

Avaya Solution & Interoperability Test Lab

# Application Notes for VoIP over Frame Relay Link with Quality of Service using Kentrox Q-Series Routers with Avaya IP Office - Issue 1.0

### Abstract

These Application Notes describe a configuration for supporting Voice over IP (VoIP) over a Frame Relay link with Quality of Service (QoS) on Kentrox Q-Series routers connected to an Avaya IP Telephony infrastructure intended for small office scenarios using low traffic serial T-1 links. The Kentrox Q-Series Q2400 and the Q2200 routers were compliance-tested with an Avaya IP Office. Emphasis was placed on verifying voice quality in a small office scenario using low traffic serial T-1 links in a converged network. QoS based on Layer 3 Differentiated Services was implemented across the network to prioritize voice traffic over the WAN. Information in these Application Notes has been obtained through compliance testing and additional technical discussions. Testing was conducted via the Developer*Connection* Program at the Avaya Solution and Interoperability Test Lab.

### 1. Introduction

These Application Notes describe a configuration for supporting Voice over IP (VoIP) over a Frame Relay link with Quality of Service (QoS) on Kentrox Q-Series routers connected to an Avaya IP Telephony infrastructure. The Kentrox Q-Series Q2400 and the Q2200 routers were compliance-tested with an Avaya IP Office.

#### Q-Series Q2200 T1 QoS Access Router

The Q-Series Q2200 Access Router provides VPN functionality and supports QoS based on DiffServ over its WAN link. The Q2200 supports PPP and Frame Relay encapsulation.

#### Q-Series Q2400 QoS Access Router

The Q-Series Q2400 Access Router is a multi-port router with two T1 ports and one Ethernet WAN port. It provides the same functionality as the Q2200.

Compliance testing emphasis was placed on verifying voice quality in a small office scenario using low traffic serial T-1 links in a converged network. QoS based on Layer 3 Differentiated Services was implemented across the network to prioritize voice traffic over the WAN.

The configuration in **Figure 1** shows a corporate site connected to a branch office site via a Frame Relay link. The corporate site consists of an Avaya IP Office 412 connected to the Kentrox Q2400 router, which in turn is connected to the WAN. The branch office site consists of an Avaya IP Office 403 and it is also connected to the WAN via a Kentrox Q2200 router. Each site contains a Layer-2 managed Ethernet switch to connect the Avaya IP Telephones and the Avaya IP Office. The corporate site also provides a DHCP server for assigning IP network parameters, VLAN information, and Option 176 settings to the Avaya IP Telephones. DHCP was used to exercise DHCP relay on the Kentrox Q-Series router at the branch office. The voice and data traffic were separated onto different VLANs.



Figure 1: Network Configuration

# 2. Equipment and Software Validated

The following equipment and software were used for the sample configuration provided:

Equipment	Software
Avaya IP403 Office	2.1(27)
Avaya IP412 Office	2.1(27)
Avaya 4612, 4624 IP Telephones	1.81
Avaya 6400 Series Digital Telephones	
Kentrox Q-Series Q2400 QoS Access Router	1.3
Kentrox Q-Series Q2200 T1 QoS Access Router	1.3

# 3. Configure the Avaya IP412 Office

This section describes the configuration steps for providing the Avaya IP Office, located in the corporate site, with an IP configuration, DSCP values for VoIP traffic, IP trunks to the branch site, short codes for routing VoIP calls, and a default route. The IP Office was configured using the **Avaya IP Office Manager** application.

Step	Description					
1.	To configure the Avaya II to the IP Office via IP. In a subnet mask of 255.255. configuration options are a	P Office, open itially, the IP ( 255.0. The M selected from	the <b>Manag</b> Office is as <b>lanager</b> ma the tree vie	ger applica signed IP ain window w of the N	ation from address 19 w is displa <b>/anager</b> v	a PC connected 92.168.42.1 with ayed. All of the window.
	File Edit View Tools Window Help		TE-0754.clg			
	Configuration Tree					
	BOOTP (0)	Name	IPAddr 1	IPMask 1	IPAddr 2	IPMask 2
	Perturbative     P	CORPSITE-6734	192.45.70.190	255.255.2	192.168.43.1	255.255.2
	E911 System(1)					

Step	Description
2.	To configure an IP address on the IP Office, select the System option. In the LAN1
	tab, set the IP Address and IP Mask to values that correspond to the customer's
	network and select <b>Disabled</b> for DHCP Mode.
	System Configuration : CORPSITE-6734
	System LAN1 LAN2 DNS Voicemail Telephony Gatekeeper LDAP SNMP
	IP Address 192.45:70.190 Number Of DHCP IP Addresses 200
	IP Mask 255.255.0 DHCP Mode
	Primaru Trans, IP Address
	C Dialin
	Enable NAT
	RIP Mode (● None
	C Listen Only (Passive)
	C RIP 2 Broadcast (RIP 1 Compatibility)
	C RIP 2 Multicast
	OK <u>C</u> ancel <u>H</u> elp
3.	In the Gatekeeper tab, verify that the DSCP values for VoIP media and signaling
	traffic are set to 46 and 34, respectively. The Avaya IP Telephones that register with
	the Avaya IP Office need to be configured manually to use these DSCP values. These
	are the DSCP values used in the configuration described in these Application Notes.
	System Configuration : CORPSITE-6734
	System LAN1 LAN2 DNS Voicemail Telephony Gatekeeper LDAP SNMP
	🔽 [Gatekeeper Enable]
	Direct Routed Signaling Enable
	✓ Auto-create Extn Enable
	0x88 DSCP(Hex) 46 DSCP
	0xFC DSCP Mask (Hex) 63 DSCP Mask
	0x88 SIG DSCP (Hex) 34 SIG DSCP
	176 SSON

Step	Descrip	otion					
4.	Next, c	reate an IP trunk	to the Av	vaya IP Office	403 at the bra	nch site. Select	the Line
	option	from the Manag	er tree vi	ew and add an	IP Line. Sp	becify the Line I	Number,
	the nur	mber of <b>Outgoi</b>	ng Chan	nels and Voic	e Channels	in this IP line,	and the
	Incom	ing and Outgoing	g Group I	ID. The Outgo	oing Group I	<b>D</b> is specified in	the short
	code th	at routes outgoin	g calls to	the branch site.			
		E IB Line					
		Line ShortCodes VolP					
		Line Number	03				1
		Telephone Number			Number Of Channels	5	
		Outgoing Channels	5		Data Channels	5	
		Voice Channels	5		TEI		
		Incoming Group ID	3		International Prefix		
		Outaoina Group ID	3		international Frenk		
		National Profin	0				
		National Frenx	lo.				
					Prefix		
					OK	<u>C</u> ancel <u>H</u> elp	
							_
5.	Under	the VoIP tab of	f the <b>IP</b>	Line form, set	the Gatewa	y IP Address t	o the IP
	address	s of the Avaya II	P Office 4	103 at the brand	ch site. The	Compression M	ode was
	set to A	Automatic Select	ion so the	it the codec typ	e used for the	call would be n	egotiated
	during	call setup.					
		🧧 IP Line				_0	×
		Line ShortCodes VolP					1
		Gateway IP Address	[	192.45.72.192	🔲 Silence Suppression		
			,		🔲 Enable Faststart		
		Voice Pkt. Size	l	0	Fax Transport Suppo	ort	
		Compression Mode	1	Automatic Selection	Local Hold Music		
					Local Lones		
					Out Of Band DTMF		
					Allow Direct Media P	Path	
					Voice Networking		
		H450 Support	ļ	H450 💌			
						1	
					OK	<u>Cancel</u> <u>H</u> elp	

Step	Description
6.	To route calls to the IP telephones at the branch site, create a short code by selecting
	the Shortcode option from the Manager tree view. The extensions at the branch site
	begin with the digit '5' and are 5-digits in length. In this example, the short code
	specifies that calls with dialed digits in the format <b>5xxxx</b> , where 'x' denotes a wildcard,
	be routed over Line Group ID 3 that was configured in Step 4. The Telephone
	Number field was set to 5N, which means that the 5xxxx digits dialed are sent over the
	IP trunk.
	Short Lode EN
	OK <u>C</u> ancel <u>H</u> elp
7.	Next, select the <b>IP Route</b> option from the left panel of the <b>Manager Main Window</b> to
	add a default route. The IP Route form specifies the Q2400 at the corporate office as
	the default gateway. IP address 192.45.70.2 belongs to the Ethernet port on the Q2400
	router associated with the voice VLAN (VLAN ID 70). This route is used to route
	VoIP media and signaling packets to the branch site.
	TP Route
	IP Mask
	Gateway IP Address 192.45.70.2
	Destination
	Metric
	E ProxvABP
8	Add <b>IP Extensions</b> and <b>Users</b> for the IP telephones that will register with the IP
0.	Office. The reader should consult the Avava IP Office documentation listed in Section
	10 for instructions on adding IP stations.

# 4. Configure the Avaya IP403 Office

This section describes the configuration steps for providing the Avaya IP Office, located in the branch site, with an IP configuration, DSCP values for VoIP traffic, IP trunks to the corporate site, short codes for routing VoIP calls, and a default route. The IP Office was configured using the **Avaya IP Office Manager** application.



Step	Description
2.	To configure an IP address on the IP Office, select the <b>System</b> option. In the <b>LAN1</b>
	tab, set the <b>IP Address</b> and <b>IP Mask</b> . In the field, specify the IP configuration that
	corresponds to the customer's network. Select <b>Disabled</b> for DHCP Mode. Although
	the integrated DHCP server in the IP Office could have been used, DHCP relay to the
	corporate site was used for mustrative purposes.
	System Configuration : SITEB-75CB
	System LAN1 DNS Voicemail Telephony Gatekeeper LDAP SNMP
	IP Address 192.45.72.192 Number Of DHCP IP Addresses
	IP Mask 255.255.255.0 DHCP Mode
	C) Server
	C Disabled
	C Client
	RIP Mode
	C Listen Only (Passive)
	C RIP 1 C RIP 2 Broadcast (RIP 1 Compatibility)
	C RIP 2 Multicast
3	In the <b>Gatekeener</b> tab, verify that the DSCP values for VoIP media and signaling
5.	traffic are set to 46 and 34, respectively. The Avava IP Telephones that register with
	the Avaya IP Office need to be manually configured to use these DSCP values. These
	are the DSCP values used in the configuration described in these Application Notes.
	System LAN1 DNS Voicemail Telephony Gatekeeper LDAP SNMP
	🔽 (Gatakeener Franke
	Direct Routed Signaling Enable
	☑ Auto-create Extn Enable
	Enable RSVP
	0x88 DSCP(Hex) 46 DSCP
	OK Cancel Help

Step	Descri	ption					
4.	Next, o	create an IP trunk	to the Avaya IP	Office a	at the corpora	ate site. Selec	ct the Line
	option	from the Manag	er tree view and	add an l	IP Line. Sp	ecify the Line	e Number,
	the nu	mber of <b>Outgoi</b>	ng Channels and	d Voice	Channels 1	in this IP lin	e, and the
	Incom	ing and Outgoing	g Group ID. The	Outgon	ng Group II	Is specified i	in the short
	code ti	lat Toules outgoin	g cans to the corp		Ċ.		
		📮 IP Line				_	
		Line ShortCodes VolP					
		Line Number	06				
		Telephone Number			Number Of Channels	5	
		Outgoing Channels	5	1	Data Channels	5	
		Voice Channels	5		TEI	0	
		Incoming Group ID	6	1	International Prefix	00	
		Outgoing Group ID	6				
		National Prefix	0				
					Prefix	-	-
						,	
					ОК	Cancel Help	
5.	Under addres to Aut during	the <b>VoIP</b> tab of s of the Avaya IP comatic Selection call setup.	f the <b>IP Line</b> for Office at the corp so that the code	rm, set porate si c type u	the Gateway te. The Con sed for the c	y <b>IP Address</b> npression Mo call would be	to the IP de was set negotiated
		<b>Q</b> IP Line				_	
		Line ShortCodes VolP					
		Gateway IP Address	192.45.70.190		🔲 Silence Suppression		
		Vaice Pkt Size	0		Enable Faststart		
		VOIDET N. OIDE			Local Hold Music	t	
		Compression Mode	Automatic Select	tion 💌	Local Tones		
					🔲 Enable RSVP		
					Out Of Band DTMF		
					Voice Networking	ath	
		H450 Support	H450	•			
					ΠΚ	Cancel Holo	

Step	Description	
6.	To route calls to the IP telep	phones at the corporate site, create a short code by selecting
	the Shortcode option from	the Manager tree view. The extensions at the corporate
	site begin with the digit '2'	and are 5-digits in length. In this example, the short code
	specifies that calls with dial	ed digits in the format <b>2xxxx</b> , where 'x' denotes a wildcard,
	be routed over Line Grou	<b>p ID 6</b> that was configured in <b>Step 4</b> . The <b>Telephone</b>
	Number field was set to 2N	, which means that the 2xxxx digits dialed are sent over the
	IP trunk.	
	# Shortcode 2YYYY	X
	Charl Code	70000
	Telephone Number	2N
		6
	Feature	Dial
	l seels	
	Force Account Code	
		OK <u>C</u> ancel <u>H</u> elp
7.	Next, select the <b>IP Route</b> of	ption from the left panel of the Manager Main Window to
	add a default route. The <b>IP</b>	<b>Route</b> form specifies the Q2200 at the branch office as the
	default gateway. IP addres	s 192.45.72.1 belongs to the Ethernet port on the Q2200
	router associated with the	voice VLAN (VLAN ID 72). This route is used to route
	voip media and signaling p	ackets to the corporate site.
	TP Rout	
	IP Address	
	IP Mask	
	Gateway IP	Address 192.45.72.1
	Destination	LAN1
	Metric	
		ProxyARP
	Г	OK Cancel Help
	-	
8.	Add IP Extensions and U	sers for the IP telephones that will register with the IP
	Office. The reader should c	onsult the Avaya IP Office documentation listed in Section
	10 for instructions on adding	g IP stations.

## 5. Configure the Kentrox Q-Series Routers for Frame Relay

The Kentrox Q-Series routers provide WAN connectivity for the corporate and branch office sites using Frame Relay links. The Q2400 at the corporate site and the Q2200 at the branch site both connect to the public network.

#### 5.1. Kentrox Q2400 in the Corporate Site

This section provides the configuration of the Q2400 in the corporate site. The Q2400 connects to the Avaya IP412 Office via a Layer-2 switch.

Step	Description		
1.	To configure the Kentrox connected to the Q2400. with a subnet mask of 255 credentials when the Q24	Q2400, launch Internet Explorer f Initially, the Q2400 is assigned an 5.255.255.0. Log into the Q2400 us 00 authentication window appears.	rom a PC directly IP address 192.168.1.1 sing the appropriate
	Enter Net	work Password	<u>? ×</u>
	<b>?</b>	Please type your user name and password. Site: 192.168.1.1 Realm WebAdmin User Name admin	
		Bassword	
			Cancel



Step	Description
5.	The message 'DHCP Operations Disabled' now appears for the DHCP Configuration.
	월 12400 - Microsoft Internet Evolution
	Ele Edit View Favorites Tools Help
	↓ Back × → ✓ ◯ ◯ ◯ ◯ ◯ ◯ ◯ ◯ Gearch malFavorites ◯ #Hstory       ↓□ × ◯ ◯ ◯         Address ◯ http://192.168.1.1/configuration/kt:DhcpServer2.html/edit_dhcp       ▼ 🔗 Go ◯ Links ≫
	KENTROX Q2400 Customer Location Help Log Out Online Support
	MONITOR       Configure > Router > DHCP         System       Interfaces         Traffic       Configuration         Logs       DHCP Configuration         CONFIGURE       System         System       Interfaces         Router       Fixed Hosts add         Firewall       VPN         Qos       Configuration Not Saved
6.	To configure the IP address on the Q2400, select <b>Interfaces</b> → <b>Ethernet Ports 1-4</b> under CONFIGURE in the tree view. In the Configure > Interfaces > Ethernet Ports 1- 4 page that appears, select <b>Edit IP</b> in the Controls pull-down menu for IP address 192.168.1.1.
	Address 🙆 http://192.168.1.1/configuration/KtxL2switchifConfig.html
	KENTROX Q2400 Customer Location Help Log Out Online Support
	MONITTOR       Configure > Interfaces > Enternet Ports 1-4         System       Interfaces         Traffic       Logs         Logs       Layer 2 Switch Alias         System       Interfaces         System       Interfaces         System       Layer 2 Switch Alias         System       Layer 2 Switch Alias         System       Interface         System       Interfaces         Router       Interfaces         Firewall       VPN         QoS       Config         Changed       Save Now?
	<b>NOTE</b> : In the configuration used for these Application Notes, the PC used to initially configure the Q2400 was directly connected to Port 1 and the Layer 2 switch connected to the Q2400 was connected to Port 4.

Step	Description
7.	In the Configure > Interfaces > Ethernet Ports 1-4 > IP Configuration page that
	appears, set IP Address to 192.45.70.2, Subnet Mask to 255.255.255.0 and click OK.
	2 [Q2400 - Microsoft Internet Explorer
	Elle Edit View Favorites Iools Help
	Address D http://192.168.1.1/configuration/KtxEditL2SwitchiP.html?ImRouter.ImipInterfaces.plan
	KENTBOX Q2400 Customer Location Help Log Out Online Support
	MONITOR Configure > Interfaces > Ethernet Ports 1-4 > IP Configuration
	System Interfaces Edit IP Configuration
	Traffic IP I/F Name * intern
	Logs (Must be unique, ex: IP-32) IP Address * 192.45.70.2
	CONFIGURE Subnet Mask * 255.255.0
	Interfaces TCP MSS Clamp 🔽
	Router Security Zone Trusted
	Firewall * Required Field VPN The router is configuring the IP Interface, Please wait
	QoS
	Config Configuration Not Saved
	Changed Save Now?
8.	Change the IP address of the PC directly connected to the Q2400, browse to
0	192.45.70.2 and log in again into the Q2400.
9.	Select Interfaces $\rightarrow$ Ethernet Ports 1-4 under CONFIGURE in the tree view. In the Configure $\geq$ Interfaces $\geq$ Ethernet Ports 1.4 mage that appears select Switch to VI AN
	in the Configuration null-down menu for LAN Layer 2 Switch Interface
	in the configuration pair down mond for Erfly Edger 2 Switch methade.
	202400 - Microsoft Internet Explorer
	(→ Back - → - ⊘ ② △ ② Search ⓐFavorites ③History ▷ → ④ ■ □
	Agdress (2) http://192.45.70.2/configuration/Rbd/2switchil/Config.html
	KENTRAX Q2400 Customer Location Help Log Out Online Support
	MONITOR Configure > Interfaces > Ethernet Ports 1-4 System
	Interfaces Ethernet Layer 2 Switch Configuration hide all
	Traffic Layer 2 Switch Alias Status MAC Address Trap Port 1 Port 2 Port 3 Port 4 Configuration
	CONFIGURE LAN Layer 2 Switch O0:00:00:00:00:00 Disabled Up Down Down Up AMake Selection
	System         iplan (Static)         Subnet Mask         IP MTU         MSS Clamp         Security Zone         Make Selection> Edit           122.45.70.2         255.255.05         1500         Enabled         Trighted         Switch to MAN
	Firewall Refresh Saved
	VPN
	QoS
	Config Changed
	Save Now?

Step	Description						
10.	Click <b>OK</b> at the 'This will detach the IP interface and disrupt traffic. Are you sure?'						
	popup that appears.						
11.	Configure VLAN 70 in the Configure > Interfaces > Ethernet Ports 1-4 > VLAN						
	Configuration page that appears. Set VLAN Name to VLAN-70-74. VLAN ID to 70						
	check Port 1 Enable, check Port 4 Enable, and click OK.						
	202400 - Microsoft Internet Explorer						
	↓→     ↓→    <						
	Address 😰 http://192.45.70.2/configuration/KtxL2Switch/LANAdvanced.html?ImKtxlfTree.ethlan&switch						
	KENTROX Q2400 Customer Location Help Log Out Online Support						
	MONITOR Configure > Interfaces > Ethernet Ports 1-4 > VLAN Configuration						
	System						
	Interfaces						
	VLAN Name (Must be unique, ex: VLAN-3) * VLAN-70-74						
	CONFICUEDE						
	System Port 1 Enable VLAN ID						
	Interfaces Port 2 Enable						
	Router     Port 3 Enable       Port 4 Enable     Image: Control of the second						
	Firewall * Required Field						
	Configuration Not						
	Changed						
	Save Now?						
12	This change causes the connection to the browser to dron. Browse to 192.45.70.2 and						
12.	log in again into the O2400						
13	Select Interfaces $\rightarrow$ Ethernet Ports 1-4 under CONFIGURE in the tree view. In the						
15.	Configure > Interfaces > Ethernet Ports 1-4 made that annears select Edit in the						
	Configuration null-down menu for LAN Layer 2 Switch Interface						
	configuration pair down mena for Erny Eager 2 ownen merface.						
	KENTROX Q2400 Customer Location Help Log Out Online Suppor						
	MONITOR Configure > Interfaces > Ethernet Ports 1-4						
	System						
	Interfaces						
	Traffic Laver 2 Switch Alias Status MAC Address Trap Port Port Port Port Configuration						
	Logs Enabled 1 2 3 4						
	CONFIGURE Interface Amake Selection> 1 System VLAN Name Status VLAN Alias VLAN Port 1 Port 2 Port 3 Port 4 Edit						
	Interfaces VLAN-70-74 LinkUp 70 Enabled Disabled Disabled Enabled Switch to NO VLAN						
	Router iplan (Static) Subnet Mask IP MTU MSS Clamp Security Controls						
	Firewall         192.45.70.2         255.255.255.0         1500         Enabled         Trusted <make selection<="" th=""></make>						
	Refresh Configuration Not Saved						
	Changed Status New 2						

Step	Description							
14.	In the Configure > Interfaces > Ethernet Ports 1-4 > Edit Ethernet Configuration pag	e						
	that appears, set Port 4 VLAN Link Mode to trunk and click OK.							
	KENTBOX Q2400 Customer Location							
	MONITOR Configure > Interfaces > Ethernet Ports 1-4 > Edit Ethernet Configuration							
	System							
	Interfaces Ethernet Configuration - Kentrox Q2400 Ethernet interface ethlan							
	Traffic Interface Enable LinkUp							
	Logs Alias LAN Layer 2 Switch Inter							
	CONFIGURE MTU 1500							
	System MAC Address 00:00:00:00:03							
	Interfaces Link Up/Down Trap							
	Router LAN Ports							
	Firewall Port VLAN Link Link 10/100 Duplex Physical Mode							
	VPN							
	QoS 2 access DOWN 10 Half AutoNegotiate							
	Config 3 access DOWN 10 Half AutoNegotiate							
	Changed 4 Trunk V UP 100 Full AutoNegotiate V							
	OK Cancel Apply Configuration Not							
	Saved							
	<b>NOTE</b> : The port on the Layer-2 switch connecting to port 4 on the Q2400 was							
	configured for 802.1q (VLAN) mode. This allows VLAN header information to be							
	exchanged between the switch at the corporate site and the Q2400. The corporate site	e						
15	contains voice VLAN 70 and data VLAN 72.							
15.	In the Configure > Interfaces > Ethernet Ports 1-4 page that appears, select Add							
	<b>VLAN</b> in the Configuration pull-down menu for LAN Layer 2 Switch Interface.							
	KENTREX Q2400 CUStomer Location Help Log Out Online Support							
	MONITOR System							
	Interfaces Ethernet Layer 2 Switch Configuration hide all							
	Traffic							
	Logs Layer 2 Switch Allas Status MAC Address Enabled Port 1 Port 2 Port 3 Port 4 Configuration LAN Layer 2 Switch							
	CONFIGURE Interface VLAN Alias VLAN ID Port 1 Port 2 Port 3 Port 4 Chiefer							
	Interfaces							
	Router         192.45.70.2         255.255.255.0         1500         Enabled         Trusted         Make Selection							
	Firewall							
	VPN Configuration Not Saved							
	Config							
	Changed Save Num2							
	<u> </u>							

Step	Description
16.	Configure VLAN 74 in the Configure > Interfaces > Ethernet Ports 1-4 > VLAN
	Configuration page that appears. Set VLAN Name to VLAN-74-70, VLAN ID to 74,
	check Port 4 Enable, IP I/F Name to iplan74, IP Address to 192.45.74.2, Subnet Mask
	to <b>255.255.255.0</b> , and click <b>OK</b> .
	KENTROX Q2400 Customer Location Help Log Out Onlin
	MONITOR Configure > Interfaces > Ethernet Ports 1-4 > VLAN Configuration
	System           Interfaces         Add VLAN Configuration         IP Configuration
	Traffic     VLAN Name     * VLAN-74-70     Existing IP Interfaces     < New IP Interface > •
	Logs (Must be unique, ex: VLAN-3) IP I/F Name * plan74 VLAN Alias (Must be unique, ex: IP-32)
	CONFIGURE VLAN ID * 74 IP Address * 192.45.74.2
	System         Port 1 Enable         Subnet Mask         * 255.255.255.0
	Interfaces     Port 2 Enable     Security Zone     Trusted       Port 3 Enable     Image: Security Zone     Image: Security Zone
	Firewall Port 4 Enable
	VPN * Required Field
	QoS
	Configuration Not
	Changed
	Save Now?
17	
17.	Select Interfaces $\rightarrow$ T1 Ports 1-2 under CONFIGURE in the tree view. In the
	Configure > Interfaces > 11 Ports 1-2 page that appears, select Switch to Frame in the
	Controls pull-down menu for 11 Port Name t1-1.
	11 Interfaces Configuration bide all
	T1 Port Name Status Line Type Line Coding Line Build Out Source Loopback Controls
	Image Section         Ear         Docs         Fit         RxClock         Indire         Times Section >           T1         Docs         DS0 Channels         Edit T1
	Swach to Frame           Port         1         2         3         4         5         6         7         8         9         10         11         12         13         14         15         16         17         18         19         20         21         22         23         24           Port         1         2         3         4         15         16         17         18         19         20         21         22         23         24           1536 khror         1536 khror         1536 khror         1536 khror         1536 khror         1536 khror         1536 khror
	PPP I/F Name         Status         Interval         Conf         LCP Max Fail         Term         Trap         Controls           ppp-1         tetwork         5 seconds         10 requests         5 failures         2 requests         Disabled         -Make Selection.>
	ipwan-1 (Static) Subnet Mask IP MTU MSS Clamp Security Zone Controls 40.1.1.1 255.255.255.0 1500 Frahled Ibbruted Make Salertion
	T1 Port Name Status Line Type Line Coding Line Build Out Transmit Clock Loopback Controls
	- ti-2 LinkDown ESF B825 Short Haul: 0-133 System Timing: TI-1 None Make Selection>
	Data         Data           Port         DS0 Channels         Bandwidth           1         2         3         4         5         6         7         8         10         11         12         13         14         15         14         17         18         19         20         21         27         28         24

Step	Description									
18.	In the "This will delete the PPP interface and the IP interface. Are you sure?"									
	popup that appears, click <b>OK</b> .									
	Microsoft Internet Explorer									
	This will delete the PPP interface and the IP interface. Are you sure ?									
	OK Cancel									
10										
19.	In the Configure > Interfaces > T1 Ports $1-2$ > Frame Relay Configuration page that									
	appears, configure the frame relay settings needed to connect the T1 to the WAN and									
	click <b>OK</b> .									
	Configure > Interface > T1 Parts 1-2 > Ecomo Polya Configuration									
	MONITOR         Configure / Interfaces / Information /									
	Interfaces Add Frame Relay Configuration Link Management Settings									
	Traffic         Frame Relay I/F Name         * [r-1         T391 Polling Interval [secs]         10           LOGS         (Must be unique, ext FR-2)									
	Alias N391 Full Inquiry Interval [polling intervals] 6 CONFIGURE N392 Error Threshold [errors] 3									
	System N393 Monitored Events [ events ] 4									
	Interfaces     Link Up/Down Trap       Router     Frame Relay Status Trap									
	Firewall Frame Relay Trap Rate [msecs]									
	QoS * Required Field									
	Config Changed									
	Save Nuwr Cancel Saved									
•										
20.	In the Configure > Interfaces > T1 Ports 1-2 page, select <b>Edit T1</b> in the Controls pull-									
	down menu for T1 Port Name t1-1.									

Step	Description
21.	In the Configure > Interfaces > T1 Ports 1-2 > Edit T1 Configuration page that
	appears, configure the line settings needed to connect the T1 to the WAN and click <b>OK</b> .
	KENTROX Q2400 Customer Location Help Log Qut Online Support
	MONITOR       Configure > Interfaces > T1 Ports 1-2 > Edit T1 Configuration         System       Interfaces         Traffic       Linkt/p =         Alas       T1 to STEB         CONFIGURE       Circuit D (eptional)         System       Edit T1 configuration - Kentrox Q2400 T1 Interface t1-1         Interfaces       Circuit D (eptional)         CoonFigUre > TPP       ESF =         Line Build Out       Short Hudin 0-133 PF =         Friewall       Transmit Clock Status         YPN       Coonfig Changed         Save Now?       Iss Status Change Trap         Line Status Change Trap       Line Status Change Trap         Line Kuty Down Trap       Configuration Not
	Saved
22.	In the Configure > Interfaces > T1 Ports 1-2 page, select <b>Add DLCI</b> in the Controls pull-down menu for Frame Relay I/F Name <b>fr-1</b> .
	Q2400 Customer Location Help Log Out Online Support
	Configure > Interfaces > T1 Ports 1-2
	Edit Channels Show Discovered DLCIs
	T1 Interfaces Configuration show all
	Ti Port Name       Status       Line Type       Line Coding       Line Build Out       Transmit Clock       Loopback       Controls         I       III-1       UnkDown       ESF       B825       Short Hauli 0-133       System Timing:       None       Make Selection>       Image: Controls         I       III-1       UnkDown       ESF       B825       Short Hauli 0-133       System Timing:       None       Make Selection>       Image: Controls         I       I       2       3       4       5       6       7       9       10       11       12       13       14       15       16       17       18       19       20       21       22       24       1556 kbps         Frame Relay I/F Name       Status       LMI Type       LMI Status       Link Up/Down       Frame Relay       Frame Relay       Controls         Fr-1       LinkDown       AutoObeted       Faulted       Disabled       Disabled       Omsacs       Make Selection>       Make Selec
	U UZ V UNKLOWN ESP BKZS R LocalClock None Make Selections V

Step	Description									
23.	In the Configure > Interfaces > T1 Ports 1-2 > DLCI Configuration page that appears,									
	set DLCI I/F Name to dlci-101, DLCI to 101, Encapsulation to RFC-1490, Committed									
	Information Rate [kbps] to 1536, Far-End IP Address (Static) to 40.1.1.2, IP I/F Name									
	to ipwan-1, IP Address to 40.1.1.1, Subnet Mask to 255.255.255.0, check Enable									
	Inverse ARP and click OK.									
	KENTROX Q2400 Customer Location Help Log Out Online Support									
	MONITOR Configure > Interfaces > T1 Ports 1-2 > DLCI Configuration									
	System         Add DLCI Configuration         IP Configuration									
	Traffic         DLCI I/F Name         # dici-101         Existing IP Interfaces         < New IP Interface >           (Midt be unique, ext DI CI-101)         * dici-101         Existing IP Interfaces									
	CONFIGURE Alias (Must be unique, ext IP-32)									
	System         DLCI         IDI         IP Address         40.1.11           Encapsulation         RFC-1490         Subnet Mask         255.255.250									
	Interfaces         Committed Information Rate [kbps]         IS36         Security Zone         Untrusted           Router         Function Rate [kbps]         40.112         40.112         40.112         40.112									
	Firewall Enable Inverse ARP									
	QoS * Required Field									
	Config Changed									
	OK Cancel Saved									
24.	Select <b>Router</b> $\rightarrow$ <b>Routes</b> under CONFIGURE in the tree view. In the Configure >									
	Router > Routes page that appears, click <b>Add</b> for Static Routes.									
	MONITOR Configure > Router > Routes									
	System Show Active Routes Show ARP Entries									
	Interfaces									
	Traffic Default Route add									
	LOOS The Default Deute has act have use for and									
	The Default Route has not been configured.									
	Configure									
	Static Routes add									
	Interfaces There are currently no Static Routes in the list									
	Router									
	Firewall Configuration Nat									
	VPN Refresh Saved									
	QoS									

Step	Description	
25.	<ul> <li>In the Configure &gt; Router &gt; Routing &gt; Route Configuration page that Name to SiteB-Voice, Destination IP Address to 192.45.72.0, Subnet I 255.255.255.0, Gateway IP Address to 40.1.1.2, select ipwan-1 in the Interface list and click OK.</li> </ul>	appears, set Mask to Gateway
	MUNITOR       Add Static Route         System       Add Static Route         Interfaces       SiteB-Voice         Logs       Destination IP Address         System       Subnet Mask         System       Gateway IP Address         Interfaces       IP Interface List         Router       IP Interface List         Interfaces       IP Interface List         Router       IP Interface List         Ippan 192, 45, 70, 2 Trusted       IP Interface List         Ippan 192, 45, 70, 2 Trusted       IP Interface List         Ippan 0, 0, 0 Untrusted       IP Interface List         Ippan 0, 0, 0 Untrusted       IP Interface List         Ippan 0, 0, 0       Interface         Ippan	
26.	In the Configure > Router > Routes page that appears again, click Add	I for Static
	Routes.	

Step	Description										
27.	In the Configure > Rout	ter > Routing > Route Configuration page that appears, set									
	Name to SiteB-Data, Destination IP Address to 192.45.73.0, Subnet Mask to										
	255.255.255.0, Gateway IP Address to 40.1.1.2, select ipwan-1 in the Gateway										
	Interface list and click	list and click <b>OK</b> .									
	MONITOR	Configure > Router > Routing > Route Configuration									
	System										
	Interfaces	Add Static Route									
	Traffic	Name SiteB-Data									
	Logs	Destination IP Address 192.45.73.0									
	CONFIGURE	Subnet Mask 255.255.255.0									
	System	Gateway IP Address 40.1.1.2									
	Router	iplan 192.45.70.2 Trusted									
	Firewall	ipwan-1 40.1.1.1 Untrusted ipwan-2 0.0.0.0 Untrusted									
	VPN	Gateway Interface iplan74 192.45.74.2 Trusted									
	QoS										
	Config Change	ad a second s									
	Save Now?	Cost 1									
		OK Cancel Configuration Not Saved									
28	In the Configure > Rout	ter > Routes pages that appears, the newly defined static routes									
	are listed	in routes puges that appears, the newly defined state routes									
	ure noted.										
	Config	ure > Router > Routes									
	System Show	Active Routes Show ARP Entries									
	Traffic Defau	Ilt Route add									
	Logs	afruik Dauta haa wat haan amfuu wad									
	CONFIGURE	erauit Route has not been configureu.									
	System	- Pourtos add									
	Interfaces	s nonces and									
	Router	tame Destination Net Mask Gateway Interface Cost Configure									
	VPN Site	B-Voice 192,45,72,0 255,255,55,0 40,11,2 ipwan-1 1 ≪Make Selection> ▼									
		(make Selection)     (0.020,020,00)     (0.01,00)									
	Config Changed										
	Save Now?	afresh Configuration Not Saved									

Step	Description		
29.	Select Firewall $\rightarrow$ Globa	al Settings under CONFIGURE in the tree view. In the	
	Configure > Firewall > C	Global Settings page that appears, uncheck Enable ACL	
	Firewall, uncheck Enable	le Intrusion Detection and click OK.	
	MONITOR	Configure > Firewall > Global Settings	
	System	Advanced Settings	
	Interfaces		
	Traffic	Firewall Settings <u>check all</u>	
	Logs		
	CONFICURE	Enable ACL Firewall	
	Sustem	Enable Intrusion Detection	
	Interfaces	Firewall Logs	
	Bester		
	Router	Enable Session Log 🔽	
	Firewall	Enable Blocking Log 🗹	
	VPN	Enable Intrusion Log	
	QoS		
	Config Changed		
	Save Now?	OK Cancel Apply Saved	
	NOTE: The firewall set	tings were disabled for the purposes of the test configuration	i
	and these Application No	otes therefore document this step. However, it is not necessa	ıry
20			2
30.	Click <b>OK</b> at the Disablin	ing the Firewall leaves the LAN and the Router unprotected.	
	popup that appears.		

<ul> <li>31. Select Router → NAT under CONFIGURE in the tree view. In the Configure &gt; Router &gt; NAT page that appears, uncheck NAT and click OK.</li> <li>Select Router → NAT under CONFIGURE in the tree view. In the Configuration and these Application Notes therefore document this step. However, it is not necessary to do so.</li> <li>32. Click OK at the 'Changing the NAT configuration will terminate the session. Do you want to continue?' popup that appears.</li> <li>33. Select QoS Summary.</li> </ul>
Router > NAT page that appears, uncheck NAT and click OK.         Image: constraint of the second sector of the s
<ul> <li>Second and the second se</li></ul>
<ul> <li>NOTE: The NAT settings were disabled for the purposes of the test configuration and these Application Notes therefore document this step. However, it is not necessary to do so.</li> <li>Click OK at the 'Changing the NAT configuration will terminate the session. Do you want to continue?' popup that appears.</li> <li>Select QoS under CONFIGURE in the tree view. In the Configure &gt; QoS page that appears, click QoS Summary.</li> </ul>
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<ul> <li>NOTE: The NAT settings were disabled for the purposes of the test configuration and these Application Notes therefore document this step. However, it is not necessary to do so.</li> <li>Click OK at the 'Changing the NAT configuration will terminate the session. Do you want to continue?' popup that appears.</li> <li>Select QoS under CONFIGURE in the tree view. In the Configure &gt; QoS page that appears.</li> <li>Select QoS summary.</li> </ul>
<ul> <li>NOTE: The NAT settings were disabled for the purposes of the test configuration and these Application Notes therefore document this step. However, it is not necessary to do so.</li> <li>Click OK at the 'Changing the NAT configuration will terminate the session. Do you want to continue?' popup that appears.</li> <li>Select QoS under CONFIGURE in the tree view. In the Configure &gt; QoS page that appears, click QoS Summary.</li> </ul>
<ul> <li>Isother in the second se</li></ul>
System       If briefs and the stand         If briefs and the stand       If briefs and the stand         VIN       Use of the stand the stand         UN       Use of the stand the stand         VIN       Use of the stand the stand         UN       Use of the stand the stand         VIN       Use of the stand the
Interfaces       Interfaces <thinterfaces< th=""> <thinterfaces< th=""> <thinterfaces< th=""></thinterfaces<></thinterfaces<></thinterfaces<>
32.       Click OK at the 'Changing the NAT configuration will terminate the session. Do you want to continue?' popup that appears.         33.       Select QoS summary.         Select QoS summary.
WN       WN <td< th=""></td<>
Q05       IP before       NAT to Cold       2010 Cold       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration         Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Configuration         2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Image: 2010 Cold       Image
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Norte: Induction in the second problem in the area currently no Magned P address configued.         Image: I
Image: Displayed Displaye
<ul> <li>NOTE: The NAT settings were disabled for the purposes of the test configuration and these Application Notes therefore document this step. However, it is not necessary to do so.</li> <li>Click OK at the 'Changing the NAT configuration will terminate the session. Do you want to continue?' popup that appears.</li> <li>Select QoS under CONFIGURE in the tree view. In the Configure &gt; QoS page that appears, click QoS Summary.</li> </ul>
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<ul> <li>32. Click OK at the 'Changing the NAT configuration will terminate the session. Do you want to continue?' popup that appears.</li> <li>33. Select QoS under CONFIGURE in the tree view. In the Configure &gt; QoS page that appears, click QoS Summary.</li> </ul>
want to continue?' popup that appears.         33.       Select QoS under CONFIGURE in the tree view. In the Configure > QoS page that appears, click QoS Summary.         Image: Configure > QoS         System       QoS Summary         Interfaces       Quality of Service         Use QoS to make the best use of your WAN bandwidth by prioritizing and policing the traffic to and from the LAN.         The Router's QoS functionality is based on the Differentiated Services (DiffServ) architecture.         System       QoS Summary         DSCP Map
33. Select QoS under CONFIGURE in the tree view. In the Configure > QoS page that appears, click QoS Summary.          MONITOR       Configure > QoS         System       QoS Summary         Interfaces       Quality of Service         Use QoS to make the best use of your WAN bandwidth by prioritizing and policing the traffic to and from the LAN.         The Router's QoS functionality is based on the Differentiated Services (DiffServ) architecture.         ONFIGURE         System         Interfaces         QoS Summary         DSCP Map
appears, click QoS Summary.         MONITOR       Configure > QoS         System       QoS Summary         Interfaces       Quality of Service         Logs       Use QoS to make the best use of your WAN bandwidth by prioritizing and policing the traffic to and from the LAN.         The Router's QoS functionality is based on the Differentiated Services (DiffServ) architecture.       OSS Summary         System       QoS Summary       DSCP Map
MONITOR       Configure > QoS         System       QoS Summary         Interfaces       Quality of Service         Logs       Use QoS to make the best use of your WAN bandwidth by prioritizing and policing the traffic to and from the LAN.         CONFFGURE       System       QoS Summary         Interfaces       DSCP Map
MONITOR       Configure > QoS         System       QoS Summary         Interfaces       Quality of Service         Logs       Use QoS to make the best use of your WAN bandwidth by prioritizing and policing the traffic to and from the LAN.         CONFIGURE       The Router's QoS functionality is based on the Differentiated Services (Diffserv) architecture.         System       QoS Summary         Interfaces       DSCP Map
Moture     QoS Summary       System     QoS Summary       Interfaces     Quality of Service       Logs     Use QoS to make the best use of your WAN bandwidth by prioritizing and policing the traffic to and from the LAN.       CONFIGURE     The Router's QoS functionality is based on the Differentiated Services (DiffServ) architecture.       System     QoS Summary       Interfaces     DSCP Map
Interfaces       Quality of Service         Logs       Use QoS to make the best use of your WAN bandwidth by prioritizing and policing the traffic to and from the LAN.         CONFIGURE       The Router's QoS functionality is based on the Differentiated Services (DiffServ) architecture.         System       QoS Summary       DSCP Map
Intraine       Quality of Service         Logs       Use QoS to make the best use of your WAN bandwidth by prioritizing and policing the traffic to and from the LAN.         CONFIGURE       The Router's QoS functionality is based on the Differentiated Services (DiffServ) architecture.         System       QoS summary         Interfaces       DSCP Map
CONFIGURE     The Router's QoS functionality is based on the Differentiated Services (DiffServ) architecture.       System     QoS Summary     DSCP Map
System         QoS Summary         DSCP Map
Interfaces
Router Use the QoS Summary page to access the QoS Config Summary Use the DSCP Map page to edit the Per Hop Behavior (PHB) for each
Firewall         table. From the summary table you can make changes to the QoS         interface. Each mapped DSCP can be assigned one of seven PHB           configuration by adjusting the bandwidth, configuring policies, and         classes.
VPN enabling or disabling QdS.
QoS Interface Configuration
Policies can be used to control access to certain services, such as the Your system has multiple interfaces eligible for QoS settings. bandwidth available for web surfing. Policies are applied based on a
Interface types include ipwan, iplan, ipdicis, and ipPPP. Each interface set of match attributes such as name, rank, source and destination can be configured manually or automatically for bandwidth, and you address, application and DSCP value. For example, traffic received
can enable or disable QoS on each interface. from the WAN could be controlled by a QoS policy, and traffic transmitted to the WAN could be controlled by shaping. Both traffic
flows could then be controlled by a single policy.
Policy

SCR; Reviewed: SPOC 8/30/2005

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25 of 39 kentrox-ipofr.doc

Step	Description										
34.	In the Configu	re > QoS >	QoS	Config	g Sumn	hary page	that a	opears,	click I	Policie	s for
the Interface iplan [192.45.70.2].											
	-	-		-							
	MONITOR	Configure > QoS >	> QoS Co	nfig Summar	y						
	System	-									
	Interfaces	QoS Config Summa	ary								
	Traffic									Carlash	
	Logs	interrace	IfType	Layer-2	[kbps]	Configured	Configured	QoS Enabled	Televier	Controis	Delision
	CONFIGURE	ipian [192.45.70.2]	Wan	Yes	1536	No	3	Yes	Interface	DscpMap	Policies
	System	ipwan-1 [40.1.1.1]	Wan	Yes	1536	Yes	1	Yes	Interface	DscpMap	Policies
	Pouter	ipwan-2 [0.0.0.0]	Wan	Yes	1536	Yes	1	Yes	Interface	DscpMap	Policies
	Firewall	iplan74 [192.45.74.2]	Lan	Yes	100000	Yes	1	Yes	Interface	<u>DscpMap</u>	Policies
	VPN										
	QoS	Refresh CO	nfigurat	ion Not Sav	ed						
	Config Changed	I			•						
	Save Now?										
35.	In the Configu	re > QoS >	QoS	Config	g Sumn	nary > Qo	oS Poli	cies pag	ge that	appea	rs,
	click Add QoS	S Policy.									
	MONITOR	Configure > QoS >	· QoS Cor	nfig Summary 🔅	> QoS Policies						
	System	Add QoS Policy									
	Traffic	Current QoS Policy	Configur	ations : iplan							
	Logs	Chakar	News	Bardh	C		- store Address	A8	. Dece	Contrate	
	CONFIGURE	enabled ip	olan-default	65535	any	Desti	any	any	any	Edit	
	Interfaces										_
	Router	Refresh									
	Firewall										
	QoS										
		-									

Step	Description									
36.	In the Configure > QoS > QoS Config Summary > QoS Policies > Add QoS Policy									
	page that appears, set Policy Name to MapDSCP34to46, Rank to 1, Source Address to									
	any, Destination Address to any, Application to any, DSCP Match Option to									
	erEntered, DSCP Match Value to 34, DSCP Marking Option to userEntered,									
	DSCP Marking Value to 46, check Enable Policy, check Enable DSCP Marking and									
	click Create.									
	Configure > OnS > OnS Config Summary > OnS Policies > add OnS Policy									
	MONITOR System									
	Interfaces QoS Policy Match Configuration : iplan QoS Attributes Configuration :									
	Traffic         Policy Name         MapDSCP34666         Enable DSCP Marking         Image: Comparison of the second s									
	Logs Rank [0-65535] 1 DSCP Marking Option userEntered V									
	CONFIGURE Source Address any  DSCP Marking Value [0-63]  46 Sustem									
	Interfaces Application Address any Enable Policing									
	Router DSCP Match Option userEnkered									
	Firewall DSCP Match Value [0-63/any] 34									
	VPN Enable Policy									
	QoS									
	Create Cancel									
	<b>NOTE</b> : The O-Series routers keen traffic marked with DSCP 46 (FF) in its own									
	priority queue However DSCP 34 (AFA) marked traffic is kent in a Weighted Fair									
	Queue (WEQ) with all other DSCP values. High traffic scenarios negatively impact									
	call signaling traffic when it is kent in the WEO. To ensure highest priority for both									
	signaling and audio, a policy was created to map DSCP 34 to 46 at both the corporate									
	and branch sites O Series routers. This ensures that signaling and audio peakets are									
	and branch sites Q-Series routers. This ensures that signaling and audio packets are transmitted using the priority queue, instead of the WFQ. However, this is not required for most non VolD installations.									
27	In the Configure $\geq OoS \geq OoS$ Config Summary $\geq OoS$ Policies note that annears the									
57.	ni the Configure > Qos > Qos Config Summary > Qos Poncies page that appears, the									
	newly added policy is listed.									
	Configure > QoS > QoS Config Summary > QoS Policies									
	System Add QoS Policy									
	Interfaces Traffic Current QoS Policy Configurations : iplan									
	Logs Status Name Rank Source Address Destination Address Application DSCP Controls									
	CONFIGURE         enabled         MapDsCP340x46         1         any         any         any         34         Edit         Delete           System         enabled         iplan-default         65535         any         any         any         any         Edit									
	Interfaces									
	Rotter         Refeat         Configuration Not Saved									
	Config Changed									
	Save Now?									
28	Select System - Save Config under CONFICURE in the tree view to save the									
30.	Select System $\rightarrow$ Save Coming under CONFIGURE in the tree view to save the									

Step	Description										
39.	Select $QoS \rightarrow QoS$ Summary under CONFIGURE in the tree view. In the Configure										
	> QoS > QoS Config Summary page that appears, click <b>Interface</b> for the Interface										
	ipwan-1 [40.1.1.1].										
	MONITOR     Configure > QoS > QoS Config Summary       System     QoS Config Summary										
	Traffic	Interface	QoS IfType	Attached to Layer-2	Bandwidth [kbps]	Bandwidth Auto- Configured	Policies Configured	QoS Enabled		Controls	
	CONFIGURE	iplan [192.45.70.2]	Lan	Yes	100000	Yes	3	Yes	Interface	<u>DscpMap</u>	Policies
	System	ipwan [0.0.0.0]	Wan	Yes	1536	No	1	Yes	Interface	<u>DscpMap</u>	Policies
	Interfaces	ipwan-1 [40.1.1.1]	Wan	Yes	1536	Yes	1	Yes	Interface	<u>DscpMap</u>	Policies
	Router	ipwan-2 [0.0.0.0]	Wan	Yes	1536	Yes	1	Yes	Interface	<u>DscpMap</u>	Policies
	Firewall	iplan74 [192.45.74.2]	Lan	Yes	100000	Yes	1	Yes	Interface	<u>DscpMap</u>	Policies
	VPN										
	QoS	Refresh									
		L. L									

	Configure > QoS > QoS Config Summary > QoS Interface Configuration								
	System	QoS Interface Configuration : ipwan-1 <u>edit</u>							
	Traffic	0-6.16							
	Logs	Qos Ir Attach	i ype ed to Lay	er-2	Yes				
	CONFIGURE	Bandw	idth		1536 kbps				
	System	Bandw	idth Auto	-Configure	ed <sup>Y</sup> es				
	Interfaces	Policíe: QoS En	s Contigu abled	ređ	r Yes				
	Router								
	Firewall	PHB C	onfigur	ation Su	immary				
	VPN		ornga		ininiai y				
	QoS	Name	Min B\W	Max BM/	Enable Remarking	Remarking Type	DSCP/Precedence	Enable Shaning	Controls
						_			
		be	5 %	100 %	No	Dscp	U	Yes	Show
		be af1	5 % 12 %	100 %	No	Dscp	10	Yes	Show Show
		be af1 af2	5 % 12 % 12 %	100 % 100 % 100 %	No No No	Dscp Dscp Dscp	10	Yes Yes Yes	Show Show
		be af1 af2 af3	5 % 12 % 12 % 12 %	100 % 100 % 100 % 100 %	No No No	Dscp Dscp Dscp Dscp	10 18 26	Yes Yes Yes Yes	Show Show Show
		be af1 af2 af3 af4	5 % 12 % 12 % 12 % 25 %	100 % 100 % 100 % 100 %	No No No No	Dscp Dscp Dscp Dscp Dscp	10 18 26 34	Yes Yes Yes Yes Yes	Show Show Show Show
		be af1 af2 af3 af4 ef	5 % 12 % 12 % 12 % 25 %	100 % 100 % 100 % 100 % 100 %	No No No No No	Dscp Dscp Dscp Dscp Dscp Dscp	0 10 18 26 34 46	Yes Yes Yes Yes Yes Yes	Show Show Show Show Show

### 5.2. Kentrox Q2200 in Branch Office Site

This section provides the configuration of the Q2200 in the branch Office Site. The Q2400 browser based administrative interface is the same for the Q2200. Therefore, screenshots have been omitted for most steps in this section.

Step	Description
1.	To configure the Kentrox Q2200, launch Internet Explorer from a PC directly
	connected to the Q2200. Initially, the Q2200 is assigned an IP address 192.168.1.1
	with a subnet mask of 255.255.255.0. Log into the Q2200 using the appropriate
	credentials when the Q2200 authentication window appears.

Step	Description
2.	Once successfully authenticated, the Q2200 main window is displayed. All of the
	configuration options are selected from the tree view on the left side of the Q2200
	main window.
3.	To disable the Q2200 DHCP Server, select <b>Router</b> $\rightarrow$ <b>DHCP</b> under CONFIGURE in
	the tree view. In the Configure > Router > DHCP page that appears, select <b>Disable</b>
	<b>DHCP</b> from the Configuration pull-down menu for the DHCP Server.
4.	Click <b>OK</b> at the 'This will disable DHCP. Are you sure?' popup that appears.
5.	In the Configure > Router > DHCP page that appears, the message 'DHCP Operations
	Disabled' now appears for the DHCP Configuration.
6.	To configure the IP address on the Q2200, select Interfaces $\rightarrow$ Ethernet Ports 1-4
	under CONFIGURE in the tree view. In the Configure > Interfaces > Ethernet Ports 1-
	4 page that appears, select Edit IP in the Controls pull-down menu for IP address
	192.168.1.1. <b>NOTE</b> : In the configuration used for these Application Notes, the PC
	used to initially configure the Q2200 was directly connected to Port 1 and the Layer 2
	switch connected to the Q2200 was connected to Port 4.
7.	In the Configure > Interfaces > Ethernet Ports 1-4 > IP Configuration page that
	appears, set IP Address to 192.45.72.1, Subnet Mask to 255.255.255.0 and click OK.
8.	Change the IP address of the PC directly connected to the Q2200, browse to
	192.45.72.1 and log in again into the Q2200.
9.	Select Interfaces $\rightarrow$ Ethernet Ports 1-4 under CONFIGURE in the tree view. In the
	Configure > Interfaces > Ethernet Ports 1-4 page that appears, select Switch to VLAN
	in the Configuration pull-down menu for LAN Layer 2 Switch Interface.
10.	Click <b>OK</b> at the 'This will detach the IP interface and disrupt traffic. Are you sure?'
	popup that appears.
11.	Configure VLAN 72 in the Configure > Interfaces > Ethernet Ports 1-4 > VLAN
	Configuration page that appears. Set VLAN Name to VLAN-72-73, VLAN ID to 72,
	check Port 1 Enable, check Port 4 Enable, and click OK.
12.	This change causes the connection to the browser to drop. Browse to 192.45.72.1 and
	log in again into the Q2200.
13.	Select Interfaces $\rightarrow$ Ethernet Ports 1-4 under CONFIGURE in the tree view. In the
	Configure > Interfaces > Ethernet Ports 1-4 page that appears, select <b>Edit</b> in the
	Configuration pull-down menu for LAN Layer 2 Switch Interface.
14.	In the Configure > Interfaces > Ethernet Ports 1-4 > Edit Ethernet Configuration page
	that appears, set Port 4 VLAN Link Mode to <b>trunk</b> and click <b>OK</b> .
	<b>NOTE:</b> The port on the Layer-2 switch connecting to port 4 on the Q2200 was
	configured for 802.1q (VLAN) mode. This allows VLAN header information to be
	exchanged between the switch at the branch site and the Q2200. The branch site
1.5	contains voice VLAN /2 and data VLAN /3.
15.	In the Configure > Interfaces > Ethernet Ports 1-4 page that appears, select Add
	<b>VLAN</b> in the Configuration pull-down menu for LAN Layer 2 Switch Interface.

Step	Description				
16.	Configure VLAN 73 in the Configure > Interfaces > Ethernet Ports 1-4 > VLAN				
	Configuration page that appears. Set VLAN Name to VLAN-73-72, VLAN ID to 73,				
	check Port 4 Enable, IP I/F Name to iplan73, IP Address to 192.45.73.1, Subnet Mask				
	to <b>255.255.255.0</b> , and click <b>OK</b> .				
17.	In the Configure > Interfaces > T1 Port 1 page, select <b>Edit T1</b> in the Controls pull-				
	down menu for T1 Port Name <b>t1-1</b> .				
18.	In the Configure > Interfaces > T1 Port 1 > Edit T1 Configuration page that appears, configure the line settings needed to connect the T1 to the WAN and click <b>OK</b> .				
	KENTROX Q2200 Customer Location Help Log Out Online Support				
	Configure > Interfaces > T1 Port 1 > Edit T1 Configuration				
	System				
	Interfaces Edit T1 Configuration - Kentrox Q2200 T1 interface t1-1 Edit Channel Configuration				
	IPartic         Interface Enable         LinkUp         Bandwidth         24 channels, 1536 kbps           Logs         The control of th				
	Alias II to Corpste DS0 End Channel 24 v				
	System Line Type ESF V DS0 Speed [kbps] 64 V				
	Interfaces         Line Coding         B825           Router         Line Build Out         Short Haul: 0-133 Ft				
	Firewall Transmit Clock Source LoopTiming				
	VPN Loopback Configuration None				
	QoS FDL Mode None				
	Config Changed     Excessive Error Threshold     12       Save Now?     Line Status Change Trap				
	Link Up/Down Trap				
	Refresh Ok Cancel				
19	In the Configure $>$ Interfaces $>$ T1 Ports 1-2 page select Add DLCL in the Controls				
17.	null-down menu for Frame Relay I/F Name <b>fr-2</b>				
	KENTROX Q2200 Customer Location Help Log Quit Opline Surgert				
	Configure > Interfaces > T1 Part 1				
	System Show Discovered DLCIs				
	Interfaces				
	Traffic T1 Interfaces Configuration hide all				
	CONIETCITIEE T1 Port Name Status Line Type Line Coding Line Build Out Transmit Clock Loopback Controls				
	System - t1-1 • LinkDown ESF B825 Short Haul: 0-133 R LocalTiming None <make selection=""> •</make>				
	Interfaces DS0 Channels Bandwidth				
	Router         Port 1         2         3         5         6         7         8         10         11         12         15         16         17         18         19         20         21         22         23         24           Firewall         Port 1         D				
	VPN Frame Relay I/F Name Status LMI Type LMI Status Link Up/Down Frame Relay Frame Relay Controls				
	QoS fr-2 inkDown AutoDetect Faulted Disabled 0 msecs Ake Selections				
	Config Changed Edit Frame				
	Refresh Configuration Not Saved				

Step	Description				
20.	In the Configure > Interfaces > T1 Port 1 > DLCI Configuration page that appears, set				
	DLCI I/F Name to dlci-100, DLCI to 100, Encapsulation to RFC-1490, Committed				
	Information Rate [kbps] to 1536, Far-End IP Address (Static) to 40.1.1.1, IP I/F Name				
	to ipwan, IP Address to 40.1.1.2, Subnet Mask to 255.255.255.0, check Enable				
	Inverse ARP and click OK.				
	Hele Log Out Online Support				
	MONITOR Configure > Interfaces > T1 Port 1 > DLCI Configuration				
	System         Add DLCI Configuration         IP Configuration				
	Traffic DLCI I/F Name • dlr:-100 Existing IP Interfaces < New IP Interface > •				
	Logs (Must be unique, ex: DLCI-101) IP I/F Name * ipwan Alias (Must be unique, ex: IP-32)				
	CONFIGURE DLCI * 100 IP Address * 40.1.1.2				
	Interfaces Encapsulation RFC-1490 Subnet Mask * 255.255.0				
	Router Far-end IP Address (Static) 40.1.1.1				
	VPN Enable Inverse ARP				
	QoS * Required Field				
	Config Changed				
	OK Cancel Saved				
21.	Select <b>Router</b> $\rightarrow$ <b>Routes</b> under CONFIGURE in the tree view. In the Configure >				
	Router > Routes page that appears, click Add for Default Route.				
22.	In the Configure > Router > Routing > Route Configuration page that appears, set				
	Name to default, Gateway IP Address to 40.1.1.1, select ipwan in the Gateway				
	<i>Interface</i> list and click <b>OK</b> .				
23.	Select Interfaces $\rightarrow$ T1 Port 1 under CONFIGURE in the tree view. In the Configure				
	> Interfaces > T1 Port 1 page that appears, select <b>Switch to Frame</b> in the Controls				
	pull-down menu for T1 Port Name <b>t1-1</b> .				
24.	In the "This will delete the PPP interface and the IP interface. Are you sure?"				
	popup that appears, click <b>OK</b> .				

Step	Description				
25.	In the Configure > Interfaces > T1 Port 1 > Frame Relay Configuration page that				
	appears, configure the frame relay settings needed to connect the T1 to the WAN and				
	click <b>OK</b> .				
	KENTROX Q2200 Customer Location Help Log Out Online Support				
	MONITOR Configure > Interfaces > T1 Port 1 > Frame Relay Configuration				
	System Add Frame Relay Configuration Link Management Settings				
	Traffic				
	Logs     Frame Relay I/F Name     * [r-2]     T391 Polling Interval [secs]     10       Logs     (Must be unique, ex: FR-2)     N391 Full Inguiry Interval [polling intervals]     6				
	CONFIGURE     Alias       LMI Type     Auto Detect   N392 Error Threshold [errors]				
	System         N393 Monitored Events         4           Interfaces         Viel the (Own Target)         4				
	Router Frame Relay Status Trap				
	Firewall     Frame Relay Trap Rate [msecs]     0				
	QoS * Required Field				
	Config Changed				
	Save Now?				
26.	Select <b>Firewall</b> $\rightarrow$ <b>Global Settings</b> under CONFIGURE in the tree view. In the				
	Configure > Firewall > Global Settings page that appears, uncheck <b>Enable ACL</b>				
	Firewall, uncheck Enable Intrusion Detection and click OK.				
	<b>NOTE</b> : The firewall settings were disabled for the purposes of the test configuration				
	and these Application Notes therefore document this step. However, it is not necessary				
	to do so.				
27.	Click <b>OK</b> at the 'Disabling the Firewall leaves the LAN and the Router unprotected.'				
	popup that appears.				
28.	Select <b>Router</b> $\rightarrow$ <b>NAT</b> under CONFIGURE in the tree view. In the Configure >				
	Router > NAT page that appears, uncheck <b>NAT</b> and click <b>OK</b> .				
	<b>NOTE:</b> The NAT settings were disabled for the purposes of the test configuration and				
	these Application Notes therefore document this step. However, it is not necessary to				
20	$\begin{array}{c} 0 0 \\ 0 0 \\ $				
29.	Click <b>OK</b> at the Changing the NAT configuration will terminate the session. Do you				
20	want to continue? popup that appears. Select $O_2 S$ and $I_2 O_2 S$ and $I_2$				
30.	select Qos under CONFIGURE in the tree view. In the Configure > Qos page that				
21	appears, click Q05 Summary.				
31.	In the Configure > Qos > Qos Config Summary page that appears, click <b>Policies</b> for				
20	In the Configure > OoS > OoS Config Summary > OoS Deligies note that any set				
32.	In the Configure > QoS > QoS Config Summary > QoS Policies page that appears,				
	CIICK Add QOS POIICY.				

Step	Description				
33.	<ul> <li>In the Configure &gt; QoS &gt; QoS Config Summary &gt; QoS Policies &gt; Add QoS Policy page that appears, set <i>Policy Name</i> to MapDSCP34to46, <i>Rank</i> to 1, <i>Source Address</i> to any, <i>Destination Address</i> to any, <i>Application</i> to any, <i>DSCP Match Option</i> to userEntered, <i>DSCP Match Value</i> to 34, <i>DSCP Marking Option</i> to userEntered, <i>DSCP Marking Value</i> to 46, check Enable Policy, check Enable DSCP Marking and click Create.</li> </ul>				
	<b>NOTE</b> : The Q-Series routers keep traffic marked with DSCP 46 (EF) in its own priority queue. However, DSCP 34 (AF4) marked traffic is kept in a Weighted Fair Queue (WFQ) with all other DSCP values. High traffic scenarios negatively impact call-signaling traffic when it is kept in the WFQ. To ensure highest priority for both signaling and audio, a policy was created to map DSCP 34 to 46 at both the corporate and branch sites Q-Series routers. This ensures that signaling and audio packets are transmitted using the priority queue, instead of the WFQ. However, this is not required for most non-VoIP installations				
34.	In the Configure > QoS > QoS Config Summary > QoS Policies page that appears, the newly added policy is listed.				
35.	Select <b>Router</b> $\rightarrow$ <b>DHCP</b> under CONFIGURE in the tree view. In the Configure > Router > DHCP page that appears, the message 'DHCP Operations Disabled' now appears for the DHCP Configuration. Select <b>Enable DHCP Relay</b> from the Configuration pull-down menu.				
	KENTRO       Q2200       Customer Location       Hele       Log Out       deg         MONITOR       Configure > Router > DHCP </th				
	branch office.				
36.	Click <b>OK</b> at the 'This will clear all DHCP configuration. Are you sure?' popup that appears.				

Step	Description		
37.	In the Configure > Router > DHC	P page that appears, the message 'T	here are no
	remote servers configured for DH	CP Relay' now appears for the DHC	CP Configuration.
	Select Add Remote DHCP Serve	<b>r</b> from the Configuration pull-dowr	n menu.
	KENTROX Q2200	Customer Location	Help Log Out C
	Configure > Router > DHCP		
	System		
	Interfaces DHCP Configuration		
	Traffic	Current Operation	Configuration
	Logs	DHCP Relay	<make selection=""></make>
	CONFIGURE Remote DHCP Se System	rver Address Security Zone There are no remote servers configured for DHCP Relay	<make selection=""> Add Remote DHCP Server Add DHCP Relay Interface</make>
	Interfaces	DHCP Relay Interfaces	Enable DHCP Server Disable DHCP
	Router	iplan [192.45.72.1] (Trusted)	<make selection=""></make>
	Firewall	ipwan [40.1.1.2] (Untrusted)	
	QoS Refeth	runation Not Saved	
38	In the Configure > Pouter > DHC	P > A dd Permote DHCP Server page	a that appears sat
50.	Pamota DHCP Samuer to 102 45 7	<b>0</b> 28 and aliak <b>OK</b>	c mai appears, sei
	Remote DITCI Server to 192.43.7		
	KENTROX Q220	Customer Locati	on
	Con	figure > Router > DHCP > Add Remote DHCP Server	
	NONITOR		
	Interfaces Add	l Remote DHCP Server	
	Traffic		
	Logs Ente	er IP address and security zone of DHCP server.	
	Ren	note DHCP Server 192.45.70.38	
	CONFIGURE	urity Zone	
	System		
	Interfaces		
	Router	OK Cancel Configuration Not	
	Firewait	i i	
	QOS		
39.	Select System $\rightarrow$ System Restart	under CONFIGURE in the tree vie	w. In the
	Configure > System > System Res	start page that appears, click <b>OK</b> to	save the
	configuration and restart the Q220	00.	
40.	This change causes the connection	to the browser to drop. Browse to	192.45.72.1 and
	log in again into the Q2200.	-	
41.	Select $QoS \rightarrow QoS$ Summary un	der CONFIGURE in the tree view.	In the Configure
	> QoS > QoS Config Summary pa	ge that appears, click Interface for	the Interface
	ipwan [40.1.1.2].		

Step	Description
42.	In the Configure > QoS > QoS Config Summary > QoS Interface Configuration page
	that appears, the QoS configuration for the ipwan interface is listed. Modify the
	Bandwidth for the link and/or each DSCP value as necessary.
	<b>NOTE</b> : By default, the Q-Series routers perform traffic shaping on the traffic going through the WAN interface. DSCP 46 (EF) traffic is limited to 33% of the bandwidth. According to Kentrox, these default settings are optimal for the targeted small and/or low traffic configurations the products are intended for. The reader is advised to make the appropriate modifications for their own environment.

### 6. Interoperability Compliance Testing

Interoperability compliance testing covered feature functionality and performance testing. Feature functionality testing focused on the QoS and VLAN implementation in the Avaya/Kentrox configuration. Specifically, compliance testing verified that VoIP media and signaling traffic could be carried together with low priority data traffic on a low traffic serial T-1 link while still achieving good voice quality. Prioritization of voice traffic was achieved by implementing DiffServ-based QoS on a Frame Relay link. Voice and data traffic were segmented in the enterprise network using VLANs.

Performance testing was conducted by generating voice calls with a bulk call generator and data traffic with a data traffic generator to simulate a converged network for a prolonged period of time. The bulk call generator was also used to quantify the speech quality of the VoIP calls. At the end of the performance test, it was verified that the network devices continued to operate successfully for small office scenarios using low traffic serial T-1 links.

### 6.1. General Test Approach

All feature functionality test cases were performed manually. The general test approach entailed verifying the following:

- LAN/WAN connectivity between the Avaya and Kentrox products,
- Registration of Avaya IP Telephones with the Avaya IP Office,
- Verification of the DHCP relay configuration,
- VoIP calls between the corporate and the branch office sites using IP trunks between the sites,
- Inter-office calls using G.711 mu-law and G.729 codec sets, and conferencing, and
- Sending low priority data traffic over the WAN links and verifying that QoS directed the voice signaling and voice media to the higher priority egress queue based on the packets' DSCP value.

The performance tests were performed with a bulk call generator and data traffic generator running simultaneously. The most important verification step was checking voice quality while transmitting low priority data traffic for small office scenarios using low traffic serial T-1 links.

### 6.2. Test Results

All feature functionality and performance test cases passed. The Q-Series QoS implementation (including the signaling packet DSCP remarking) over the Frame Relay link yielded good voice quality. The stability of the Avaya/Kentrox solution was successfully verified through performance tests.

### 7. Verification Steps

This section provides the steps for verifying end-to-end network connectivity and QoS in the field from the perspective of the Q-Series routers. In general, the verification steps include:

- 1. Verify IP communication from the Q-Series router to the following network devices and interfaces by using the **ping** command.
  - Ping the Avaya IP Office.
  - Ping the Avaya IP telephones registered to the Avaya IP Office.
  - Ping the DHCP server.
- 2. Check that the Avaya IP Telephones have successfully registered using the IP Office **System Monitor**.
- 3. If a Q-Series router is unable to communicate with any of the aforementioned IP devices and interfaces, check the routing and status of the Ethernet and WAN interfaces through the Q-Series browser interface.
- 4. Place calls between the DCP and IP telephones at each site. If the call cannot be established, check the status of the IP trunks on the IP Offices using the IP Office **System Monitor**.
- 5. If the voice quality is poor, check the QoS configuration in the Q-Series routers.

## 8. Support

For technical support on the Kentrox Q-Series routers, contact Kentrox Technical Support using any of the following options:

- Toll-free: (800) 733-5511
- Direct: (503) 643-1681
- Email: <u>care@kentrox.com</u>

## 9. Conclusion

These Application Notes describe the configuration steps required for integrating the Kentrox Q-Series Q2400 and Q2200 routers into a small office and/or low traffic/bandwidth Avaya IP Office infrastructure. For the configuration described in these Application Notes, the Q-Series routers were responsible for enforcing QoS using DiffServ. The Avaya IP Offices delivered the voice traffic to the routers for transmission over the WAN together with data traffic. Good voice quality was successfully achieved in the Avaya/Kentrox configuration described herein.

# 10. Additional References

This section references the Avaya and Kentrox product documentation that are relevant to these Application Notes. The Avaya product documentation can be found at <u>http://support.avaya.com</u> and the Kentrox product documentation can be found at <u>http://www.kentrox.com</u>.

[1] Avaya IP Office 2.1 Manager, Issue 15c, May 2004.

[2] Kentrox QoS Access Router User's Guide, Software Release 1.3, Document #650-00319-03.

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