Avaya Solution & Interoperability Test Lab

Application Notes for Proxim Tsunami(TM) MP.11 WiMAX-Capable Point-to-Multipoint System with Avaya Communication Manager and Avaya IP Telephones in a Multi-Site Converged VoIP and Data Network - Issue 1.0

Abstract

These Application Notes describe a sample configuration of a Voice over IP (VoIP) solution using a Proxim Tsunami MP.11 WiMAX-Capable Point-to-Multipoint System with Avaya Communication Manager and Avaya IP Telephones in a Converged VoIP and Data Network. Proxim Tsunami MP.11 Base Stations (BSU) and Subscriber Units (SU) were compliance-tested with Avaya Communication Manager and Avaya IP Telephones with emphasis placed on verifying voice quality in a converged VoIP and Data network scenario. 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 sample configuration of a Voice over IP (VoIP) solution using a Proxim Tsunami MP.11 WiMAX-Capable Point-to-Multipoint System with Avaya Communication Manager and Avaya IP Telephones in a Converged VoIP and Data Network. Proxim Tsunami MP.11 BSUs and SUs were compliance-tested with Avaya Communication Manager and Avaya IP Telephones with emphasis placed on verifying voice quality in a multi-site converged VoIP and Data network scenario. QoS (Quality of Service) based on 802.1p (Layer 2 Priority) and Layer 3 Differentiated Services was implemented across the network to prioritize voice traffic over the LAN. The Avaya IP Telephones get QoS priority settings from Avaya Communication Manager. The QoS settings are enforced in the network by the Tsunami MP.11 Series Base Station (BSU) and Subscriber Units (SU). Tests were performed by oversubscribing the LAN interfaces with low priority data and verifying that good voice quality was achieved when calls are routed over all LAN interfaces. Compliance testing included QoS, throughput, Open Shortest Path First (OSPF), Direct Media and the G.711 and G.729 codecs.

1.1. Tsunami MP.11 5054-R

The Tsunami MP.11 is a broadband wireless transport system based on WiMAX technology, including Quality of Service to enable smooth delivery of voice, video and data traffic. While WiMAX is generally a technology used by communications service providers, the MP.11 makes WiMAX capabilities available to enterprises through compact form factors and license-free radio frequency bands that are available for enterprise use. The system consists of an outdoor, roof- or pole-mounted Base Stations Unit (BSU) which serves as the hub, and Subscriber Units (SUs) which serve as the remotes.

1.2. Avaya Communication Manager and Proxim Tsunami MP.11

The configuration in **Figure 1** shows a multi-site converged VoIP and Data network with multiple locations configured with VLANs and OSPF.

For compliance testing, the DHCP server function on the Avaya G350 Media Gateway was disabled and a centralized DHCP server was used. To better manage the different traffic types, the voice and data traffic were separated onto different VLANs.

1.3. Campus Headquarters

The Campus Headquarters consists of an Avaya G350 Media Gateway with an Avaya S3800 Media Server running Avaya Communication Manager Software, one Avaya 2400 Series Digital Telephone, two Avaya 9600 Series one-X Deskphone Edition IP Telephones, Proxim Tsunami MP.11 5054-R BSU, Extreme Summit 300-48 and one DHCP/ File Server. The DHCP server provides IP network parameters to the Avaya IP Telephones. The Proxim Tsunami MP.11 5054-R, will enforce QoS policies that it is passed from the network endpoints.

1.4. Campus A

Campus A consists of an Proxim Tsunami MP.11 5054-R SU, Extreme Summit X450e-24p Switch, one Avaya 9620 one-X Deskphone Edition IP Telephone and one Avaya 4620SW IP Telephone on VLAN Voice1 and one PC running Avaya one-X Desktop on VLAN Datavlan1. The Proxim Tsunami MP.11 5054-R, will enforce QoS policies that it is passed from the network endpoints.

1.5. Campus B

Campus B consists of an Proxim Tsunami MP.11 5054-R SU, Extreme Summit X450e-24p Switch, one Avaya 9620 one-X Deskphone Edition IP Telephone and one Avaya 4620SW IP Telephone on VLAN Voice2 and one PC running Avaya one-X Desktop on VLAN Datavlan2. The Proxim Tsunami MP.11 5054-R, will enforce QoS policies that it is passed from the network endpoints.

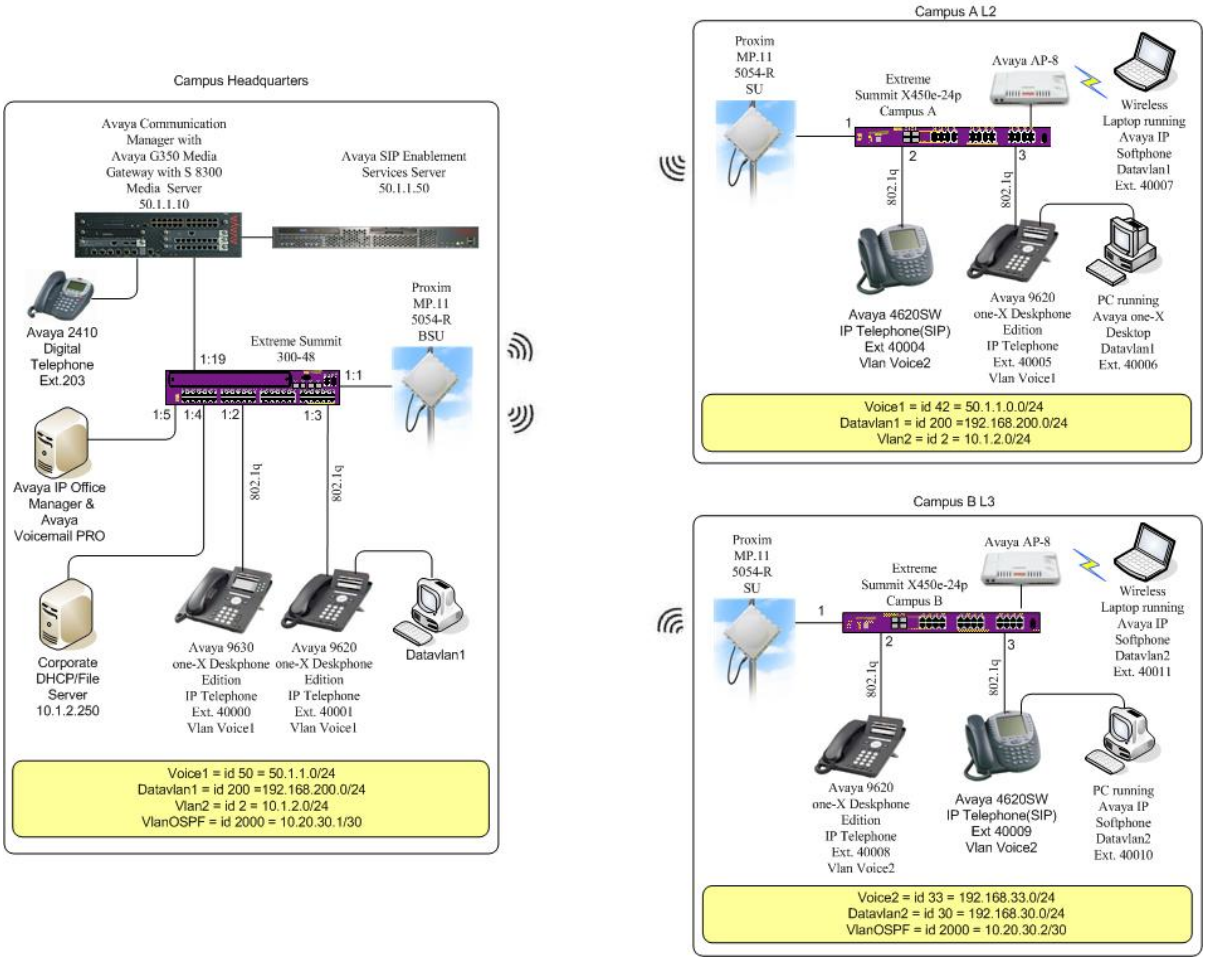


Figure 1: Network Configuration for Avaya Communication Manager and Extreme Summit X450a-24t

2. Equipment and Software Validated

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

Equipment	Software/Firmware
Avaya S8300 Media Server	Avaya Communication Manager 3.1.2 Load 632.1 (R013x.01.2.632.1)
Avaya G350 Media Gateway	25.28.0
Avaya SIP Enablement Services Server	3.1.1
Avaya 4620SW IP Telephones (SIP)	2.2
Avaya 9630 one-X Deskphone Edition IP Telephone with SBM24 24-button module (H.323)	1.2
Avaya 9620 one-X Deskphone Edition IP Telephone (H.323)	1.2
Avaya 2410 Digital Telephone	N/A
Proxim Tsunami MP.11 5054-R	2.5.3 build 221
Extreme Summit X450e24p	ExtremeXOS 11.5.1.4 (FCS code)
Extreme Summit 300-48	ExtremeWare 7.6

3. Configure Avaya Communication Manager

This section illustrates the relevant Avaya Communication Manager configuration.

For detailed information on the installation, maintenance, and configuration of Avaya Communication Manager, please consult references [**1**], [**2**], [**3**] and [**4**].

IP networks were originally designed to carry data on a best-effort delivery basis, which meant that all traffic had equal priority and an equal chance of being delivered in a timely manner. As a result, all traffic had an equal chance of being dropped when congestion occurred. To carry voice, Quality of Service (QoS) has to be implemented throughout the entire network.

In order to achieve good voice quality, the VoIP traffic must be classified. The Avaya S8300 Media Server, Avaya G350 Media Gateway and Avaya IP Telephones support both Layer 2 802.1.p/Q priority and Layer 3 Differentiated Services (DiffServ). The Extreme Summit X450a-24t can be configured to prioritize VoIP traffic based on these values.

All network components are in network region 1 for this sample configuration. The DiffServ and 802.1p/Q values configured here will be downloaded to the Avaya IP Telephones.

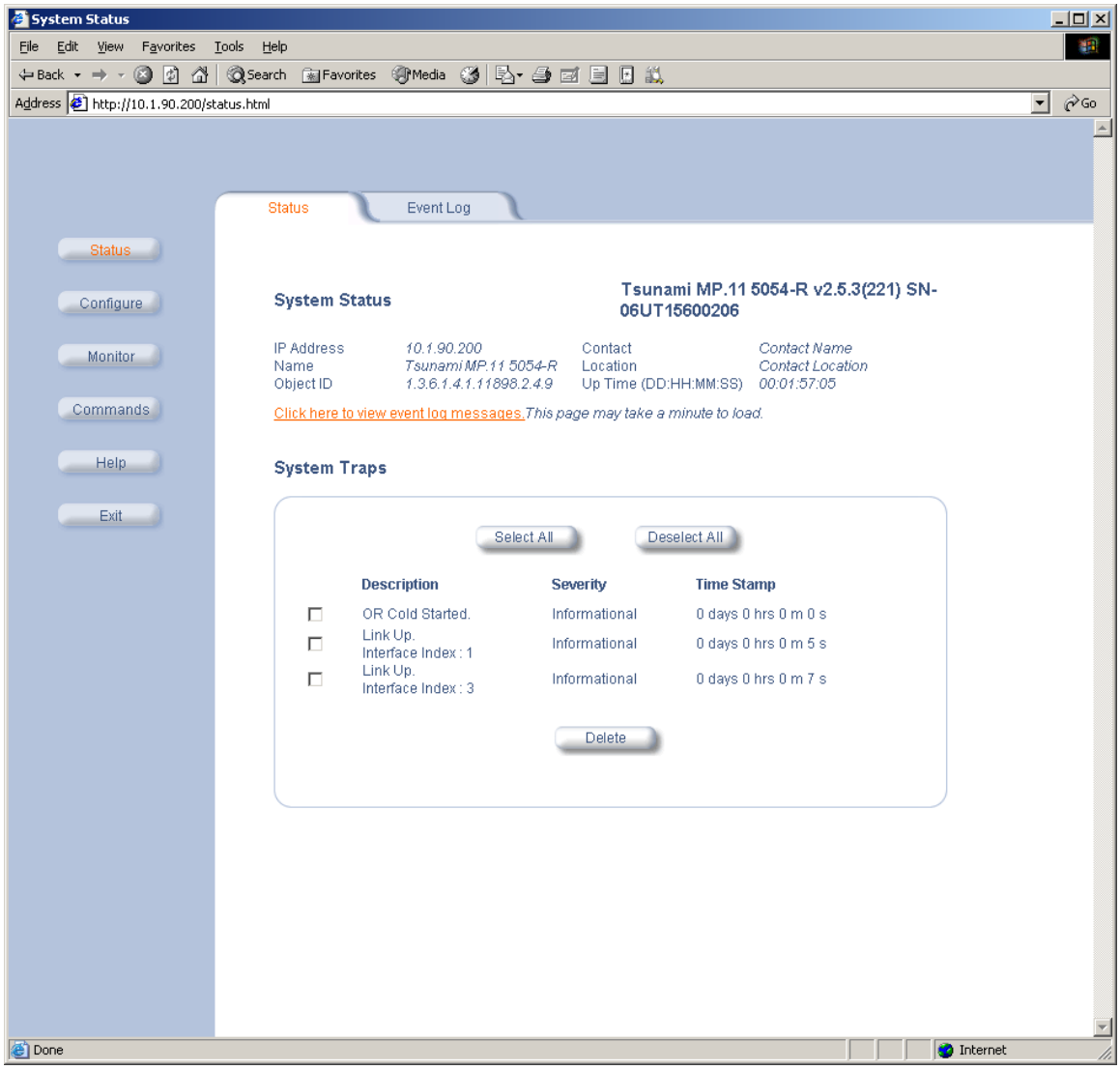
The commands listed in the following section were issued at the Avaya System Access Terminal (SAT) screen to configure the Avaya S8300 Media Server.

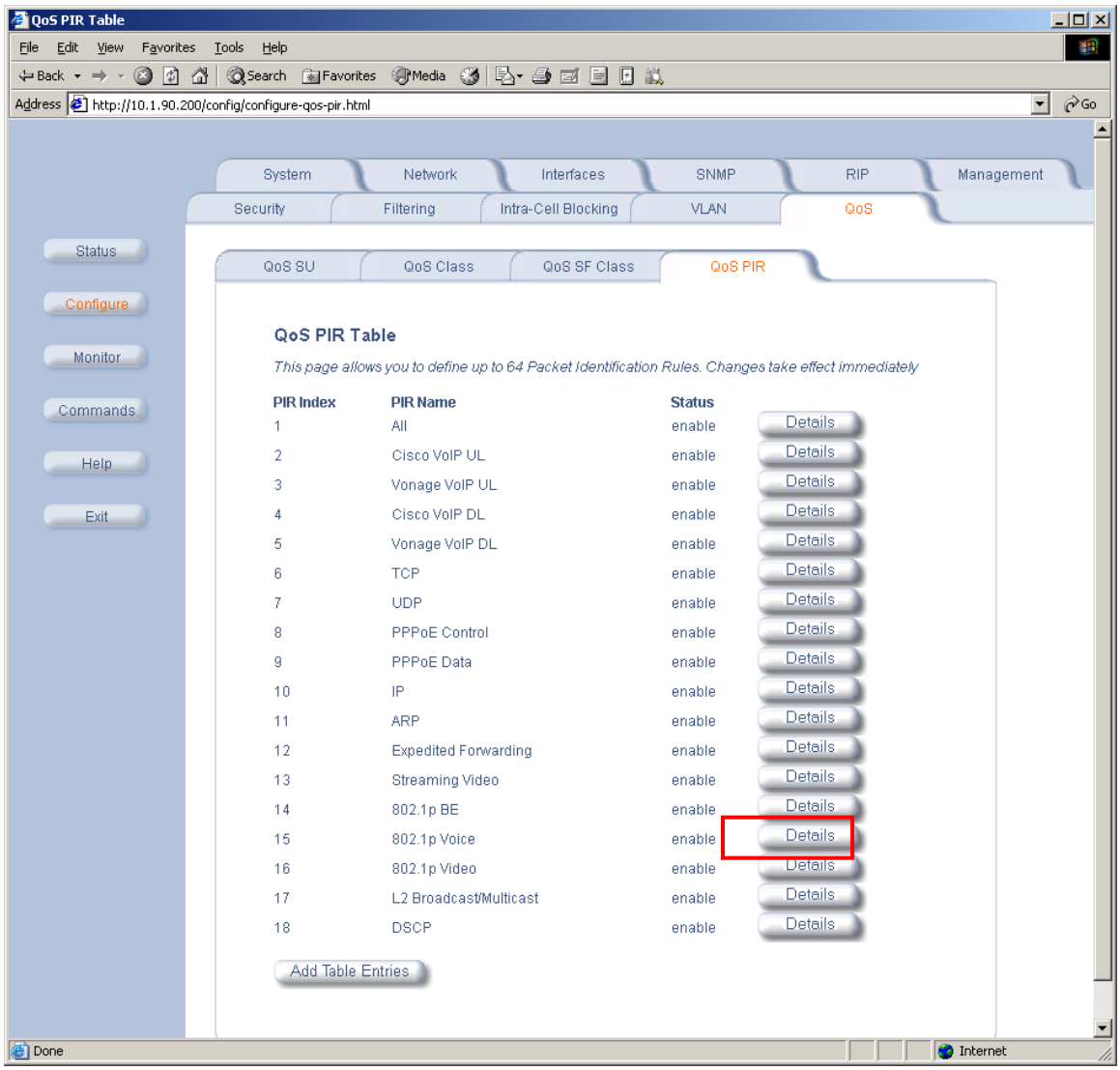
Use the **change ip-network-region 1** command to change the DIFFSERV/TOS **PARAMETERS** and **802.1P/Q PARAMETERS** settings configured in Avaya Communication Manager. The **Call Control PHB Value** should be **46** and the **Audio PHB Value** should be **46**. The **Call Control** and **Audio 802.1P** priority are set to **6**.

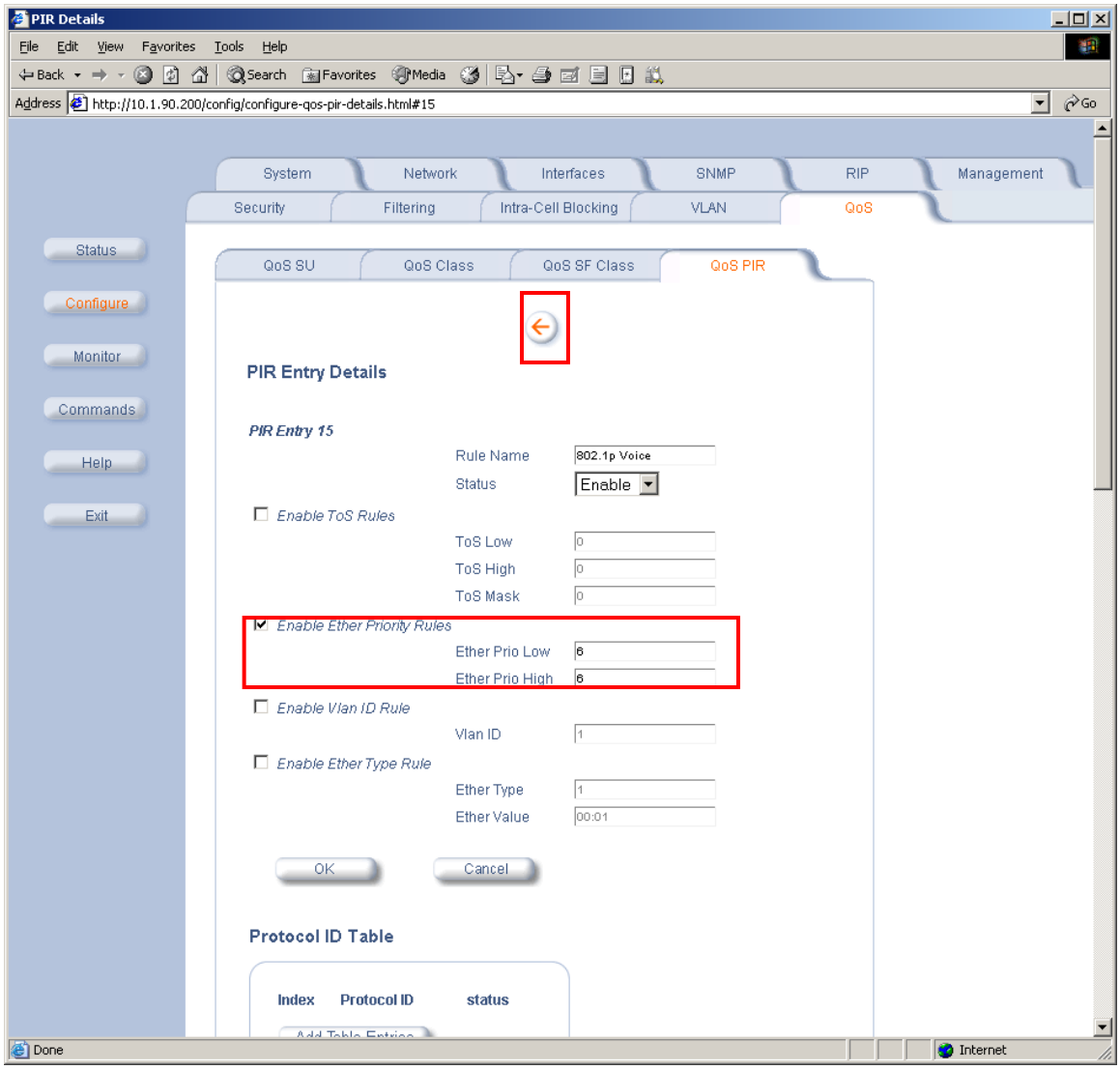
```
change ip-network-region 1                                    Page   1 of  19
                             IP NETWORK REGION
  Region: 1
Location:         Authoritative Domain: devcon.com
    Name:
MEDIA PARAMETERS                Intra-region IP-IP Direct Audio: yes
      Codec Set: 1              Inter-region IP-IP Direct Audio: yes
   UDP Port Min: 2048                        IP Audio Hairpinning? y
   UDP Port Max: 3027
DIFFSERV/TOS PARAMETERS                  RTCP Reporting Enabled? y
 Call Control PHB Value: 46      RTCP MONITOR SERVER PARAMETERS
        Audio PHB Value: 46       Use Default Server Parameters? y
        Video PHB Value: 26
802.1P/Q PARAMETERS
 Call Control 802.1p Priority: 6
        Audio 802.1p Priority: 6
        Video 802.1p Priority: 5      AUDIO RESOURCE RESERVATION PARAMETERS
H.323 IP ENDPOINTS                                       RSVP Enabled? n
  H.323 Link Bounce Recovery? y
 Idle Traffic Interval (sec): 20
   Keep-Alive Interval (sec): 5
            Keep-Alive Count: 5
```

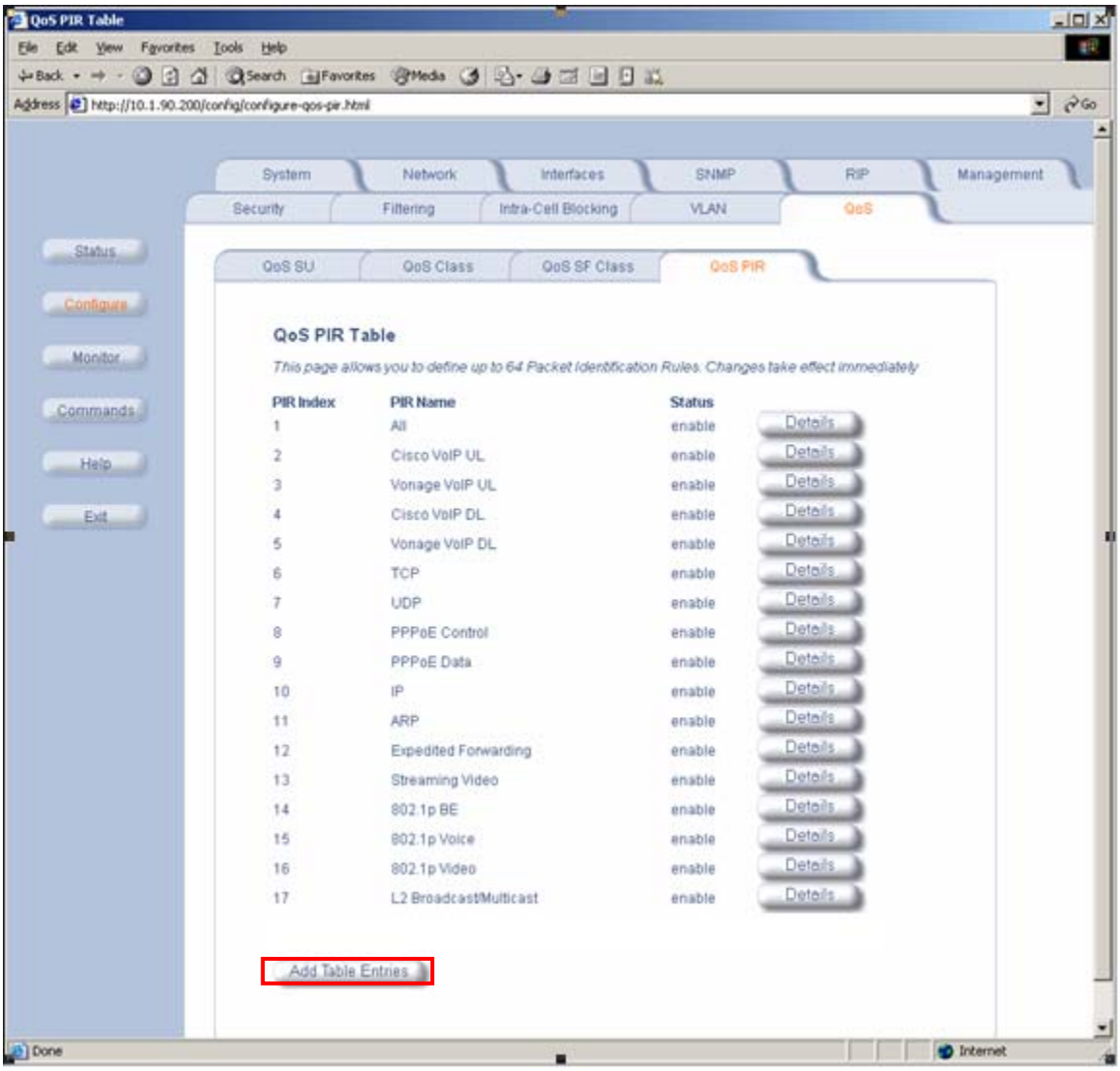
4. Configure Proxim Tsunami MP.11 5054-R Base station at the Headquarters

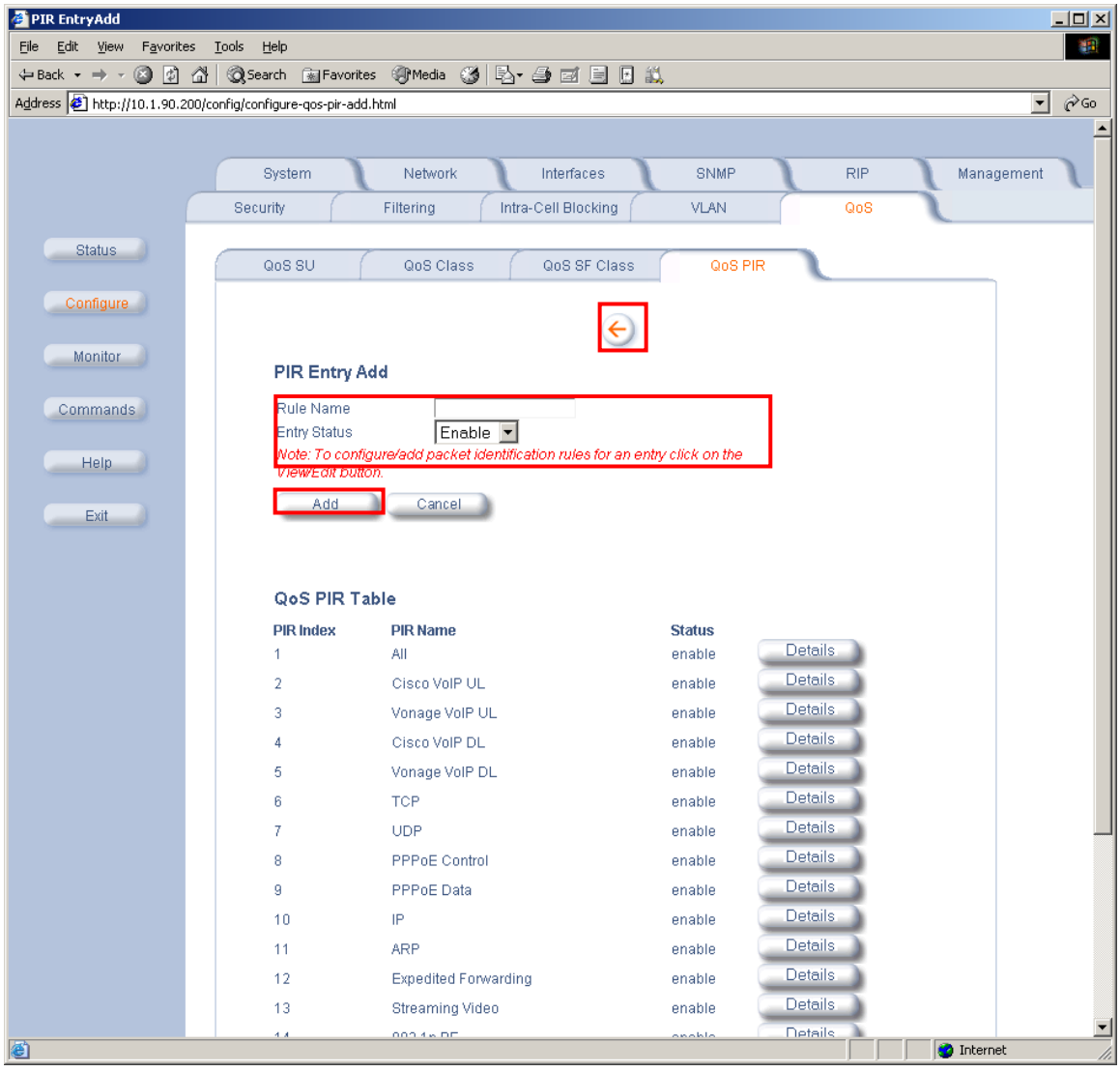
This section shows the necessary steps in configuring the Proxim Tsunami MP.11 5054-R base station at the headquarters as shown in the sample network. Except where stated the parameters in all steps are the default settings and are supplied for reference.

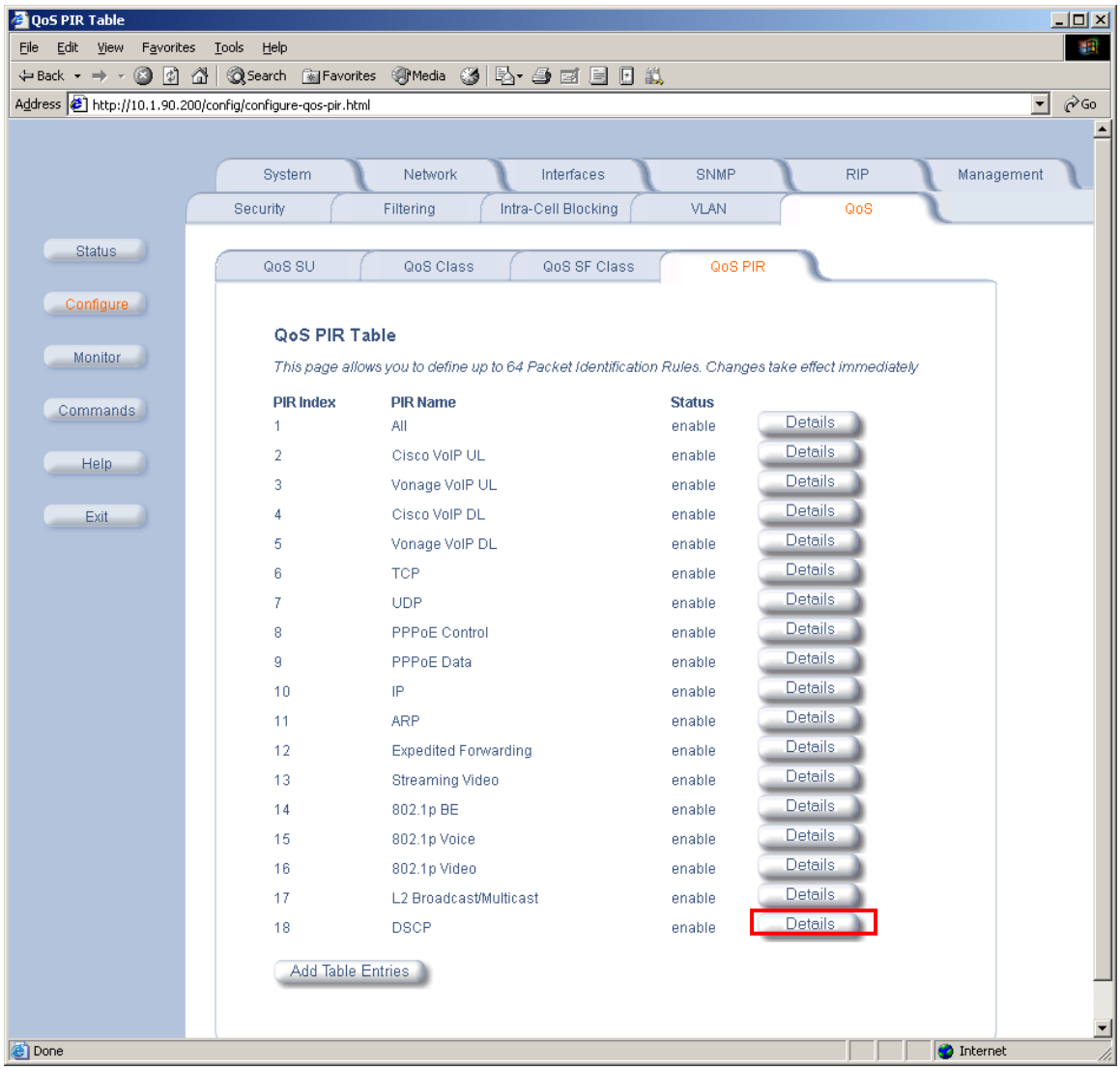
Step	Description
1.	**Logging into Proxim Tsunami MP.11 5054-R BSU** Connect to the Proxim Tsunami MP.11 5054-R BSU through a web browser. Log in using the appropriate Login ID and Password. Click on the **Status** button to view the **System Status** information. 

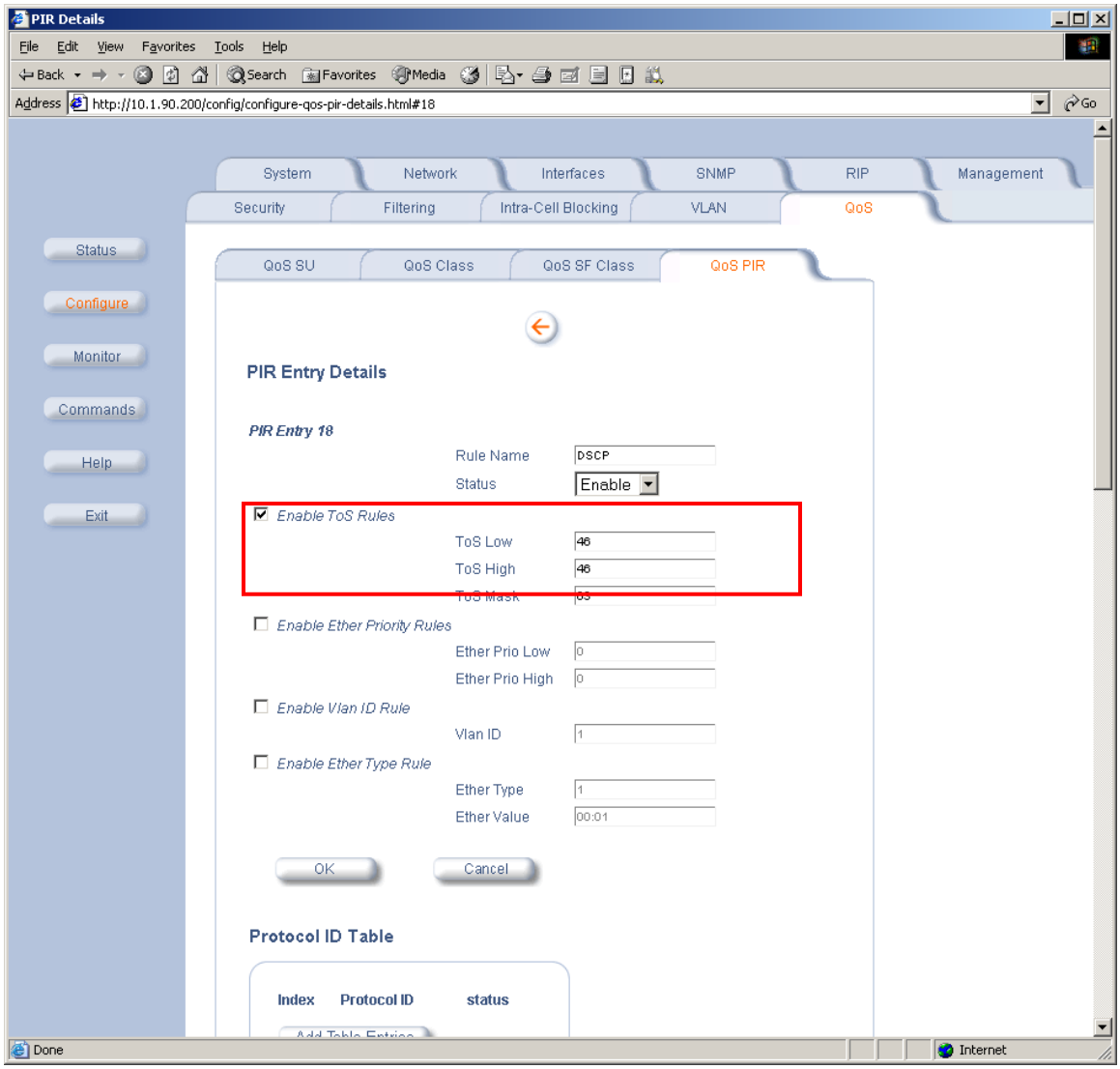
Step	Description
2.	**Configuring 802.1p QoS Parameters on the Proxim Tsunami MP.11 5054-R at the HQ.** Select **Configure → QoS → QoS PIR.** Click the **Details** button next to the **802.1p Voice** PIR Name. 

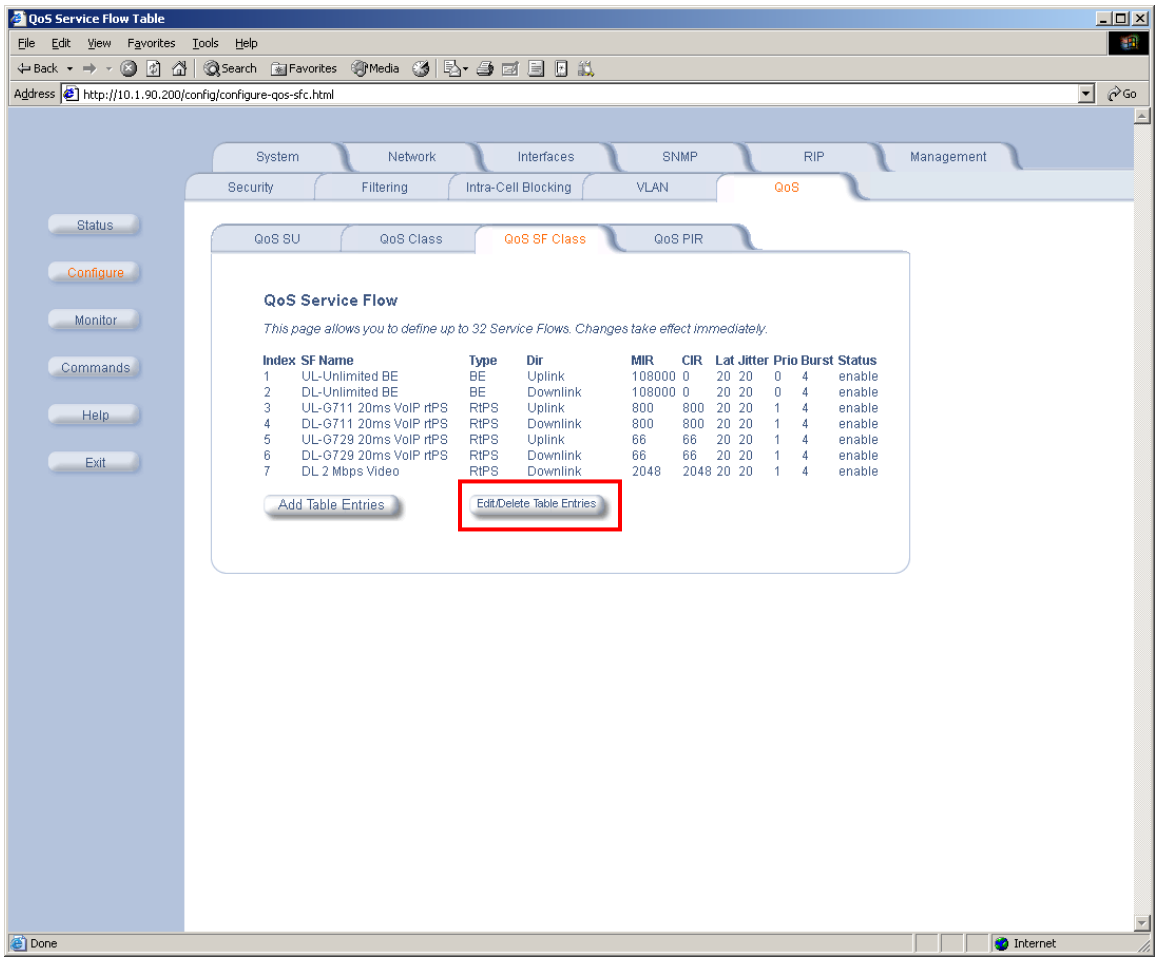
Step	Description
3.	Click the check box next to the **Enable Ether Priority Rules** field to add check mark. Ensure that the **Ether Prio Low** and **Ether Prio High** fields are set to **6.** Click the ← (arrow) button to continue. 

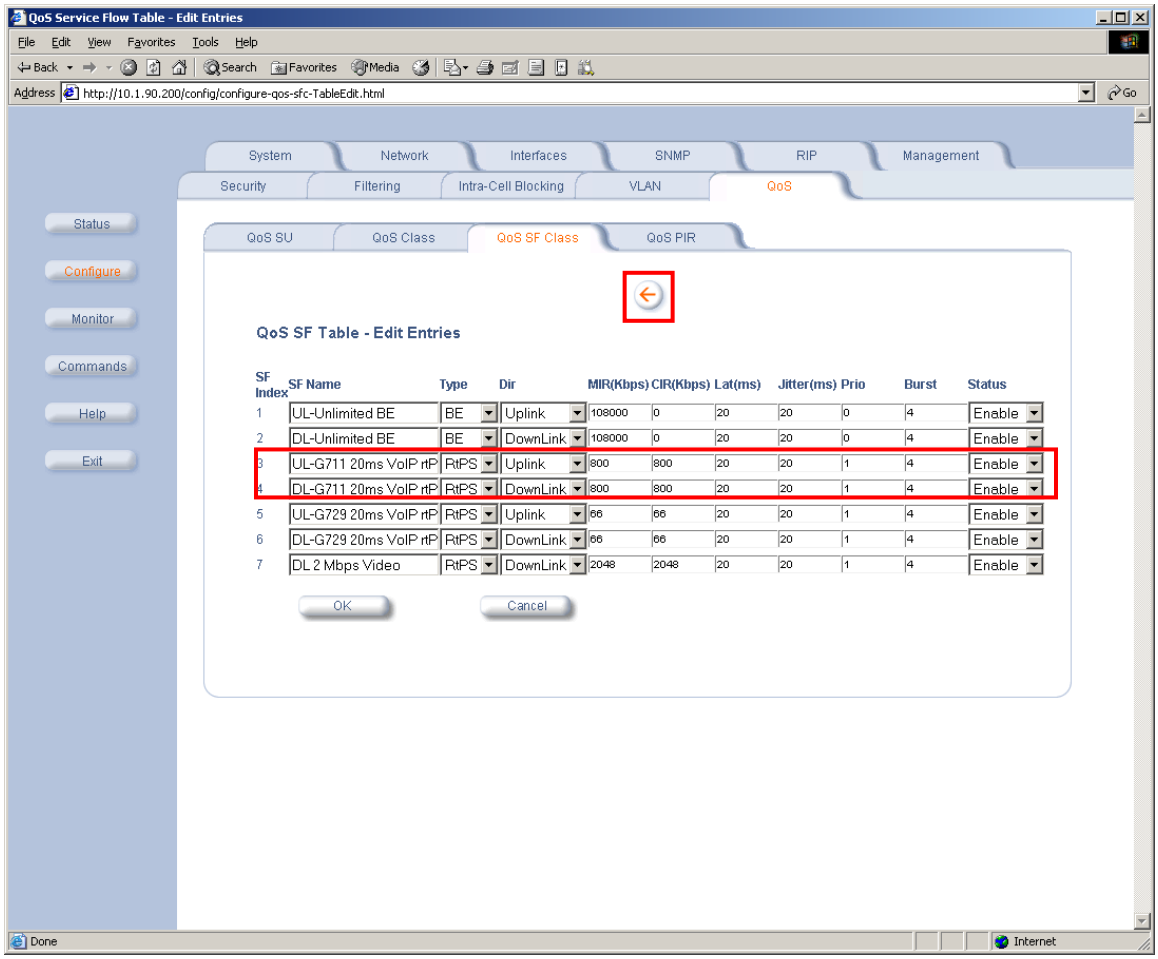
Step	Description
4.	**Creating a DSCP QoS Rule set** Select **Configure → QoS → QoS PIR.** Click the **Add Table Entries** button at the bottom of the page. 

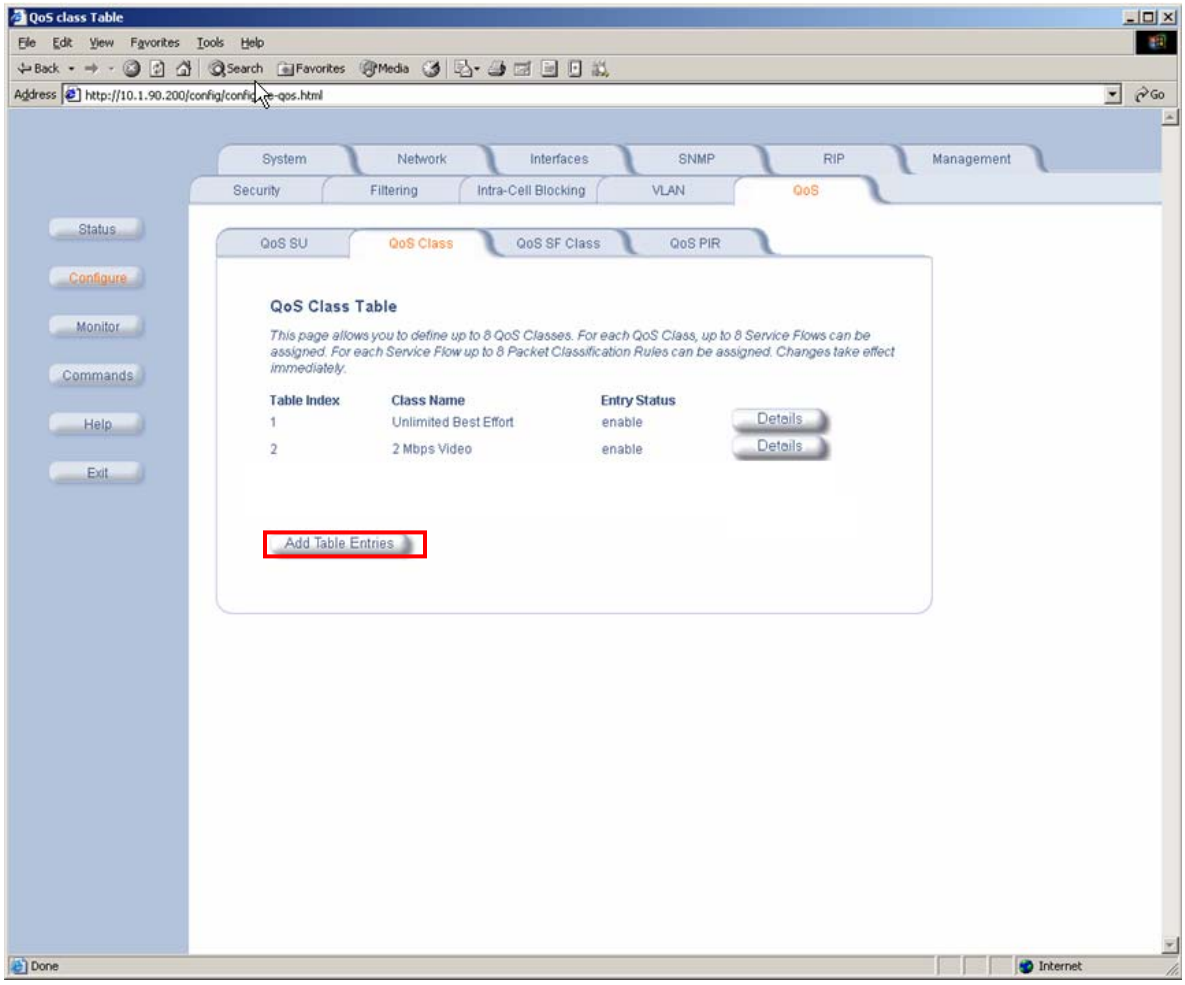
Step	Description
5.	Enter the following parameters for the DSCP table entry: • Enter **DSCP** in the **Rule Name** field. • Verify that the **Entry Status** field is set to **Enable**. • Click the **Add** button. Click the ← button to continue. 

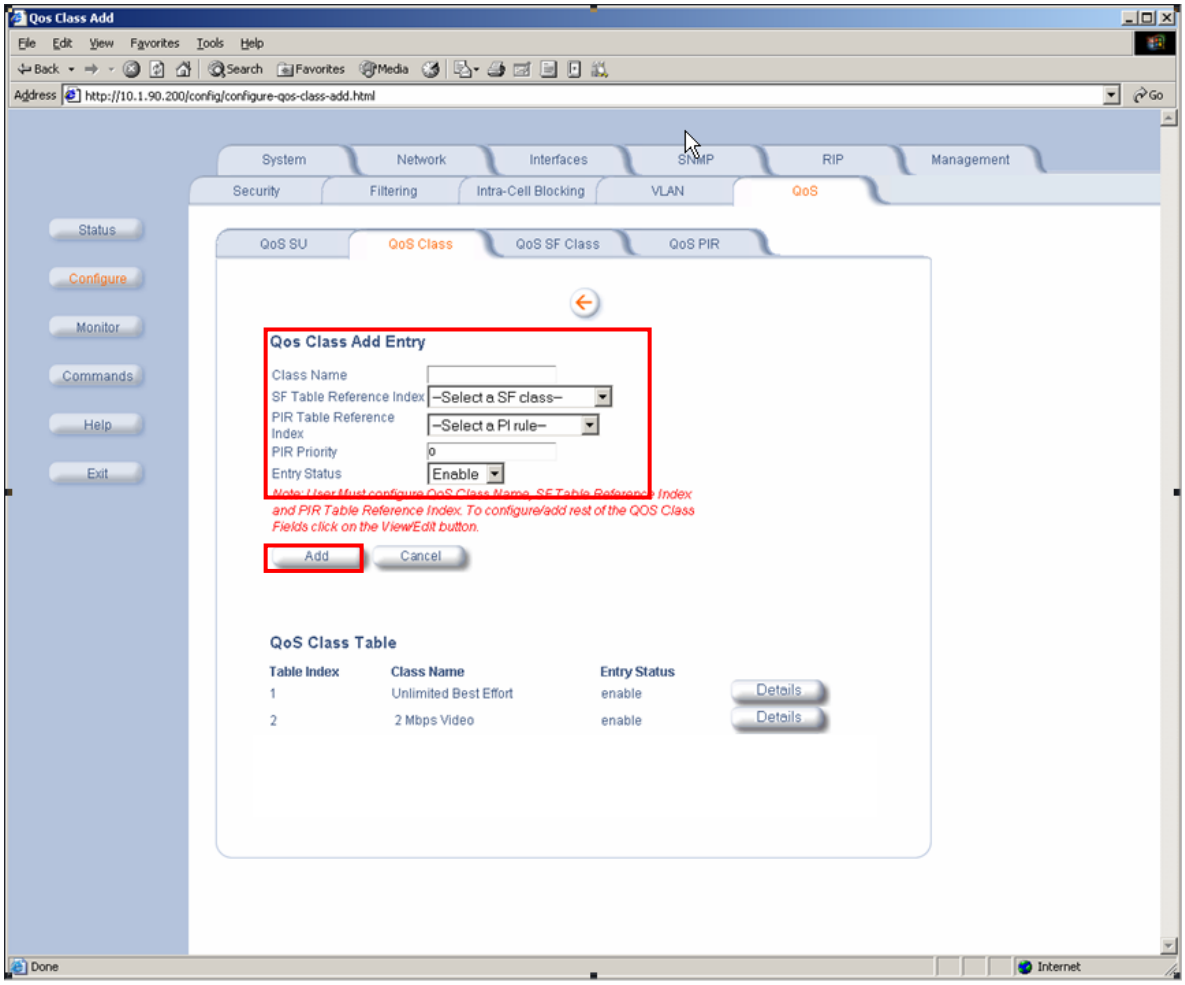
Step	Description
6.	**Creating and configuring DSCP QoS Parameters on the Proxim Tsunami MP.11 5054-R at the HQ** Select **Configure → QoS → QoS PIR.** Click the **Details** button next to the **DSCP** PIR Name. 

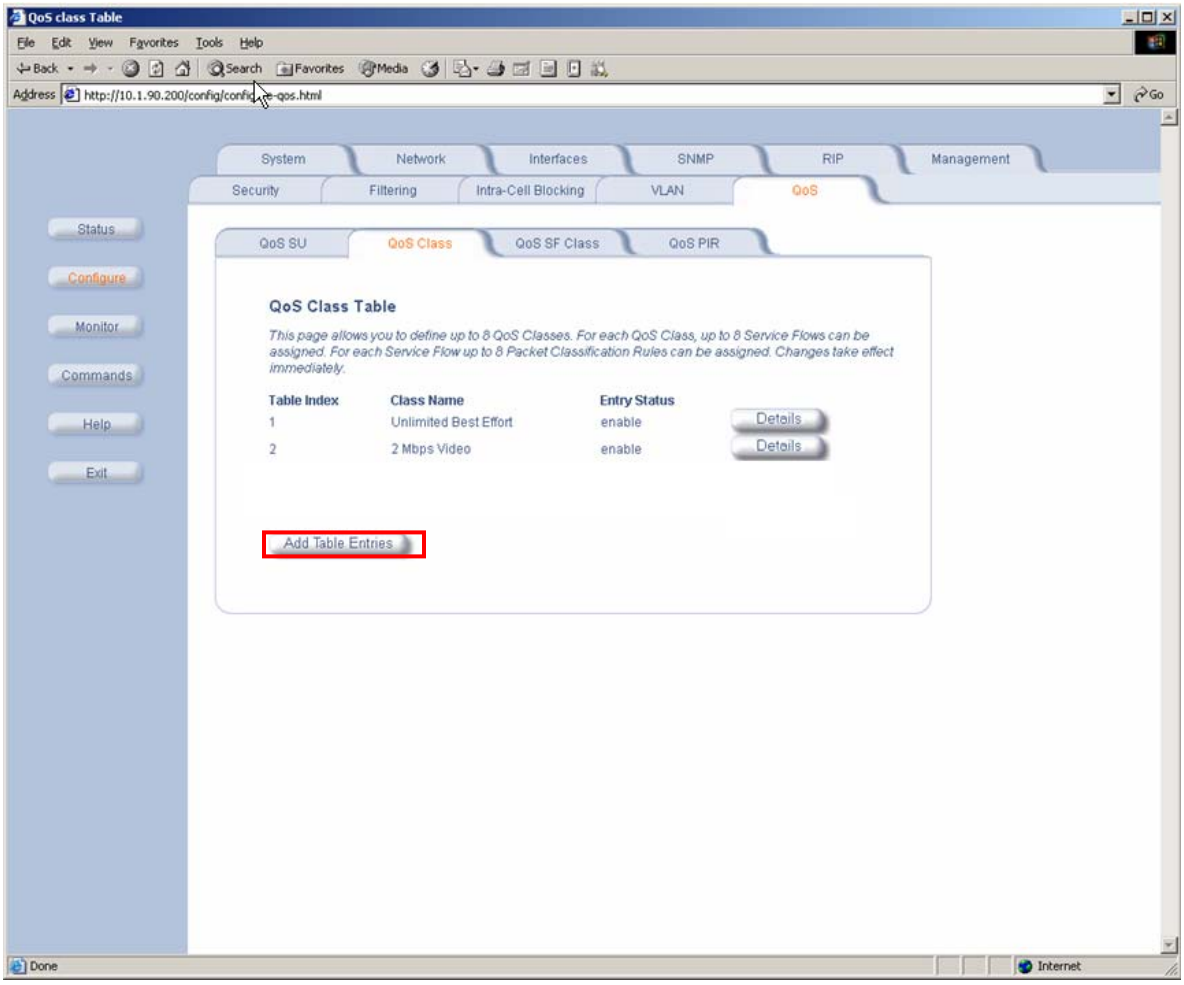
Step	Description
7.	Enter the following parameters for the DSCP QoS entry: • Click the check box next to the **Enable ToS Rules** field to add check mark. • Set the **ToS Low** and **ToS high** fields to **46** and the **ToS Mask** field to **63**. Click the ← button to continue. 

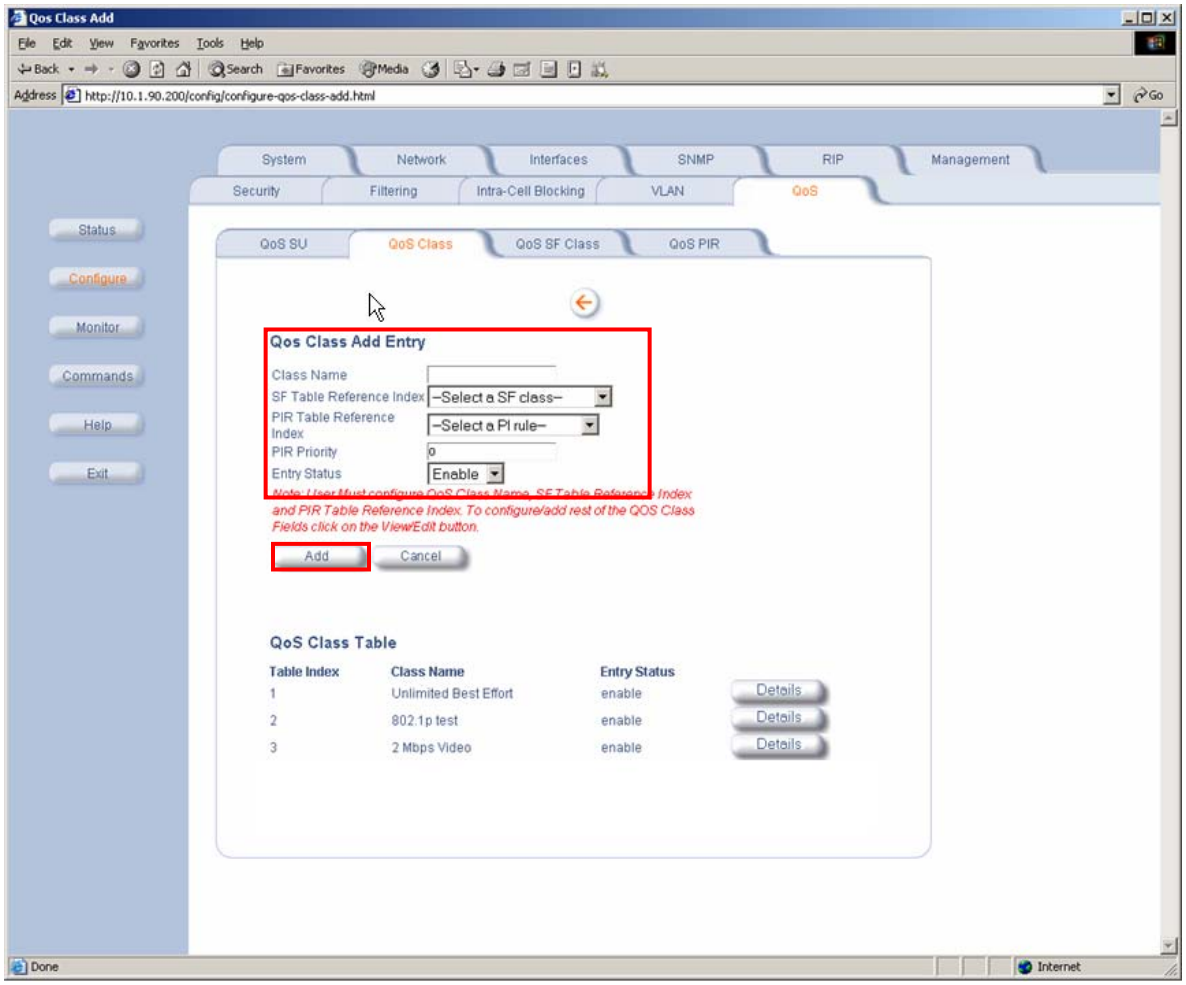
Step	Description
8.	**Editing the QoS SF information UL-G711 20ms VoIP rtPS and DL-G711 20ms VoIP rtPS index CIR(Kbps) and MIR(Kbps)** Select **Configure → QoS → QoS SU → QoS SF → Edit/Delete Table Entries** button. 

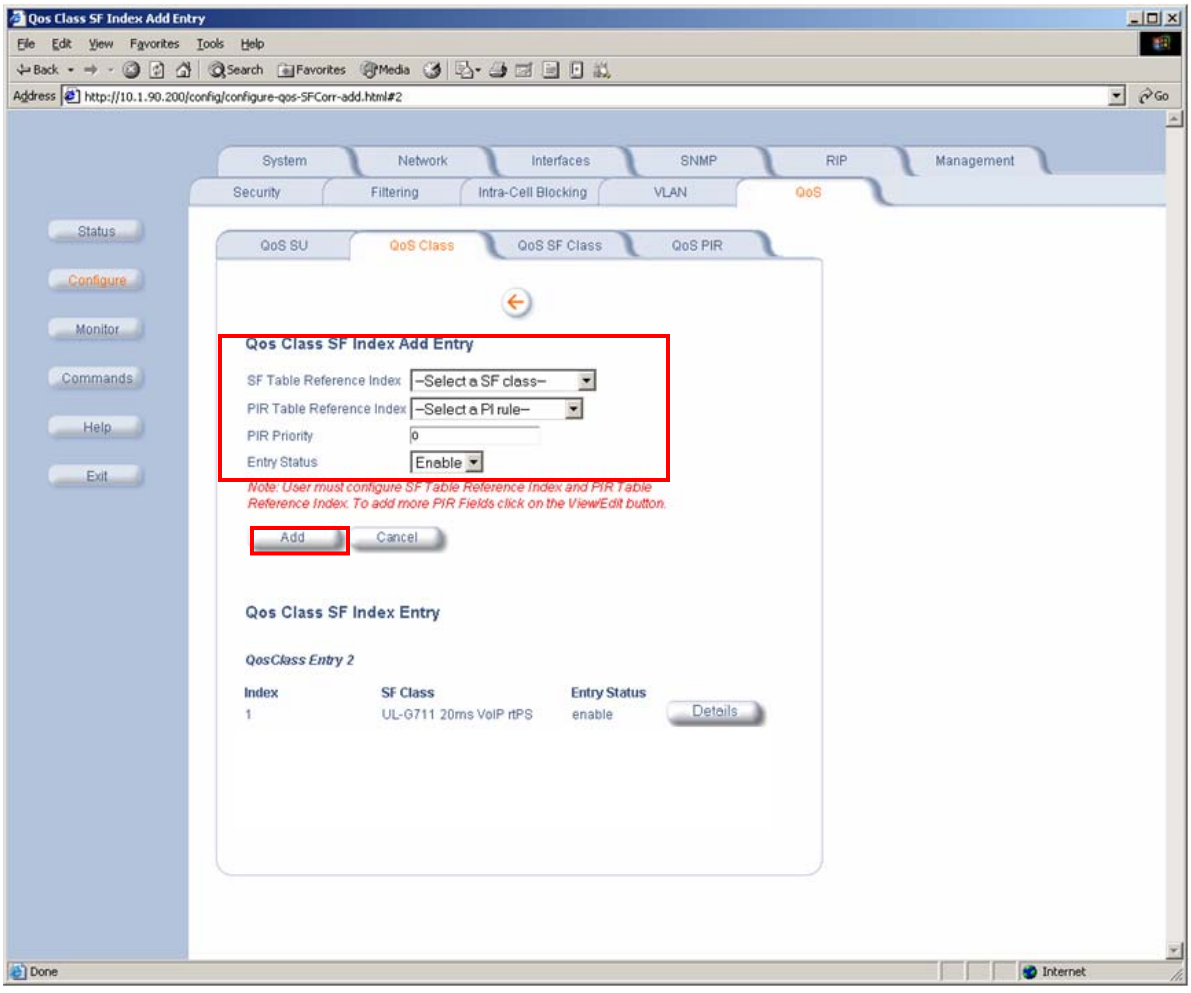
Step	Description
9.	For the **UL-G711 20ms VoIP rtPS** and **DL-G711 20ms VoIP rtPS** entries (**SF Index 3** & **4**) change the **CIR(Kbps)** and **MIR(Kbps**) fields to **800** (the number of calls planed). Click the **OK** button and then the ← button to continue. **Note:** The "**UL-G711 20ms VoIP rtPS**" and "**DL-G711 20ms VoIP rtPS**" entries in the **SF Name** field are just the default descriptive labels and can be modified as desired. These labels remain as default in these Application Notes. 

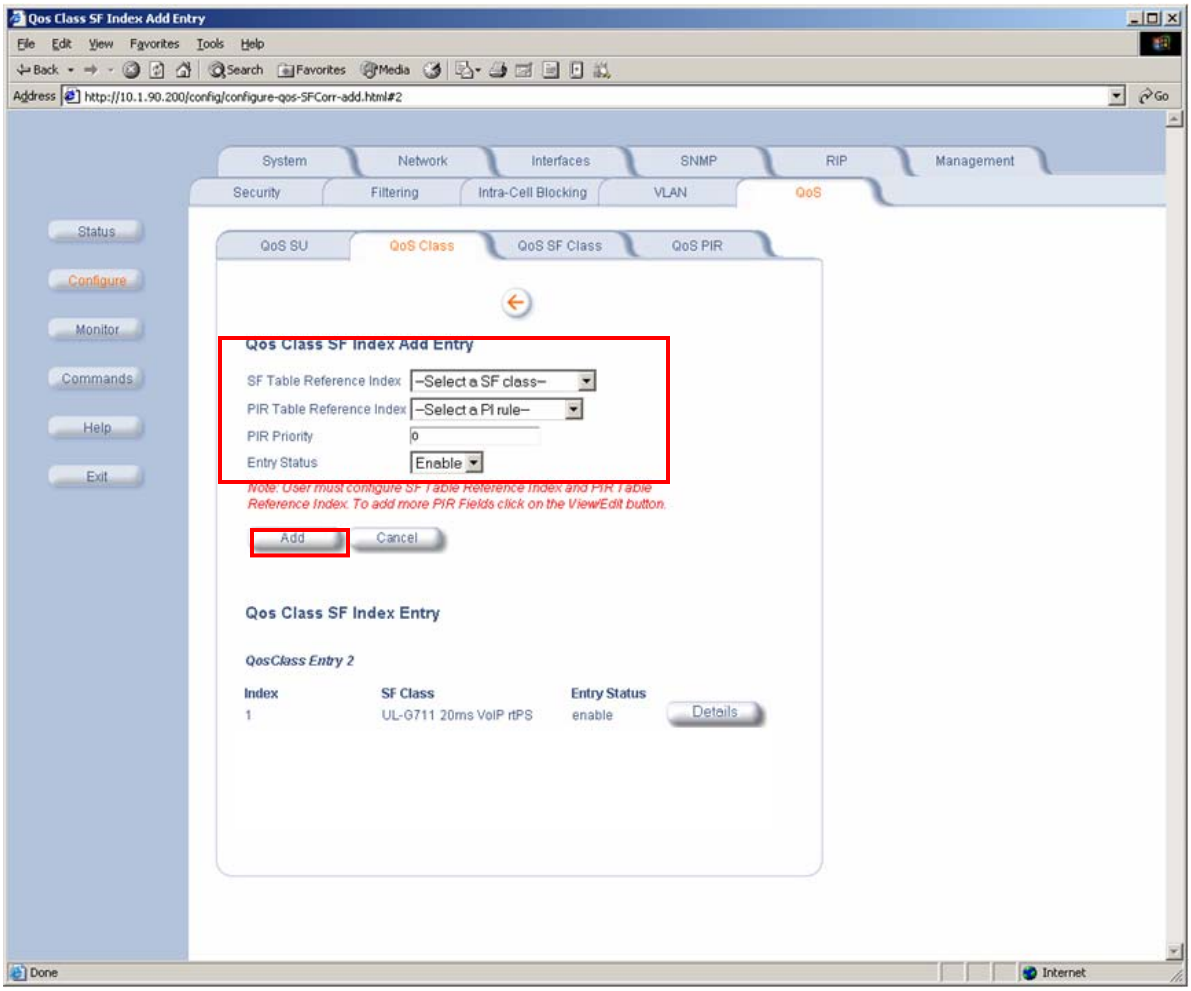
Step	Description
10.	**Adding the QoS Class information for 802.1p test.** Select **Configure → QoS → QoS Class.** Click the **Add Table Entries** button. 

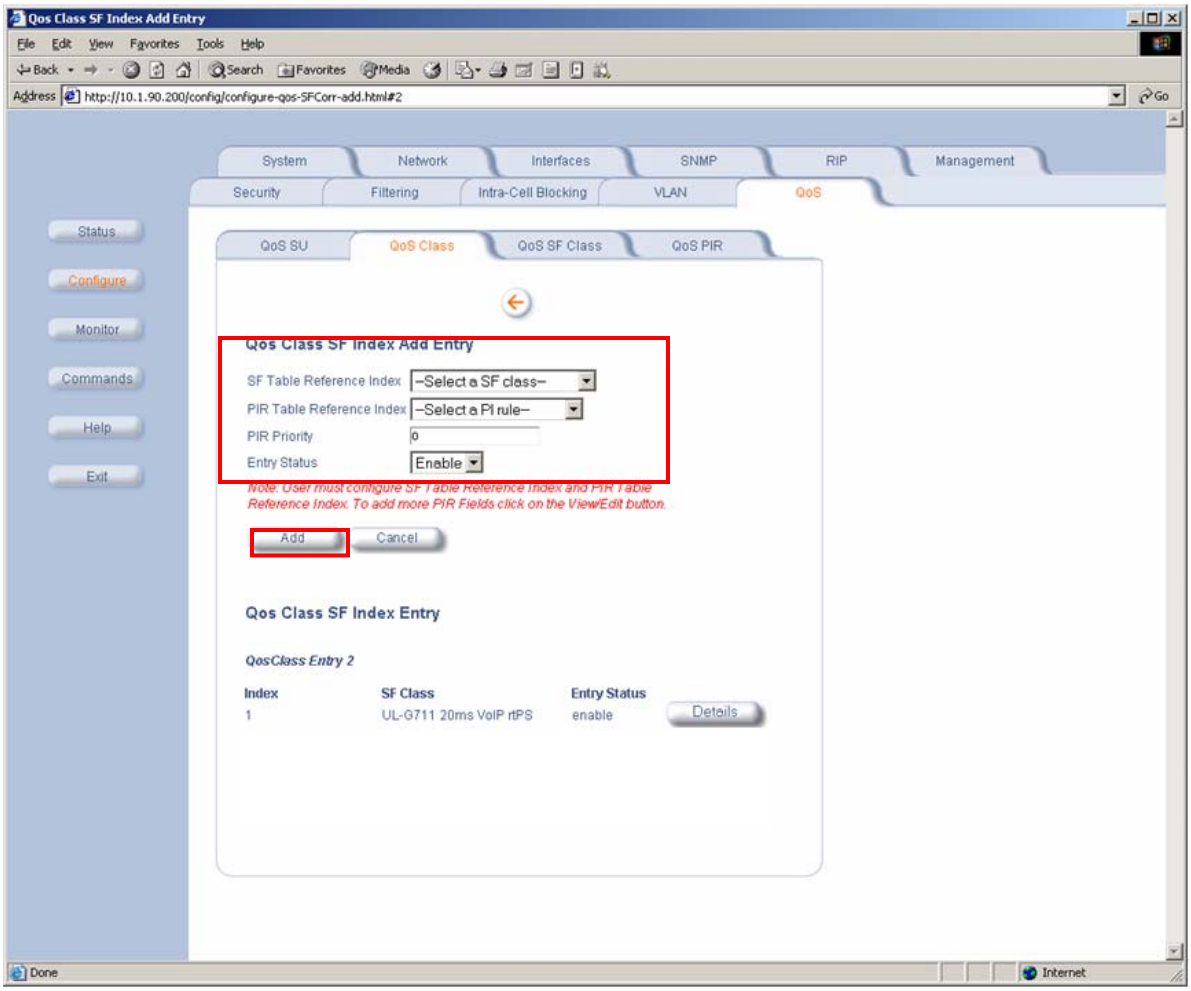
Step	Description
11.	**Creating the QoS Class information for 802.1p high priority traffic** Configure the following parameters: • Enter **802.1p test** in the **Class Name** field. • For the **SF Table Reference Index** field, select **UL-G711 20ms VoIP rtPS** for the SF class. • For the **PIR Table Reference Index** field, select **802.1p Voice** for the Pt rule. • Set the **PIR Priority** field to **7**. Click the **Add** button. 

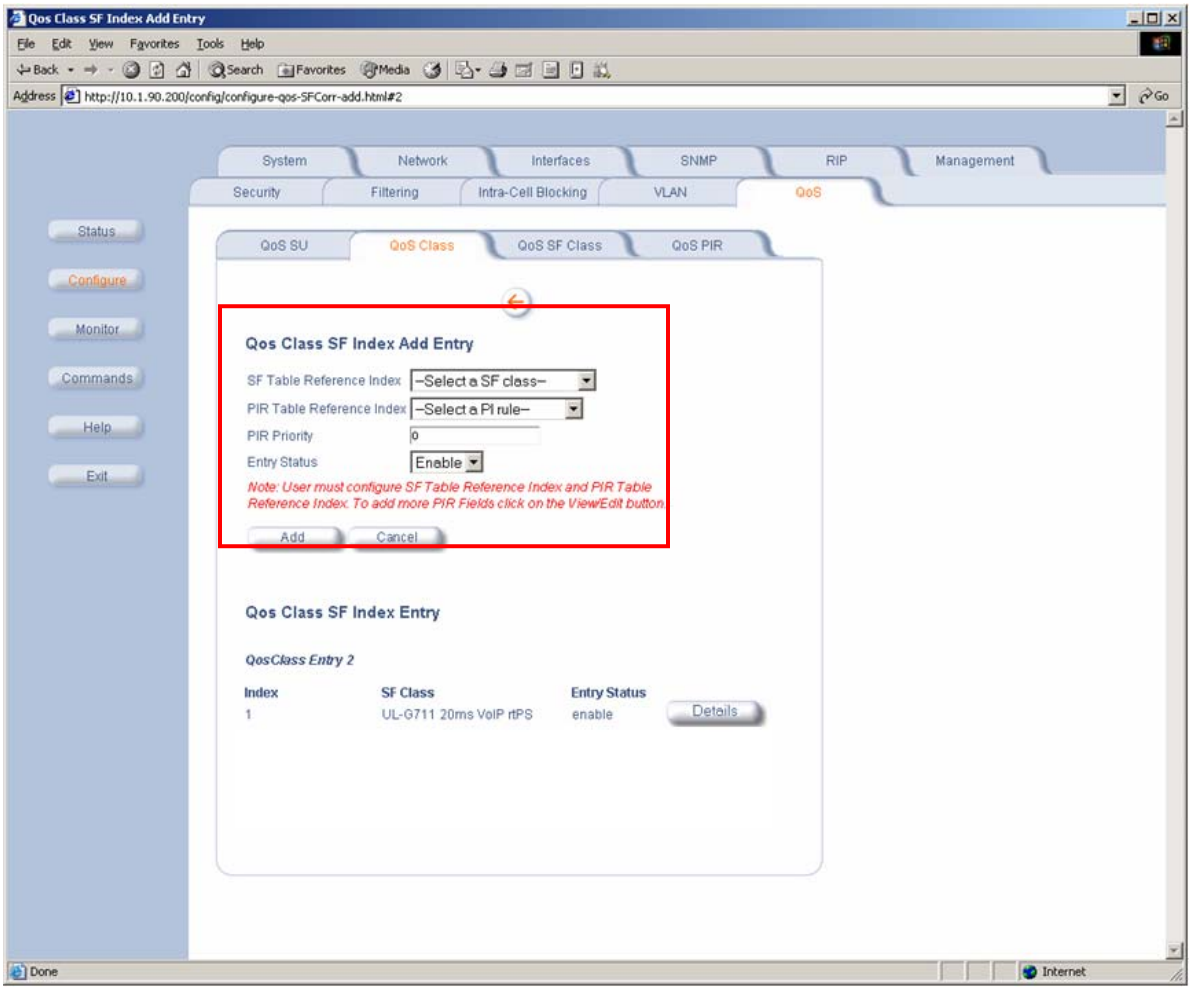
Step	Description
12.	**Adding the QoS Class information for DSCP** Select **Configure → QoS → QoS Class.** Click the **Add Table Entries** button. 

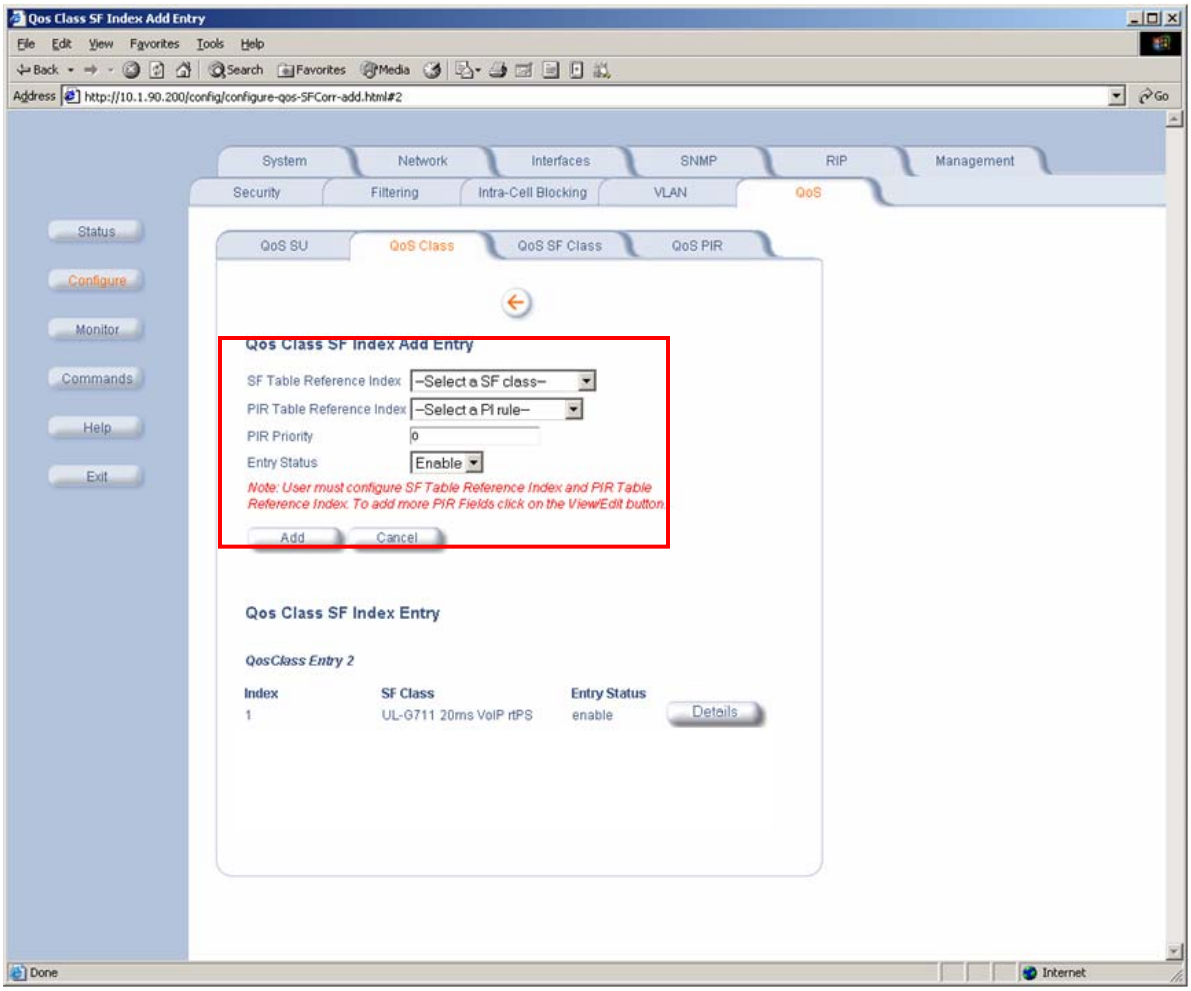
Step	Description
13.	**Creating the QoS Class information for DSCP priority traffic.** Configure the following parameters: • Enter **DSCP test** for the **Class Name** field. • For the **SF Table Reference Index** field, select **UL-G711 20ms VoIP rtPS** for the SF class. • For the **PIR Table Reference Index** field, select **DSCP** for the Pt rule. • Set the **PIR Priority** field to **7**. Click the **Add** button. 

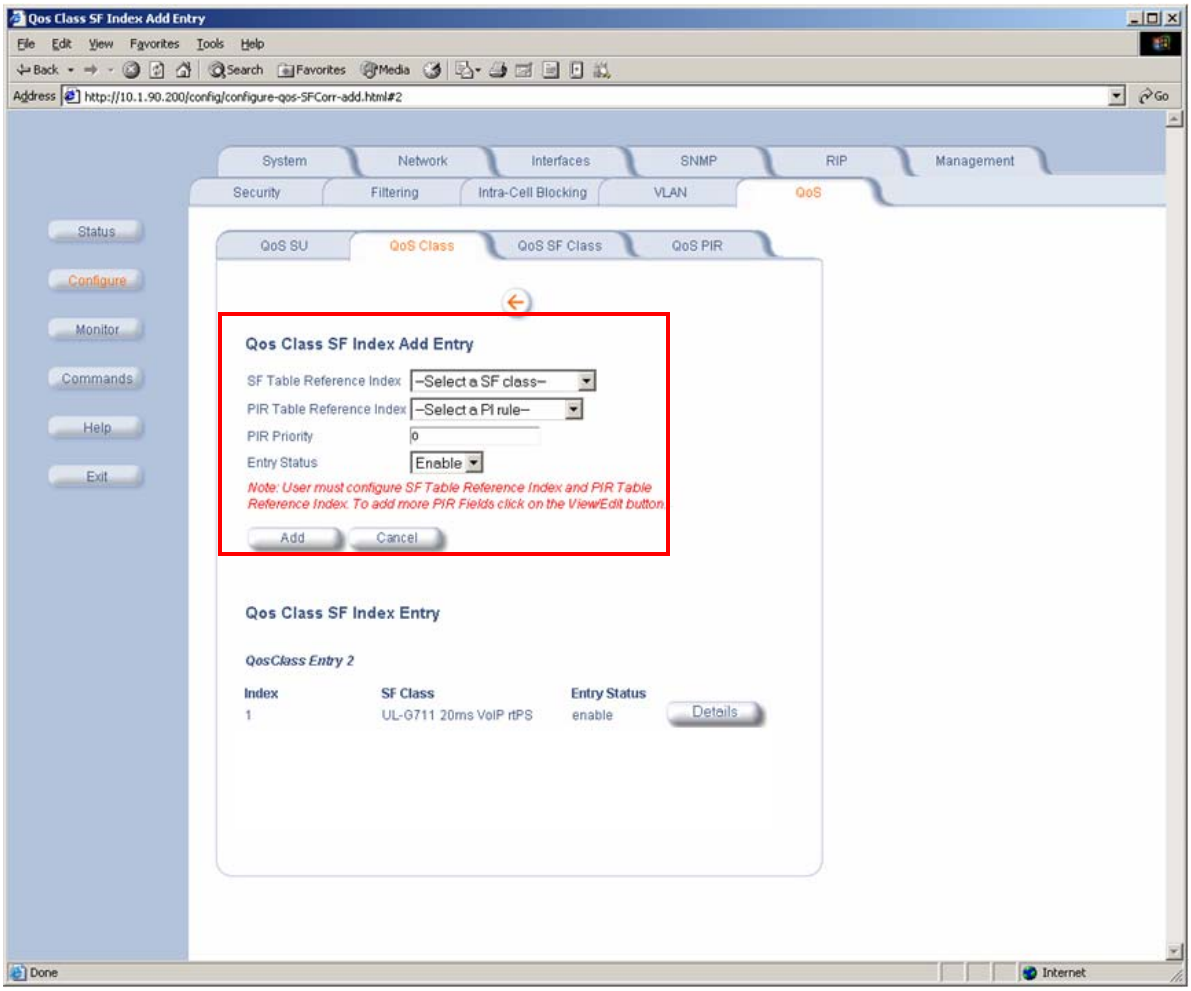
Step	Description
14.	**Configuring the QoS Class information, DL-G711 20ms VoIP rtPS QoS SF Class for 802.p test** Select **Configure → QoS → QoS Class**. Click on the **Details** button for **802.p test** under **QoS Class Table** (not shown)**.** Configure the following parameters: • For the **SF Table Reference Index** field, select **DL-G711 20ms VoIP rtPS** for the SF class. • For the **PIR Table Reference Index** field, select **802.1p** for the Pt rule. • Set the **PIR Priority** field to **7**. Click the **Add** button. 

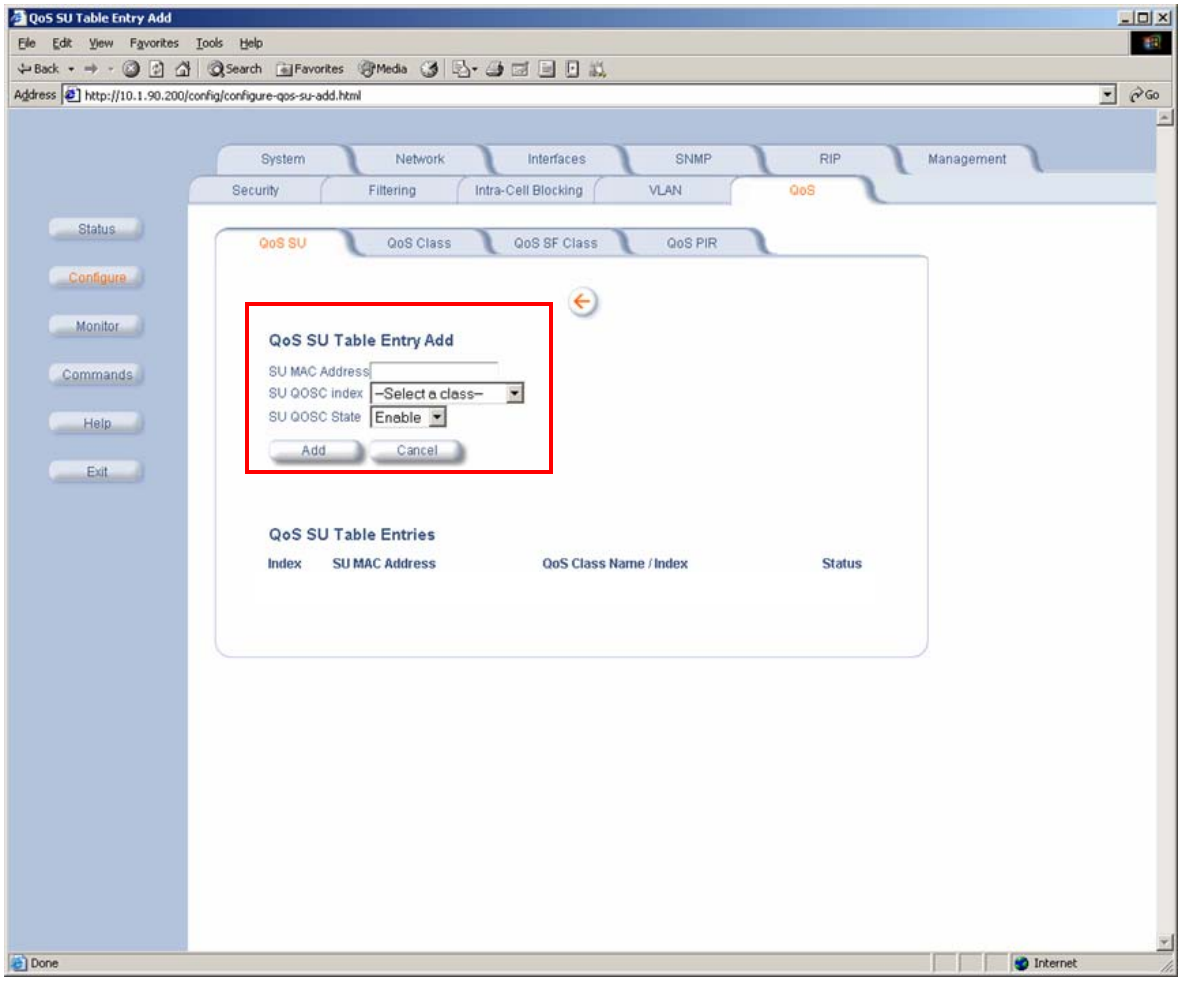
Step	Description
15.	**Configuring the QoS Class information, UL-Unlimited BE QoS SF Class for 802.p test** Select **Configure → QoS → QoS Class**. Click on the **Details** button for **802.p test** under **QoS Class Table** (not shown). Configure the following parameters: • For the **SF Table Reference Index** field, select **UL-Unlimited BE** for the SF class. • For the **PIR Table Reference Index** field, select **All** for the Pt rule. • Set the **PIR Priority** field to **0**. Click the **Add** button. 

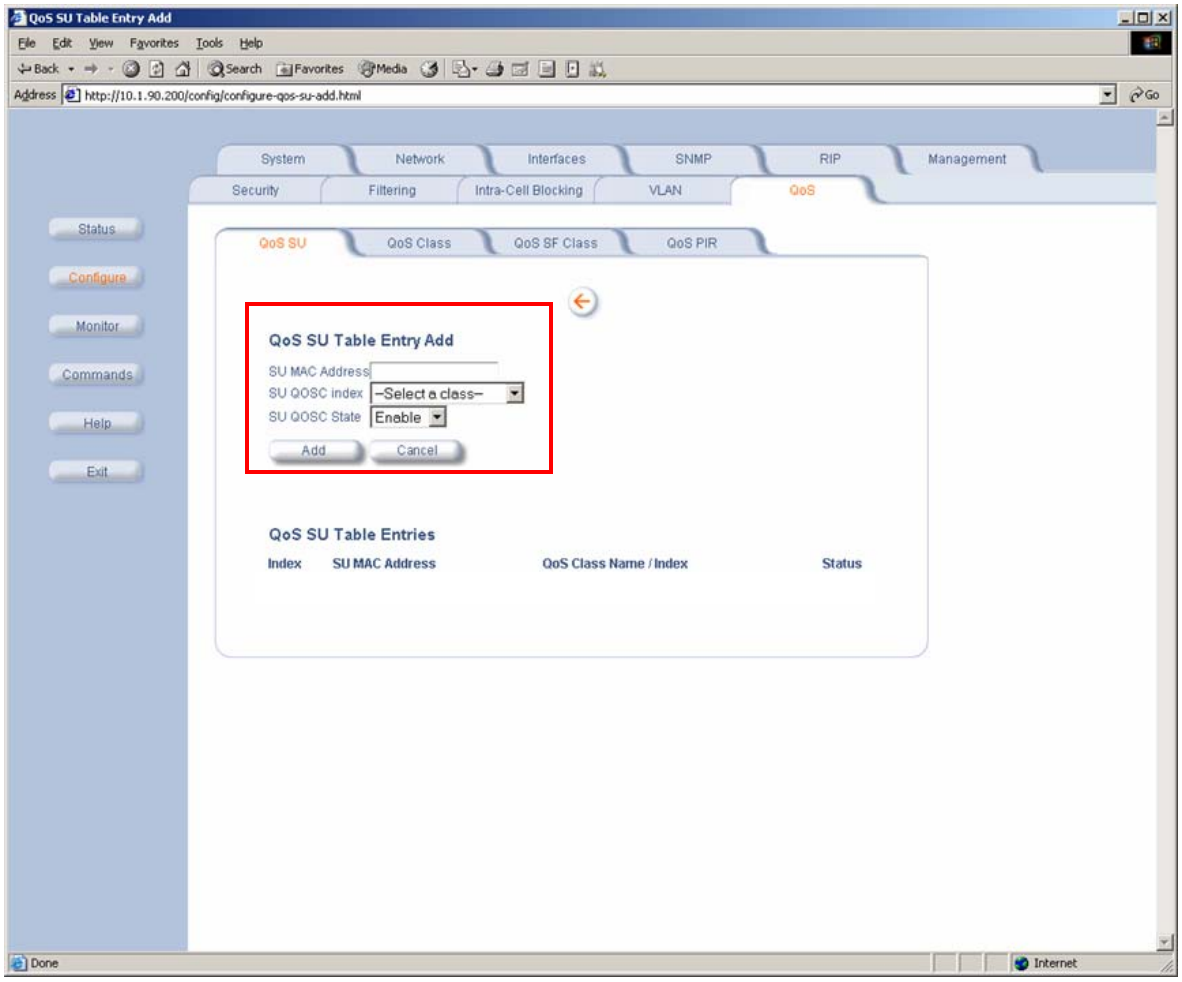
Step	Description
16.	**Configuring the QoS Class information, DL-Unlimited BE QoS SF Class for 802.p test** Select **Configure → QoS → QoS Class**. Click on the **Details** button for **802.p test** under **QoS Class Table** (not shown). Configure the following parameters: • For the **SF Table Reference Index field,** select **DL-Unlimited BE** for the SF class. • For the **PIR Table Reference Index,** select **All** for the Pt rule. • Set the **PIR Priority** field to **0**. Click the **Add** button. 

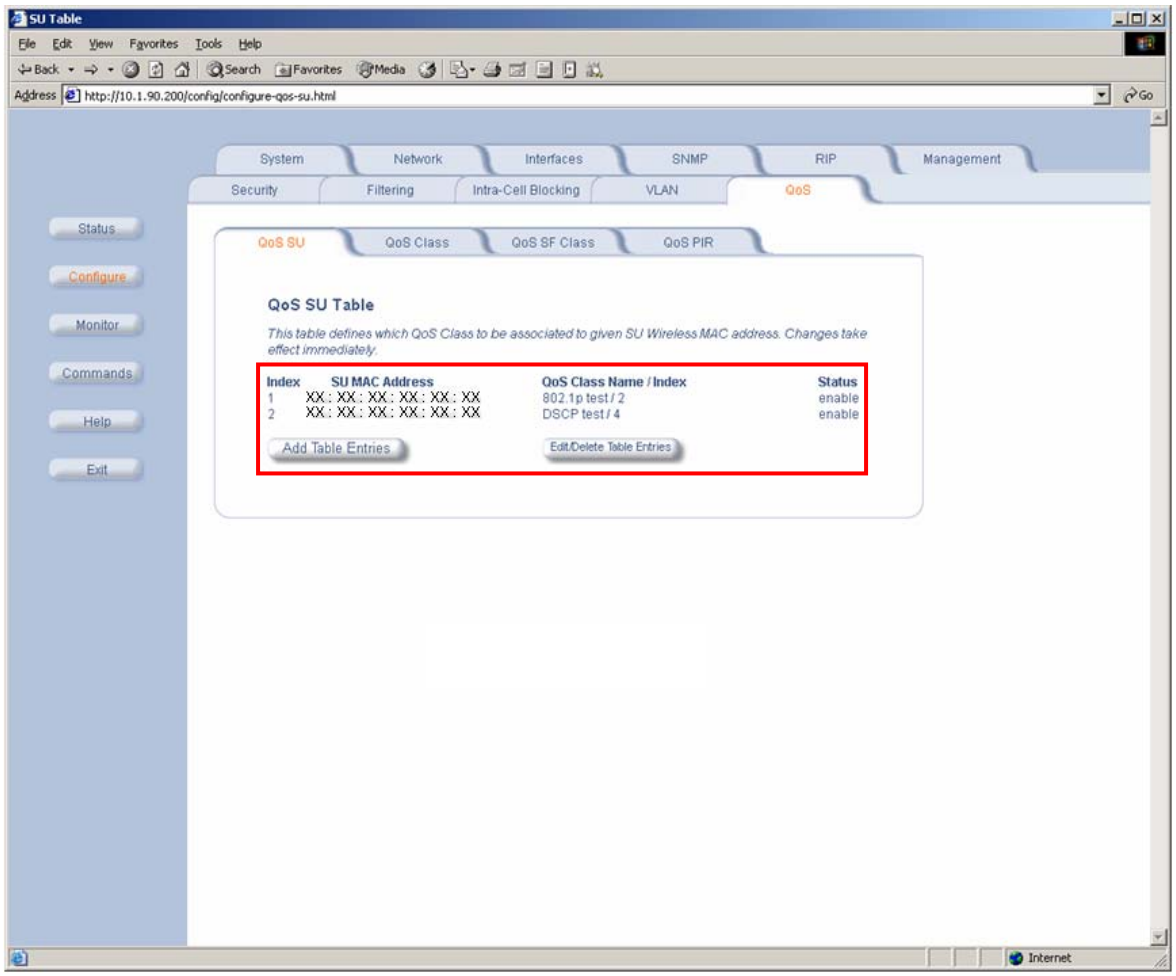
Step	Description
17.	**Configuring the QoS Class information, DL-G711 20ms VoIP rtPS QoS SF Class for DSCP test** Select **Configure → QoS → QoS Class**. Click on the **Details** button for **DSCP test** under **QoS Class Table** (not shown). Configure the following parameters: • For the **SF Table Reference Index** field, select **DL-G711 20ms VoIP rtPS** for the SF class. • For the **PIR Table Reference Index** field, select **DSCP** for the Pt rule. • Set the **PIR Priority field** to **7**. Click the **Add** button. 

Step	Description
18.	**Configuring the QoS Class information, UL-Unlimited BE QoS SF Class for DSCP test** Select **Configure → QoS → QoS Class,** click on the **Details** button for **DSCP test** under **QoS Class Table** (not shown). Configure the following parameters: • For the **SF Table Reference Index** field, select **UL-Unlimited BE** for the SF class. • For the **PIR Table Reference Index** field, select **All** for the Pt rule. • Set the **PIR Priority** field to **0**. Click the **Add** button. 

Step	Description
19.	**Configuring the QoS Class information, DL-Unlimited BE QoS SF Class for DSCP test:** Select **Configure → QoS → QoS Class,** click on the **Details** tab for **DSCP test** under **QoS Class Table.** Configure the following parameters: • For the **SF Table Reference Index** field, select **DL-Unlimited BE** for the SF class. • For the **PIR Table Reference Index** field, select **All** for the Pt rule. • Set the **PIR Priority** field to **0**. Click the **Add** button. 

Step	Description
20.	**Adding 802.1p QoS SU addresses for Campus A** Select **Configure → QoS → QoS SU**. Configure the following parameters: • For the **SU MAC Address** field, enter the MAC address of the SU at Campus A. • For the **SU QOSC index** field, select **802.1p test** for the class. • For the **SU QOSC State** field, select **Enable**. Click the **Add** button. 

Step	Description
21.	**Adding DSCP QoS SU addresses for Campus B** Select **Configure → QoS → QoS SU**. Configure the following parameters: • For the **SU MAC Address** field, enter the MAC address of the SU at Campus B. • For the **SU QOSC index** field, select **DSCP test** for the class. • For the **SU QOSC State** field, select **Enable**. Click the **Add** button. 

Step	Description
22.	**Verifying the QoS SU Table** Select **Configure → QoS → QoS SU**. To verify the information in the **QoS SU Table**, click the **Edit/Delete Table Entries** button. 

5. Configure Proxim Tsunami MP.11 5054-R Subscriber Units at Campus A & Campus B

When the Proxim Tsunami MP.11 5054-R Subscriber Units for Campus A & B connect to the Base Station at the Headquarters, the SUs receive the configured QoS policy information. Therefore, there are no configuration steps required.

6. Configure the Extreme Summit 300-48 Switch

This section shows the necessary steps in configuring the Extreme Summit 300-48 as shown in the sample network.

The Extreme Summit 300-48 will be used as the core router and will run Layer 2 and Layer 3, enforce QoS policies and run OSPF.

Step	Description

1.	Connect to the Extreme Summit 300-48 Switch. Log in using the appropriate Login ID and Password.
	`Login:`
	`Password:`
	`Summit300-48:1 #`

2.	Ensure the ports are not already configured. Use the **show port <port> info detail** command to check the current configuration for the port. `Summit300-48:1 # show port 1:1 info detail` Repeat for ports 1:2, 1:3, 1:4 and 19.

3.	If any of the ports are configured with VLAN information, delete the information on the port or look for one that is not in use, use the **configure vlan <VLAN NAME> delete ports <port>** command to delete the port information or the **show port <port> info detail** command to find another one.
	`Summit300-48:1 # configure vlan <VLAN NAME> delete ports <port>`
	`Summit300-48:1 # show port <port> info detail`

4.	Create the VLAN VlanOSPF.
	`Summit300-48:1 #  create vlan VlanOSPF`
	`Summit300-48:1 #  configure VlanOSPF tag 2000`

5.	Add an IP address for VLAN VlanOSPF, and enable IP forwarding.
	`Summit300-48:1 # configure VlanOSPF ipaddress 10.20.30.1/30`
	`Summit300-48:1 # enable ipforwarding VlanOSPF`

6.	Assign ports to VLAN VlanOSPF. `Summit300-48:1 # configure VlanOSPF add ports 1:1 tag`

Step	Description
7.	Enable OSPF. `Summit300-48:1 # enable ospf`

8.	Configure OSPF for VlanOSPF.
	`Summit300-48:1 # configure ospf VlanOSPF area 0.0.0.0`
	`Summit300-48:1 # configure ospf add VlanOSPF area 0.0.0.0`

9.	Enable OSPF to forward information for directly connected interfaces. `Summit300-48:1 # enable ospf export direct cost 2 type ase-type-2`

10.	Create VLAN Voice1.
	`Summit300-48:1 #  create vlan Voice1`
	`Summit300-48:1 #  configure Voice1 tag 50`

11.	Add an IP address for VLAN **Voice1**, and enable IP forwarding.
	`Summit300-48:1 # configure Voice1 ipaddress 50.1.1.254/24`
	`Summit300-48:1 # enable ipforwarding Voice1`

12.	Assign ports to VLAN Voice1.
	`Summit300-48:1 # configure Voice1 add ports  1:1, 1:2, 1:3 tagged`
	`Summit300-48:1 # configure Voice1 add ports  1:5`

13.	Assign a port to VLAN Voice1 for Avaya Communication Manager**.** `Summit300-48:1 # configure Voice1 add ports 1:19`
14.	Enable DiffServ examination on port 1:19. `Summit300-48:1 # enable diffserv examination ports 1:19`
15.	Add QoS profile to port 1:19. `Summit300-48:1 # configure port 1:19 qosprofile qp7`

16.	Set all ingress traffic on port **1:19** to **priority 6**.
	`Summit300-48:1 # create access-mask port19pri6 port`
	`Summit300-48:1 # create access-list pri19 access-mask port19pri6 port 1:19 permit set dot1p 6`

Step	Description

17.	Create VLAN Datavlan1.
	`Summit300-48:1 # create vlan Datavlan1`
	`Summit300-48:1 # configure Datavlan1 tag 200`

18.	Add Datavlan1 to QoS profile qp1 (best effort). `Summit300-48:1 # configure Datavlan1 qosprofile qp1`

19.	Add an IP address for VLAN Datavlan1, and enable IP forwarding.
	`Summit300-48:1 # configure Datavlan1 ipaddress 192.168.200.254/24`
	`Summit300-48:1 # enable ipforwarding Datavlan1`

20.	Assign ports to VLAN Datavlan1.
	`Summit300-48:1 # configure Datavlan1 add ports 1:1 tagged`
	`Summit300-48:1 # configure Datavlan1 add ports 1:2, 1:3`

21.	Create VLAN Vlan2.
	`Summit300-48:1  create vlan Vlan2`
	`Summit300-48:1  configure Vlan2 tag 2`

22.	Add an IP address for VLAN Vlan2, and enable IP forwarding.
	`Summit300-48:1 # configure Vlan2 ipaddress 10.1.2.1/24`
	`Summit300-48:1 # enable ipforwarding Vlan2`

23.	Assign ports to VLAN Vlan2. `Summit300-48:1 # configure Vlan2 add ports 1:4`

24.	Create VLAN Prox1.
	`Summit300-48:1  create vlan Prox1`
	`Summit300-48:1  configure Prox1 tag 90`

25.	Add an IP address for VLAN Prox1, and enable IP forwarding.
	`Summit300-48:1 # configure Prox1 ipaddress 10.1.90.1/24`
	`Summit300-48:1 # enable ipforwarding Prox1`

26.	Assign ports to VLAN Prox1. `Summit300-48:1 # configure Prox1 add ports 1:1 tag`

Step	Description

27.	Enable DHCP relay.
	`Summit300-48:1 **enable bootprelay**`
	`Summit300-48:1 **configure bootprelay add 10.1.2.250**`

28.	Save the running configuration to the startup configuration. `Summit300-48:1 # **save**`

7. Configuration of the Extreme Summit X450e-24p Switch for Campus A

This section addresses configuring the Extreme Summit X450e-24p Switch for Campus A. The Extreme Summit X450e-24p Switch will run Layer 2 VLANs, enforce QoS policies and supply PoE to the Avaya IP Telephones.

Step	Description

1.	Log into the Extreme Summit X450e-24p Switch for Campus A.
	Connect to the Extreme Summit X450e-24p Switch. Log in using the appropriate Login ID and Password.
	`Login:`
	`Password:`
	`X450e-24p:1 #`

2.	Ensure the ports are not already configured. Use the **show port <port> info detail** command to check the current configuration for the port. `X450e-24p:1 # **show port 1 info detail**` Repeat for ports 2 and 3.

3.	Verify ports are not configured with VLAN information, delete the information on the port or look for one that is not in use, use the **configure vlan <VLAN NAME> delete ports <port>** command to delete the port information or the **show port <port> info detail** command to find another one.
	`X450e-24p:1# **configure vlan <VLAN NAME> delete ports <port>**`
	`X450e-24p:1# **show port <port> info detail**`

Step	Description

4.	Create VLAN Voice1.
	`X450e-24p:1 #  create vlan Voice1`
	`X450e-24p:1 #  configure Voice1 tag 50`

5.	Assign ports to VLAN Voice1 for the interfaces. `X450e-24p:1 # configure Voice1 add ports  1, 2, 3 tagged`

6.	Create VLAN Datavlan1.
	`X450e-24p:1 # create vlan Datavlan1`
	`X450e-24p:1 # configure Datavlan1 tag 200`

7.	Add Datavlan1 to QoS profile qp1 (best effort). `X450e-24p:1 # configure Datavlan1 qosprofile qp1`
8.	Assign ports to VLAN Datavlan1. `X450e-24p:1 # configure Datavlan1 add ports 1, 2, 3 tagged`
9.	Save the running configuration to the startup configuration. `X450e-24p:1 # save`

8. Configuration of the Extreme Summit X450e-24p Switch for Campus B

This section addresses configuring the Extreme Summit X450e-24p Switch. The Summit X450e-24p Switch will run Layer 2 and Layer 3, enforces QoS policies, run OSPF, and supply PoE to the Avaya IP Telephones.

Step	Description

1.	Log into the Extreme Summit X450e-24p Switch.
	Connect to the Extreme X450e-24p Switch. Log in using the appropriate Login ID and Password.
	`Login:`
	`Password:`
	`X450e-24p.1 #`

Step	Description
2.	Ensure the ports are not already configured. Use the **show port <port> info detail** command to check the current configuration for the port. `X450e-24p.1 # show port 1 info detail` Repeat for ports 2 and 3.

3.	Verify ports are not configured with VLAN information, delete the information on the port or look for one that is not in use, use the **configure vlan <VLAN NAME> delete ports <port>** command to delete the port information or the **show port <port> info detail** command to find another one.
	`X450e-24p:1# configure vlan <VLAN NAME> delete ports <port>`
	`X450e-24p:1# show port <port> info detail`

4.	Enable DiffServ examination on port 1. `X450e-24p.1 # enable diffserv examination ports 1`
5.	Create QoS profile qp7 `X450e-24p.1 # create qosprofile qp7`
6.	Assign DiffServ DSCP replacement value for qp7 to 46. `X450e-24p.1 # configure diffserv replacement qp7 code-point 46`

7.	Create VLAN VlanOSPF.
	`X450e-24p.1 #  create vlan VlanOSPF`
	`X450e-24p.1 #  configure VlanOSPF tag 2000`

8.	Add an IP address for VLAN VlanOSPF and enable IP forwarding.
	`X450e-24p.1 # configure VlanOSPF ipaddress 10.20.30.2/30`
	`X450e-24p.1 # enable ipforwarding VlanOSPF`

9.	Assign ports to VLAN VlanOSPF. `X450e-24p.1 # configure VlanOSPF add ports 1 tag`
10.	Enable OSPF `X450e-24p.1 # enable ospf`

Step	Description

11.	Configure OSPF for VlanOSPF.
	`X450e-24p.1 # configure ospf VlanOSPF area 0.0.0.0`
	`X450e-24p.1 # configure ospf add VlanOSPF area 0.0.0.0`

12.	Enable OSPF to forward information for directly connected interfaces. `X450e-24p.1 # enable ospf export direct cost 2 type ase-type-2`

13.	Create VLAN Voice2.
	`X450e-24p.1 #  create vlan Voice2`
	`X450e-24p.1 #  configure Voice2 tag 33`

14.	Add an IP address for VLAN Voice2 and enable IP forwarding.
	`X450e-24p.1 # configure Voice2 ipaddress 192.168.33.254/24`
	`X450e-24p.1 # enable ipforwarding Voice2`

15.	Assign ports to VLAN Voice2. `X450e-24p.1 # configure Voice2 add ports  1, 2, 3 tagged`

16.	Create VLAN Datavlan2.
	`X450e-24p.1 # create vlan Datavlan2`
	`X450e-24p.1 # configure Datavlan2 tag 30`

17.	Add Datavlan2 to QoS profile qp1 (best effort). `X450e-24p.1 # configure Datavlan2 qosprofile qp1`

18.	Add an IP address for VLAN Datavlan2 and enable IP forwarding.
	`X450e-24p.1 # configure Datavlan2 ipaddress 192.168.30.254/24`
	`X450e-24p.1 # enable ipforwarding Datavlan2`

19.	Assign ports to VLAN Datavlan2. `X450e-24p.1 # configure Datavlan2 add ports 2, 3`

20.	Enable DHCP relay.
	`X450e-24p.1 # enable bootprelay`
	`X450e-24p.1 # configure bootprelay add 10.1.2.250`

Step	Description
21.	Save the running configuration to the startup configuration. `X450e-24p.1 # save`

9. Interoperability Compliance Testing

Interoperability compliance testing covered feature functionality, serviceability, and performance testing.

For feature functionality testing, emphasis was placed on verifying voice quality in a multi-site converged VoIP and data network scenario. Specifically, compliance testing verified that when the Proxim Tsunami MP.11 interfaces are oversubscribed with low priority data traffic, the higher priority VoIP media and signaling traffic still gets through with good voice quality. Prioritization of voice traffic was achieved by implementing Layer 3 DiffServ and Layer 2 priority (802.1p) QoS. Voice and data traffic were segmented in the enterprise network using VLANs.
QoS and performance testing were verified by making voice calls while a traffic generator generated low priority data traffic. At the end of the performance test, it was verified that the network devices continued to operate successfully.

Serviceability testing was conducted to verify the ability of the Avaya/Proxim VoIP solution to recover from adverse conditions, such as power cycling Avaya Communication Manager, Proxim Wireless devices and disconnecting cables between the LAN interfaces. In all cases, the Avaya Communication Manager and Proxim Wireless devices recovered without intervention.

9.1. General Test Approach

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

- LAN connectivity between the Avaya and Proxim products
- Registration of Avaya IP Telephones with Avaya Communication Manager
- Verification of the DHCP relay configuration
- VoIP calls over Layer 2 and Layer 3 connections
- Inter-office calls using G.711 mu-law & G.729 codecs, direct media, conferencing, and sending low priority data traffic over the LAN
- Verifying that QoS directed the voice signaling and voice media to the higher priority egress queue based on the packets' DSCP value
- Layer-2, Layer-3, port based and VLAN based Quality of Service
- Chariot was used to verify voice quality

The performance tests were performed by oversubscribing the network interfaces with low priority data traffic and verifying that good voice quality was achieved when calls were made over the routed and switched interfaces.

9.2. Test Results

All feature functionality, serviceability, and performance test cases passed. The Proxim Wireless implementation yielded good voice quality. The stability of the Avaya/Proxim solution was successfully verified through performance and serviceability testing.

10. Verification Steps

This section provides the steps for verifying end-to-end network connectivity and QoS. In general, the verification steps include:

- Verify that the DHCP relay on the is functioning by confirming that the Avaya IP Telephones receive their IP addresses from the DHCP server connected to the network
- Verify that the Avaya wireless IP endpoints have successfully registered with Avaya Communication Manager by typing the **list registered-ip-stations** command on the SAT. A sample output of the command is shown below.

```
list registered-ip-stations
REGISTERED IP STATIONS
Station      Set    Product      Prod Station        Net Orig     Gatekeeper
Ext          Type   ID           Rel IP Address      Rgn Port     IP Address
40000        4610   IP_Phone     2.130 10.1.2.170    1            10.1.2.7
40001        4606   IP_Phone     1.500 10.1.2.19     1            10.1.2.7
40003        4620   IP_Soft      5.146 10.2.2.162    1            10.1.2.7
```

- Place calls between the Avaya 2410 Digital Telephone and Avaya IP Telephones.
- Verify good voice quality using a Chariot server and clients.

11. Troubleshooting

11.1. Proxim Wireless Troubleshooting

- If the voice quality is poor, check sections 4 thru 6 for QoS options.
- If any of the endpoints are unable to communicate with any of the aforementioned IP devices and interfaces, check the VLAN configuration, routing and status of the Ethernet and LAN interfaces on the switches and the BSU and SU.

12. Conclusion

These Application Notes describe the configuration steps required for integrating Proxim WiMAX Base Stations and Subscriber Units into an Avaya Communication Manager VoIP infrastructure. For the configuration described in these Application Notes, the Proxim MP.11 Base stations and subscriber units were responsible for enforcing QoS policies using Layer 3 Differentiated Services and Layer 2 (802.1p). Good voice quality was successfully achieved in the Avaya/Proxim configuration described herein.

13. Additional References

This section references the Avaya and Extreme product documentation that are relevant to these Application Notes.

Product documentation for Avaya products may be found at http://support.avaya.com

[1] *Administrator Guide for Avaya Communication Manager*, Doc # 03-300509, Issue 2.1, May 2006

[2] *Avaya Communication Manager Advanced Administration Quick Reference*, Doc # 03-300364, Issue 2, June 2005

[3] *Administration for Network Connectivity for Avaya Communication Manager*, Doc # 555-233-504, Issue 11, February 2006

[4] *Avaya IP Telephony Implementation Guide*, May 1, 2006

The Proxim product documentation can be found at:
http://www.proxim.com