

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.

Table 3-1 Supported Codecs

Codec	Sample Rate	Effective Sample Size	Data Rate	Supported ShoreTel Endpoints
LI6/1600 (Linear Broadband)	16 KHz	16 bits	256 Kbps	IP 110/115/212/230/230g/265/560/560g/655
LI6/8000 (Linear)	8 KHz	16 bits	128 Kbps	All
PCMU (G.711 μ -law)	8 KHz	8 bits	64 Kbps	All
PCMA (G.711 A-law)	8 KHz	8 bits	64 Kbps	All
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				

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.

Table 3-2 Port Usage Part 1

Originating Device	Traffic Type	Destination Device			
		Switch	IP Phone	Communicator	Softphone
Switch	Call Control	Location Service UDP 5440 Call Control UDP 5441 Bandwidth Manager UDP 5443 Admission Control UDP 5445	MGCP UDP 2427		MGCP UDP 2427
	Media Stream	RTP UDP 5004 (dynamic: 1024-65535)	RTP UDP 5004 (dynamic: 1024-65535)		

Table 3-2 Port Usage Part 1 (Continued)

Originating Device	Traffic Type	Destination Device			
		Switch	IP Phone	Communicator	Softphone
Service Appliance	Call Control	Location Service UDP 5440 Call Control UDP 5441 Bandwidth Manager UDP 5443 Admission Control UDP 5445			
		HTTP Web share TCP 80 HTTPS Web share TCP 443		Instant Messaging XMPP TCP 5222 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
Service Appliance	Media Stream V Switch only				NTP UDP 123
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 5554		UDP 5004 RTP if dynamic: 10000-10550

Table 3-2 Port Usage Part 1 (Continued)

Originating Device	Traffic Type	Destination Device			
		Switch	IP Phone	Communicator	Softphone
Communicator	Video			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 MGCP - Media proxy UDP 2427 Location Service UDP 5440 Call Control UDP 5441 Bandwidth Manager UDP 5443 Admission Control UDP 5445		Remote TAPI TCP 1024-65535	
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			

Table 3-2 Port Usage Part 1 (Continued)

Originating Device	Traffic Type	Destination Device			
		Switch	IP Phone	Communicator	Softphone
HQ/Director Server	Call Control	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		TCP 1024-65535 Remote TAPI	
	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			
	Configuration Control	Firmware download TCP 1024-65535			RTP UDP 5004 [if dynamic 1024-65535]
HQ/Director Server	Maintenance	Diagnostic ipbxctl TCP 5555	TCP 5555 Diagnostic phonectl		

Table 3-2 Port Usage Part 1 (Continued)

Originating Device	Traffic Type	Destination Device			
		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 SNMP UDP 161	Telnet TCP 23		

Table 3-3 Port Usage Part 2

Originating Device	Traffic Type	Destination Device			
		Service Appliance	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	

Table 3-3 Port Usage Part 2 (Continued)

Originating Device	Traffic Type	Destination Device			
		Service Appliance	DVM Server	HQ/Director Server	Other
Switch	Call Control: Softswitch		Call Control UDP 5441 DRS UDP 5442 Bandwidth Manager UDP 5443 Admission Control UDP 5445 DRS keepalive UDP 5446	Call Control UDP 5441 DRS UDP 5442 Bandwidth Manager UDP 5443 Admission Control UDP 5445 DRS keepalive UDP 5446	
	Call Control: TMS RPC		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	

Table 3-3 Port Usage Part 2 (Continued)

Originating Device	Traffic Type	Destination Device			
		Service Appliance	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		Port Mapper RPC TCP 111 UDP 111	Port Mapper RPC TCP 111 UDP 111	
	Configuration Control		FTP CTL - Boot files TCP 21 FTP DATA - Boot files TCP 20	FTP CTL - Switch Boot TCP 21 FTP DATA - Switch Boot TCP 20	DHCP Server UDP 67
	Database V Switch only		MYSQL TCP 4306 MYSQL Config TCP 4308	MYSQL TCP 4306 MYSQL Config TCP 4308	
	Transport V Switch only		CDS TCP 5432	CDS TCP 5432	
	Maintenance				SNMP TRAP UDP 162

Table 3-3 Port Usage Part 2 (Continued)

Originating Device	Traffic Type	Destination Device			
		Service Appliance	DVM Server	HQ/Director Server	Other
Service Appliance	Call Control	Location Service UDP 5440	Softswitch Location Service UDP 5440	Softswitch Location Service UDP 5440	
		Call Control UDP 5441	Call Control UDP 5441	Call Control UDP 5441	
		Bandwidth Manager UDP 5443	DRS UDP 5442	DRS UDP 5442	
		Admission Control UDP 5445	Bandwidth Manager UDP 5443	Bandwidth Manager UDP 5443	
			Admission Control UDP 5445	Admission Control UDP 5445	
	Call Control: TMS RPC		DRS Keepalive UDP 5446	DRS Keepalive UDP 5446	
			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	
	Configuration Control		FTP CTL - Boot files TCP 21	FTP CTL - Boot files TCP 21	
			FTP DATA -Boot files TCP 20	FTP DATA -Boot files TCP 20	
	Database		MySQL TCP 4306	MySQL TCP 4306	
			MySQL Config TCP 4308	MySQL Config TCP 4308	
				MySQL CDR TCP 4309	
	Transport		CDS TCP 5432	CDS TCP 5432	

Table 3-3 Port Usage Part 2 (Continued)

Originating Device	Traffic Type	Destination Device			
		Service Appliance	DVM Server	HQ/Director Server	Other
Service Appliance	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 Endpoints UDP 1024-65535
	Collaboration Management (CMCA)	(Web Share) Ping Sync UDP/TCP 5450			Ping Sync/ UDP 5450 (CMCA) to other Service Appliance 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 STTS - Media			TCP 5467 TCP 5468	
					NTP UDP 123 DHCP Server UDP 67 SMTP Trap UDP162 SMTP TCP 125 DNS TCP/UDP 53

Table 3-3 Port Usage Part 2 (Continued)

Originating Device	Traffic Type	Destination Device			
		Service Appliance	DVM Server	HQ/Director Server	Other
IP Phone	Call Control				
	Media Stream		RTP UDP 5004 if dynamic 10000-10550 FTP TCP 21	RTP UDP 5004 if dynamic 10000-10550 FTP TCP 21	
	Configuration Control		FTP CTL - Config TCP 21 FTP DATA - Config TCP 20 ICMP PING	FTP CTL - Config TCP 21 FTP DATA - Config TCP 20 ICMP - PING UDP 5004 RTP [if dynamic 1024-65535]	DHCP Server UDP 67 SNTP UDP 123
Communicator	Call Control		MS RPC - Remote TAPI TCP/UDP 5500-5600 Remote TAPI Event TCP 1024-65535	MS RPC - Remote TAPI TCP/UDP 5500-5600 Remote TAPI Event TCP 1024-65535	
	Configuration Control		CAS TCP 5440 CAS TCP 5447 Web-proxy, Mgmt API TCP 5449, 5469	Web client, Online help TCP 80 HTTP CAS TCP 5440 CAS TCP 5447 Web-proxy, Mgmt API TCP 5449, 5469	
	RPC Connection Negotiation		Port Mapper RPC TCP 135 MS	Port Mapper RPC TCP 135 MS	

Table 3-3 Port Usage Part 2 (Continued)

Originating Device	Traffic Type	Destination Device			
		Service Appliance	DVM Server	HQ/Director Server	Other
Communicator	Web		Web-proxy, WCM options page/Mgmt API TCP 5449, 5469 Session Mgmt AD/non-AD login auth & Web content TCP 80 CAS TCP 5447	Web-proxy, WCM options page/Mgmt API TCP 5449, 5469 Session Mgmt AD/non-AD login auth & Web content TCP 80 CAS TCP 5447	
	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 3-3 Port Usage Part 2 (Continued)

Originating Device	Traffic Type	Destination Device			
		Service Appliance	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 UDP 5446	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 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 3-3 Port Usage Part 2 (Continued)

Originating Device	Traffic Type	Destination Device			
		Service Appliance	DVM Server	HQ/Director 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

Table 3-3 Port Usage Part 2 (Continued)

Originating Device	Traffic Type	Destination Device			
		Service Appliance	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		

3.2.2.3 Bandwidth in the LAN

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

Table 3-4 LAN Bandwidth—Bytes

	Linear Broadband	Linear	G.711	ADPCM (G.722)	G.729a	G.729a
Voice data (10 msec)	320	160	80	40+4 ^a	20 (20 msec) ^b	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 ^c	26	26	26	26	26	26