inside a ShoreTel network
- · Ability to load custom ring tones in.wav file format

<sup>1.</sup> IP560g and newer IP560 models support this feature while older IP560 models do not. To determine an IP560's compatibility, look at the model number on the back of the phone. If the model number ends with "-03" or higher, the phone supports this feature. If the model number ends with "-01" or "-02," the phone does not support the feature.

# 9.3.3 ShoreTel IP Phone 212k

The 212k IP phone is designed to function as a key phone and offers 12 custom buttons that can be used for line appearance and other functions. The 212k is ideal for small offices and branch offices that require key system functionality.

Its features include:

- Scrolling text that allows for the display of more information.
- Menu and Select buttons that provide services similar to soft keys and scroll bar, and that assist in phone navigation and programming.
- Eight function keys (Voice Mail, Transfer, Options, Conference, Directory, Intercom, Redial, Hold).
- InstaDial<sup>TM</sup> functionality in which calls are automatically transferred after digit collection stops and a configurable timeout period has expired.
- Automatic Off-Hook Preference that lets users select which audio path. (speakerphone or headset) is auto-activated when calls are sent or received.
- Ethernet Switch port for connecting a PC to the back of the phone.
- A first (upper left-most) custom button that is reserved for line appearance only and cannot be configured to perform other functions.
- Support for basic media encryption for calls inside a ShoreTel network.
- Ability to load custom ring tones in.way file format.
- Built-in handset lifting functionality to support certain Plantronics wireless headset models.

# 9.3.4 ShoreTel IP Phone 230/230g

The ShoreTel IP230 Phone is a full-featured IP phone with the added functionality of programmable buttons.

The ShoreTel IP Phone 230g offers all features of the IP Phone 230 with the addition of switchable 10BaseT, 100BaseT, and 1000BaseT support for users with gibabit network requirements for their desktop workstation.

Its features include:

- The IP230 has 3 custom buttons that can be programmed for extension monitoring, speed dial, and other functions. Note that the top-most button is re-served for line appearance. (Each "button" is an LED-enabled hard key and has an associated 6 character label on the LCD.)
- Eight function keys (Voice Mail, Transfer, Options, Conference, Directory, Intercom, Redial, Hold).
- InstaDial<sup>TM</sup> functionality in which calls are automatically transferred after digit collection stops and a configurable timeout period has expired.
- Monochrome black and white display.
- Automatic Off-Hook Preference that lets users select which audio path (speakerphone or headset) is auto-activated when calls are sent or received.
- Ethernet Switch port for connecting a PC to the back of the phone.
- Support for basic media encryption for calls inside a ShoreTel network.
- Support for two-line caller ID display feature, which displays the caller name and number on two separate lines for in-coming calls and outbound calls.
- Ability to load custom ring tones in wav file format.
- Built-in handset lifting functionality to support certain Plantronics wireless headset models.
- Integrated VPN client (IP 230g only).



# 9.3.5 ShoreTel IP Phone 265

The ShoreTel IP265 Phone is a full-featured IP phone that is similar to the ShoreTel IP230 phone but with three additional programmable buttons and a color LCD display.

Its features include:

- 2.7-inch TFT-LCD Color display with backlighting.
- Ability to download and display a 24-bit.bmp "wallpaper" file.
- Six custom buttons that can be programmed for extension monitoring, speed dial, and other functions. Note that the top-most button is reserved for line appearance. (Each "button" is a tri-color LED-enabled hard key and has an associated 6-character label on the LCD.)
- Eight function keys (Voice Mail, Transfer, Options, Conference, Directory, Intercom, Redial, Hold).
- InstaDial<sup>TM</sup> functionality, in which calls are automatically transferred after digit collection stops and a configurable timeout period has expired.
- Automatic Off-Hook Preference that lets users select which audio path (speaker, headset, wireless headset) is auto-activated when calls are sent or received.
- Ethernet Switch port for connecting a PC to the back of the phone.
- Support for basic media encryption for calls inside a ShoreTel network.
- Support for two-line caller ID display feature, which displays the caller name and number on two separate lines for in-coming calls and outbound calls.
- Ability to load custom ring tones in.wav file format.
- Built-in handset lifting functionality to support certain Plantronics wireless headsets.

# 9.3.6 ShoreTel IP Phone 560

The ShoreTel IP Phone 560 is for managers, assistants, and operators who have high call volumes and share call flows with other users. Its features include:

- Caller ID display for up to six calls simultaneously.
- Backlit display.
- Monitoring support for up to five extensions.
- Eight function keys.
- Four soft keys.
- Ethernet Switch port for connecting a PC to the back of the phone.
- InstaDial<sup>TM</sup> functionality in which calls are automatically transferred after digit collection stops and a configurable timeout period has expired.
- Automatic Off-Hook Preference that lets users select which audio path (speakerphone or headset) is auto-activated when calls are sent or received.
- Support for basic media encryption for calls inside a ShoreTel network.
- Support for programmable buttons and extension monitoring.
- Support for two-line caller ID display feature, which displays the caller name and number on two separate lines for in-coming calls and outbound calls.
- Ability to load custom ring tones in.wav file format.
- Built-in handset lifting functionality to support certain Plantronics wireless headsets.

# 9.3.7 ShoreTel IP Phone 560g

The ShoreTel IP Phone 560g is a high-end phone designed for executives, assistants, and operators who handle high call volumes and share call flows with other users yet require the benefit of 1000BaseT operations.

Its features include:

- Supports 10BaseT, 100BaseT, and 1000BaseT operations.
- Six custom buttons that can be used for line appearance and other functions.
- Eight function keys (Voice Mail, Transfer, Options, Conference, Directory, Intercom, Redial, Hold).
- Four soft keys.
- Gigabit Ethernet Switch port for connecting a PC to the back of the phone.
- Caller ID displayed for up to six calls simultaneously.
- Backlit display.
- Monitoring for up to five extensions.
- InstaDial<sup>TM</sup> functionality in which calls are automatically transferred after digit collection stops and a configurable timeout period has expired.
- Automatic Off-Hook Preference that lets users select which audio path (speakerphone or headset) is auto-activated when calls are sent or received.
- Support for basic media encryption for calls inside a ShoreTel network.
- Support for programmable buttons and extension monitoring.
- Support for two-line caller ID display feature, which displays the caller name and number on two separate lines for in-coming calls and outbound calls.
- Ability to load custom ring tones in.wav file format.
- Built-in handset lifting functionality to support certain Plantronics wireless headsets.
- Integrated VPN client.

Installation Notes:

- The ShoreTel IP560g telephone requires a gigabit-compatible Power over Ethernet (POE) power supply that complies with IEEE802.af. The 560g phone is a Class 3 device with a maximum consumption of 8.2 watts. Please use 8.2 watts for capacity planning with Gig POE switches on multiple deployments.
- The 560g model requires more power than the other ShoreTel models, and thus the 560g phone is not compatible with the ShoreTel IP Phone power adapter used with other ShoreTel phone models.
- The 560g model cannot be daisy-chained from the Button Box (BB24). The BB24 passthrough power is limited to Class 2 devices and the 560g is a Class 3 device. This means the BB24 cannot forward adequate power to an IP 560g phone.
- The ShoreTel IP560g telephone uses Category 5e or Category 6 Ethernet cables. We do not certify the use of Category 5 Ethernet cables because they can lead to lower connection speed or performance problems during high data-rate transfers.

# 9.3.8 ShoreTel IP Phone 565g

The ShoreTel IP Phone 565g is a high-end phone designed for executives, assistants, and operators who handle high call volumes and share call flows with other users. The ShoreTel IP Phone 565g supports 1000BaseT operations and Bluetooth wireless headsets.

Its features include:

- 3.5-inch TFT-LCD Color display with backlighting.
- Ability to download and display a 24-bit.bmp "wallpaper" file.
- Support for some Bluetooth wireless headset models.
- Supports 10BaseT, 100BaseT, and 1000BaseT operations.
- Six tri-color custom buttons that can be used for line appearance and other functions.
- Eight function keys (Voice Mail, Transfer, Options, Conference, Directory, Intercom, Redial, Hold).



- Four soft keys.
- Gigabit Ethernet Switch port for connecting a PC to the back of the phone.
- Caller ID displayed for up to six calls simultaneously.
- Monitoring for up to five extensions.
- InstaDial<sup>TM</sup> functionality in which calls are automatically transferred after digit collection stops and a configurable timeout period has expired.
- Automatic Off-Hook Preference lets a user select the audio outlet to activate when initiating or receiving calls (speaker, headset, wireless headset, or Bluetooth).
- Support for basic media encryption for calls inside a ShoreTel network.
- Support for programmable buttons and extension monitoring.
- Support for two-line caller ID display feature, which displays the caller name and number on two separate lines for in-coming calls and outbound calls.
- Ability to load custom ring tones in.wav file format.
- Built-in handset lifting functionality to support certain Plantronics wireless headsets.
- Integrated VPN client.

Installation Notes:

- The ShoreTel IP565g telephone requires a gigabit-compatible Power over Ethernet (POE) power supply that complies with IEEE802.af. The 565g phone is a Class 3 device with a maximum consumption of 8.2 watts. Please use 8.2 watts for capacity planning with Gig POE switches on multiple deployments.
- The 565g model requires more power than the other ShoreTel models, and is thus not compatible with the ShoreTel IP Phone power adapter used with other ShoreTel phone models.
- The 565g model cannot be daisy-chained from the Button Box (BB24). The BB24 passthrough power is limited to Class 2 devices and the 565g is a Class 3 device. This means the BB24 cannot forward adequate power to an IP 565g phone.
- The ShoreTel IP565g requires the use of Category 5e or Category 6 Ethernet cables. We do not certify the use of Category 5 Ethernet cables. They can lead to lower connection speed or performance problems during high-data transfer conditions.

# 9.3.9 ShoreTel IP Phone 655

The ShoreTel IP Phone 655 is a high-end IP phone for executives and executive assistants. It also functions as a highly capable speakerphone for use in executive offices and small to medium-size conference rooms. The ShoreTel IP Phone 655 offers advanced audio performance and IP telephony functionality.

The ShoreTel IP Phone 655 provides a touch screen interface that enhances productivity. Advanced applications enabled by the large color touch screen display include enhanced directory and call history applications with real-time telephony presence information and visual voicemail with both playback and composition capabilities. For more details about the ShoreTel IP Phone 655, see the *ShoreTel IP Phone 655 Installation and User Guide*.

Its features include:

- 5.7-inch TFT-LCD color touch-screen display with backlighting and haptic feedback.
- Connectors for up to two remote microphones for better conference room coverage.
- 10/100/1000 Ethernet.
- Five capacitive touch keys (mute, headset, redial, volume control and speakerphone).
- Beam-forming microphone array with noise-canceling capabilities for offices and small to medium-size conference rooms. An optional pair of extension microphones enhance the microphone pickup in larger rooms.
- Visual voicemail and enhanced Directory with telephony presence.

- Virtual keyboard for text entry for additional user capabilities.
- Easy personalization wallpaper images and ring tones.
- Supports 10BaseT, 100BaseT, and 1000BaseT operations.
- 12 line buttons that can be used for line appearance and other functions.
- 6 function and audio control keys (Voice Mute, Speaker, Headset, Redial, Call Volume +/-).
- Gigabit Ethernet Switch port for connecting a PC to the back of the phone.
- InstaDial<sup>TM</sup> functionality in which calls are automatically transferred after digit collection stops and a configurable timeout period has expired.
- Automatic Off-Hook Preference that lets users select which audio path (speaker, headset) is auto-activated when calls are sent or received.
- Support for secure RTP with AES encryption for calls inside a ShoreTel network.
- Support for programmable buttons and extension monitoring.
- Integrated VPN client.

Installation Notes:

- The ShoreTel IP Phone 655 telephone requires a gigabit-compatible Power over Ethernet (POE) power supply that complies with IEEE802.af. The phone is a Class 3 device with a maximum consumption of 9.1 watts. Please use 9.1 watts for capacity planning with Gig POE switches on multiple deployments.
- The ShoreTel IP Phone 655 model requires more power than the other ShoreTel models, and is thus not compatible with the ShoreTel IP Phone power adapter used with other ShoreTel phone models.
- The ShoreTel IP Phone 655 model cannot be deployed with a Button Box (BB24).
- The ShoreTel IP Phone 655 requires the use of Category 5e or Category 6 Ethernet cables when deployed in 1000 BaseT networks. Using Category 5 Ethernet cables is not officially supported and may lead to lower connection speed and/or performance issues during high-data transfer scenarios.

# 9.3.10 ShoreTel IP Phone BB24

The ShoreTel 24 IP Button Box provides additional shortcut functions for users of the multiline phones. The BB24 behaves like an additional set of 24 programmable buttons in additional to the buttons that already exist on the multiline phones.

Its features include:

- Twenty-four programmable buttons.
- Ability to assign up to four Button Boxes to a multiline phone.
- Support for programmable buttons feature.
- Ability for each user to define layouts for up to four BB24s allowing a maximum of almost 100 programmable buttons for most phones (exact number varies depending on which phone the BB24 is connected).
- Custom buttons in which each is an LED-enabled hard key and has an associated six character label on the LCD.
- Ethernet switch port for connecting a PC to the back of the phone.
- Ability to forward power to one additional unpowered device to support a daisy-chain configuration.

For detailed information on available options and how to use them, refer to the *ShoreTel Programmable Buttons User Guide*.

For installation instructions, refer to the ShoreTel 24 IP Button Box Quick Install Guide.



# 9.4 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 289, 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. Shore Tel *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 stay "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.

# 9.4.1 Caller ID Standard Support

Table 9-1 lists the callerID standards the ShoreTel system supports for analog telephones by country.

Caller ID Standard	Country
BELLCORE	United States
BELLCORE	Canada
BELLCORE	Hong Kong
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

 Table 9-1
 Caller ID Standard Support for Analog Phones by Country



Caller ID Standard	Country
ETSI	*Argentina
BT	United Kingdom
BT	Ireland
NONE	Australia
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

 Table 9-1
 Caller ID Standard Support for Analog Phones by Country

\*\*Indicates uncertainty as to whether country supports configured standard.

# 9.5 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.

# 9.5.1 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.

## 9.5.2 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 helps with the specific hardware and software requirements for the ShoreTel headquarters server main and the distributed ShoreTel servers. The topics in include:

- "General Recommendations" on page 161
- "Requirements for ShoreTel Enterprise Systems" on page 161
- "Requirements for ShoreTel Enterprise Systems" on page 161
- "Requirements for VMWare Environments" on page 167
- "Hard Disk Requirements" on page 168
- "Upgrading to Windows Server 2008" on page 170
- "Preparing the Server for ShoreTel Operation" on page 172
- "Requirements for ShoreTel Mobility Router" on page 178
- "Third-Party Applications Supported" on page 179

# **10.1 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.

# **10.2** 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.

## 10.2.1 Capacity and Hardware Requirements for Headquarters Servers

Table 10-1 shows information about system capacity for each tier of the headquarters (HQ) servers. The table shows the number of users, calls, and reports that the server can support for each tier. Table 10-2 shows our recommendations for each tier of HQ server. Use these tables to determine the needs for HQ servers in the ShoreTel deployment. You can mix servers of different capacities, but choose the right servers for the telephony environment.

Size	Maximum number of users per System	Maximum number of users assigned to HQ Server	Maximum System BHCC <sup>1</sup>	Maximum BHCC per server <sup>2</sup> Reports run outside business hours	Maximum BHCC per server <sup>2</sup> Reports run during <b>business hours</b>
If an upgrade from SBE	500	100	500	Not Recommended <sup>3</sup>	Not Recommended <sup>3</sup>
Small	500	500	5,000	1,000	Not Recommended <sup>3</sup>
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 <sup>4</sup> or 1,000	100,000	10,000	10,000

 Table 10-1
 Headquarter Server Capacity for Enterprise System

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> 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.

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.

<sup>4</sup> 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 10-2 displays the minimum hardware requirement for ShoreTel Headquarters servers.

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 10-2
 Headquarter Server Hardware Recommendations for Enterprise System

Table 10-3 displays maximum usage ShoreTel DVS supports by usage type per server type.

# **10.2.2** Capacity and Hardware Requirements for Distributed Voice Servers

Table 10-3 provides information about system capacity for each of the tiers for ShoreTel Distributed Voice Servers (DVSs). The table provides information about the number of users and calls that a DVS in each tier can support. Table 10-4 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 that for the entire telephony environment.

Size	Maximum Users per DVS Server
Branch Office	100
Bundle	
Small	500
Medium	1,000
Large	1,000
Very Large	500 <sup>1</sup> or 1,000

Table 10-3Distributed Voice Server (DVS) Capacity

<sup>1</sup> 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.

Size	Processor	RAM	Networks
Branch Office	Intel Pentium G680, DualCore 2.7 Ghz.	2 GB	100 Base-T
Bundle			
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

Table 10-4     DVS Hardware Minimum	Table 10-4	DVS Hardware Minimums
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# **10.2.3** Operating System Requirements for All Servers

This section lists the operating systems that ShoreTel 13 supports on the headquarters server and distributed voice servers. If you are upgrading a system to ShoreTel 13, refer to ShoreTel 13 Release Notes for special instructions that might apply.

ShoreTel 13 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)

NOTE ShoreTel servers (HQ and DVS) on the same ShoreTel network can have different operating systems.

# 10.3 ShoreTel SBE System

- SBE does not support DVS, SMDI, AMIS, QSIG, or on-net dialing.
- SBE reports should be run outside normal business hours.
- SBE is available on a ShoreTel server or a Customer server.

NOTE Server supplied by customer must meet SBE server requirements.

• SBE can be upgraded to Enterprise Edition (EE).

# **10.3.1** Summary of SBE Requirements

ShoreTel can ship its 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. Furthermore, ShoreTel configures, tests, and prepares the server for ShoreTel Director Small Business Edition software.

Microsoft Windows Server OS for Telecommunications Systems is an embedded operating system for standalone telecommunication products. Because this OS is an embedded operating system, it cannot support a keyboard, mouse, or monitor, so the customer must use a remote desktop application or an embedded Web tool to manage the system. This consequence of using Microsoft Windows Server OS for Telecommunications Systems applies to any SBE regardless of who sells the server to the customer.

NOTE ShoreTel's SBE server usually is appropriate 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 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.

#### 10.3.1.1 ShoreTel SBE Option with the ShoreTel Server

The server that ShoreTel currently 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 2003 for Telecommunications Systems
- Mouse: No Mouse Option
- NIC: On board Network Adapter
- Optical Drive: 16X DVD-ROM SATA

#### 10.3.1.2 ShoreTel SBE Requirements 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
- Microsoft Windows Server 2003/2008 Standard or Enterprise edition

#### 10.3.1.3 Using 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 an HQ server or a DVS server.

#### **Option1: Using the SBE server as an HQ 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 and workgroups)

- Busy hour completion has a limit 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 and workgroups)
- Busy hour completion has a limit 500.
- SBE supports Web Reports because these reports run on the HQ server.

# 10.3.2 Capacity for Small Business Edition

Table 10-5 describes the capacities for all Small Business Edition installations. Table 10-6 lists hardware recommendations for customers who independently buy a own server.

Maximum number of users per System License	Maximum number of users assigned per Server	Maximum System BHCC <sup>1</sup>	Maximum BHCC per server <sup>2</sup> Reports run outside business hours	Maximum BHCC per server <sup>2</sup> Reports run during business hours
50	50	500	500	Not Recommended
100 (HQ and DVS)	100	500	N/A	

 Table 10-5
 Server Capacity for Small Business Edition

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> By default, the ShoreTel report generation tools 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. However, customers that rely very much on reports and experience a degradation of voicemail or other services during report generation might need a more powerful server.

NOTE The generation of reports affects the server's performance. ShoreTel recommends that you run reports outside of business hours. If reports are needed during business hours, then the supported calls per server for the medium and large server tiers is reduced as noted in the table.

# **10.3.3 SBE Hardware Requirements**

Table 10-6 lists the minimum hardware requirement for SBE headquarters and DVS servers.

rable 10-0 Readquarter Server naruware Recommendations for SBE	Fable 10-6	Headquarter Server Hardware Recommendations for SBE
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Processor	RAM	Network
E3400/2.6GHz, 1MB, 800FSB	2GB	100 Base-T



#### 10.3.4 **SBE Operating System Requirements**

ShoreTel 13 supports the following operating systems for SBE:

- Windows Server 2008 32-bit, SP2 (Standard, Enterprise) •
- Windows Server 2008 R2, SP1, 64-bit, (Standard, Enterprise) ٠

#### 10.4 **Requirements for VMWare Environments**

This section provides information necessary to install the ShoreTel system software on servers running VMWare.

ShoreTel 13 supports the core telephony platform in VMWare only. Service applications such as ShoreTel Call Center are not supported.

#### 10.4.1 ShoreTell Capacity in VMWare Environments

Table 10-7 provides information about ShoreTel capacities when install on servers running VMWare.

Size	Maximum Users per DVS Server	Maximum DVS per Server BHCC Reports run outside business hours <sup>1</sup>	Maximum BHCC per Server Reports run during business hours
SBE	50	500	Not Recommended
Small	500	5,000	1000 <sup>1</sup>
Medium	2,500	25,000	5,000
Large	10,000	50,000	10,000

Table 10-7 **VMWare** Capacity

Table 10-8

#### Hardware Requirements for VMWare Installation 10.4.2

Table 10-8 provides information about server requirements for installing ShoreTel HQ and DVS on servers with VMWare.

		Hard
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				Hard Disk for HO	Hard Disk Size for DVS
	Cores per			VMWare	VMWare
Size	VM	Processor	RAM	Server	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 <sup>®</sup> 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

VMWare Hardware Recommendations

## 10.4.3 Operating System Requirements for VMWare

This section lists the operating systems ShoreTel 13 supports that you can use with VMWare. You can install these operating systems on both headquarters and distributed voice servers. If you are upgrading your system to ShoreTel 13, refer to ShoreTel 13: Release Notes for any special instructions that may apply.

ShoreTel 13 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)

### **10.4.4 VMWare Software Requirements**

ShoreTel 13 supports the use of VMware on the HQ server only. You can install the following versions of VMware on the HQ:

- VMWare ESX 4.1 for High Availability or VMotion configurations.
- VMWare ESXi 5.0 for High Availability or VMotion configurations.

# **10.5** 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 ShoreTel 13, 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:
  - 1. Uninstall the Double-Take Availability software after finishing the ShoreTel 13 installation.
  - 2. Install Double-Take Availability version 5.3.

# **10.6 Hard Disk Requirements**

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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 10-9 shows the minimum amount of hard disk require for ShoreTel applications. In addition, the dynamic files for voice mail, call detail records on the HQ server only, and log files need hard disk space.

Table 10-9	Hard Disk Space Requirements	

Туре	Space Required
ShoreTel HQ Server	1600 MB
ShoreTel DVS Server	800 MB
ShoreTel Client	600 MB <sup>a</sup>

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a. This amount might be necessary if you are installing from off the network. In this situation, the process creates a copy of the installer.



# 10.6.1 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 10-10 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.

		Length		
# Users	# Messages	(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

Table 10-10Voice Mail Hard Disk Space

# **10.6.2** Call Detail Records

For each call on the system, call detail records are generated on the HQ 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 10-11.

# Calls/Day	# Calls/Month (20 days <sup>a</sup> )	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

Table 10-11 Call Detail Records

a. 20 working days per month (i.e. 4 weeks/month \* 5 days/week = 20)

# 10.6.3 Log Files

Log files are generated on the system for the purposes of technical support. The hard disk space used on the server for log files varies greatly, depending on the overall system activity.

The size of the log files on the server depends on the parameters in ShoreTel Director. Log files can remain 1–30 days (default 7 days) with a size in the range 0.5 GB–5 GB (the default is 4 GB). Table 10-12 shows the hard disk space that log files need.

	<b>^</b>
File Size	Storage (GB)
Minimum	0.5 GB
Default	4.0 GB
Maximum	30.0 GB

Table 10-12Log File Hard Disk Space

# 10.7 Upgrading to Windows Server 2008

For ShoreTel 13, the system supports Windows Server 2008 only. (In contrast, the ShoreTelsupplied SBE servers use the pre-installed, embedded Windows 2003 OS Telecom Edition.)

If a system is using Windows Server 2003 Enterprise or Standard edition, you must update it to Windows Server 2008 before installing ShoreTel 13. In most cases, this is a straightforward installation of Windows Server 2008 on all of the customer-provided ShoreTel servers.

However, if you want to upgrade a Windows Server 2003, 32-bit server to Windows Server 2008, 64-bit server, you must upgrade the server and its connected voice switches to the 64-bit platform before upgrading the server to Windows Server 2008, 64-bit. The reason is that the differences in how the two platforms use communication ports can cause the ShoreTel server-network to malfunction.

- NOTE In the current release of ShoreTel 13, not all servers need to use the same Windows Server 2008 platform. The ShoreTel system allows a mixture of 32-bit and 64-bit server platforms if the customer needs this assortment.
- NOTE ShoreTel continues to support the embedded servers in Branch Office Bundle and Small Business Edition configurations.

### 10.7.1 Requirements for Upgrading Windows Server 32-bit to Windows Server 64-bit

This section lists the requirements for migrating a Windows Server 2003 32-bit operating system to a Windows Server 2008 64-bit operating system for ShoreTel 13.

- Hardware server platform that supports Windows Server 2008, 64-bit
- ShoreTel software that supports the 64-bit platform (ShoreTell 11, build 16.5.8506.0 or higher)
- Uboot version 1.1.3.25 or higher installed on ShoreTel switches
- Microsoft Windows Server 2008 R2, 64-bit, (Standard, Enterprise)

The tasks you must to ensure that your ShoreTel system continues to function properly are outlined below. A detailed description is provided in the "Migrating from Windows 2003, 32-bit to Windows 2008 R2, 64-bit" section on page 171.

- 1. Prior to starting the Windows OS upgrade, upgrade the ShoreTel software throughout your current, 32-bit system to a build that supports Windows 2008 R2 64-bit (ShoreTell 11, build 16.5.8506.0 or higher).
- 2. Verify that all of the ShoreTel servers in the entire system are upgraded to the same version.
- 3. Make sure that the ShoreTel switches are running Uboot version 1.1.3.25 or higher.



- 4. Back up the newly upgraded 32-bit system.
- 5. Upgrade your Windows OS to Windows 2008 R2 Server (64-bit).

For recommendations on the migration path of releases from existing releases of ShoreTel software to the latest release, see "Upgrade Paths and Application Support" in the ShoreTel Server Software Release Notes.

### 10.7.2 Migrating from Windows 2003, 32-bit to Windows 2008 R2, 64bit

To ensure a seamless migration without disruptions in telephone service, you must make sure that the ShoreTel server and the switches the server manages are compatible with the Windows Server 64-bit operating system. To migrate a 32-bit system to a 64-bit system, do the following:

- Step 1 Install an appropriate version of the ShoreTel software that supports the 64-bit operating system on the server. (ShoreTel 11 build 16.5.8506.0 or higher.)
- Step 2 Reboot the switches as follows:
  - Step a Launch ShoreTel Director. The Quick Look page appears.
  - Step b In the Site column, select the site that contains the server (see Server/Appliance column) that you are migrating. The Maintenance: Voice Switches and Service Appliances Summary page appears.
  - Step c Select the switch that you want to reboot. The Voice Switch Maintenance page for the switch appears.
  - Step d In the Voice Switch section, click the Command field and select Reboot.
    - NOTE Switches with voicemail capability (e.g., ShoreTel 50V) can take up to 45 of minutes to reboot.
  - Step e After the switch reboots, check the following in the Details section of the Voice Switch Maintenance page:
    - In the Boot ROM Version field, make sure that the boot version is 1.1.3.25 or higher.
      - If the version is lower than specified, you must upgrade the switch manually before you continue.
    - In the Firmware Version field, make sure the version is 16.5.8506.0 or higher.
- Step 3 On the server, do the following:
  - Disable LDAP Active Directory? and the distributed database facility (DDB) if either is enabled.
  - Backup the Shoreline Data and MySQL Config folders.
  - Remove the Shoreline Data and ShoreTel server(?) folders.
  - Record the unit IP address, subnet mask, gateway IP address.
- Step 4 Uninstall the ShoreTel software.

- Step 5 Install Windows Server 2008 R2 64-bit on hardware platforms that support it.
- Step 6 After installation, confirm that the network address parameters are not disturbed. If necessary, restore the recorded values.
- Step 7 Prepare the new OS system with the necessary components (Application Server Role Services, Web Server Role Services, SMTP Server and FTP Server).
- Step 8 Copy Shoreline Data folder in correct location.
- Step 9 Install ShoreTel 13.

# **10.7.3 Upgrading UBOOT**

- Step 1 Launch ShoreTel Director.
- Step 2 Click Maintenance > Quick Look. The Quick Look page appears.
- Step 3 In the Site column, click the site where the switch that you want to verify the UBOOT version resides. The Maintenance - Voice Switches and Service Appliance Summary page for the site appears.
- Step 4 In the Switch/Appliance column, click the switch that you want to verify. The Voice Switch Maintenance page for the switch appears.
- Step 5 In the Details area, verify that the Boot ROM Version is 1.1.3.25 or higher. This indicates the UBOOT version that is installed on the switch.

ShoreTel build number 16.5.8506.0 or higher automatically updates the Uboot code on the V Switches (voice switches that also provide voicemail—the ShoreTel Voice Switch 90V, for example) as part of the installation.

- Step a If the non V-switches do not have the correct Uboot code:
- Step b Telnet or SSH to the half-width switch (non V-switch).
- Step c Go to Shell.
- Step d Enter the command uboot\_update on the CLI. Do not turn off the unit until the operation is complete.
- Step 6 Upgrade Uboot on all half-width switches to version 1.1.3.25. To check the current Uboot version, use ShoreTel Director's Quick Look to navigate to the display of a particular site and then select individual switches to see the Uboot version listed near the bottom of the window.

# **10.8** Preparing the Server for ShoreTel Operation

This section describes how to prepare the server for operation in the ShoreTel telephony network.

## **10.8.1** 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.



## 10.8.2 Workgroup Mode

The server should be configured as a Workgroup rather than as part of the domain to avoid having group policies impact the DCOM / COM permissions. It is possible to place the server on the domain after installation of the server software.

# **10.8.3 DHCP on the ShoreTel Server**

ShoreTel recommends that the ShoreTel server not be used as a Dynamic Host Configuration Protocol (DHCP) server. If you want to use the ShoreTel server to assign IP addresses to the ShoreTel voice switches, you should use the BOOTP server included within ShoreTel Director.

## 10.8.4 Preparing Microsoft Windows Server 2008

Before you install ShoreTel server software, you must prepare Microsoft Windows Server 2008 to run ShoreTel services. You must enable IIS, COM+, SMTP, and FTP. Other required tasks include 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.

#### 10.8.4.1 Application Server Role

This section describes how to configure the server roles required to run the ShoreTel server. Refer to the Microsoft Windows Server 2008 documentation for configuration instructions.

Step 1 On the Windows desktop, click Start > Programs > Administrative Tools > Server Manager to launch the Service Manager as shown in Figure 10-1.

Server Manager		<u>×</u>
File Action View Help		
🗢 🔿 🙋 📅 🔯		
Server Manager (FRANCIS2K8E)	Roles         Image: Roles Summary         Roles: 0 of 16 installed	Roles Summary Help  Roles Remove Roles
	Configure refresh 4/20/2009 4:04:26 PM Configure refresh	

Figure 10-1 Installation Windows Role Services

- Step 2 In Server Manager, click the Add Roles icon on the right pane. The Add Roles Wizard appears.
- Step 3 In the left pane of the Add Roles Wizard page, click Server Roles. The Server Roles menu as shown in Figure 10-2.



Figure 10-2 Required Server Roles

Step 4 Check the Application Server and Web Server (IIS) check boxes.

Step 5 In the left pane of the Add Roles Wizard page, locate Web Server (IIS) and click Role Services. The Server Roles menu as shown in Figure 10-3.



Figure 10-3 Required Web Server Roles



Step 6 Do the following:

- Select all Common HTTP Features
- Select all Application Development Features
- Select the following Health and Diagnostics Features
  - HTTP Logging
  - Logging Tools
  - Request Monitor
  - Tracing
- Select all Security options
- Select all Performance options
- Select all Management Tools options.
- NOTE To upgrade ShoreTel 11 to ShoreTel 13, you must activate IIS 6 WMI Compatibility and IIS 6 Scripting Tools. The upgrade will fail and roll back to ShoreTel 11 if these services are not enabled.
- Select all FTP Servicer options.
- Step 7 Click Next. The Confirm Installation Selections page appears.

Step 8 Click Install.

#### 10.8.4.2 Installing SMTP

ShoreTel requires the installation of SMTP Server. To install SMTP, do the following:

- Step 1 On the Windows desktop, click Start > Programs > Administrative Tools > Server Manager. The Service Manager page appears.
- Step 2 Click Features. The Features panel appears on the right.
- Step 3 Click Add Features. The Add Features Wizard appears.
- Step 4 Select Features in the menu. The Select Features Installation page appears as shown in Figure 10-4.



Figure 10-4 Select Feature Page

Step 5 Check the SMTP Server check box.

Step 6 Click Next. The Confirm Installation Selections page appears.

Step 7 Click Install.

#### 10.8.4.3 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.
  - Step 1 Access the Services table by selecting Server Manager -> Configuration -> Services.
  - Step 2 Right click Simple Mail Transfer Protocol and select Properties on the menu. The Simple Mail Transfer Protocol (SMTP) Properties page as shown in Figure 10-5 appears.



Simple Mail Trans	fer Protocol (SMTP) Properties (TPATTANAIK320 🗙	
General Log On	al Log On Recovery Dependencies	
Service name:	SMTPSVC	
Display name:	Simple Mail Transfer Protocol (SMTP)	
Description:	Transports electronic mail across the network.	
Path to executable: C:\Windows\system32\inetsrv\inetinfo.exe		
Startup type:	Automatic	
Help me configure service startup options.		
Service status: Started		
Start	Stop Pause Resume	
You can specify the start parameters that apply when you start the service from here.		
Start parameters		
	OK Cancel Apply	

Figure 10-5 Simple Mail Transfer Protocol Properties Page

- Step 3 Select Automatic on the Startup Type drop down menu, then click the OK button.
- Step 4 Return to the Services page.
- Step 5 Right click Microsoft FTP Service and select Properties on the menu. The FTP Microsoft Service properties page appears.
- Step 6 In the Startup Type field, select Automatic and click the OK button.

## **10.8.5** Additional Considerations

This section discusses additional recommendations and requirements for installing the ShoreTel server.

#### 10.8.5.1 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.

#### 10.8.5.2 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 DVD Browser or download it from the Adobe web site.

#### 10.8.5.3 Internet Information Server (IIS) Default Web Site

The web site for ShoreTel Director is <server\_name>/ShoreTelDirector. 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.

#### 10.8.5.4 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:

- Step 1 Launch Internet Explorer.
- Step 2 Click Tools > Internet Options. The Internet Options dialog box appears.
- Step 3 Click the Privacy tab then the Advanced button. The Advanced Privacy Settings dialog box appears.
- Step 4 Check the Override automatic cookies check box.
- Step 5 Select Always allow session cookies.
- Step 6 Click OK to save the change.

#### 10.8.5.5 Microsoft Updates on the Server

ShoreTel performs weekly updates on test systems with the latest Microsoft server and desktop patches. When releasing a new build, ShoreTel publishes build notes that lists the Microsoft patches that are certified against the build. ShoreTel also highlights software changes required by the Microsoft patches.

The conservative approach is to turn off regular Microsoft updates until you review the detailed certification provided with each release.

#### 10.8.5.6 Virus Protection on the Main and Distributed Servers

ShoreTel allows the use of industry standard virus protection software on the main and distributed servers.

- NOTE The following folders and sub folders MUST be excluded from Virus checker software or disk backup/restore software.
  - c:\Shoreline Data\temp
  - c:\Shoreline Data\Database\ShoreTelCDR
  - c:\Shoreline Data\Database\ShoreTelConfig
  - c:\Shoreline Data\Call Records 2\Data
- WARNING If the folders listed above are not excluded before installation, your installation of ShoreTel 13 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.

# **10.9** Requirements for ShoreTel Mobility Router

ShoreTel 13 supports ShoreTel Mobility Router 4.6 and later.



# **10.10** Third-Party Applications Supported

ShoreTel 13 supports the following third-party applications:

- Microsoft OCS 2007 R2
- Microsoft Lync 2010
- IBM SameTime
# Chapter 11

# **ShoreTel Server Installation**

This chapter describes installation procedures for main and distributed ShoreTel servers. The topics discussed in this chapter include:

- "Preparing to Install the ShoreTel Server Software" on page 181
- "Preparing to Install the ShoreTel Server Software" on page 181
- "Installing the Headquarters Server Software" on page 182
- "Installing Software on a Distributed Server" on page 188
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- "Ensuring Server Performance" on page 193
- "Upgrading ShoreTel Servers from Windows 2003 (32-bit) to Windows 2008 (32-bit)" on page 196
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- "Ensuring Proper Server Performance" on page 202

## **11.1 Preparing to Install the ShoreTel Server Software**

This section provides information about installing ShoreTel server software.

### 11.1.1 Requirements

Before beginning software installation, do the following:

- Close all open programs on the server.
- Verify that no anti-virus software is running.
- Verify that the Data Execution Prevention settings have been set correctly.

#### 11.1.2 Installing ShoreTel Server Software Basic Concepts

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. ShoreTel Server Setup checks for prerequisite software. If the required software is not installed, setup will automatically stop and it will be necessary to install the proper prerequisite software before continuing.

### 11.1.3 Network Connection Before Installation

Connect the server to the Ethernet network prior installing the ShoreTel server software. Prior connection ensures that the installation program detects the correct interface.

### 11.1.4 Upgrading Software on the Headquarters Server

If you are upgrading your ShoreTel Headquarters server, follow the same process used for installing new software. 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.)

NOTE If during the installation process the installer discovers unsupported characters in user names, it will halt the installation. A pop-up window appears listing the user names containing 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.

Setup will look for the ShoreTel database. If a database is found and it is an older version, Setup will make a backup copy and convert the database to the latest release. Note that 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.

After the installation, a panel warns that the installation will stop all ShoreTel services (Figure 11-1).

Question	
?	Setup must stop all ShoreWare services before continuing. This includes shutting down the Microsoft Internet Information Server services. Please ensure that all users of the ShoreWare system are not currently using Voice Mail or other ShoreWare services before proceeding.
	Would you like to proceed with the ShoreWare installation at this time?

Figure 11-1 Warning Message

To finish the upgrade, restart the ShoreTel Voice Switches. This process upgrades the firmware on the switches but also affects all calls in progress. Next, upgrade the DVSs.

# **11.2** Installing the Headquarters Server Software

This section describes how to install the ShoreTel headquarters server software. Use this procedure for new installations and for upgrades. However, if you are upgrading, refer first to "Installing Software on a Distributed Server" section on page 188 for information about upgrade installation behavior.



Requirements:

- Make sure that the server meets the physical requirements for the customer's implementation. For more information, see "Server Requirements" on page 161.
- Close all programs on server.
- Verify that no anti-virus software is running.
- Install the ShoreTel server on an NTFS partition.
- Microsoft Visual C ++ with SP1 Redistributable Package (x86)

#### **11.2.1** Preparing to Upgrade the Headquarters Software

This section provides information about upgrading the headquarters server software.

#### **11.2.1.1** Migration Path

You can directly upgrade to the current release of ShoreTel software from one of the following versions:

- ShoreTel 11
- ShoreTel 11.1
- ShoreTel 11.2
- ShoreTel 12
- 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 bullet list before upgrading to ShoreTel 13.

CAUTION You cannot upgrade versions ShoreTel 12.x to ShoreTel 13.

#### 11.2.1.2 Preliminary Steps for Upgrade

Before starting the upgrade, do the following:

- Backup server
- Make sure that Windows 2008 Server is installed.

#### **11.2.2** Installing the Software

To install ShoreTel server software for the first time, do the following:

Step 1 Insert the ShoreTel DVD into the DVD drive. The installation program launches automatically. The ShoreTel Intelligent Phone Systems splash screen as shown in Figure 11-2 appears.



Figure 11-2 ShoreTel Intelligent Phone Systems Splash Screen

- NOTE If the auto-run does not start, browse to the DVD, open the Server and Setup folders, and double-click setup.exe. The InstallShield Wizard appears.
- Step 2 Click the Install ShoreTel Server button for ShoreTel Server for Windows.

The ShoreTel installation software performs an initial check of your system. If anything that requires is not installed, you will be prompted to install what is missing. You must installed the required software before continuing.

The ShoreTel Server InstallShield Wizard appears as Figure 11-3 shows.



Figure 11-3 ShoreTel Server InstallShield Wizard Welcome



Step 3 Click Next. The License Agreement appears as Figure 11-4 shows.

😽 ShoreWare Server - InstallShield Wizard	×		
License Agreement Please read the following license agreement carefully.			
	-		
ShoreWare(TM) End User License Agreement			
This End User License Agreement (the "Agreement") is a legal Agreement between you (either an individual or an entity) and ShoreTeI. Inc. (the "Company"), regarding the use of The Company's software, which may include user documentation provided in "online" or electronic form (the "Software"). By installing, copying, or otherwise using the Software product described in the cover sheet, you agree to be bound by the terms of this Agreement. If you do not agree to the terms of this Agreement, promptly return all CD's, packages and accompanying items (including printed materials and binders or other containers) to the place you obtained them for a full refund.			
linternal ourposes onlu. The Software is "in use" on a computer when it is loaded into the 👘 🛄	1		
C I accept the terms in the license agreement			
I do not accept the terms in the license agreement			
	_		
< Back Mext > Cancel			
	-		

Figure 11-4 License Agreement

Step 4 Review the license agreement and click I accept... radio button. Click Next. The Destination Folder dialog box appears as shown in Figure 11-5.



Figure 11-5 Destination Folder Dialog Box

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 backup plan for the server

Click Next. The Setup Type dialog box appears as shown in Figure 11-6.



Figure 11-6 Setup Type Dialog Box

Step 5 Select the radio button for the type of install that you want. Complete is the default. Click Next. The Ready to Install the Program dialog box appears as shown in Figure 11-7.

🖥 ShoreWare Server - InstallShield Wizard 🛛 🗶
Ready to Install the Program The wizard is ready to begin installation.
Click Install to begin the installation.
If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.
nstalibriero

Figure 11-7 Ready to Install the Program

Click Install. The InstallShield Wizard appears as shown in Figure 11-8 and the installation begins.



👘 Shore Wa	re Server - InstallShield Wizard
Installing The prog	ShoreWare Server gram features you selected are being installed.
P	Please wait while the InstallShield Wizard installs ShoreWare Server. This may take several minutes.
	Status:
InstallShield -	
	< Back Next > Cancel

Figure 11-8 InstallShield Wizard

Step 6 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.

This completes the headquarters server software installation.

#### **11.2.3** Verifying the Installation

It typically take 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.

- Step 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.
- Step 2 To log in to ShoreTel Director, do the following:
  - NOTE For instructions about logging in to and registering ShoreTel Director, refer to the *ShoreTel 13 System Administration Guide*
  - Step a In the User ID field, enter the user name that you want to use. The default user ID is admin.
  - Step b In the Password field, enter the password for the user. The default password is changeme.
  - Step c Click Login. The Welcome page appears.
  - Step d Click Later in regards to the registration. The navigation menu and Quick Look panel appear.
  - Step e Ensure that in the Servers and Appliance section in the Services column the status for the headquarters server is Running.

# **11.3 Installing Software on a Distributed Server**

A distributed ShoreTel server has the same software prerequisites as the main ShoreTel server. Before beginning software installation, you should close all programs and be sure no anti-virus software is running.

The Distributed ShoreTel server 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 DSV server must be exclusively dedicated to supporting ShoreTel.

Prior to installing the software, please verify that the Data Execution Prevention setting is set up correctly. See "Preparing to Install the ShoreTel Server Software" section on page 181 for details on this procedure.

Requirements:

- Make sure that the target server meets the physical requirements for your implementation. For more information, see "Server Requirements" on page 161.
- Close all programs on the target server.
- Verify that no anti-virus software is running.
- Install the remote server software on an NTFS partition.
- Microsoft Visual C ++ with SP1 Redistributable Package (x86)

To install the ShoreTel software on the distributed server:

NOTE ShoreTel supports the use of a remote desktop to install the remote server software.

Step 1 Do one of the following:

- Insert the ShoreTel DVD in the server on which you want to install the remote server application. If the auto-run does not engage, navigate to the DVD ROM drive and click ShoreTel Remote Server. The ShoreTel Remote Server InstallShield Wizard appears as shown in Figure 11-9.
- Open a Web browser and do the following:
- a. In the URL field enter support.shoretel.com. The ShoreTel Support page appears.
- b. In the By Release menu, select the current release number. The Customers and Partners login page appears.
- c. Enter your login information. The Documentation/ Downloads page appears.
- d. Click ShoreTel 13 Remote Server (or the current release) to download the remote server software.
- e. Procedure to the ShoreTel Remote Server InstallShield Wizard as shown in Figure 11-9.





Figure 11-9 ShoreTel Remote Server InstallShield Wizard

Step 2 Review the welcome window that appears. Click Next. The License Agreement dialog box appears as shown in (Figure 11-10).

🙀 ShoreWare Call Manager - InstallSh	ield Wizard		×	
License Agreement Please read the following license agreen	nent carefully.			
ShoreWare(TM) End User Lic	ense Agreer	nent	<u>▲</u>	
This End User License Agreement (the "Agreement") is a legal Agreement between you (either an individual or an entity) and ShoreTel, Inc. (the "Company"), regarding the use of The Company's software, which may include user documentation provided in "online" or electronic form (the "Software"). By installing, copying, or otherwise using the Software product described in the cover sheet, you agree to be bound by the terms of this Agreement. If you do not agree to the terms of this Agreement, promptly return all CDs, packages and accompanying items (including printed materials and binders or other containers) to the place you obtained them for a full returnd.				
Grant of License. This Agreement permits you to use the software products you acquired for				
• I do not accept the terms in the license agreement $O$ I do not accept the terms in the license agreement				
InstallShield				
	< <u>B</u> ack	Next >	Cancel	

Figure 11-10 License Agreement Dialog Box

Step 3 Click I accept... if you agree to the license terms and click Next. The Destination Folder dialog box appears as shown in Figure 11-11.

👘 Shore Wa	are Remote Server - InstallShield Wizard	×
<b>Destinati</b> Click Nex	on Folder At to install to these folders, or click Change to choose different folders.	-A
	Install ShoreWare Remote Server to: d:\Program Files\Shoreline Communications\ShoreWare Remote Server\	nange
	Install ShoreWare Remote Director to: d:\Program Files\Shoreline Communications\ShoreWare Remote Director\	<u>1</u> ange
	Folder for ShoreTel Data: d:\Shoreline Data\Ch	iange
InstallShield –	< <u>B</u> ack	Cancel

Figure 11-11 Select Destination Folders

Step 4 Select the appropriate folder for the software files. Click Next. The ShoreTel Server Information dialog box appears as shown in Figure 11-12.

🞼 ShoreWare Remote Server - Install	Shield Wizard		×
ShoreWare Server Information Please enter information about your mai	in ShoreWare Serv	er.	
Server Name (or IP address):			
10.7.0.35			
InstaliShield			
	< <u>B</u> ack	<u>N</u> ext >	Cancel

Figure 11-12 ShoreTel Server Information Dialog Box

- Step 5 In the Server Name or IP address field, enter the server name or IP address of the server on which the ShoreTel Headquarters software is installed.
  - NOTE Make sure that the IP address used for the remote server does not conflict with the IP addressed used for the Headquarters server.

Click Next. The Ready to Install Program dialog box appears Figure 11-13.





Figure 11-13 Ready to Install Dialog Box

Click Install. The installation process begins.

Step 6 When the wizard is done the InstallShileld Wizard Completed dialog box appears as shown in Figure 11-14. Click Finish.



Figure 11-14 InstallWizard Completed Dialog Box

The ShoreTel Remote Server Installed Information dialog box appears as shown in Figure 11-15.



Figure 11-15 ShoreTel Remote Server Installed Information dialog box

Step 7 Click Yes to restart the server.

When the server restarts, all the necessary software will automatically start. 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.

### 11.3.1 Notes About Upgrading Software on the Distributed Server

If you are upgrading your distributed ShoreTel server, follow the same process as for installing new software. 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.)

## **11.4 Installing Licenses**

Many features and function involve the need for a license.  $\$ 

## **11.4.1 Obtaining Conference License**

To obtain a conference license, do the following:

- Step 1 Contact the ShoreTel partner or reseller and purchase the number and type of needed licenses. The partner or reseller give a purchase order number to you.
- Step 2 Launch and then log into ShoreTel Director.
- Step 3 Navigate to Administrator > System Parameters >Licenses > Keys. The License Keys page opens.
- Step 4 Click the Register and Request System Key button at the top of the page. The Contact Information page appears.
- Step 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.
- Step 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.

### **11.4.2** Installing the License

To install the license, do the following:

- Step 1 View the license packet that you received from ShoreTel.
- Step 2 Launch ShoreTel Director and in the ShoreTel Director menu click Administration > System Parameters >Licenses > Keys. The License Key Info dialog box appears.
- Step 3 Click the New button at the top of the page. The License Key Info dialog box appears.



- Step 4 In the Key field, enter the license key that you received from ShoreTel.
- Step 5 In the Comment field, enter a description of the license.
- Step 6 Click Save. The license activates and the information appears in the License Key panel.

## 11.4.3 Upgrading ShoreTel Server Software

If you are upgrading the Headquarters server, follow the same process used for installing new software. The Setup operation determines 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.)

The Setup process searches for the ShoreTel database. If a database is found and is an older version, Setup makes a backup copy and convert the database to the latest release. Note that Setup does not overwrite an existing database.

The upgrade affects all server-based voice applications (voice mail, Auto-Attendant, workgroups, and so on) until the upgrade is complete. After the installation, a panel warns that installation stops all ShoreTel services (Figure 11-16).

Question	×
?	Setup must stop all ShoreWare services before continuing. This includes shutting down the Microsoft Internet Information Server services. Please ensure that all users of the ShoreWare system are not currently using Voice Mail or other ShoreWare services before proceeding.
	Would you like to proceed with the ShoreWare installation at this time?

Figure 11-16 Warning

Next, upgrade your DVS servers. To finish the upgrade, restart your ShoreTel voice switches so that they will upgrade their firmware (this affects all calls in progress).

The Distributed ShoreTel server must be a dedicated server and run no other applications than ShoreTel software. Therefore, do not use this server for any of the following: Windows Domain controller, Terminal Server, Database Server (with MySQL), Web server, or Exchange server.

# **11.5 Ensuring Server Performance**

The brief list of guidelines in this section helps to ensure the best performance from a ShoreTel server. For a detailed discussion of this subject, refer to a reference on this subject or information at www.microsoft.com.

- Verify the server meets the hardware requirements, especially memory.
- Make sure the hard disk is not fragmented.
- Make sure you 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.

To set the parameter for optimization on the server, do the following:

Step 1 Launch the Control Panel and click the System icon. In the System Properties dialog box appears (Figure 11-17).

System Properties
General Network Identification Hardware User Profiles Advanced
Performance Performance options control how applications use memory, which affects the speed of your computer.
Performance Options
Environment Variables
Environment variables tell your computer where to find certain types of information.
Environment Variables
Startup and Recovery
Startup and recovery options tell your computer how to start and what to do if an error causes your computer to stop.
<u>Startup and Recovery</u>
OK Cancel Apply

Figure 11-17 System Control Panel

Step 2 Click the Advanced tab and click the Performance Options button. The Performance Options dialog box appears (Figure 11-18).

Performance Options	<u>? ×</u>
Application response	
Optimize performance fo	or:
C Applications	Background services
Virtual memory	
Total paging file size for	all drives: 192 MB
	<u>C</u> hange
	OK Cancel

Figure 11-18 Performance Options

Step 3 Click the Background services radio button to optimize performance.

- Make sure the paging file size (virtual memory) on the server is large enough. You can check the paging file size in the Performance Options dialog box. 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. Increase the paging file size by clicking the Change button.
- Make sure you set the server to maximize for network performance.



To set the server to maximize network performance, do the following:

- Step 1 Launch the Control Panel and select the Network and Dial-up Connections icon.
- Step 2 Double-click the Local Area Connection icon.
- Step 3 Click the Properties button. The Local Area Connection Properties dialog box appears (Figure 11-19).

Local Area Connection Properties	×		
General			
Connect using:			
3Com 3C920 Integrated Fast Ethernet Controller (3C905C-			
, <u>C</u> onfigure	11		
Components checked are used by this connection:	1		
Client for Microsoft Networks			
File and Printer Sharing for Microsoft Networks      Sector 2 State      Sector 2			
Install	] [		
Allows other computers to access resources on your computer using a Microsoft network.			
Sho <u>w</u> icon in taskbar when connected			
0K Cancel			

Figure 11-19 Local Area Connection Properties Dialog Box

Step 4 Select the File and Printer Sharing for Microsoft Networks item and click Properties. The File and Printer Sharing for Microsoft Networks (Figure 11-20) dialog box appears.



Figure 11-20 File and Printer Sharing for Microsoft Networks Dialog Box

# 11.6 Upgrading ShoreTel Servers from Windows 2003 (32bit) to Windows 2008 (32-bit)

The following procedure is required when upgrading the operating system to Windows Server 2008 (32-bit) on a server that is running ShoreTel server software.

- IMPORTANT Active Directory settings must be disabled before proceeding with the upgrade process. If Active Directory is not disabled, you will not be able to start ShoreTel Director after upgrading.
- NOTE When installing ShoreTel server on Windows Server 2008 (32-bit) you must launch Setup.exe using "Run as Administrator."





Figure 11-21 Upgrading Servers Running Previous ShoreTel Software

Step 5 Upgrade the ShoreTel Server software to Version 12.

- Step 6 Disable Active Directory if you have this option enabled.
- Step 7 Stop all ShoreTel services and backup the Configuration and CDR databases.

Refer to the ShoreTel Administrator Guide for instructions on backing up and restoring a ShoreTel database.

- NOTE ShoreTel recommends that you back up these databases to a storage device separate from the server you intend to upgrade.
- Step 8 Uninstall the ShoreTel Server software and delete the following folders:
  - Shoreline Data
  - Shoreline Communications
  - FTPRoot
  - NOTE Make sure Windows PowerShell is not present. Refer to Microsoft support for information on uninstalling Windows PowerShell.
- Step 9 Upgrade the server operating system to Windows Server 2008 (32-bit). After the operating system is upgraded, you must activate the operating system prior to installing ShoreTel Server software.
  - NOTE Do not use Autorun from the Windows Server 2008 CD. Autorun will only allow a new installation of Windows 2008.
- IMPORTANT If you did not disable Active Directory prior to upgrading to Windows 2008 and Active Directory is then enabled after upgrading, you will not be able to access ShoreTel Director.

- Step 10 Ensure that the Application Server Roles and Web Server Roles are configured.
- Step 11 Install the ShoreTel Server software.
- Step 12 Restore the Configuration and CDR database files.

Refer to the *ShoreTel 13 System Administration Guide* for instruction on restoring a backup copy of a ShoreTel database

NOTE Active Directory Login will not be available after upgrading to Windows 2008.

# 11.7 Upgrading from Windows 2008 (32-bit) to Windows 2008 R2 (64-bit)

IMPORTANT Verify that the version of the Uboot code on all switches is 1.1.3.25 or later prior to installing Windows Server 2008 R2 on the HQ system. Use Quick Look to confirm the version of boot ROM on each switch.

## 11.7.1 Uboot Upgrade Considerations for Windows 2008 R2 (64-bit)

Users that want to upgrade to Windows Server 2008 R2 will need to ensure their 1/2 width switches are running Uboot Version 1.1.3.25.

If you have a ShoreTel VxWorks-based switch (not a voice mailbox switch), you will need to update the Uboot version to 1.1.3.25

Steps to Upgrade Uboot Version

Telnet to the switch

Use the VxWorks command line uboot\_update to update the uboot code.

# 11.8 Upgrading Windows 2008, 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 system to malfunction. 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. Perform the intermediate upgrade steps described in this section, otherwise the entire network ceases to function and connectivity is lost.

NOTE For new installations of the 64-bit OS, this section is not necessary.

NOTE Builds 16.5.8506.0 and higher support heterogeneous environments. For example, ShoreTel Release 11 software or higher supports a mix of the Headquarter Server and DVMs running either the 32-bit OS or the R2 64-bit OS.

ShoreTel supports a particular 64-bit version of the Windows Server 2008 operating system. Specifically, its 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.



The following points are an overview of the tasks to perform for the migration from a 32-bit OS to the 64-bit OS:

- 1. Upgrade the ShoreTel server software on a 32-bit system to a new 32-bit version (build 16.5.8506.0 or higher).
- 2. After rebooting all the switches, confirm that the version of Uboot code on the half-width switches is 1.1.3.25 or higher on all switches in the ShoreTel network. The reason is that 1.1.3.25 or higher supports FTP service on both port 150 (for the 64-bit OS) and port 125 (for the 32-bit OS).
- 3. After confirming that the upgraded 32-bit OS is stable and operating correctly, the system administrator backs up the entire system.
- 4. Thereafter, the detailed steps for upgrading the server software begin.

To upgrade a 32-bit system to a 64-bit system, do the following:

- Step 1 Upgrade the current 32-bit system to version 16.5.8506.0 or higher.
- Step 2 Reboot the switches.
- Step 3 Go to Maintenance > Quick Look > Sites or Switches and verify the Uboot version is 1.1.3.25 or higher. The version is in the Boot ROM Version in the "Details" area of the window.

ShoreTel build number 16.5.8506.0 or higher automatically updates the Uboot code on the V Switches (voice switches that also provide voicemail—the ShoreTel Voice Switch 90V, for example) as part of the installation.

- Step a If the non V-switches do not have the correct Uboot code:
- Step b Telnet or SSH to the half-width switch (non V-switch).
- Step c Go to Shell.
- Step d Enter the command uboot\_update on the CLI. Do not turn off the unit until the operation is complete.
- Step 4 Upgrade Uboot on all half-width switches to version 1.1.3.25. To check the current Uboot version, use ShoreTel Director's Quick Look to navigate to the display of a particular site and then select individual switches to see the Uboot version listed near the bottom of the window.
- Step 5 Disable LDAP and the distributed database facility (DDB) if either is enabled.
- Step 6 Make a backup of Shoreline Data.
- Step 7 Make a backup of Config DB. Uninstall ShoreTel Release 11 (or other release whose build is above 16.5.8506.0). Be sure to remove Shoreline Data and ShoreTel Server folder.
- Step 8 Record the IP address, gateway IP, netmask, and so on, of each ShoreTel server.

- Step 9 Install Windows Server 2008 R2 64-bit on hardware platforms that support it.
  - Step a If a hardware platform does not support Windows Server 2008 R2 64-bit, install the new OS on a completely new system and bring down the old system.
  - Step b After installation, confirm that the network parameters recorded in Step 8 are not disturbed. If necessary, restore the recorded values.
- Step 10 Prepare the new OS system with the necessary components (Application Server Role Services, Web Server Role Services, SMTP Server and FTP Server).
- Step 11 Copy Shoreline Data folder in correct location.
- Step 12 On the server with the new Windows Server 2008 R2 64-bit (from Step 1), install Release 11 or other version of ShoreTel software that supports the newly upgraded Windows OS.

# 11.8.1 Existing HQ server hardware will not support the 64-bit version of Windows Server 2008 (R2)

- Step 1 Upgrade Uboot on switches to version 1.1.3.25.
- Step 2 Disable Active Directory and Distribute Database, if enabled.
- Step 3 Backup the existing ShoreTel data files.
- Step 4 Backup the existing ShoreTel databases.
- Step 5 Record the IP address, gateway IP address, netmask value and other network parameters of the current server.
- Step 6 Bring down the current system and Install Windows 2008 R2 on new hardware.
- Step 7 Set the network values on the new server to match what was recorded from the old server.
- Step 8 Prepare the new operating system with the necessary components (Application Server Role Services, Web Server Role Services, SMTP Server, etc.
- Step 9 Copy the Shoreline Data backup in the proper location.
- Step 10 Install the current release of ShoreTel software on the new platform.

# 11.8.2 Existing DVS server hardware will not support the 64-bit version of Windows Server 2008 (R2)

- Step 1 Backup the existing ShoreTel data files.
- Step 2 Disable Distributed Database, if enabled.
- Step 3 Record the IP address, gateway IP address, netmask value and other network parameters of the current DVS server.
- Step 4 Bring down the current DVS system and Install Windows 2008 R2 on new hardware.



- Step 5 Set the network values on the new DVS server to match what was recorded from the old server.
- Step 6 Prepare the new operating system with the necessary components (Application Server Role Services, Web Server Role Services, SMTP Server, etc.
- Step 7 Install the current release of ShoreTel software on the new platform.

#### 11.8.3 Existing HQ Server hardware will be upgraded to Windows Server 2008 R2

- Step 1 Upgrade Uboot on switches to version 1.1.3.25.
- Step 2 Disable Active Directory and Distributed Database, if enabled.
- Step 3 Backup the existing ShoreTel data files.
- Step 4 Backup the existing ShoreTel databases.
- Step 5 Uninstall ShoreTel server software and remove the Shoreline Data and ShoreTel Server folders.
- Step 6 Record the IP address, gateway IP address, netmask value and other network parameters of the current server.
- Step 7 Upgrade the server platform with Windows 2008 R2 on the old server platform (complete wipeout installation of Windows 2008 R2).
- Step 8 Confirm the network values on the server match what was recorded from the old server.
- Step 9 Prepare the new operating system with the necessary components (Application Server Role Services, Web Server Role Services, SMTP Server, etc.
- Step 10 Copy the Shoreline Data backup into the proper location.

Step 11 Install the current release of ShoreTel software on the new platform.

#### 11.8.4 Existing DVS Server hardware will be upgraded to Windows Server 2008 R2

- Step 1 Backup the existing ShoreTel data files.
- Step 2 Disable Distributed Database, if enabled.
- Step 3 Uninstall ShoreTel server software and remove the Shoreline Data and ShoreTel Server folders.
- Step 4 Record the IP address, gateway IP address, netmask value and other network parameters of the current server.
- Step 5 Upgrade the server platform with Windows 2008 R2 on the old server platform (complete wipeout installation of Windows 2008 R2).

- Step 6 Confirm the network values on the server match what was recorded from the old server.
- Step 7 Prepare the new operating system with the necessary components (Application Server Role Services, Web Server Role Services, SMTP Server, etc.
- Step 8 Install the current release of ShoreTel software on the new platform.

# **11.9 Ensuring Proper Server Performance**

The following are some guidelines for ensuring the best performance from your ShoreTel server. This list is not exhaustive. Please refer to a reference book on the subject or information on the web at www.microsoft.com.

- Verify the server meets the hardware requirements, especially memory.
- Make sure the hard disk is not fragmented.
- Make sure you 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.

To configure this option, do the following:

- Step 1 On the ShoreTel server desktop click Start > Control Panel > System. The Systems window appears.
- Step 2 Click the Advanced tab or Advance system setting. The System Properties dialog box appears.
- Step 3 Click the Performance Options or Settings button. If your system has a Performance Options button, the Performance Options dialog box appears. If your system has the Settings button, the Performance Options dialog box includes tabs. Click the Advanced tab.
- Step 4 Click the Background services radio button.
- Step 5 Make sure the paging file size (virtual memory) on the server is large enough.
  - To check the paging file size, go back to the Performance Options window. 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. Increase the paging file size by clicking the Change button.
- Make sure you set the server to maximize for network performance.
  - To configure this option, go to Control Panel, open the Network and Dial-up Connections icon, and then open the Local Area Connection icon. From the Local Area Connection Properties window, select the File and Printer Sharing for Microsoft Networks item and click Properties.



# Chapter 12

# **Site Requirements and Preparation**

This chapter provides information about preparing a site for the ShoreTel system Information includes physical space, environment, and cabling. The topics are:

- "Recommendations" on page 203
- "Voice Switch Requirements" on page 204
- "Racks and Cabling" on page 210

## 12.1 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.

#### 12.1.1 Switch Models

You can locate the model number of your switches on the rear panel as shown in Figure 12-1. This document distinguishes between switches based on the model number and the number of RUs the switch occupies.



Figure 12-1 ShoreTel 120 Model Number Label

See Appendix F for a information on all ShoreTel Voice Switches. The information describes phone capabilities, connectors, and LED behavior.

# **12.2** Voice Switch Requirements

This section includes requirements for mounting the ShoreTel voice switches, along with other switch-related requirements and specifications.

## 12.2.1 Physical Requirements

The ShoreTel voice switches are designed to be mounted in a standard 19-inch rack. Table 12-1 shows the specifications for each voice switch. For more information refer to the Quick Install Guide, included with each ShoreTel voice switch.

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 12-1
 ShoreTel Voice Switch Physical Specifications

Table 12-2 shows the latest hardware line, designed to increase port density.

 Table 12-2
 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

## 12.2.2 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 12-3 shows the power requirements for the full-width ShoreTel voice 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
Number of grounded 110 VAC outlets per switch	1	1	1
Power consumption (typical)	90W typical	50W typical	50W typical

Table 12-3ShoreTel Voice Switch Power Input (Full-Width Switches)

Table 12-4 shows the power requirements for the half-width ShoreTel voice 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

Table 12-4ShoreTel Voice Switch Power Input (Half-Width Switches)

## 12.2.3 Power and Heat Dissipation

The voice switches dissipate power and heat. ShoreTel recommends that you use the information in Table 12-5 and Table 12-6 to help calculate the ventilation requirements of the room that contains the switches.

Table 12-5ShoreTel Voice Switch Power and Heat Dissipation (Full-Width<br/>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

	SG 90 SG 90BRI	SC 22071	
Parameter	SG 30 SG 30	SG 22011 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

 Table 12-6
 ShoreTel Voice Switch Power and Heat Dissipation (Half-Width Switches)

## 12.2.4 Environmental Requirements

The ShoreTel voice switches require that the environmental specifications provided in Table 12-7 be met.

 Table 12-7
 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)

## 12.2.5 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 12-8.

Predicted MTBF MTTR Demonstrated Voice Switch (hours) MTBF (hours) (hours) Availability ShoreTel 24A 99.9994% ShoreTel 30 190,606 1 n/a 1 99.9994% ShoreTel 30BRI 172,659 n/a ShoreTel 40/8 132,300 515,581 1 99.9997% ShoreTel 50 190,606 1 99.9994% n/a 1 99.9994% ShoreTel 50V 175,803 n/a 519.359 99.9993% ShoreTel 60/12 91,000 1 1 99.9994% ShoreTel 90 171,493 n/a ShoreTel 90V 159,416 n/a 1 99.9994% 99.9994% ShoreTel 90BRI 172,659 n/a 1 1 99.9994% ShoreTel 90BRIV 162,931 n/a 84,500 1 99.9997% ShoreTel 120/24 518,134

Table 12-8ShoreTel Voice Switch Dependability



Voice Switch	Predicted MTBF (hours)	Demonstrated MTBF (hours)	MTTR (hours)	Availability
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)				

 Table 12-8
 ShoreTel Voice Switch Dependability (Continued)

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 12-9 shows the reliability information for the ShorePhone phones. Hourly numbers shown are based on demonstrated reliability (as opposed to calculated).

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
IP560	56,300	360,000
IP560g	56,400	TBD
IP565g	N/A	TBD
IP 655	TBD	TBD
BB24	72,600	TBD

Table 12-9ShorePhone IP Phone Dependability

## 12.2.6 Memory and Processing

Each ShoreTel voice switch has the same memory and processing (see Table 12-10).

Туре	Details
Flash Memory	16 MB
Random Access Memory	128 MB
Main Processor	PowerPC 8245
Digital Signal Processor	Texas Instruments 5409A

 Table 12-10
 ShoreTel Voice Switch Memory and Processing

## 12.2.7 Connectors

Table 12-11 summarizes all of the connectors on the ShoreTel voice switches. Diagrams showing where these connectors are located are provided later in this chapter.

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 <sup>a</sup>		RJ-21X male 0–2,000 feet <sup>a</sup>
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 <sup>b</sup>	3.5 mini-mono
Audio output (Paging, Night Bell)	3.5 mini-mono	3.5 mini- mono <sup>b</sup>	3.5 mini-mono
Maintenance	DB-9 female	DB-9 female	DB-9 female

 Table 12-11
 ShoreTel Voice Switch Connectors

a. 2000 ft. length uses 26AWG wire

b Audio input/output on 220T1 and 220E1, but not T1/E1

#### 12.2.7.1 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).

#### 12.2.7.2 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.

#### **12.2.7.3** 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.

#### 12.2.7.4 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.

#### 12.2.7.5 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.

#### 12.2.7.6 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 k $\Omega$  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.

#### 12.2.7.7 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.

#### 12.2.7.8 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.

# 12.3 Racks and Cabling

## 12.3.1 General Cabling Overview

The diagram in Figure 12-2 highlights the key components with respect to cabling for your voice network.





Figure 12-2 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 12-2, 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.

## 12.3.2 Rack Overview

Figure 12-3 shows a typical rack installation.



Figure 12-3 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. Information on switch connectors and LEDs can be found in "Site Requirements and Preparation" on page 203. The topics discussed include:

- "Planning" on page 213
- "Mounting the ShoreTel Voice Switches" on page 213
- "Installing ShoreTel Voice Switches" on page 214
- "ShoreTel Director Switch Configuration" on page 215
- "Reference" on page 215

## 13.1 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.

## **13.2** Mounting the ShoreTel Voice Switches

To stack the ShoreTel voice switch in a rack:

- Step 1 Remove the voice switch from its shipping container.
- Step 2 Place the switch on a flat platform, such as a shelf.
- Step 3 Up to three switches can be stacked on top of each other.

To mount a full-width ShoreTel voice switch in a rack with brackets:

- Step 1 Remove the voice switch from its shipping container.
- Step 2 Attach the two included mounting brackets by using the screws we provide.

Step 3 Use standard screws to mount the switch in the rack.

To mount a half-width ShoreTel voice switch in a rack with brackets follow the steps below.

Refer to the *Quick Install Guide for the ShoreTel Dual Tray* (included with half-width switches) for details.

- Step 1 Remove the voice switch from its shipping container.
- Step 2 Mount a ShoreTel Dual Tray into the rack with the screws provided.
- Step 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.
- Step 4 Use standard screws to mount the switch in the tray.

## **13.3 Installing ShoreTel Voice Switches**

Before applying power to a new ShoreTel voice switch, configure the DHCP/BOOTP server.

To install a ShoreTel Voice Switch:

Step 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.

- Step 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.
- Step 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 13 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.

- Step 4 If applicable, connect the music-on-hold source to the audio input port.
- Step 5 If applicable, connect your site's paging system to the audio output port.
- Step 6 Refer to the *ShoreTel 13 System Administration Guide* to configure the ShoreTel voice switch according to your site's requirements.
- Step 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.



### 13.3.1 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.

To install the retainer:

- Step 1 Using a number 1 Phillips screwdriver, remove the two black Phillips head screws on either side of the RJ-21X port.
- Step 2 Place the retainer in the recessed area around the RJ-21X port.
- Step 3 Reinstall the two screws.
- Step 4 Plug in the RJ-21X cable.
- Step 5 Pull the velcro strap tightly around the connector on the RJ-21X cable, and fasten it.

## 13.4 ShoreTel Director Switch Configuration

To complete the installation, you need to configure the ShoreTel voice switches with ShoreTel Director. For more information, see the chapter on configuring switches in the *ShoreTel 13 System Administration Guide*.

## 13.5 Reference

#### 13.5.1 Environmental Requirements

The ShoreTel voice switches require that the environmental specifications provided in Table 13-1 be met.

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%

 Table 13-1
 ShoreTel Voice Switch Environmental Specifications

## 13.5.2 Packaging Requirements

Table 13-2 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 13-2
 ShoreTel Voice Switch Packaging Specifications

Parameter	Specification
Vibration	
Power:	0.4 Grms, 1h per axis
Spectral Density:	5-500Hz @ 0.000323303 g2/Hz

Parameter	Specification
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

 Table 13-2
 ShoreTel Voice Switch Packaging Specifications (Continued)

## 13.5.3 Regulatory Compliance

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 13-3
 ST-E1 Voice Switch Physical Specifications

Table 13-4ST 120/24, ST 90, ST 60/12, ST 50, ST 40/8, ST 30Voice Switch Physical<br/>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


Table 13-4	ST 120/24, ST 90, ST 60/12, ST 50, ST 40/8, ST 30Voice Switch Physical
	Specifications (Continued)

Parameter	Physical Specification
	EMC Directive 89 / 336 / EEC With Amendment 93 / 68 / EEC
	GS Mark from TUV Rheinland (Notified Body)
	EN 55024: 1998 +A1:2001 +A2:2003

## **13.5.4** Physical Specifications

Table 13-5ST T1, ST-220T1, ST 220T1A, ST T1k Voice Switch Physical<br/>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			

## **13.5.5** General Specifications

Table 13-6	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**

With ShoreTel IP Phones, you can deploy the phones with the wiring that already exists in the building.

ShoreTel pre-configures its IP phones to work with a ShoreTel system and the network's Dynamic Host Configuration Protocol (DHCP) server. After configuring the servers, you plug the phones into the network; the ShoreTel system automatically adds them to the network.

If the network does not have a DHCP server or it is currently offline, you can set a static IP address and other startup parameters directly at the IP phone. See the *ShoreTel 13 System Administration Guide* for more information. The topics discussed in this chapter include:

- "Recommendations" on page 219
- "Preparing Your ShoreTel System for IP Phones" on page 219
- "Associating a User Group with Unassigned IP Phones" on page 225

## 14.1 Recommendations

The following recommendations will help you install your IP phones.

- Make sure you have reviewed your network bandwidth and Quality of Service (QoS) strategies and configured your network for your IP phones as described in "Understanding the Requirements for Toll-Quality Voice" on page 30.
- Make sure you have configured DHCP vendor option 156 with boot server information.

The phones may not boot properly if incorrect configuration data is present in the telephone. This can occur if the telephones were previously used in an environment where DHCP and automatic provisioning was not used, or the telephone is from a vendor other than ShoreTel. See the *ShoreTel 13 System Administration Guide*, for information about changing the telephone to the correct settings.

## 14.2 Preparing Your ShoreTel System for IP Phones

This section provides the information you need to prepare your ShoreTel system for IP phones.

#### 14.2.1 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.

The ShoreTel voice switches send a heartbeat to the IP phones every 60 seconds. If the heartbeat is not acknowledged within approximately four seconds, the switch considers the IP phone to be offline or unavailable. The voice switches continue to broadcast the heartbeat every minute. Any currently-offline IP phone that returns an acknowledgement is considered online and available.

To configure IP phone support on a ShoreTel voice switch, you must reserve ports for IP phone support on the ShoreTel Voice Switch edit page in the ShoreTel Director. See the chapter on configuring switches in the *ShoreTel 13 System Administration Guide* for additional information.

## 14.2.2 Configuring Teleworker IP Phones

To configure an IP phone as a teleworker phone:

- Step 1 Define a range of IP addresses set aside for IP phone teleworkers as described in "Setting IP Address Ranges" on page 221.
- Step 2 Set a static IP address for the IP phone included in the range you defined in Step 1. For instructions on setting a static IP address for an IP phone, see "Manually Configuring ShorePhones" on page 259.
- Step 3 Connect the IP phone to your Ethernet connection to the Internet.

## 14.2.3 Assigning the Configuration Switches

You need to designate a switch for handling initial service requests from IP phones installed on your ShoreTel system. You have the option of assigning two switches to this function, to provide a backup in case of network problems. Every IP phone installation must have at least one configuration switch. If you do not assign a switch, the ShoreTel system automatically assigns the first two ShoreTel Voice Switches added to the system that are managed by the HQ server.

IP phones must be able to contact at least one of the assigned configuration switches when first connected to the network. If the IP phone cannot reach a configuration switch, the telephone will not be added to the system.

To assign configuration switches:

- Step 1 From the ShoreTel Director navigation pane, click IP Phones.
  - Click IP Phones Options. Figure 14-1 shows the IP Phones Options edit page.

IP Phone Options Edit	<u>S</u> ave <u>R</u>	eset	Help
			* modified
Edit this record	Refresh this page		
IP Phone Configuration Switch 1:	101 Fuji-24 🔽		
IP Phone Configuration Switch 2:	103 Bottom SG24 💌		
User Group for Unassigned IP Phones:	IP Telephones		
IP Phone Announcement:	ShoreTel 6		
IP Phone Password (except IP-100):	•••••	Confirm:	
Enable IP Phone Failover			
Delay After Collecting Digits (milliseconds):	1000		

Figure 14-1 IP Phones Options Edit Page



This page has several configurable parameters:

- IP Phone Configuration Switch 1
- IP Phone Configuration Switch 2
- User Group for Unassigned IP Phones
- IP Phone Announcement
- IP Phone Password
- Enable IP Phone Failover
- Delay After Collecting Digits

Step 2 Select an available switch from the pull-down lists for configuration switches 1 and 2.

For information on the other IP phone options, see the *ShoreTel 13 System Administration Guide*.

### 14.2.4 Setting IP Address Ranges

If your system consists of more than one site, you must define an IP address range for IP phones at each site in the system. Setting ranges for each site ensures that new phones added to the system will be associated with the correct voice switch at the telephone's site.

You can view the IP address range for each site from the IP Address Map list page, shown in Figure 14-2. The page lists the sites and associated IP address ranges.

P Phone A	ddress			<u>Help</u>
P Address Map Delete <u>N</u> ew	List		O records checked.	Showing 1 of 1
Sit	e	Low IP Address	s High IP Address	Teleworkers
Hea	<u>dquarters</u>	10.0.0.0	10.0.0.10	No
1998-2004 ShoreTr	I. Inc. All rights reserved.	tap Info - Microsoft k Number (CESID): Save Cl Inc. All rights reserved,	Internet Explorer	

Figure 14-2 IP Address Map List and IP Address Range Edit Pages

To add a site with IP phones, click New and enter the information on the Site IP Address Range edit page. To delete a site from the list, click the check box to the left of the site and click the Delete button.

To edit the IP address range for a site:

Step 1 On the IP Address Map List page, in the Site column, click the site for which you are setting a range. The Site IP Address Range edit page appears.

- NOTE If you are setting the IP address range for a site other than shown in the Site field, select it from the list.
- Step 2 Enter the lowest IP address in the Low IP Address field.
- Step 3 Enter the highest IP address in the High IP Address field.
- Step 4 If you are setting a range for teleworker IP phones, click the Teleworkers check box.
- Step 5 To set the new range, click Save. You can set ranges for other sites in the system by clicking Previous or Next.

If a phone is added with an address that is not within a specified range for any site, or there are no IP address ranges defined for any site, the telephone will be automatically assigned to the headquarters site. This causes seven-digit numbers dialed from the IP phone to be dialed as numbers within the area code of the headquarters site. In addition, this causes all telephone calls to users who are not at the headquarters to use the configured inter-site voice encoding for that system.

## 14.3 Installing a ShoreTel IP Phone

This section provides information about installing ShoreTel IP phones.

#### 14.3.1 Boot Sequence

The boot sequence to follow is:

- 1. DHCP on default VLAN. Reboot
- 2. DHCP on voice VLAN. Reboot.
- 3. Connect to HQ for firmware code. Reboot.
  - NOTE The HQ 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).

#### 14.3.2 802.1x Authentication

Most ShoreTel IP phones support 802.1x network authentication. ShoreTel IP phones that support 802.1x authentication are shipped with the feature enabled and are required to present a user id and a password the first time the phone connects to a network that has 802.1x enabled. If the authentication fails, the phone does not boot. ShoreTel IP phones deployed on networks where 802.1x authentication is not enabled boot when they connect to the Ethernet switch.

ShoreTel provides a default user ID for the phones that support 802.1x. The default user ID is the last six characters in the MAC address assigned to the phone. The MAC address is the 12-digit number on the barcode label attached to the back of the phone.

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.
- Ma nd i tory TIA-1057 LLDP-Med functionality for Class III communication device endpoints.

802.1x. The default SID (supplicant user id) is the last 6 characters of the MAC address of the phone. The password must be entered manually (no default) the first time the phone boots and is then cached if authentication succeeds.

If upgrading from another firmware that supports 802.1x (3.3.x or 3.4.x), the previous settings (802.1x on/off, SID, password) will be preserved. If upgrading from a firmware that does not support 802.1x (2.2, 2.3, 3.1, 3.2) Logical Link Discovery Protocol (LLDP) will be turned on by default and a default SID of the last 6 characters of the MAC address will be applied.

ShoreTel IP phones that do not support 802.1x authentication include:

- ShoreTel IP 110
- ShoreTel IP 210

### 14.3.3 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:

- ShoreTel server address: The ShoreTel server's address is used to access and download the latest telephone application software and the configuration information for the ShoreTel system.
- SNTP server: The SNTP provides a standard network time to maintain the telephone's displayed time and date.

#### 14.3.3.1 ShoreTel Server Address

The ShoreTel server provides the IP phones with the latest application software and the configuration information that enables the IP phone to be automatically added to the ShoreTel system. The ShoreTel server's address must be provided to the phone as a vendor-specific option. Shore Phones are pre-configured to look for the ShoreTel server's address to be specified as Vendor Specific DHCP Option 156. If these options are not available, the ShoreTel IP phones will use Option 66.

For help on configuring these DHCP Options, see "Configuring DHCP for ShoreTel IP Phones" on page 55.

#### 14.3.3.2 SNTP Server

The DHCP server should be configured to provided the address of your network's SNTP server to provide date information to the IP phones.

### 14.3.4 Manually Configuring the 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.

To manually configure a ShoreTel IP Phone at bootup:

- Step 1 Connect the Ethernet cable to the data jack on the back of the IP phone or BB24.
- Step 2 At the Password prompt, enter the default password 1234, or the password provided by your system administrator, followed by the # key.

You have four seconds to enter the password, after which the phone enters normal operation with its current settings.

The default password can be changed in ShoreTel Director. For more information, see the *ShoreTel 13 System Administration Guide*.

The BB24 setup screen can be accessed by pressing the upper left-most and lower right-most buttons.

- Step 3 Enter the values listed in Table 14-1 when prompted.
- Step 4 Press # to advance to the next settings or \* to exit.

Prompt	Value
Clear All Values?	Press #. (No)
DHCP=	Press * to toggle to the "off" position and then press #.
FTP=	Enter the IP address of your ShoreTel server. Press #.
MGC=	Press #. (The phone obtains the address from configuration files on the ShoreTel server).
SNTP=	Enter the IP address of your time server. Press #.
802.1Q Tagging=off	Press #. Consult your network administrator before changing this value.
VLAN ID=	Press #.
Country=	Enter the country code (see Table 3-12 on page 56).
Language=	Enter the language code (see Table 3-13 on page 57).
Save all Changes	Press #. (Yes)

Table 14-1Configuration Values

The phone downloads the latest bootROM and 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.

To manually configure an operational ShorePhone from the keypad:

- Step 1 With the phone on hook, press the MUTE key followed by 73887# (SETUP#).
- Step 2 At the Password prompt, enter 1234, or the password provided by your system administrator, followed by the # key.

The default password can be changed in ShoreTel Director. For more information, see the *ShoreTel 13 System Administration Guide*.

Step 3 Enter the values listed in Table 14-1 when prompted. Press # to advance to the next settings or \* to exit.



The phone downloads the latest bootROM and 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.

# 14.4 Displaying ShoreTel IP Phone Settings

You can display the phone's current IP parameter settings by pressing a sequence of buttons on the phone's number pad.

To display the phone's IP parameter settings:

- Step 1 With the phone on hook, press the MUTE key followed by 4636# (INFO#). The phone will display the first two parameters.
- Step 2 Press # to advance the display or \* to exit. The phone will resume normal operation after the last parameter has been displayed.

### 14.4.1 Resetting a ShoreTel IP Phone

You can reset the phone by entering a key sequence from the phone's keypad.

To reset the phone, place the phone on hook, press the MUTE key followed by 73738# (RESET#). The phone will reboot.

# 14.5 Associating a User Group with Unassigned IP Phones

Unassigned IP phones are available for users configured for Any IP Phone. Select the user group that will have access to unassigned IP phones from the pull-down list.

Since unassigned IP phones are not associated with a user, you cannot report on calls made from these telephones and associate them with an individual user. It is recommended that unassigned IP phones be configured with a class of service with minimal calling privileges.



# 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. The topics discussed include:

- "Recommendations" on page 227
- "Hardware Requirements" on page 227
- "Software Requirements" on page 229
- "Virus Protection Desktop Systems" on page 231
- "Virus Protection Desktop Systems" on page 231

The installation procedures are covered in Chapter 10.

## **15.1 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.

## **15.2 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 15-1 provides information about the processor requirements for different configurations of ShoreTel Communicator. Table 15-2 provides information about the minimum memory requirements for different configurations of ShoreTel Communicator. Table 15-3 provides information about the requirements for installing different configurations of ShoreTel Communicator for end-users in a Microsoft Windows terminal server (WTS) environment.

ShoreTel Communicator Version	Windows XP and Vista	Windows 7	Max Presence Load		
Communicator with Personal Access	Pentium 3, 800 MHz	Pentium 4 - 1.6 GHz	No Presence supported		
Communicator with Professional Access	Pentium 4, 3.0 GHz w/HT or Dual Core 1.6GHz	Pentium 4, 3.0 GHz w/HT or Dual Core 1.6GHz	1 Event/Second		
Communicator with Agent, Supervisor, Operator Access (<40 extension presences)	Pentium 4, 3.0 GHz w/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 15-1 C	Client Device Hardware	Requirements
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	Hard Disk Space <sup>1</sup>		RAM <sup>2</sup>			Available RAM <sup>2</sup>			
ShoreTel Communicator Version		Vista	Win 7	XP	Vista	Win 7	ХР	Vista	Win 7
Communicator with Personal Access: Presence On									
Communicator with Personal Access: Presence Off	1GB	1GB	1GB	1GB	2GB	2GB	100MB	100MB	150MB
Communicator with Professional Access	1GB	1GB	1GB	1GB	2GB	2GB	150MB	150MB	250MB
Communicator with Agent, Supervisor, Operator Access (<40 extension presences)	1GB	1GB	1GB	1GB	2GB	2GB	150MB	150MB	250MB
Communicator with Agent, Supervisor, Operator Access (<500 extension presences)	1GB	1GB	1GB	1GB	2GB	2GB	150MB	150MB	250MB
All Versions, VGA Video	1GB	1GB	1GB	1GB	2GB	2GB	150MB	150MB	250MB
All Versions, XGA Video	1GB	2GB	2GB	1GB	2GB	2GB	150MB	150MB	250MB

<sup>1</sup>Disk space requirement is for installation on a system without .NET Framework previously installed. Otherwise, Communicator requires less than 100 MB hard disk space.

<sup>2</sup>ShoreTel Communicator memory requirements are during normal operation. When running other Microsoft Office applications



on the PC in addition to Communicator, additional memory recommendations are 512 MB (XP), 1 GB (Vista/Windows 7). If Microsoft Outlook contacts are imported, memory requirements will increase in relation to the number of contacts imported.

WTS Version	Max Number of Users per WTS	Max Presence/Call Load <sup>1</sup>	RAM Memory required per client within the WTS	Minimum Processor <sup>2</sup>
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

Table 15-3	WTS Server Minimum Hardware Require	ements
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<sup>1</sup>Presence events refers to the Presence status displayed in the Contacts viewer of ShoreTel Communicator.

<sup>2</sup> Please consider that other applications and environments such as Microsoft Office, etc. 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

# 15.3 Software Requirements

This section discusses the software requirements for installing the ShoreTel Communicator client software on computers end-users use.

## 15.3.1 Operating Systems

In the current release, the following operating systems support ShoreTel Communicator client software:

- Windows Operating Systems
  - Windows XP Professional, 32 bit, SP3
  - 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
  - Unicode support (Double Byte Character)

- Mac OS X 10.7
- 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
- Citrix XenApp: For platform details on Windows Terminal Server and Citrix XenApp, see Appendix C, Installing ShoreTel Communicator on Citrix and Windows Terminal Servers.

### 15.3.2 .NET Framework

On Windows-based computers, ShoreTel Communicator requires the installation of .NET Framework version 3. 5 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 (.Net Framework is not shipped with the product) or trigger a download from Microsoft before installing Communicator. The person doing the installation will be prompted to accept the end user license agreement from Microsoft to proceed with the .NET installation.

## 15.3.3 ShoreTel Communicator for Web Browser Requirements

ShoreTel Communicator for Web can be accessed and controlled via web browser. The following browser versions are supported in ShoreTel 13:

- Safari 5.0 on Macintosh.
- Microsoft Internet Explorer 9.0.
- Firefox 12.0 on Windows and Mac OS.
- Adobe Flash 9 or higher should also be installed.

#### 15.3.4 Microsoft Outlook Integration

This section discusses different ways ShoreTel 13 Communicator integrates with Microsoft Outlook.

#### **15.3.4.1** Integrating with E-mail

ShoreTel 13 Communicator supports e-mail integration with the following products:

- Microsoft Outlook 2007, SP2.
- Microsoft Outlook 2010 (32 bit).
- Microsoft Outlook 2010 (64 bit)

NOTE ShoreTel 13 does not support Microsoft Outlook 2003.

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 (supporting multiple mail service providers) and not for *Internet-only* mode before installing Microsoft Outlook integration features.
- 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.

#### **15.3.4.2** Integrating with Call Handling

ShoreTel 13 can integrate with Microsoft Outlook 2007 and Microsoft Outlook 2010 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

# **15.4** Virus Protection Desktop Systems

ShoreTel allows the use of industry standard virus protection software on desktop systems running the client application.



# Chapter 16

# **Desktop Installation**

This chapter describes the procedure for installing ShoreTel Communicator on PC and Mac computers. 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.

The topics discussed in this chapter include: *ShoreTel 13 System Administration GuideShoreTel 13 Planning and Installation GuideShoreTel 13 Maintenance Guide*"Recommendations" on page 233

- "Notifying Users via Email" on page 234
- "Installation Procedure" on page 234
- "Installing Outlook Integration" on page 243
- "Upgrade Procedures" on page 245
- "User Licensing" on page 245
- "User Licensing" on page 245

See "Planning Applications and Services" on page 121 for all hardware and software requirements for the ShoreTel Communicator application.

## 16.1 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.

# 16.2 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 16-1).

Notify Users		Help
Notify:	C All users	
	C All users on this server: Main Server 🔽	
	All users not yet notified	
	O This one user:	Search

Figure 16-1 Notify Users page

# **16.3 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

## 16.3.1 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 XP Professional, or Windows Vista
- Publish a package
- Remove a package

You will need to have the following files from the Client DVD 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 articles:

How To Use Group Policy to Remotely Install Software in Windows 2003.
 Article # 816102 (for Windows 2003)

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 13 System Administration Guide*.

## 16.3.2 Installation Requirements

This section provides information about the operating system and hardware requirements for installing ShoreTel Communicator for Windows on and client computers.

#### 16.3.2.1 .NET Installation

Communicator requires the installation of version 3.5 (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.

#### 16.3.2.2 64-bit Platform Support

ShoreTel 13: Communicator for Windows supports Windows 2008 R2 running Windows Terminal Server, 64-bit. To install ShoreTel 13: Communicator for Windows on 64-bit Windows 2008 Terminal Server:

Step 1 Install .Net Framework for 64-bit Windows machines – Version 3.5 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.
- Step 2 Install Communicator for Windows.
- Step 3 Access Control Panel > Phone and Modem > Advanced (tab) and remove ShoreTel Remote TAPI Service Provider.

Step 4 Run TSPInstall.exe

TSPInstall.exe is provided with the ShoreTel installation software.

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

#### 16.3.2.3 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 3.5 or higher.
- Access to the World Wide Web (if .NET Framework 3.5 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 3.5 (or higher). In the other scenario, .NET Framework 3.5 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 3.5 (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.

#### 16.3.3 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.

#### 16.3.3.1 Manual Installation

This section contains instructions for manual installation in two scenarios. In one scenario, the Prerequisites folder contains .Net Framework 3.5. In the other scenario, .Net Framework 3.5 does not exist at all on the ShoreTel server.

#### 16.3.3.2 Manual Setup with .Net Framework in Prerequisites

The ability to install ShoreTel software manually depends on the availability of .Net Framework 3.5. If the Prerequisites folder contains .Net Framework 3.5 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.

#### 16.3.3.3 Manual Setup with .Net Framework Absent

If the Prerequisites folder does not contain .Net Framework 3.5, the system must have Internet connectivity because, when the system administrator runs setup.exe, the system automatically downloads .Net Framework 3.5.



#### 16.3.3.4 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:

- Step 1 Microsoft .Net Framework 3.5 (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.)
- Step 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.
- Step 3 Communicator (CMWin), located in the Setup folder.

### 16.3.4 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 you are prompted to restart your desktop.

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.

### 16.3.5 Installing the ShoreTel Communicator Software

This section describes how the end-user installs ShoreTel Communicator on their computer.

To install the ShoreTel Communicator software, do the following:

- Step 1 Open the e-mail notification from the ShoreTel administrator containing the instructions for installing the ShoreTel client.
- Step 2 Click on the http: link to the ShoreTel software or copy the address and paste it in the URL field of an open browser. The link will be similar to the following:

http://<ShoreTel\_server\_name>/Shorewareresources/clientinstall

where *ShoreTel\_server\_name* is the name or IP address of the ShoreTel server.

The ShoreTel Communicator Install page for Windows computers shown in Figure 16-2 appears.



Compatible with most of today's business PCs, ShoreTel Communicator applications are compatible with today's business PC platforms running 32-bit or 64-bit OS. To run ShoreTel Communicator applications, the following are required:

Figure 16-2 ShoreTel Communicator Install Page

Step 3 Review the information on this page and click the Click Here to Install ShoreTel Communicator link to launch the installation. The ShoreTel Communicator InstallWizard appears as shown in Figure 16-3.



Figure 16-3 Welcome from InstallShield Wizard for ShoreTel Communicator

Step 4 Click Next. The ShoreTel End User License Agreement appears as shown in Figure 16-4.





Figure 16-4 ShoreTel Software License Agreement

Step 5 Review the license terms, select the option I accept the terms in the license agreement, and click Next. The Destination Folder page as shown in Figure 16-5.

😼 Shore Te	el Communicator - InstallShield Wizard 🛛 🛛 🔯
Destinati Click Nex	on Folder «t to install to this folder, or click Change to install to a different folder.
	Install ShoreTel Communicator to: C:\Program Files\Shoreline Communications\ShoreWare Client\
InstallShield -	< Back Mext > Cancel

Figure 16-5 InstallShield Wizard Destination Folder

- Step 6 The default destination the program uses to install the ShoreTel application appears in the field. Do one of the following:
  - Click Next to accept the default destination.
  - Click Change to install the software at another location.

The Ready to Install screen appears as shown in Figure 16-6.

🗒 ShoreTel Communicator - InstallShield Wizard	X
Ready to Install the Program The wizard is ready to begin installation.	
Click Install to begin the installation.	
If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.	
InstaliShield	

Figure 16-6 Ready to Install

Step 7 Click Install. The installation status screen appears as shown in Figure 16-7. Installation may take a few minutes. When it is complete, click Next.

🛃 Shore Te	el Communicator - InstallShield Wizard 📃 🗆 🔯
Installing The prog	ShoreTel Communicator rram features you selected are being installed.
1 <del>6</del>	Please wait while the InstallShield Wizard installs ShoreTel Communicator. This may take several minutes.
	Status:
InstallShield _	
	< <u>B</u> ack Next > Cancel

Figure 16-7 InstallShield Wizard Installation Status

Step 8 When installation is complete, click Next. The InstallShield Wizard Completed screen appears as shown in Figure 16-8.





Figure 16-8 InstallShield Wizard Installation Completed

Step 9 Click Finish. The restart prompt appears as shown in Figure 16-9.



Figure 16-9 InstallShield Wizard Restart Prompt

Step 10 Click Yes.

After the computer reboots, the ShoreTel Communicator icon appears on the desktop.

#### **16.3.6 Installing Communicator for Mac**

ShoreTel Communicator support all Macintosh platforms. To install ShoreTel Communicator on a Mac, do the following:

- Step 1 Open the e-mail notification from the ShoreTel administrator containing the instructions for installing the ShoreTel client. The e-mail notification contains the user name and password assigned to the user and a link to the ShoreTel server the user is to use to access the client software.
- Step 2 Click on the http: link to the ShoreTel software or copy and paste the address in the URL field of a Web browser. The link will be similar to the following:

http://<server IPaddress>/ShoreWareresources/Clientinstall/ ShoreTel%20Communicator.dmg

where *<server IPaddress>* is the IP Address of the ShoreTel Headquarters or distributed voice server. The ShoreTel Communicator Install page appears as shown in Figure 16-10.



Figure 16-10 ShoreTel Communicator Install Page

An image file (.dmg) downloads and opens on the computer. Two icons appear as shown in Figure 16-11.



Figure 16-11 ShoreTel Icon on Mac Desktop

Step 3 Drag and drop the ShoreTel Communicator icon into the applications folder. When the installation is complete, the ShoreTel Communicator icon appears on the desktop.

## 16.3.7 Configure the TAPI Dialing Parameters

The installation of the ShoreTel Communicator application will require the user to provide his area code and dialing rules if not previously configured. When this is required, the Phone and Modem Options control panel applet will start during the installation to prompt for the necessary configuration information. To continue, specify the location and area code



information. Additionally, configure the dialing rules section with the appropriate information for dialing external and long distance numbers. When the information is configured and the OK button is pressed, the installation will continue.

## 16.3.8 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.

# 16.4 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 nor Outlook voice Mail/ Calendar Integration.

## **16.4.1** Installing 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

#### 16.4.1.1 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.

#### 16.4.1.2 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.

To install voice mail integration:

- Step 1 In the ShoreTel Communicator tool bar, click the ShoreTel icon. A shortcut menu appears.
- Step 2 Click Configure ShoreTel System. The ShoreTel System dialog box appears.
- Step 3 Click the Outlook tab as shown in Figure 16-12.

Seneral	Outlook	
QuickDialer	Contact Import	
Call Handling Mode		Town and On Name
Standard	Import contacts from Outlook	Import Options
In a Meeting Out of Office	Open Outlook contacts when calls arrive	
Extended Absence	Voice Mail	
ersonalized Call Handling	Attach Wave file to message when moved to different following and the second	der
xtension Assignment	Delete voice mail when message is moved to different fold	ler
ind Me	Outlook Voice Mail Integration is installed.	
oice Mail		Uninstall
Escalation	color day	
utlook	Calendar	
elephony	Use Outlook appointments to change Call Handling Mode	
nstant Messaging	Colondar integration with Outlook is not surroutly installed	
Presence	Calendar integration with Oddook is not currently installed.	Install
ionferencing		
oftPhone		
ounds		
anguage		

Figure 16-12 ShoreTel System Control Panel (Outlook Tab)

Step 4 Click Install. In some cases, a warning appears requesting that you close running applications before continuing. Close the applications as requested.

## 16.4.2 Activating the Integration of Voice Mail with Microsoft Outlook

This section describes the steps that an end-user performs in Communicator to activate the integration of ShoreTel 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:

- Step 1 Navigate to the Options and Preferences window (for example, through Tools -> Options at the top of the Communicator interface).
- Step 2 Click Outlook. in the command navigation panel on the left side of this window.
- Step 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.

## 16.4.3 Memorized Phone Number Management

ShoreTel Communicator Quick Dial has an option for importing Outlook contacts.

To set the option under Memorized Phone Number Management:

- Step 1 In the Memorized Phone Number Management section, click Read phone numbers from Outlook on startup option.
- Step 2 If you want to exclude FAX numbers from the search, click Don't include FAX numbers.
- Step 3 If you want Outlook Contact to appear when you have an incoming call, click Pop Outlook contacts on incoming call.
- Step 4 Click More Options to select which Outlook contacts to import. The MAPI Import Options dialog box appears.
- Step 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.
- Step 6 Click the Import Configurator tab.
- Step 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.

- Step 8 Click OK.
- Step 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.

# 16.5 Upgrade Procedures

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.

# 16.6 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.

## 16.6.1 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.

## 16.6.2 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 13 System Administration Guide*.

## 16.6.3 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.
- 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.

Details:

- 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.

Refer to the *ShoreTel 13 System Administration Guide* for instructions on configuring licenses in ShoreTel Director or for more information about the following types of Keyed License Types and Self-Audited License Types:

- Keyed License Types:
  - ShoreWare System License (Enterprise)
  - ShoreWare Additional Site License
  - ShoreWare Extension License
  - ShoreWare Mailbox License
  - ShoreWare SoftPhone License
  - ShoreWare Additional Language License
  - Mobile Access License
  - ShoreWare SIP Trunk License
  - ShoreWare SIP Phone License
  - ShoreWare Standard Resolution Video License
  - ShoreWare High Resolution Video License
  - Professional Access License

- Operator Access License
- Workgroup Agent Access License
- Workgroup Supervisor Access License
- ShoreWare External Unified Messaging SIP Link License
- Audio Conference License
- Web Conference License
- Self-Audited License Types:
  - ShoreTel Communicator with Personal Access
  - Remote Server Software License
  - TAPI Application Server License
  - Phone API License



# Chapter 17

# ShoreTel Integration with External Applications

To work with some external applications, additional setup may be required after you have installed the system.

This chapter identifies and describes some setups that allow the system to integrate with external applications.

Topics include:

- "Importing Public Contacts" on page 249
- "Installing the ShoreTel Telephony Interface (STI)" on page 251

## **17.1 Importing Public Contacts**

A new batch utility on the HQ server allows you to import public contacts.

It can be run once, or you can set up a Task Scheduler on the server to run this batch file at a regular interval.

The batch utility can be found under the default installation path:

```
C:\Program Files (x86)\Shoreline Communications\ShoreWare
Server\ImportContacts\ImportPublicContacts.bat
```

The utility connects to your Microsoft Exchange (2007 or 2010) server via the Exchange Web Services with an account that is allowed to read contacts in the Exchange public folders (contact list).

The utility reads the contacts from the specified public folders and places them in a CSV (Comma Separated Value).

The batch file then invokes the dbimport tool to import these contacts into the ShoreTel system directory.

These contacts are then displayed in any end points able to access the system directory, such as the phones and ShoreTel Communicator.

The batch utility xml config file must be adjusted to specify the Exchange account, the Exchange location, and the folders to import.

NOTE This utility does not allow contacts to be imported from the GALs.

## 17.1.1 Creating a CSV File

You can use CSV files for importing public directory information into the ShoreTel system for end users.

Use the following parameters to create CSV files used by ShoreTel to import public directory information:

- File name must have a .csv extension.
- Standard CSV formatting supported.
- First line in file must start with "Source=" or "Volume=". You can include both. If a value for source is used, it overrides the file name as the name of the file.
- The next populated line contains the field names used for this file.
- Field names can include any of the following:
  - Contact ID
  - First Name
  - Middle Name
  - Last Name
  - Business Phone
  - Business Phone 2
  - Home Phone
  - Home Phone 2
  - Mobile Phone
  - Pager
  - Business Fax
  - Company
  - Department
  - E-mail Address
  - E-mail Address 2
  - IM Address
  - Contact ID



# **17.2** Installing the ShoreTel Telephony Interface (STI)

ShoreTel 13 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 have to manually install the STI.

This section describes how to install STI on Windows clients with third-party applications that integrate with ShoreTel Communicator for Windows. For information on installing STI on Citrix terminal servers, see Appendix C.

## 17.2.1 Requirements

- Close all open programs (reboot is required).
- ShoreTel Communicator for Windows is installed.
- Location of ShoreTel system software is known.

## 17.2.2 Installation Procedure

- Step 1 Install (or upgrade) ShoreTel Communicator for Windows.
- Step 2 Launch Windows Explorer.
- Step 3 Enter the following URL:

#### http://serverIP/shorewareresources/shoreteltelephonyinterface

The ShoreTel Telephony Interface Install site is opened.

- Step 4 Click the link to install the ShoreTel Telephony Interface (download and install the interface on the client computer).
- Step 5 Reboot the client computer.
- Step 6 Verify that the interface is installed:
  - Step a Open Control Panel.
  - Step b Click Phone and Modem Options.
  - Step c Click Advanced.
  - Step d Verify that ShoreTel Remote TAPI Service Provider is installed.
  - Step e Select ShoreTel Remote TAPI Service Provider.
  - Step f Click Configure.

The ShoreTel Remote TSP dialog is opened.

- Step g In Provider Usage, verify that the provider is enabled.
- Step 7 Launch ShoreTel Communicator for Windows.

The TAPI service registers the ID, password, and address of the user for transactions with the third-party application.


# 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.

An integrated voice network can:

- 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.

This chapter describes how to migrate your legacy system to the ShoreTel system. The topics include:

- "Introduction" on page 254
- "Coordinated Dialing" on page 254ShoreTel 13 System Administration Guide
- "Trunk Requirements" on page 254
- "Coordinated Dialing Plan" on page 255
- "PSTN Services" on page 256
- "Multi-Site Integration" on page 256
- "Single Site Integration" on page 256
- "Consolidated Long Distance" on page 257
- "Voice Mail Integration" on page 257
- "System Requirements" on page 274
- "Connection Cable" on page 274
- "Administration and Configuration" on page 275
- "Trunk Configuration" on page 276

### **18.1** Introduction

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.

### **18.2** 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
- The type of legacy PBX equipment integrated with the ShoreTel system

### **18.3** 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 83.

### **18.4** 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. For example:

- 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 the following template:

	System One	System Two
Location		
DID Range		
Local Extensions (Prefix + Number)		
Remote Extensions (Prefix + Number)		

Table 18-1Dial Plan template

### **18.5 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.

### 18.6 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.

### **18.7** 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 s 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.

### **18.8** 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.

### **18.9** 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.

#### 18.9.1 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.

To simplify AMIS systems and increase 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 13 System Administration Guide.

#### 18.9.2 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.

#### 18.9.2.1 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.

#### 18.9.2.2 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.

#### 18.9.2.3 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.

#### 18.9.2.4 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 18-1 shows the ShoreTel system providing PBX services and the legacy equipment providing voice mail services.



Figure 18-1 External Voice Mail with ShoreTel as PBX

Figure 18-2 shows the legacy system providing PBX services and the ShoreTel equipment providing voice mail services.



Figure 18-2 ShoreTel Voice Mail with legacy PBX

#### 18.9.2.5 Details

- Figure 18-2 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 (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 (e.g. user did not answer, line was busy, etc.).
- 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.

#### 18.9.2.6 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

#### 18.9.3 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.

The former of these two operational modes (External voice mail) is discussed below, while the procedure for the latter configuration (ShoreTel voice mail) follows in "Configuring ShoreTel Voice Mail Integration Using SMDI" section on page 267.

To integrate a legacy voice mail system with ShoreTel, you need to perform the following basic tasks:

- 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.

#### 18.9.3.1 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

To configure COM port communication:

- Step 1 From the Start menu on the Windows server connected to the legacy voice mail server, select Settings, and then Control Panel.
- Step 2 In the Control Panel, open the Computer Management folder.
- Step 3 Open the Device Manager.
- Step 4 From the right pane in the window, expand the item Ports (COM & LTP).
- Step 5 Right-click the COM port used to connect the ShoreTel server and legacy voice mail system, and select Properties from the menu.

Ask your server administrator if you need help in determining the correct COM port.

- Step 6 In the Properties window, enter the settings for the legacy voice mail server COM port.
- Step 7 Click OK to save the settings.
- Step 8 In ShoreTel Director, open the *Server* edit page.
- Step 9 Enter the COM port the server will use for SMDI communications in the COM Port (1-10) text box.
- Step 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.

#### 18.9.3.2 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.

To configure the extensions, you need to do the following:

- 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."

#### **18.9.3.3** Configuring the ShoreTel Server

Follow these steps to set up communication between ShoreTel Director and the legacy voice mail server.

To set up ShoreTel Director to communicate with the legacy voice mail server:

- Step 1 From ShoreTel Director, click Servers in the navigation frame.
- Step 2 Select the server connected to the legacy voice mail system.



- Step 3 In the Edit Server page under Simplified Message Desk Interface, change the settings as follows:
  - Step a Make sure that the ShoreTel as PBX box is selected.
  - Step b In the COM Port field, enter the port on the server that will be used for SMDI communication.
  - Step c In the Message Desk Number field, enter the Message Desk number (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.
  - Step d In the Number of Digits field, enter the extension length. (range 2-32 digits). This value is used to determine how many digits the Shore Tel 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.
  - Step 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, see the *ShoreTel 13 System Administration Guide*.

Step f Click Save.

#### **18.9.3.4** 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 see the *ShoreTel 13 System Administration Guide*.

Table 18-2 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."

Extension N	/lapping	Digit Translation Table	
ShoreTel	Legacy	Original Digits	Replacement Digits
5xx	65xx	5	65
3xx	73xx	3	73
2xx	83xx	2	83

Table 18-2Digit Translation Mapping

Table 18-3 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 digit "75" will be replaced by "3."

Extension N	Aapping	Digit Translation Table	
ShoreTel	Legacy	Original Digits	Replacement Digits
65	5xx	65	5
66xx	6xx	66	6
75xx	3xx	75	3

Table 18-3	<b>Digit Translation Mapping</b>
------------	----------------------------------

Figure 18-3 illustrates how digit translation functions between the ShoreTel server and legacy voice system.



Figure 18-3 Mixed Extension Length SMDI Integration

To create a digit translation table, follow the procedure below:

- Step 1 Launch ShoreTel Director and enter the user ID and password.
- Step 2 Click Administration > System Parameters.



- Step 3 Click Digit Translation Tables.
- Step 4 Click the New button.
- Step 5 Enter a name in the Name field and click Save to store your digit translation table.

Step 6 Click the New button again to display the Digit Translation window (Figure 18-4).

🚰 Digit Translation Info - M	icrosoft Internet Explore	r <u>- 0 ×</u>
Original Digits: Replacement Digits:	2	
Save Clg	rights reserved.	Ne <u>w</u> t



Next, you must select the digit translation mapping that you just created at the server.

- Step 7 Click on the Application Servers link and click on the name of the ShoreTel server that will be handling the digit translation.
- Step 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.
- Step 9 Click on the arrow-button and select the name of the digit translation table that you just created.
- Step 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 when:
  - 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.
- Step 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.

Application Servers	Hew Copy Save Delete Reset
Eult Server	* modified
Edit this record	Refresh this page
Name:	Remote
Host IP Address:	121.212.3.5 Ping this Server
Site:	Headquarters
SoftSwitch Name:	Remote
Voice Mail and Auto Attendent:	
Voice Mail Extension:	123
Voice Mail Login Extension:	124
Auto Attendant Extension:	125
Assigned User Group:	Anonymous Telephones 💌
Default Auto-Attendant Menu:	Default 💌
Simplified Message Desk Interface	
Mode:	ShoreTel Voice Mail 💌
Trunk Group:	Analog Loop Start 💌
COM Port (1 - 10):	1
Message Desk Number (1 - 999):	1
Number of Digits (2 - 32):	10
Translation Table:	<none></none>
✓ Use for Call Data	
✓ Use for MWI Data	
☑ Use Flash to Route Calls	

Figure 18-5 Enabling digit translation for MWI and call data, and flash routing

Step 12 Click the Save button to store your changes.

#### 18.9.3.5 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 redirected to the legacy voice mail system.

To set up the user group:

- Step 1 Open ShoreTel Director.
- Step 2 From the navigation frame, click Users and then User Groups.
- Step 3 Select an existing user group or create a new user group.
- Step 4 Change the Simplified Message Desk Interface Mode option to ShoreTel as PBX by selecting this setting from the drop-down menu.
- Step 5 Click Save.



#### **18.9.4** 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.

The former of these two operational modes (External voice mail) is discussed in "Configuring Legacy Voice Mail Integration Using SMDI" section on page 261. The procedure for the latter configuration (ShoreTel voice mail) follows.

Configuring the "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

#### 18.9.4.1 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 13 System Administration Guide*.

To create a trunk group for SMDI trunks, follow the procedure below:

- Step 1 Launch ShoreTel Director and enter the user ID and password.
- Step 2 Click on the Administration link to expand the list (if it has not already been expanded).
- Step 3 Click on the Trunks link to expand the list.
- Step 4 Click on the Trunk Groups link to display the Trunk Groups window.
- Step 5 Select the trunk group site, and select Analog Loop Start for the type. Then click the Go link.
- Step 6 Enter a name for the trunk group in the Name field, as shown below.

Trunk Groups Edit Analog Loopstart Trunk Group	New Copy Save Delete Reset Help
Edit this record	* modified Refresh this page
Name:	SMDI Trunk Group
Site:	Headquarters
Language:	English 💌
Inbound:	
Destination :	VM Search
🗖 Outbound:	
Network Call Routing:	
Access Code:	
Local Area Code:	
Additional Local Area Codes:	Edit
Nearby Area Codes:	Edit

Figure 18-6 Creating a trunk group

- Step 7 Enter a voice mail extension in the Inbound Destination field to direct inbound calls to the ShoreTel Auto Attendant system.
- Step 8 Click the Save button to store your changes.

#### **18.9.4.2** Creating Trunks

**Planning and Installation Guide** 

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, (i.e. 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.

To create a trunk line, follow the procedure below:

- Step 1 With ShoreTel Director still open, click on the Trunks link to expand the list.
- Step 2 Click on the Individual Trunks link.
- Step 3 Select the trunk line site (i.e. 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.
- Step 4 Click the Go link to display the Edit Trunk window, similar to the one shown below.



Trunks Edit Trunk	New Copy Save Delete Reset Help
Edit this record	* modified
Site:	Headquarters
Trunk Group:	SMDI Trunk Group
Number:	1
Switch Port:	End Top Sg24 - 2 💌
Jack #.	



Step 5 In the Number field, enter the Logical Terminal Number. This value can range from 1 to 9999. For many systems the extension number of the port is used.

The Logical Terminal Number 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.

Step 6 Click the Save button to store your changes.

#### 18.9.4.3 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.

To configure the ShoreTel voice mail server for SMDI operations, follow the procedure below:

- Step 1 With ShoreTel Director still open, click on the Application Servers link.
- Step 2 Click on the name of the server (Headquarters or Remote) that will be acting as the voice mail server for the legacy PBX.
- Step 3 In the Simplified Message Desk Interface section of the Application Servers window, click on the drop-down menu and select ShoreTel Voice Mail. A new set of fields and menus related to SMDI appear.

Application Servers Edit Server	<u>N</u> ew <u>C</u>	ору	Save	Delete	Reset	Help
					*	modifie
Edit this record	Refresh this page					
Name:	Headquarters					
Host IP Address:	10.1.1.150	Pi	ng this Server			
Site:	Headquarters					
SoftSwitch Name:	SoftSwitch	1				
Voice Mail and Auto Attendent						
∀oice Mail Extension:	1105	1				
Voice Mail Login Extension:	1106	1				
Auto Attendant Extension:	1104	l.				
Assigned User Group:	Voice Mail Notification	•				
Default Auto-Attendant Menu:	Default 💌					
Simplified Message Desk Interfac	B:					
Mode:	ShoreTel Voice Mail	·				
Trunk Group:	<none></none>					
COM Port (1 - 10):						
Message Desk Number (1 - 999):		]				
Number of Digits (2 - 32):	10	1				
Translation Table:	<none> 💌</none>					
☐ Use for Call Data						
Use for MWI Data						

Figure 18-8 Configuring ShoreTel voice mail server

- Step 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.
- Step 5 In the COM Port field, enter the numerical value (from 1-10) 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.)
- Step 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.

Step 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.



Step 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.

Step 9 Click the Save button to store your changes.

#### 18.9.4.4 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.

To create a user group for users on the legacy PBX system, follow the procedure below:

Step 1 With ShoreTel Director still open, click on the Users link to expand the list. Step a Click on the User Groups link.

User Groups Edit User Group	New	<u>C</u> opy	<u>S</u> ave	Delete	Reset	<u>Help</u>
			~		1 *	nodified
Edit this record	Refresh this par	<u>1e</u>				
Name:	External PBX Use	ers				
COS - Telephony:	Fully Featured	Go to	this Class of	Service		
COS - Call Permissions:	Internal Only	💽 <u>Go</u>	to this Class	of Service		
COS - Voice Mail:	Large Mail Box	Go to th	nis Class of S	ervice		
Simplified Message Desk Interface Mode:	None	•				
Account Code Collection:	None External Voice N	lail				
Manager users a list of acco	ShoreTel Voice	Mail Glaling.				
Send Caller ID as Caller's Emergency	Service Identificat	ion (CESID).				
Send DID as Caller's Emergency Service	ce Identification (	CESID).				
Outgoing Trunk Groups (Access Code):	C Analog Loop	) Start (9)			*	
	Digital Loop	Start (9)				
	Digital Wink	Start (9)				
	New Trunk (	Group (9)				
	OSE PRI (9)					
	PRI (9)					
	Remote PRI	(9)				
					-	
	L					

Step b Click on the Add New link to display the User Groups window.

Figure 18-9 Creating a user group for legacy users

- Step 2 Enter a Name for the user group in the Name field.
- Step 3 In the Simplified Message Desk Interface Mode drop-down window, select ShoreTel Voice Mail from the list.
- Step 4 Click the Save button to store your changes.

#### 18.9.4.5 Adding an Individual User

After creating the user group, you can create user profiles for the legacy PBX users. To do so, follow the procedure below:

- Step 1 With ShoreTel Director still open, click on the Users link to expand the list.
- Step 2 Click on the Individual Users link.
- Step 3 In the Add new user at site field, select the server where you configured the ShoreTel voice mail for the PBX link device.
- Step 4 Click the Go link to display the Edit User window, shown below.

Users Edit User	New Copy Save Delete Reset	<u>Help</u>
		* modified
🔻 General	Personal Options Distribution Lists <u>Refresh this</u>	page
First Name:	Daffe	
Last Name:	Dukke	
Number:	1822	
License Type:	Mailbox-Only	
Caller ID:	(e.g. +1 (408) 331-3300)	
DID:	+1408331 💌 3921 (DID Range: +14083313921 - 3940)	
PSTN Failover:	None	
User Group:	External PBX Users  Go to this User Group	
Site:	Executives External PBX Users House Telephones	
Language:	IP Telephones Managers	
Home Port:	Staff Voice Mail Notification e	
	<ul> <li>Ports End Top Sg24 - 3 </li> <li>SoftSwitch SoftSwitch </li> </ul>	
Current Port:	SoftSwitch Go Home	
Jack #		

Figure 18-10 Creating a user record for a legacy user

- Step 5 Enter a name for the user in the First Name and Last Name fields.
- Step 6 In the License Type drop-down menu, click on 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.
- Step 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.
- Step 8 Click the Save button to store your changes.

#### **18.9.4.6** 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 (i.e. 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:

- Step 1 Right-click My Computer.
- Step 2 Select Manage.
- Step 3 Select Device Manager.
- Step 4 Left-click on Ports (COM & LPT).
- Step 5 Right-click Communications Port (COM1) and select Properties.
- Step 6 Left-click on the Port Settings tab.
- Step 7 Verify that the settings match those suggested by the documentation that came with your legacy PBX device.

#### 18.9.4.7 PBX

Table 18-4 Supported PBXs

Manufacturer	Model
Nortel	Meridian 1
	Nortel Norstar
Avaya	• System 75/85
	• Definity
Mitel	• SX50
	• SX200
	• SX2000
Siemens	• 300S
NEC	• NEAX

#### 18.9.4.8 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, provides 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, 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

### 18.10 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.

### **18.11** Connection Cable

#### 18.11.1 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.



#### 18.11.2 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.

### 18.12 Administration and Configuration

#### 18.12.1 Tie Trunk Configuration

The following summary describes the administration and configuration of the digital trunk for connecting the ShoreTel system to the legacy system.

#### 18.12.2 Services Summary

Before starting, a summary of the required configuration should be made based on the required services in the interface.

Desired Service	Required Configuration		
Extension-to-Extension	Enable inbound services on the trunk.		
Calling	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.		

 Table 18-5
 Service Configuration Requirements

Desired Service	Required Configuration		
	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.		

 Table 18-5
 Service Configuration Requirements (Continued)

### 18.13 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.

To create a new trunk group

- Step 1 In the ShoreTel Director, select Trunk Groups from the navigation frame to open the Trunk Groups list page.
- Step 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.
- Step 3 Click Save to store the trunk group configuration changes.

To configure inbound services with extension routing

- Step 1 In ShoreTel Director, open the Trunk Group edit page for the tie trunk.
- Step 2 Configure the number of digits received to match the number of digits sent by the remote PBX. This must match the extension length.
- Step 3 Enable Extension Routing by checking the box. This directs all the received calls to the configured ShoreTel extension that matches the received DNIS digits.
- Step 4 Select a Destination to provide a back-up when the received digits do not match an extension in the ShoreTel system.
- Step 5 Click *Save* to save the trunk group configuration.

To configure off-system extensions

- Step 1 In ShoreTel Director, open the Trunk Group edit page for the tie trunk.
- Step 2 Select the Edit button by the off-system Extensions. The Off Systems Extension Range dialog is displayed.
- Step 3 Click New and define the extension ranges for the extension off the remote PBX.
- Step 4 Click Save to save the trunk group configuration.

To configure outbound call routing (via the remote PBX)

- Step 1 In ShoreTel Director, open the Trunk Group edit Page for the tie trunk.
- Step 2 Enable outbound services by selecting the Outbound check box.



- Step 3 Configure the access code and areas codes for the trunk to match the PSTN connection of the remote PBX.
- Step 4 Select the desired trunk services to match the services provided via the remote PBX.
- Step 5 Select the desired Trunk Digit Manipulations to match the tie trunk and the required dialing for the PSTN connection to your legacy PBX.
- Step 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 13 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:

- "Cut-Over Requirements" on page 279
- "Cut-Over Implementation" on page 280
- "Cut-Over Worksheet" on page 282

### **19.1** 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.

#### **19.1.1** 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.

Use a pencil when preparing the cut-over worksheets, to allow for changes that may occur during the cut-over.

#### 19.1.2 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.

#### **19.1.3** 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.

### **19.2** 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.

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.	

### 19.2.1 Basic Cut-Over Checklist

Table 19-2Basic 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.	

#### 19.2.2 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 19-3Trunking Cut-Over 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.	

Table 19-3Trunking Cut-Over Checklist (Continued)

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.

#### 19.2.3 Cut-Over of Remaining Devices

Use the following checklist to test each new end-user device that is being installed.

Table 19-4	Remaining Devices Cut-over 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 similar to the following:	
"This is <your_name> from <company_ name="">. Welcome to your new, revolutionary, IP-based communications system. You will find the following materials on your desk"</company_></your_name>	
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.	

#### **19.2.4** 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.

### **19.3** Cut-Over Worksheet

Table 19-5	Cut-Over	Worksheet
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Name	Extension/DID	ShoreTel Port #	Patch Panel #	IDF #	Station Cable #



Name	Extension/DID	ShoreTel Port #	Patch Panel #	IDF #	Station Cable #

Table 19-5Cut-Over Worksheet (Continued)

Name	Extension/DID	ShoreTel Port #	Patch Panel #	IDF #	Station Cable #

Table 19-5	Cut-Over	Worksheet (	(Continued)	۱
		WORKSHEEL (	Continueu	,



# 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.

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 or visit the ShoreTel QuickStart web center, available through www.goShoreTel.com.

The topics discussed in this chapter include:

- "Recommendations" on page 285
- "Training Materials" on page 286
- "End-User Training" on page 286
- "Operator Training" on page 286
- "Workgroup Training" on page 287
- "System Administrator Training" on page 287

### 20.1 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.

### **20.2** 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 ShoreTelauthorized partner or through ShoreTel, Inc.
- Additional training materials can be downloaded from ShoreTel.

### 20.3 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.

### 20.4 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.



### 20.5 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.

### 20.6 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 (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" on page 289
- "Language Packs" on page 289
- "Analog Telephones, Tones, Cadences, and Impedances" on page 292
- "Dialing Plan Considerations" on page 292
- •

## A.1 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/

## A.2 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

Director panels that program language options include:

• Edit Site panel: The Edit Site panel, shown in Figure A-1, specifies the language pack used by the Backup Auto-Attendant (BAA).

To access the Edit Site panel, select Administration > Site from the main menu, then click on the name of the desired site.

Sites Edit Site	New	<u>С</u> ору	Save	<u>D</u> elete	Reset
Edit this record	Refresh this pa	ge			
Name:	Remote_Site				
Country:	Australia	•			
Language:	English(UK)	>			
Parent:	Headquarters	-			

Figure A-1 Language set at Site level

• Workgroup panel: The Workgroup panel, shown in Figure A-2, specifies the language that the system uses for playing prompts to inbound callers.

To access the Edit Workgroup panel, select Administration > Workgroups from the main menu, then click on the name of the desired site.

Workgroups	New Copy Save Delete Reset Help
Eait workgroup	* modified
Edit this record	Refresh this page
Name:	Spain Sales
Extension:	888-55889
Backup Extension:	888-55677 : INFO PROV ( Search
DID:	✓ +140896 ✓ 21325 (DID Range: +14089621320 - 21334)
DNIS:	Edit DHIS Map
User Group:	Executives
Mailbox (server)	Hq Server 🔄 Escalation Profiles and Other Mailbox Options
Language:	English(US)
☑ Accept Broadcast Messages	English(US) Spanish(Spain)
Include in System Dial By Name Dire	ect English(UK)
🗖 Make Number Private	French Dutch
Recorded Name:	Spanish(CALA) Danish Import no audio input
Voice Mail Password:	Italian Swedish Chinace(Simplified)
Enable Automatic Agent Logout on R	ling No Answer

Figure A-2 Language set at Workgroup level

• Edit Trunk Group panel: The Edit Trunk Group panel, shown in Figure A-3, specifies the language prompts are played to incoming callers.

To access the Edit Trunk Group panel, select Administration > Trunks > Trunk Groups from the main menu, then click on the name of the desired trunk group.



Trunk Groups	New	Copy	Save	Delete	Reset	<u>Hel</u> p
Edit this record	Refresh this nam			68 - S		
Name:	E911 trnk grp	<u> </u>				
Site:	HeadQuarters					
Language:	English(US)	-				
Inbound: Number of Digits from CO: ☞ DNIS ☞ DID ■ Extension	English(US) Spanish(Spain) German English(UK) French -Dutch Spanish(CALA) Danish Halian Swedish					
<ul> <li>Translation Table:</li> <li>Prepend Dial In Prefix:</li> <li>Use Site Extension Pref</li> </ul>	Chinese(Simplifie None>	ed) <u> </u>				

Figure A-3 Language set at Trunk Group level

• Edit User panel: The Edit User panel, shown in Figure A-4, specifies the language prompts used for the user's telephone interface and voicemail prompts.

To access the Edit User panel, select Administration > Users > Individual Users from the main menu, then click on the name of the desired user.

Users Edit User	New Copy Save Delete Reset	<u>Help</u>
		* modified
🛩 General	Personal Options Distribution Lists Workgroups	Refresh this page
First Name:	Johnny	
Last Name:	Smith	
Number:	888-55308	
License Type:	Extension and Mailbox	
Caller ID:	(e.g. +1 (408) 331-3300)	
DID:	+1408331 - 3917 (DID Range: +14083313916 - 3939)	
PSTN Failover:	None	
User Group:	Executives Go to this User Group	
Site:	HeadQuarters 💌	
Language:	English(UK)	
Home Port:	Spanish(Spain) German English(UK) French Dutch Spanish(CALA) Danish	
Current Port:	Italian Swedish Go Home	
Jack #	Chinese(Simplified) Viewegian	

Figure A-4 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.

## A.3 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.

## A.4 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.

## A.4.1 Single-Extension Plan

Across the global voice network, all extensions must be unique and cannot overlap.

## A.4.2 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.

## A.4.3 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.

## A.4.4 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 13 System Administration Guide* about emergency 911 operations.

### A.4.5 **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.

## A.5 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 longdistance 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 longdistance 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 A-1 lists the carrier code and application for the countries that use them.

Table A-1Carrier Code by Country

Code	<b>Country and Application</b>		
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" on page 295
- "EMC Compliance Statements (SG-8/12/24 and T1)" on page 296
- "Safety" on page 297

## **B.1** 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		

Category	Regulatory Compliance / Agency Approval		
	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		
	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		

Table B-1Agency Approvals (Continued)

## **B.2** EMC Compliance Statements (SG-8/12/24 and T1)

## **B.2.1** 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.

## **B.2.2** 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.



### B.2.3 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.

## **B.2.4** 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.



## **B.2.5** 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.

## **B.3** 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.

## **B.3.1** 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.

## **B.3.2** 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 Terminal Servers

You can install ShoreTel Communicator for Windows on Citrix XenApp and Windows terminal servers to provide ShoreTel Communicator functionality to terminal server clients.

ShoreTel Communicator for Windows supports desktop and published modes in standard environments, but does not support isolation environments.

This appendix describes how to install ShoreTel Communicator for Windows on Citrix and Windows terminal servers.

For information on Citrix XenApp and Windows terminal servers, refer to the documentation from the manufacturer.

The topics discussed in this appendix include:

- "XenApp Support Considerations" on page 299
- "Installing ShoreTel Communicator on WTS or Citrix XenApp" on page 300
- "Using Third-Party Applications with ShoreTel Communicator on a Citrix Terminal Server" on page 302

## C.1 XenApp Support Considerations

This section provides information about best practices and restrictions when installing ShoreTel Communicator for Windows in a Citrix XenApp environment.

### C.1.1 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 HQ server or the DVS servicing the ShoreTel Communicator clients.

## C.1.2 Citrix XenApp Restrictions

ShoreTel Communicator for Windows does not support the following XenApp operations:

- Streaming mode.
- Application Isolation Environment (AIE).
- Virtual deployment.

The following ShoreTel Communicator for Windows features are not supported in the Citrix XenApp environment:

- Automatic import of Microsoft Outlook contacts.
- Voicemail integration in Microsoft Outlook.
- Call handling mode integration in Microsoft Outlook.
- Conferencing integration in Microsoft Outlook.
- SoftPhone.
- Video.
- Presenter for Java must be used because ShoreTel does not support Presenter for Windows (ShoreTel Conferencing).
- NOTE Microsoft Outlook integration may work when properly configured on the XenApp/ terminal server side, but this configuration is not officially supported by ShoreTel.

# C.2 Installing ShoreTel Communicator on WTS or Citrix XenApp

ShoreTel 13 supports ShoreTel Communicator on the following platforms:

- Windows Server 2008 for Terminal Licensing, 32-bit, SP2 (Enterprise).
- Windows Server 2008 for Terminal Licensing, 64-bit, SP2 (non R2)(Standard and Enterprise).
- Windows Server 2008 for Terminal Licensing, 64-bit, R2.
- XenApp 5.0 on Windows Server 2008 for Terminal Licensing, 32-bit, SP2 (Isolation mode is not supported).
- XenApp 6.0 on Windows Server 2008 for Terminal Licensing, R2 (Isolation mode is not supported).



### C.2.1 Preliminary Steps for Upgrading ShoreTel Communicator on 64bit Platforms

ShoreTel Communicator for Windows requires .NET Framework version 3.5 or higher on 64bit Windows terminal server 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.

### C.2.2 Installing Communicator on a Terminal Server

- NOTE Administrative rights on the terminal server are required in order to install ShoreTel Communicator for Windows.
  - Step 1 Open a browser on the terminal server.
  - Step 2 Enter the following URL:

#### http://<ShoreTel server name>/ShoreWareresources/clientinstall

*ShoreTel\_server\_name* is the name or IP address of the ShoreTel HQ server or DVS that manages the client software on the terminal server.

The ShoreTel Communicator Install page for Windows computers is opened (Figure C-1).

Step 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.

Step 4 Follow the prompts to install Communicator.

When installation is complete, the terminal server is restarted automatically.

The ShoreTel Communicator is opened on the desktop.

NOTE The installation process places files in the following folder by default: C:\Program Files (x86).

#### ShoreTel<sup>™</sup> ShoreTel Communicator Install

#### Click Here to install ShoreTel Communicator

Did you know that **ShoreTel Communicator** is the easiest way to communicate efficiently with your colleagues and work partners? **ShoreTel Communicator** offers a set of productivity tools for better communication whether you are a standard user, an operator, whether you are working from home, on the road or based in an office.

ShoreTel Communicator will allow you to:

- Revolutionize and optimize the way you make calls with the intuitive call control buttons so you may handle multiple calls faster and more
  efficiently.
- Catalog and listen to your voicemails directly from Outlook or from the integrated Voice Mail Viewer.
- · Engage in top-notch video call sessions with little or no configuration on your computer.
- Communicate with work partners via Instant Messaging and find the best method of contacting your work partners based on their Presence Information.
- Control phones, including external phones outside of the ShoreTel Pure IP Unified Communications System, with the Extension Assignment functionality.
- Turn your PC into a phone with the SoftPhone feature.
- Adjust the ShoreTel Communicator user interface according to your needs.

Compatible with most of today's business PCs, ShoreTel Communicator applications are compatible with today's business PC platforms running 32-bit or 64-bit OS. To run ShoreTel Communicator applications, the following are required:

Figure C-1 ShoreTel Communicator Install Page for Windows

## C.3 Using Third-Party Applications with ShoreTel Communicator on a Citrix 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.

### C.3.1 Installing ShoreTel Telephony Interface (STI) on a Citrix Terminal Server

- Step 1 Install (or upgrade) ShoreTel Communicator.
- Step 2 Install ShoreTel Telephony Interface:
  - Step a Launch Windows Explorer.

Step b Enter the following URL:

#### http://serverIP/shorewareresources/shoreteltelephonyinterface

The ShoreTel Telephony Interface Install site is opened.

- Step c Click the link to install the ShoreTel Telephony Interface (download and install the interface on the client computer).
- Step 3 Reboot the terminal server.
- Step 4 Launch the Control Panel.



Step 5 Select Phone and Modem Options.

The Phone and Modem Options dialog is opened.

- NOTE If this is the first time this option is activated, another dialog box is opened first, requiring outbound dialing information.
- Step 6 Click Advanced.
- Step 7 Remove all ShoreTel providers.
- Step 8 Click OK.

The changes are saved and the dialog is closed.

- Step 9 On the terminal server, click Start > Run.
- Step 10 Type cmd, then click OK.

The Command Prompt is opened.

- Step 11 Navigate to the directory where the ShoreTel Telephony Interface is installed (\Program Files\ShoreTel\ShoreTel 3rd Party).
- Step 12 At the prompt, type the following:

#### TSPinstall -i StServer HQ servername

**HQ** servername is the hostname or IP address of your ShoreTel HQ server.

The TSPinstall utility is launched (Figure C-2).

- Step 13 Close the cmd prompt and reboot the server.
- Step 14 Verify that multiple lines are provided for the ShoreTel Telephony Interface:
  - Step a On the terminal server, navigate to the Phone and Modem Options Advanced tab.
  - Step b In the Provider list, select the ShoreTel provider, then click Configure.

The ShoreTel Remote TSP dialog is opened (Figure C-3).

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.

To remove the provider: Go to the Control Panel and open Phone and Modem Options Advanced. Click ShoreTel Remote TAPI Service Provider. Click Remove.

C:\WINNT\System32\cmd.exe	_ 🗆 ×
H:\>TspInstall.exe -i StServer Powerbar CTapiReg: Read Provider ID Value: < (-1) CTapiReg: lineAddProvider (RpcTsp.TSP): < 22 CTapiReg: Read Tapi Providers from Registry CTapiReg: Read Provider ID Value: < (2008199536) CTapiReg: Write Provider ID Value: 22	
H:\>_	
1	- - -

Figure C-2 TSPInstall Command Line

9	ihoreTel Rei	mote TSP		×	
	Device				
	6	Provider ID:	12		
		Server:			
		Login:			
		Password:			
	Owi	ned Numbers:			
	Monitored Numbers:				
	- Provider	Status			
	Connection type: ShoreTel User Server: (0.0.0.0) Login: Provider unable to complete server connection: RPC server unavailable. This may indicate that the				
			Refresh Save As		
	Provider Usage:				
	Use this service provider (enable)				
	OK Cancel Apply				

Figure C-3 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 Configuration steps and significant details for SIP exist in the Session Initiation Protocol chapter in the ShoreTel 13 System Configuration Guide.

The topics discussed in this appendix include:

- "Overview" on page 305
- "General SIP Comments" on page 306

## **D.1** 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 teardown.

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.

## **D.2** General SIP Comments

## **D.2.1** Conferencing

- Ports for MakeMe conferences must be available on the initiating side of a 3-way conference call involving a SIP end-point.
- MakeMe conference ports are needed even for 3-way conference. Note that configuration of any Make Me conferencing support in Director requires a minimum of 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.

## **D.2.2 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 outof-band DTMF is needed but RFC 2833 is not applicable. SIP INFO for DTMF signaling is available on only SIP trunks.

## **D.2.3** 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.

## **D.2.4** 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.

### **D.2.5** 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.

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.

Topics discussed in this appendix include:

- "Reverse Proxy Settings" on page 309
- "Example Reverse Proxy Configuration for Apache 2.2 On a Linux Server" on page 311
- "Example Reverse Proxy Configuration for Apache 2.2 On a Microsoft Windows Server" on page 315

## **E.1** 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 E-1 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 E-2 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.

## E.2 Example Reverse Proxy Configuration for Apache 2.2 On a Linux Server

The following script example illustrates how to configure a Linux server to provide reverse proxy on port 5500 for connection to the HQ server at 10.0.0.1.

Step 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
```

```
Step 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
```

Step 3 Edit conf\extra\ httpd-vhosts.conf: Step 4 # 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>

## E.3 Example Reverse Proxy Configuration for Apache 2.2 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.

### E.3.1 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.

### E.3.2 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 (Apache SSL certificate have a different format than the Microsoft Windows SSL certificate), you can convert a Windows certificate to the Apache format.

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 (e.g.: proxy.yourdomain.com or gateway.yourdomain.com wherein the name of the server would be proxy or gateway which would also 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 3 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.

#### E.3.2.1 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.

#### E.3.2.2 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.

#### E.3.2.3 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.

To convert the format an SSL certificate for Windows uses to a format that Apache can use, do the following:

- Step 1 On the Apache server, open the command line in Windows.
- Step 2 Navigate to the OpenSSL installation. Typically it is located at: C:\Apache Software Found\Apache2.2\bin
- Step 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.

Step 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.

Step 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.

Step 6 In each of the exported files, change the extension from .pem to .crt.(??)

### E.3.3 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.

```
Step 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
```

#### Step 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
```

#### Step 3 Verify that the following line is also enabled (uncommented)

Include conf/httpd-vhosts.conf

#### Step 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." <math display="inline">\$ # # 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  $\ensuremath{\mbox{I/O}}$  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. Switch model numbers are located on the rear panel, as shown in Figure F-1.



Figure F-1 Switch Model Number Label

## F.1 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.

## F.1.1 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)

## F.1.2 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)

#### F.1.2.1 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

## F.1.3 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)

## F.1.4 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)

# F.2 Specifications – SG 1-U Half-Width Switches

## F.2.1 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 F-2 displays the ShoreTel 90 front plate.



Figure F-2 ShoreTel 90 Front Plate

## **F.2.1.1** 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

## **F.2.1.2** 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.

#### F.2.1.3 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 F-1 lists the RJ-21X Ring and Tip pin numbers for the SG 90.

Dout	Trues		Ring		Tip	
Port	Туре	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	
-		24	Brown/Violet	49	Violet/Brown	
-		25	Slate/Violet	50	Violet/Slate	

Table F 1	ShoraTal 00 R I 21 Y Talanhona and Trunk Connector Pins
	Shore fer 90 KJ-21X relephone and frunk Connector I his

# F.2.2 ShoreTel 90BRI Voice Switch

The following sections describe ShoreTel 90BRI resource capacity, LED behavior, and connectors. Figure F-3 displays the ShoreTel 90BRI front plate.



Figure F-3 ShoreTel 90BRI Front Plate

## F.2.2.1 Switch Capacity

- Analog Circuit Resources
   Ports 9-12: Extensions
- 10165 / 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

## F.2.2.2 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).

## F.2.2.3 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 F-2 lists the RJ-21X Ring and Tip pin numbers for the SG 90BRI.

Port	Туре	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

Table F-2ShoreTel 90BRI RJ-21X Telephone and Trunk Connector Pins



Dort	Туре	Ring		Tip	
Fon		Pin #	Cable Color	Pin #	Cable Color
_		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

 Table F-2
 ShoreTel 90BRI RJ-21X Telephone and Trunk Connector Pins

## F.2.3 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 F-4 displays the ShoreTel 50 front plate.



Figure F-4 ShoreTel 50 Front Plate

## F.2.3.1 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

## F.2.3.2 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.

### F.2.3.3 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 F-3 lists the RJ-21X Ring and Tip pin numbers for the SG 50.

Dout	Turna	Ring		Tip	
Pon	Туре	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

Table F-3ShoreTel 50 RJ-21X Telephone and Trunk Connector Pins

# F.2.4 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 F-5 displays the ShoreTel 30 front plate.





Figure F-5 ShoreTel 30 Front Plate

## F.2.4.1 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

### **F.2.4.2 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.

#### F.2.4.3 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 F-4 lists the RJ-21X Ring and Tip pin numbers for the SG 30.

Port	Туре		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	

Table F-4ShoreTel 30 RJ-21X Telephone and Trunk Connector Pins

Port Typ	Turno	Ring		Tip	
	Туре	Pin #	Cable Color	Pin #	Cable Color
12	Extension - DID	23	Green/Violet	48	Violet/Green
Ι		24	Brown/Violet	49	Violet/Brown
-		25	Slate/Violet	50	Violet/Slate

 Table F-4
 ShoreTel 30 RJ-21X Telephone and Trunk Connector Pins (Continued)

# F.2.5 ShoreTel 30BRI Voice Switch

The following sections describe ShoreTel 30BRI resource capacity, LED behavior, and connectors. Figure F-6 displays the ShoreTel 30BRI front plate.





## F.2.5.1 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



## **F.2.5.2 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

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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).

### F.2.5.3 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 F-5 lists the RJ-21X Ring and Tip pin numbers for the SG 30BRI.

Deut	Trues	Ring		Tip	
Ροπ	Туре	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

Table F-5	ShoreTel 30BRI RJ-21X Telephone and Trunk Connector Pins
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# F.2.6 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 F-7 displays the ShoreTel 220T1 front plate.



Figure F-7 ShoreTel 220T1 Front Plate

## F.2.6.1 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

### **F.2.6.2** 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

TheShoreTel 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.

## F.2.6.3 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

## F.2.7 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 F-8 displays the ShoreTel 220T1A front plate.





Figure F-8 ShoreTel 220T1A Front Plate

## F.2.7.1 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

## F.2.7.2 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.

#### F.2.7.3 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 F-6 lists the RJ-21X Ring and Tip pin numbers for the SG 220T1AI.

Dout	Turno	Ring		Tip	
Poil	Type	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
I		5	Slate/White	30	White/Slate
I		6	Blue/Red	31	Red/Blue
-		7	Orange/Red	32	Red/Orange
I		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

# F.2.8 ShoreTel-220E1 Voice Switch

The following sections describe ShoreTel-220E1 resource capacity, LED behavior, and connectors. Figure F-9 displays the ShoreTel-220E1 front plate.





Figure F-9 ShoreTel-220E1 Front Plate

### **F.2.8.1** 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

### **F.2.8.2 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.

## F.2.8.3 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

## F.2.9 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 F-10 displays the ShoreTel T1k front plate.



Figure F-10 ShoreTel T1k Front Plate

## F.2.9.1 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

### **F.2.9.2 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.

### F.2.9.3 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

## F.2.10 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 F-11 displays the ShoreTel E1k front plate.





Figure F-11 ShoreTel E1k Front Plate

## F.2.10.1 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

## F.2.10.2 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.
- Framing: 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.

#### F.2.10.3 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

# **F.3** Specifications – SG Voice Model Switches

## F.3.1 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 F-12 displays the ShoreTel 90V front plate.



Figure F-12 ShoreTel 90V Front Plate

## F.3.1.1 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

## F.3.1.2 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.

#### F.3.1.3 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 F-7 lists the RJ-21X Ring and Tip pin numbers for the ShoreTel 90V.

		Ring			Tip
		Pin		Pin	
Port	Туре	#	Cable Color	#	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

Table F-7ShoreTel 90V RJ-21X Telephone and Trunk Connector Pins



		Ring		Tip	
		Pin		Pin	
Port	Туре	#	Cable Color	#	Cable Color
-		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

 Table F-7
 ShoreTel 90V RJ-21X Telephone and Trunk Connector Pins (Continued)

# F.3.2 ShoreTel 90BRIV Voice Switch

The following sections describe ShoreTel 90BRIV resource capacity, LED behavior, and connectors. Figure F-13 displays the ShoreTel 90BRIV front plate.



Figure F-13 ShoreTel 90BRIV Front Plate

## F.3.2.1 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

#### **F.3.2.2** 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).

#### F.3.2.3 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 F-8 lists the RJ-21X Ring and Tip pin numbers for the SG 90BRIV.

Dort	Tumo		Ring		Tip		
Port	туре	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		

Table F-8	Shore Tel 90 BRIV RI-21 X Telephone and Trunk Connector Pins
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# F.3.3 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 F-14 displays the ShoreTel 50V front plate.



Figure F-14 ShoreTel 50V Front Plate

#### F.3.3.1 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

#### F.3.3.2 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.

#### F.3.3.3 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 F-9 lists the RJ-21X Ring and Tip pin numbers for the SG 50V.

Dort	Tumo		Ring		Tip		
ron	Type	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		

 Table F-9
 ShoreTel 50V RJ-21X Telephone and Trunk Connector Pins

Port	Туре		Ring	Tip		
		Pin #	Cable Color	Pin #	Cable Color	
12	Extension - DID	23	Green/Violet	48	Violet/Green	
_		24	Brown/Violet	49	Violet/Brown	
_		25	Slate/Violet	50	Violet/Slate	

 Table F-9
 ShoreTel 50V RJ-21X Telephone and Trunk Connector Pins (Continued)

# F.4 Specification – SG 1U Full Width Switches

# F.4.1 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 F-15 displays the ShoreTel 120 front plate.

The ShoreTel 120 is often referred to as the ShoreTel 120/24 (SG 120/24).



Figure F-15 ShoreTel 120 Front Plate

## F.4.1.1 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



#### **F.4.1.2 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.

#### F.4.1.3 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 F-10 lists the RJ-21X Ring and Tip pin numbers for the SG 120I.



Port	Туре		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
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

Table F-10ShoreTel 120 RJ-21X Telephone and Trunk Connector Pins

# F.4.2 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 F-16 displays the ShoreTel 24A front plate.



Figure F-16 ShoreTel 24A Front Plate

## F.4.2.1 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

#### F.4.2.2 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.

#### F.4.2.3 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 F-11 lists the RJ-21X Ring and Tip pin numbers for the SG 24AI.

Dort	Trues		Ring		Tip	
Port	Туре	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	

 Table F-11
 ShoreTel 24A RJ-21X Telephone and Trunk Connector Pins



Dort	Trme		Ring	Tip	
Folt	Type	Pin #	Cable Color	Pin #	Cable Color
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

 Table F-11
 ShoreTel 24A RJ-21X Telephone and Trunk Connector Pins (Continued)

# F.4.3 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 F-17 displays the ShoreTel 60 front plate.

The ShoreTel 60 is often referred to as the ShoreTel 60/12 (SG 60/12).



Figure F-17 ShoreTel 60 Front Plat

## F.4.3.1 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

## F.4.3.2 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.

#### F.4.3.3 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 F-12 lists the RJ-21X Ring and Tip pin numbers for the SG 60.

Dort	Trees		Ring	Tip	
ron	Туре	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
_		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

Table F-12ShoreTel 60 RJ-21X Telephone and Trunk Connector Pins

## F.4.3.4 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 F-18 displays the ShoreTel 40 front plate.

The ShoreTel 40 is often referred to as the ShoreTel 40/8 (SG 40/8).





Figure F-18 ShoreTel 40 Front Plate

#### F.4.3.5 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

#### F.4.3.6 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.

#### F.4.3.7 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 F-13 lists the RJ-21X Ring and Tip pin numbers for the SG 40I.

Dort	Tumo		Ring	Tip	
Polt	Туре	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
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

Table F-13ShoreTel 40 RJ-21X Telephone and Trunk Connector Pins

Port	Trmo		Ring	Tip	
	Туре	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

 Table F-13
 ShoreTel 40 RJ-21X Telephone and Trunk Connector Pins (Continued)

# F.4.4 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 F-19 displays the ShoreTel-T1 front plate. The ShoreTel E1 front plate is identical to the ShoreTel-T1 except for the E1 labeling.



Figure F-19 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.

## F.4.4.1 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



#### **F.4.4.2 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

# F.5 Specification – IPBX Switches

## F.5.1 IPBX-24 Voice Switch

The IPBX-24 (Figure F-20) 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 F-20 IPBX-24 Front Plate

## F.5.1.1 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.

#### F.5.1.2 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 F-14 lists the RJ-21X Ring and Tip pin numbers for the IPBX-24I.

Port	Туре	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
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

Table F-14IPBX-24 RJ-21X Telephone and Trunk Connector Pins

# F.5.2 IPBX-T1 and IPBX-E1 Voice Switch

The IPBX-T1 (Figure F-21) 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 F-21 ShoreTel T1 and ShoreTel E1 Front Panel

## F.5.2.1 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.

#### F.5.2.2 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



# Glossary

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.

**BOOTP** Boot Protocol, a standard protocol for assigning networking information to client workstations over the network; similar to but less sophisticated than DHCP.

**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.

**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.

**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).

**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.

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.

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.

Internal Call A telephone call dialed between internal extensions.

Java The platform-independent programming language developed by Sun Microsystems for providing complete programs, including animated graphics.

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).

**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, or a CD player.

**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.

**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.

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.

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-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.

Workstation A personal computer (PC) or similar computer.


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"Use Flash to Route Calls" check box
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