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Avaya Solution & Interoperability Test Lab

Avaya Aura® Telephony Infrastructure in a Converged VoIP and Data Network using HP Networking Switches with Intelligent Resilient Framework (IRF) with Link Layer Discovery Protocol (LLDP), Quality of Service (QoS), and Power over Ethernet (PoE)-Issue 1.0

Abstract

These Application Notes describe the configuration of a Voice over IP (VoIP) solution including an Avaya Aura® Telephony Infrastructure running in a converged VoIP and data network built with HP Networking Ethernet switches. The HP Networking switches were compliance-tested with Avaya Aura® Communication Manager, Avaya Aura® Session Manager and Avaya Aura® Communication Manager Messaging. Emphasis was placed on verifying interoperability with LLDP, L2/L3 QoS, and PoE, along with validating high availability using IRF.

Information in these Application Notes has been obtained through DevConnect compliance testing and additional technical discussions. Testing was conducted via the DevConnect Program at the Avaya Solution and Interoperability Test Lab.

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1. Introduction

These Application Notes describe the configuration of a Voice over IP (VoIP) solution including an Avaya Aura® Telephony Infrastructure running in a converged VoIP and data network built with HP Networking 7500 modular core and 5500 Series Switches. Compliance testing verified multiple methods for configuring Voice VLAN and Quality of Service (QoS), including Aura® Communication Manager forms, settings files, and Link Layer Discovery Protocol for Media Endpoint Devices (LLDP-MED). Power over Ethernet (PoE) was also verified. Quality of Service (QoS) based on Layer 2 Priority (802.1p) and Layer 3 Differentiated Services (Diffserv) was implemented across the network to prioritize voice traffic over data traffic. The Avaya IP Telephones received QoS priority settings from Avaya Aura® Communication Manager and were enforced across the network by the HP Switches. Additionally QoS parameters were verified based on configuration file settings and LLDP auto discovery. To verify proper QoS policies, VoIP traffic was given priority over data traffic, and tests were performed by over subscribing the LAN interfaces with low priority data traffic and verifying that acceptable voice quality was achieved when calls were routed over all of the LAN interfaces. High availability and resiliency for VoIP traffic was validated using HP's Intelligent Resilient Framework (IRF) by simulating fault conditions. PoE was also verified on the HP Networking switches.

2. General Test Approach and Test Results

DevConnect Compliance Testing is conducted jointly by Avaya and DevConnect members. The jointly-defined test plan focuses on exercising APIs and/or standards-based interfaces pertinent to the interoperability of the tested products and their functionalities. DevConnect Compliance Testing is not intended to substitute full product performance or feature testing performed by DevConnect members, nor is it to be construed as an endorsement by Avaya of the suitability or completeness of a DevConnect member's solution.

2.1. Interoperability Compliance Testing

The interoperability compliance testing included the following:

All test cases were performed manually.

- LAN connectivity between the Avaya and HP Networking products.
- Registration of Avaya H.323 endpoints with Communication Manager.
- Registration of Avaya SIP endpoints with Session Manager.
- VoIP calls, including, hold, transfer and conferencing.
- QoS for voice signaling and voice media received higher priority based on 802.1p and DSCP settings.
- Configuration of QoS parameters using Avaya Communication Manager.
- Auto discovery of QoS parameters using LLDP-MED.
- Auto discovery of Voice VLAN using LLDP-MED.
- Avaya Communication Manager Messaging voicemail and MWI works properly.

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- Pulling the power cord on one of the 7500 chassis to simulate a core switch failure and verify that IRF provides network resiliency so that voice traffic continues to operate successfully.

Compliance testing focused on the QoS, VLAN, and PoE implementation in the Avaya/HP Networking configuration. Specifically, compliance testing verified that when the HP Networking switch interfaces were oversubscribed with low priority data traffic, the higher priority VoIP media and signaling traffic still got through and achieved good voice quality. Prioritization of voice traffic was achieved by implementing Layer 3 DiffServ-based QoS and Layer 2 priority (801.p). Voice and data traffic were segmented in the enterprise network using VLANs. Auto discovery of Voice VLAN, and QoS parameters, using LLDP were also verified along with the ability to power Avaya IP telephones via PoE.

2.1.1. HP Intelligent Resilient Framework Overview (IRF)

The Intelligent Resilient Framework (IRF) is an HP switch virtualization and stacking technology designed to improve the manageability, performance and resiliency of networks.

With HP IRF, one switch within a domain or stack operates as the primary switch. The associated switches provide Layer 2 and Layer 3 functionality for directly connected devices. Optimal routes are calculated based on the entire logical domain, rather than the individual switches that the domain represents. All switches in a stack or domain are managed as a single entity using one IP address by the primary managing logical switch.

Unlike with Spanning Tree Protocols (STP/RSTP/MSTP) where redundant links are pruned to prevent topology loops and only selected as a backup when an active path fails, the IRF technology keeps all links active to provide higher bandwidth connectivity throughout the IRF stack. If the primary IRF switch fails, a new switch is instantly selected, to prevent service interruption and helps ensure highly reliable network connectivity for application traffic, like VoIP and video.

2.2. Test Results

The test objectives listed in **Section 2.1** were verified. QoS and performance testing was verified by making voice calls while a traffic generator generated low priority data traffic to simulate a congested network. At the end of the performance test, it was verified that the network devices continued to operate successfully. Additionally tests were repeated using the configuration settings discovered via LLDP.

Serviceability testing was conducted to verify the ability of the Avaya/HP Networking VoIP solution to recover from adverse conditions, such as power cycling network devices to simulate an IRF switch failure and disconnecting/reconnecting cables between the LAN interfaces. In all cases, the ability to recover after the network normalized was verified.

All feature functionality, serviceability, and performance test cases passed. The HP Networking implementation prioritized VoIP traffic and yielded good voice quality without dropping any calls.

PoE parameters were verified using HP Networking show commands and fell within acceptable ranges.

All of the HP Networking products used in this compliance testing successfully passed.

2.3. Support

For technical support on HP Networking products, consult the following support pages by contacting HP Networking customer support at:

- Contact us: http://h17007.www1.hp.com/us/en/contact
- Website Support: http://h17007.www1.hp.com/us/en/support/converter/index.aspx
- Website Product Information: http://h17007.www1.hp.com/us/en/index.aspx

3. Reference Configuration

Figure 1 illustrates the configuration used for compliance testing. The network consisted of Avaya Aura® Communication Manager Server running on an S8300D card that was installed in the G450 Media gateway, Avaya Aura® Session Manager, and IP endpoints including, Avaya IP Telephones, Avaya one-X communicator, and Avaya video endpoints. All Avaya components were connected to the HP Networking switches and voice and video traffic was carried across this infrastructure. Configuration settings for the endpoints were provided by Avaya Aura® Communication Manager as well as via LLDP. To better manage the different traffic types and endpoint devices, the voice and data traffic were separated onto different VLANs. Additionally Avaya 1000 series Video Endpoints were placed into the Voice VLAN.
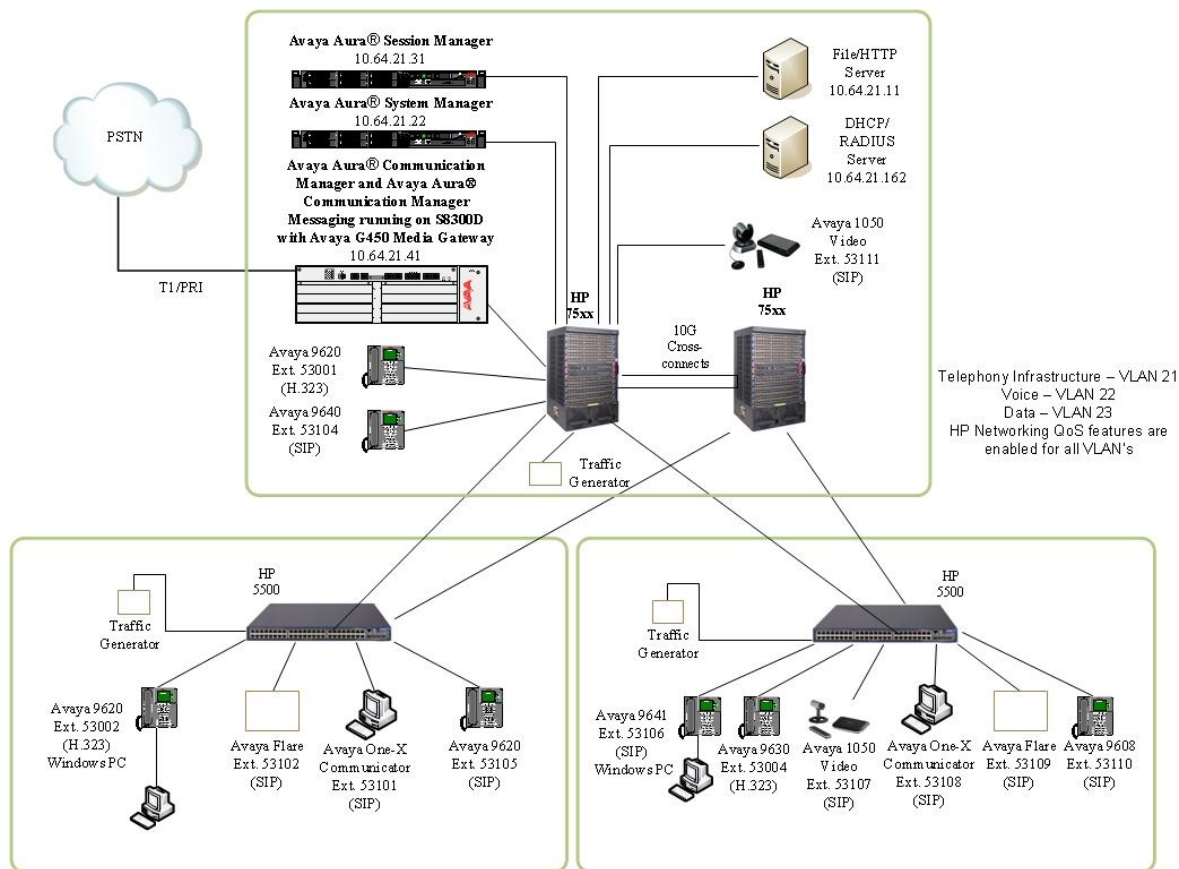

Figure 1: Network Configuration

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4. Equipment and Software Validated

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

Equipment	Software/Firmware
Avaya PBX Products	
Avaya S8300D Server with an Avaya G450 Media Gateway	Avaya Aura® Communication Manager 6.2 with SP3 (Patch 20001), Avaya Aura® Communication Manager Messaging 6.2
Avaya Aura® Session Manager	
HP Proliant DL360 G7	Avaya Aura® Session Manager 6.2 with SP3
Dell™ PowerEdge™ R610 Server	Avaya Aura® System Manager 6.2 with SP3
Avaya Endpoints	
Avaya 96xx Series IP Telephones	(H.323 3.1.5), (SIP 2.6.8)
Avaya 96x1 Series IP Telephones	(H.323 6.2.2), (SIP 6.2.0)
Avaya One-X Communicator	6.1.5.07-SP5-37495
Avaya A175Video Endpoint	1.1.2
Avaya 1020 Video Endpoint	4.8.3 (26)
Avaya 1050 Video Endpoint	4.8.3 (26)
HP Networking Products	
HP 5500	HP Comware Software Version 5.20, Release 2215
HP 7503E	HP Comware Software Version 5.20, Feature 6705

5. Configure Avaya Aura® Communication Manager

This section describes the steps required for Communication Manager to support the configuration in **Figure 1**. The following pages provide step-by-step instructions on how to administer parameters specific to the HP Networking solution only. The assumption is that the appropriate license and authentication files have been installed on the servers and that login and password credentials are available and that the reader has a basic understanding of the administration of Communication Manager. It is assumed that all other connections, e.g., to PSTN, to LAN, are configured and will not be covered in this document. The reader will need access to the System Administration Terminal screen (SAT). For detailed information on the installation, maintenance, and configuration of Communication Manager, refer to **Reference [1]**.

5.1. Configure QoS on Communication Manager for H.323 Telephones

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 insure reliable delivery of latency sensitive voice and video traffic, QoS is utilized and should be implemented consistently throughout the entire network.

In order to achieve prioritization of VoIP traffic, the VoIP traffic must be classified. The Avaya IP endpoints support both Layer 2 802.1.p priority and Layer 3 DiffServ.

In the compliance test all network components were in network region 1. The DiffServ and 802.1p values configured here will be downloaded to the Avaya H.323 IP telephones via Communication Manager.

Note: Avaya SIP endpoints can get QoS settings by downloading the 46xxsettings.txt file from the HTTP server. **See Section 6**.

LLDP can also be used for auto discovering the voice VLAN and QoS settings and is covered in **Section 12**.

For more information on QoS settings, refer to **Reference [1]**.

Use the **change ip-network-region 1** command to change the DIFFSERV/TOS PARAMETERS and 802.1P/Q PARAMETERS settings configured in Communication Manager. Set the **Call Control PHB Value** to **46** and the **Audio PHB Value** to **46**. Set the **Call Control 802.1p Priority** and **Audio 802.1p Priority** to **6**.

```
change ip-network-region 1                                   Page   1 of  20
                             IP NETWORK REGION
  Region: 1
Location:          Authoritative Domain: avaya.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? n
  UDP Port Max: 3329
DIFFSERV/TOS PARAMETERS
 Call Control PHB Value: 46
       Audio PHB Value: 46
       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
```

The Differentiated Services Code Point (DSCP) value of 46 is used for both the signaling and audio Per Hob Behavior (PHB) values for voice. DSCP 26 and 802.1p priority 5 is used for video with the Avaya A175. DSCP 46 represents the Traffic Class of Expedited Forwarding (EF) and the Traffic Type Voice.

Note: The 802.1p and DSCP values used above (i.e., 6 and 46) will be used consistently throughout the configuration of the HP Networking switches.

Use the **change ip-network-map** command to change the Voice VLAN setting configured in Avaya Communication Manager. Set the **IP address** range using the **From** and **To** fields. Enter a value for **Subnet Bits**, **Network Region**, and **VLAN**. In this example the Avaya endpoints were located in VLAN 22.

```
change ip-network-map                                        Page   1 of  63
                        IP ADDRESS MAPPING


                                        Subnet Network    Emergency
 IP Address                             Bits   Region VLAN Location Ext
 --------------------------------------- ------ ------ ---- -------------
 FROM: 10.64.22.0                        /24    1      22
   TO: 10.64.22.255
 FROM:                                   /             n
   TO:
 FROM:                                   /             n
```

6. Configure QoS for Avaya 96xx SIP Telephones using 46xxsettings.txt file

Modify the following settings in the 46xxsettings.txt file for configuring the 96xx SIP Telephones for Voice VLAN and desired L2 and L3 QoS parameters.

```
################# 802.1P/Q SETTINGS ##################
##
## Voice VLAN Identifier
##   VLAN identifier to be used by IP telephones. This
##   parameter should only be set when IP telephones are to
##   use a VLAN that is separate from the default data VLAN.
##   If the VLAN identifier is to be configured via H.323
##   signaling based on Avaya Communication Manager
##   administration forms, it should not be set here.
##   This parameter may also be changed via LLDP.
##   Note : This setting is applicable for 1603 SIP phones also.
SET L2QVLAN 22
##
## Audio Priority Value
##   Sets the layer 2 priority value for audio packets
##   from the phone. (0-7)
##   For H.323 phones, this parameter may also be
##   changed from Communication Manager. For 96xx SIP
##   phones, this parameter may also be changed via LLDP.
##   Note : This setting is applicable for 1603 SIP phones also.
SET L2QAUD 6
##
## Signaling Priority Value
##   Sets the layer 2 priority value for signaling
##   protocol messages from the phone. (0-7)
##   For H.323 phones, this parameter may also be
##   changed from Communication Manager. For 96xx SIP
##   phones, this parameter may also be changed via LLDP.
##   Note : This setting is applicable for 1603 SIP phones also.
SET L2QSIG 6
##
##  DSCPAUD Sets the DiffServ value for audio streams from the phone.
##  The default is 46 and valid values are 0-63.
##  For 96xx SIP phones, this parameter may also be changed via LLDP.
##  Note: This setting is also applicable for 1603 SIP phones and 364x SIP phones.
SET DSCPAUD 46
##
##  DSCPSIG Sets the DiffServ value for signaling protocol
##  messages from the phone. The default is 34 and valid
##  values are 0-63.  For 96xx SIP phones, this parameter
##  may also be changed via LLDP.
##  Note: This setting is also applicable for 1603 SIP phones and 364x SIP phones.
SET DSCPSIG 46
##
```

7. Configure QoS for Avaya A175 SIP Telephone using Axxxsettings.txt file
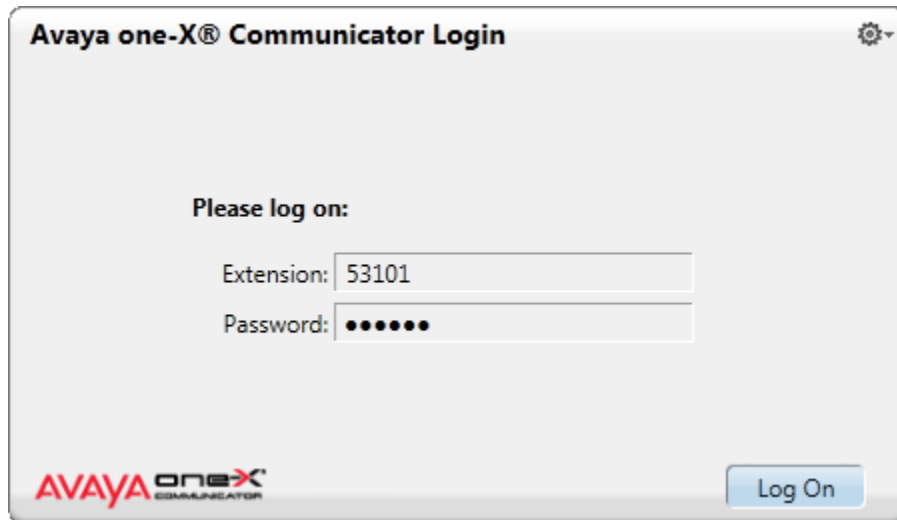
Modify the following setting in the Axxxsettings.txt file for configuring the A175 SIP Telephones for Voice VLAN and desired L2 and L3 QoS parameters for voice and video.

```
################# 802.1P/Q SETTINGS ##################
##
##   Those settings does not apply to Wi-Fi interfaces.
##
## Telephone Frame Tagging
##   Controls whether layer 2 frames generated by the
##   telephone have IEEE 802.1Q tags.
##   0 for Auto, 1 for On, and 2 for Off
SET L2Q 1
##
## Voice VLAN Identifier
##   VLAN identifier to be used by IP telephones. This
##   parameter should only be set when IP telephones are to
##   use a VLAN that is separate from the default data VLAN.
SET L2QVLAN 22
##
## Audio Priority Value
##   Sets the layer 2 priority value for audio packets
##   from the phone. (0-7). The default value is 6.
SET L2QAUD 6
##
## Signaling Priority Value
##   Sets the layer 2 priority value for signaling
##   protocol messages from the phone. (0-7)
##   The default value is 6.
SET L2QSIG 6
##
## Video Priority Value
##   Sets the layer 2 priority value for video packets
##   from the phone. (0-7). The default value is 5.
SET L2QVID 5
################### DSCP SETTINGS #######################
##
##  DSCPAUD Sets the DiffServ value for audio streams from
##  the phone. The default is 46 and valid values are 0-63.
SET DSCPAUD 46
##
##  DSCPVID Sets the DiffServ value for video streams from
##  the phone. The default is 26 and valid values are 0-63.
SET DSCPVID 26
##
##  DSCPSIG Sets the DiffServ value for signaling protocol
##  messages from the phone. The default is 34 and valid
##  values are 0-63.
SET DSCPSIG 46
##
```

8. Configure QoS for Avaya one-X Communicator

Double-click the Avaya one-X Communicator icon to start the application.
Click the drop-down arrow on the Menu button in the top right corner and select **settings** (not shown).
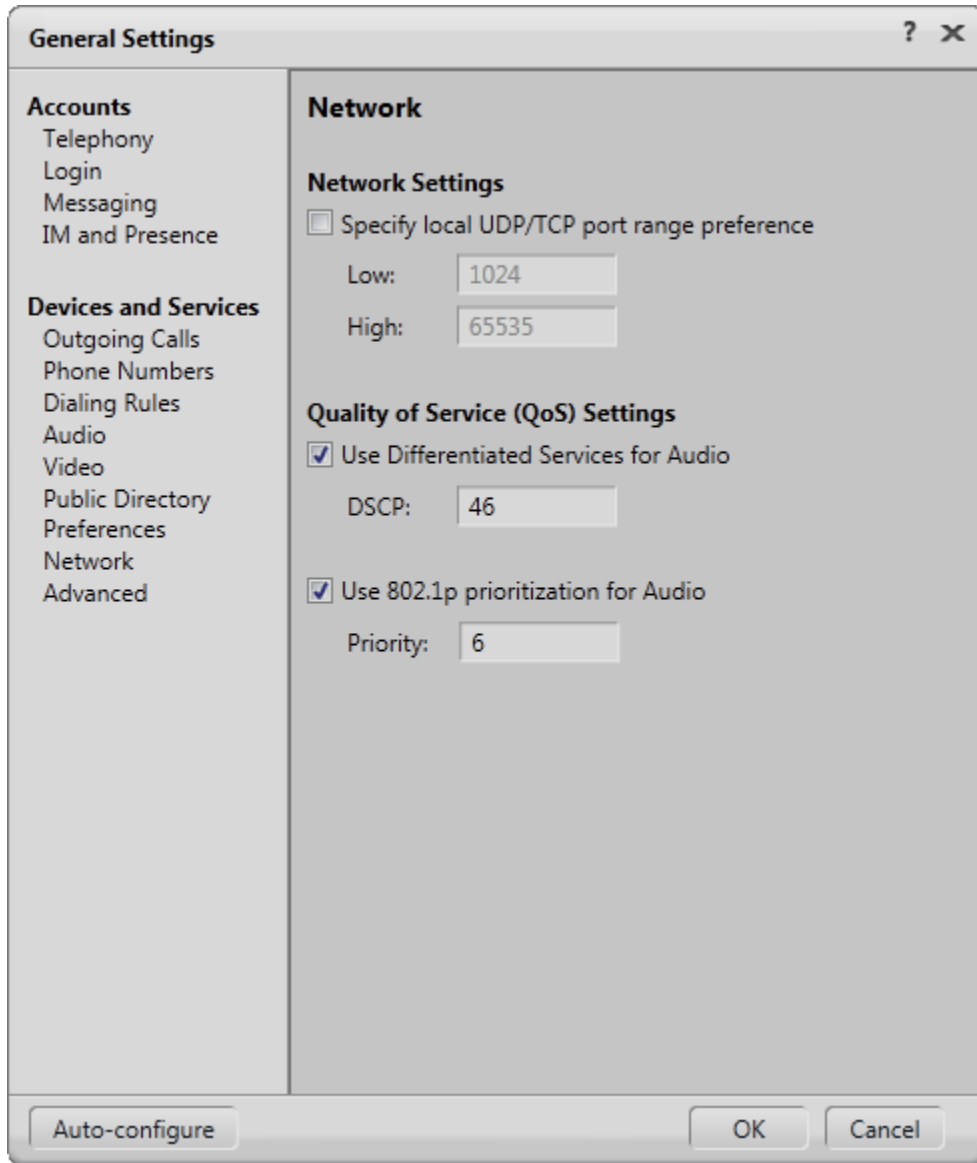

From the left pane of the General Settings screen select **Telephony**. In the right pane **c**lick the radio button for the desired protocol. Continue by entering an **Extension**: and **Password:** in the appropriate fields, configuring **Server List:** by clicking the **Add** button and providing the **IP Address** of the Proxy Server (not shown), and entering the **Domain**: name used for SIP. The compliance test used **SIP**.

**Note:** *Default values are ok for the remaining fields.*
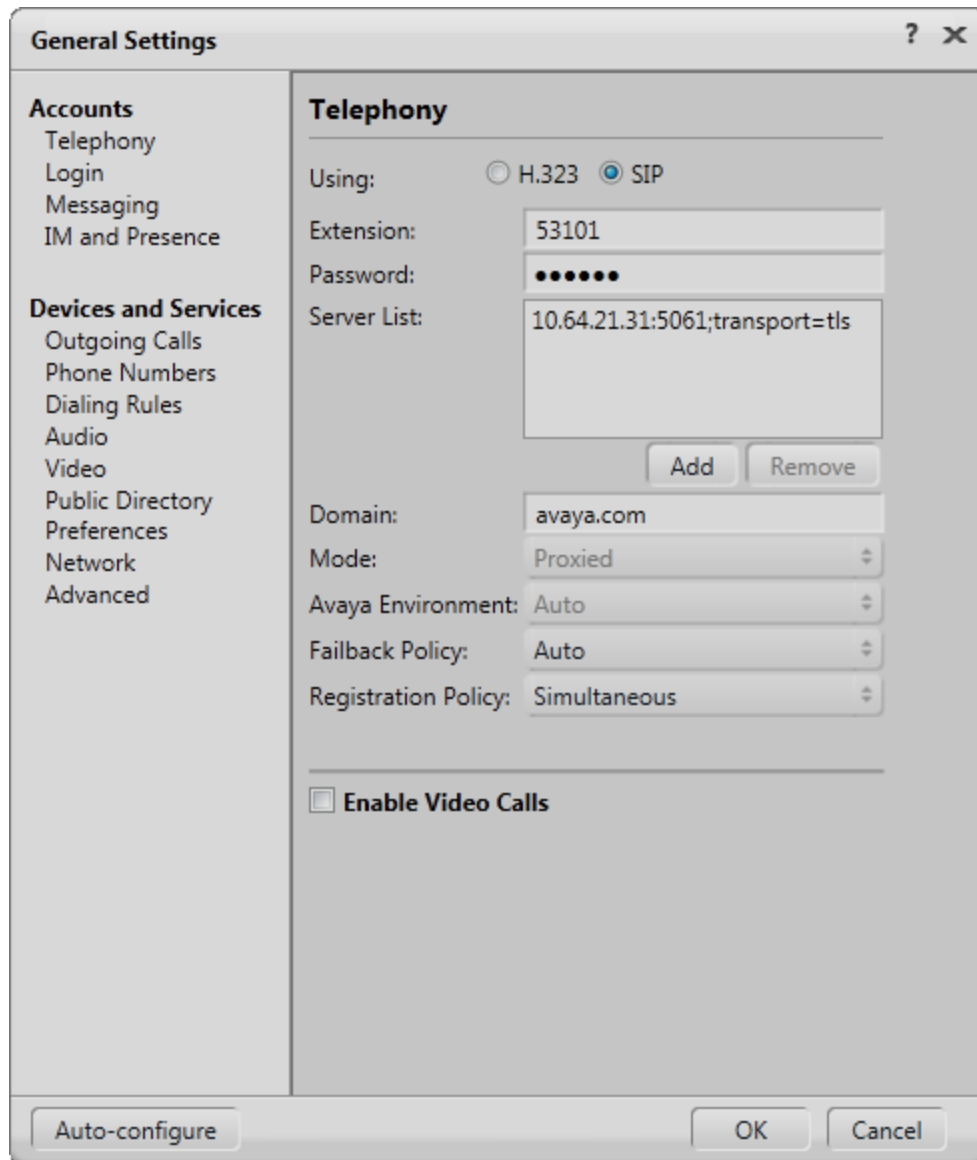
From the left pane of the General Settings screen select **Network**. Configure desired QoS parameters in the right pane.

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# 9. Configure QoS for Avaya 1000 series Video Conferencing Unit

From a web browser enter the IP address of the Avaya 1000 series Video Conferencing Unit (VCU) in the URL field to display the login page. Enter the proper login credentials and click the **Submit** button.
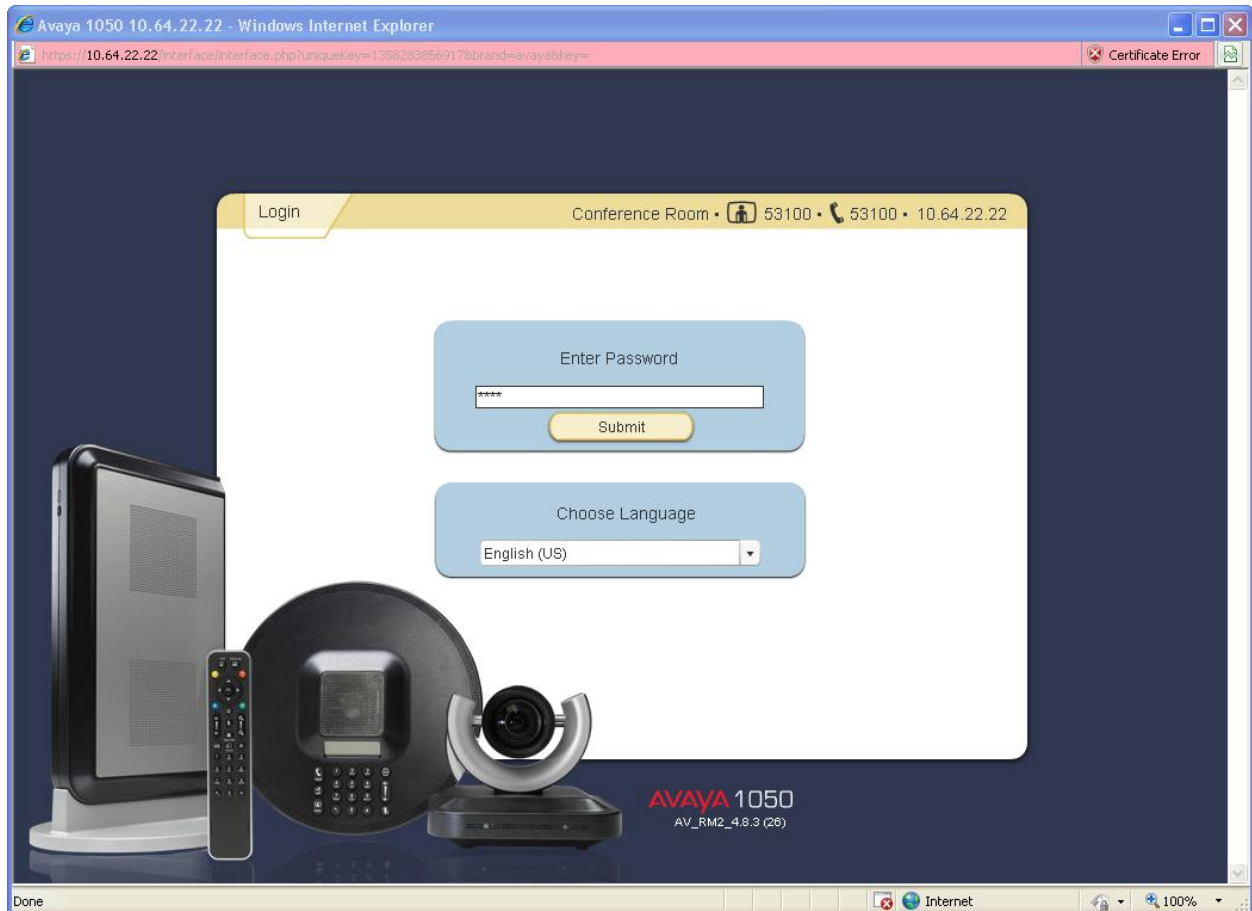
From the left pane of the **Preferences** tab, click **Communications**, and then **SIP** to display the following page. From this page select **Enabled** from the **SIP** dropdown box. Also enter the desired parameters for **SIP Username**, **Authorization Name**, and **Authorization Password**. For **SIP Registration** select **Through Proxy** and make sure **SIP Proxy** and **SIP Registrar** are both **Enabled**. For compliance testing the Session Manager IP Address was used for **Proxy** and **Registrar Hostname**. The remaining fields can be left at their default settings. Click the **Save Changes** button.
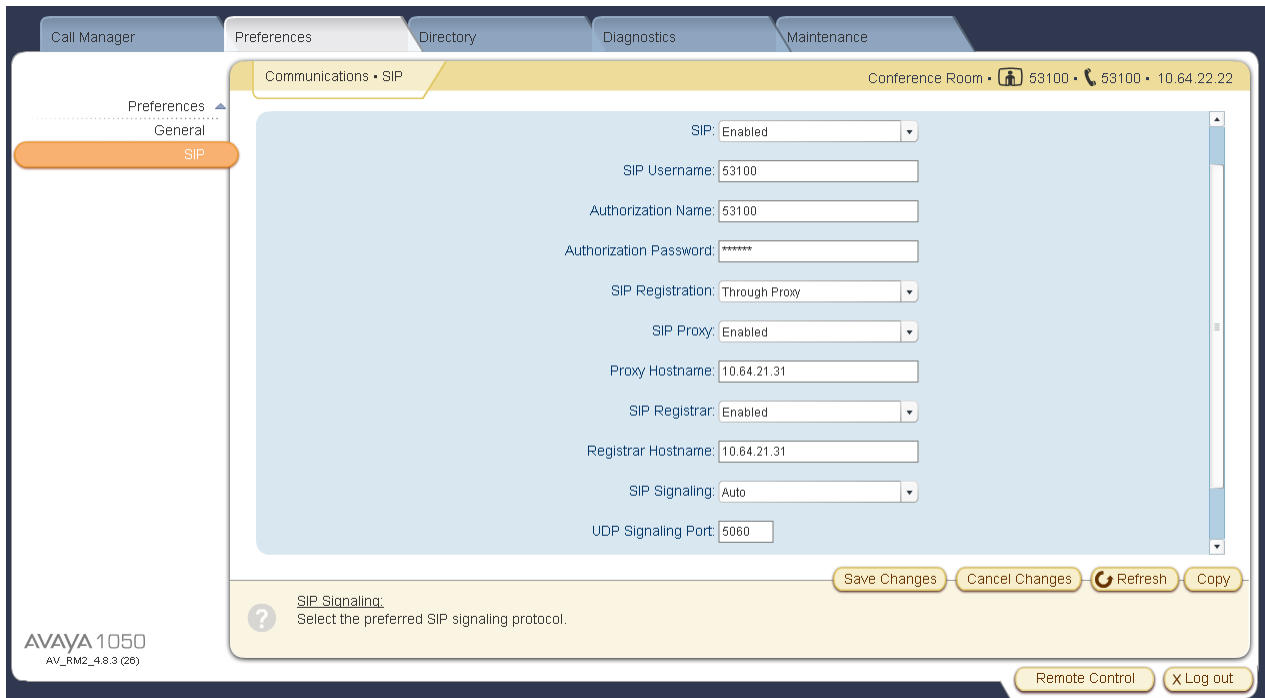
From the left pane of the **Preferences** tab, click **Network,** then **Network QoS** to display the following page. From this page select **DiffServ** from the **Network QoS** dropdown box. Also enter the desired parameters for **DiffServ Audio Priority**, **DiffServ Video Priority**, and **DiffServ Data Priority** and click the **Save Changes** button.
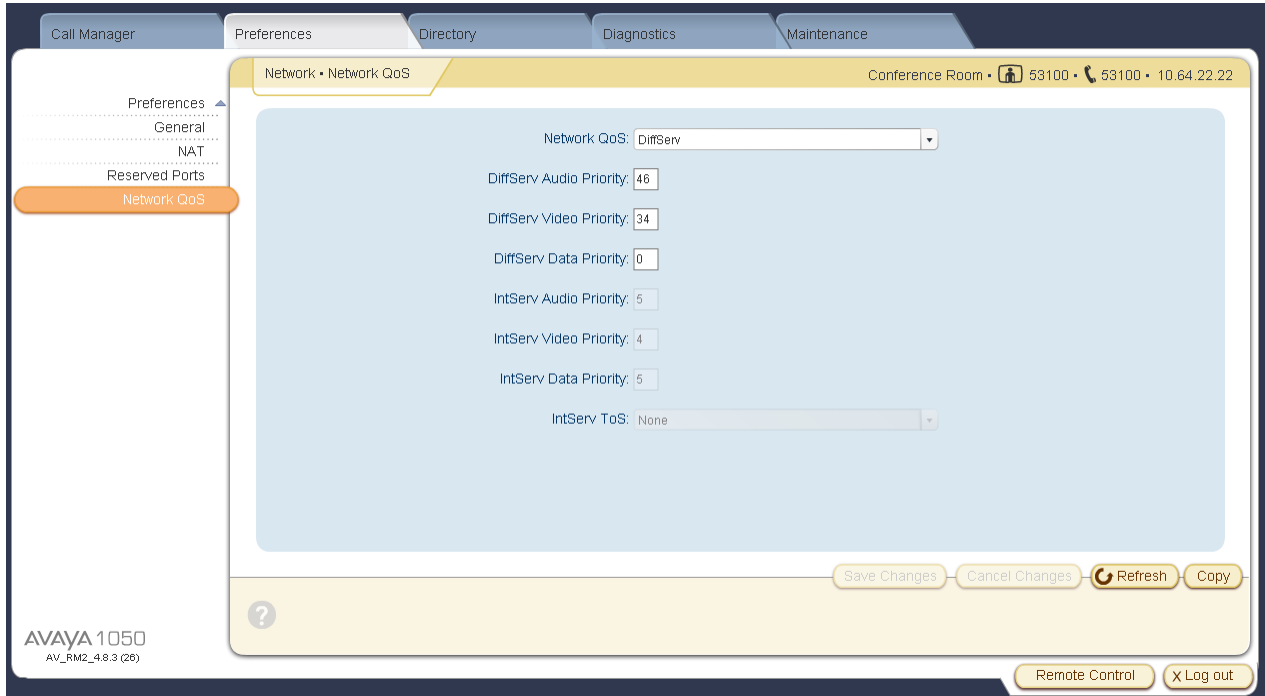
From the left pane click the **General** button to display the following page. From this page select **Enabled** from the **DHCP** dropdown box. Also enter the Voice VLAN ID in the **VLAN Tag** box and click the **Save Changes** button.

Note: *After making these changes the Avaya VCU should reboot in to the Voice VLAN.*

10. Configure the HP Networking 7503E Core Switches

To configure the HP Networking switch, connect a PC or laptop to the serial port of the switch. Run a terminal emulation program with the following configuration:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow Control: None

Alternatively, a telnet connect may be used.

1. Use Telnet to connect to the HP Networking switch. The following prompt should be displayed.

```
<HP-7503E>
```

2. Enter **system-view** to enter the System View menu and to configure the switch.

```
[HP-7503E]
```

10.1. Configure QoS

This section addresses how to configure the HP Networking 7503E Switches for enforcing QoS policies.

1. Enable the following features on the HP Networking 7503E Switch.
   - Use an Access Control List (ACL) to identify specific traffic for Avaya servers.
   - Use the ACL as a QoS traffic classifier.
   - Define the behavior of the traffic classified.
   - Bind the classifier and behavior together to form QoS Policy.
   - Apply the policy to the ports where the traffic will be located. For other traffic, set the QoS policy to trust the DSCP values.

```
# Identify specific traffic
acl n 3100
    rule 10 permit ip source 10.64.50.52 0
    rule 20 permit ip source 10.64.50.31 0
    rule 30 permit ip source 10.64.50.54 0

# Use the ACL (above) as a QoS traffic classifier
traffic classifier avaya_servers operator or
    if-match acl 3100

# Define the behavior of the traffic classified
traffic behavior avaya_servers
    remark dscp ef
    remark local-precedence 5

# Bind the classifier and behavior together to form QoS Policy
qos policy avaya_servers
    classifier avaya_servers behavior avaya_servers

# Apply the policy to the ports where the traffic will be located. For other traffic, set the QoS
policy to trust the DSCP values (example below).
interface g1/3/0/3
    qos apply policy avaya_servers inbound
    qos trust dscp
```

2. Create and configure the VLAN where all of the Avaya telephony infrastructure equipment
   and servers are located.
   - Assign a VLAN ID for the telephony infrastructure VLAN and assign a name.
   - Assign an IP address for the telephony infrastructure VLAN.
   - Assign ports to the telephony infrastructure VLAN.

```
# Assign a VLAN ID for the telephony VLAN and assign a name
vlan 21
   name Telephony Infrastructure

# Assign an IP address for the telephony VLAN
interface Vlan-interface21
   ip address 10.64.21.1 255.255.255.0

# Assign ports to the telephony VLAN (1 example below)
interface GigabitEthernet1/3/0/2
   port access vlan 21
```

3. Create and configure the voice VLAN.
   - Assign a VLAN ID for the voice VLAN and assign a name.
   - Assign an IP address for the voice VLAN.
   - Set a DHCP relay IP address.
   - Assign ports to the voice VLAN.

```
# Assign a VLAN ID for the voice VLAN and assign a name
vlan 22
   name Voice

# Assign an IP address for the voice VLAN
interface Vlan-interface22
   ip address 10.64.22.1 255.255.255.0
   dhcp select relay
   dhcp relay server-select 0

# Set a DHCP relay IP address
dhcp relay server-group 0 ip 10.64.21.162

# Assign ports to the voice VLAN (1 example below)
interface GigabitEthernet1/3/0/23
   port link-mode bridge
   port access vlan 22
```

4. Create and configure the data VLAN.
   - Assign a VLAN ID for the data VLAN and assign a name.
   - Assign an IP address for the data VLAN.
   - Set a DHCP relay IP address.
   - Assign ports to the data VLAN.

```
# Assign a VLAN ID for the data VLAN
vlan 23
name inband-mgt

# Assign an IP address for the data VLAN
interface Vlan-interface23
    ip address 10.64.23.254 255.255.255.0
    dhcp select relay
    dhcp relay server-select 0

# Set a DHCP relay IP address
dhcp relay server-group 0 ip 10.64.21.162

# Assign ports to the data VLAN (1 example below)
interface GigabitEthernet1/3/0/25
    port link-mode bridge
    port access vlan 23
```

5. Save the configuration.

```
[HP-7503E] save configuration
```

10.2. Configure LLDP

LLDP or 802.1AB is an IEEE standard designed for the discovery of directly attached adjacent network devices such as Ethernet switches and routers. LLDP-MED or ANSI/TIA-1057 is a TIA standard that extends LLDP for the discovery and auto-configuration of directly attached LLDP-MED capable media endpoint devices such as the Avaya 9600 Series IP Telephones. LLDP advertisements are encapsulated in LLDP Data Units (LLDPDU) in the format of Type Length Value or TLV for short. The IEEE 802.1AB specification defines different types of TLVs – Standard and Optional. LLDP capable devices must support the advertisement of Standard TLVs such as Chassis ID, Port ID, and Time to Live TLVs. The same LLDP capable device may also include LLDP-MED (Network Policy, Inventory), IEEE 802.3 (MAC/PHY Configuration/Status) and other Vendor specific optional TLVs as part of its LLDP advertisement. The Avaya 9600 Series IP Telephones supports the use of the Network Policy TLV as a means to auto discover voice VLAN and QoS assignment in addition to using vendor specific TLVs.

1. Enable the following features on the HP Networking 7503E Switch.

lldp enable

2. Configure auto voice vlan assignment for Avaya phones

voice vlan mac-address 0004-0d00-0000 mask ffff-ff00-0000 description Avaya phone
voice vlan mac-address 0009-6e00-0000 mask ffff-ff00-0000 description Avaya phone
voice vlan mac-address 001b-4f00-0000 mask ffff-ff00-0000 description Avaya phone
voice vlan mac-address b4b0-1700-0000 mask ffff-ff00-0000 description Avaya phone

3. Save the configuration.

[HP-7503E] **save configuration**

10.3. Configure PoE

Power over Ethernet (PoE) allows both power and data to be simultaneously carried over standard Ethernet cables. PoE-enabled Ethernet switches can supply power directly to Ethernet devices, thereby simplifying installation and removing the need for separate power supplies for those devices. The IEEE 802.3af-2003 standard defines the mechanisms for Power Sourcing Equipment (PSE), such as PoE-enabled Ethernet switches, to detect, classify, and supply up to 15.4W of power per port to Powered Devices (PDs), such as PoE-enabled IP telephones. In the compliance-tested configuration described in these Application Notes, the HP Networking Switches were configured to supply inline PoE to Avaya PDs. Many HP Networking Switches also support the IEEE 802.3at-2009 standard for Power over Ethernet Plus (PoE+), which can provide up to 30W per port.

The default configuration for the HP Networking switches has PoE/PoE+ enabled. If you need to make modifications or disable PoE or control per-port PoE priority please refer to the HP Networking Switch manuals for more information.

11. Configure HP Networking Distribution/Access Switches

This section addresses configuring the 5500 switches to support the configuration shown in **Figure 1**.

Note: *The purpose of this compliance test was to validate interoperability with each HP switch. Since each of the distribution/access switches were configured the same way, only one configuration is shown. To configure the other switches shown in Figure 1, repeat the same configuration commands on each switch.*

To configure the HP Networking switch, connect a PC or laptop to the serial port of the switch. Run a terminal emulation program with the following configuration:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow Control: None

Alternatively, a telnet connect may be used.

1. Use Telnet to connect to the HP Networking switch. The following prompt should be displayed.

```
<HP-5500-52C>
```

2. Enter **system-view** to enter the System View menu and to configure the switch.

```
[HP-5500-52C]
```

Note that configuration for VLANs, interfaces, DHCP, etc. can be done similarly using the same commands shown in **Section 10**.   See the Appendix for configuration details of each switch.

11.1. Configure QoS

This section addresses how to configure the HP Networking 5500 Switches for enforcing QoS policies.

1. Enable the following features on the HP Networking 5500 Switch.
   - For each port, set the QoS policy to trust the DSCP values.

```
interface GigabitEthernet1/0/6
    port link-mode bridge
    port access vlan 22
    poe enable
    qos trust dscp
```

1. Save the configuration.

```
[HP-5500-52C] save configuration
```

11.2. Configure LLDP

LLDP or 802.1AB is an IEEE standard designed for the discovery of directly attached adjacent network devices such as Ethernet switches and routers. LLDP-MED or ANSI/TIA-1057 is a TIA standard that extends LLDP for the discovery and auto-configuration of directly attached LLDP-MED capable media endpoint devices such as the Avaya 9600 Series IP Telephones. LLDP advertisements are encapsulated in LLDP Data Units (LLDPDU) in the format of Type Length Value or TLV for short. The IEEE 802.1AB specification defines different types of TLVs – Standard and Optional. LLDP capable devices must support the advertisement of Standard TLVs such as Chassis ID, Port ID, and Time to Live TLVs. The same LLDP capable device may also include LLDP-MED (Network Policy, Inventory), IEEE 802.3 (MAC/PHY Configuration/Status) and other Vendor specific optional TLVs as part of its LLDP advertisement. The Avaya 9600 Series IP Telephones supports the use of the Network Policy TLV as a means to auto discover voice VLAN and QoS assignment in addition to using vendor specific TLVs.

1. Enable the following features on the HP Networking 5500 Switch.

lldp enable

2. Configure auto voice vlan assignment for Avaya phones.

voice vlan mac-address 0004-0d00-0000 mask ffff-ff00-0000 description Avaya phone
voice vlan mac-address 0009-6e00-0000 mask ffff-ff00-0000 description Avaya phone
voice vlan mac-address 001b-4f00-0000 mask ffff-ff00-0000 description Avaya phone
voice vlan mac-address b4b0-1700-0000 mask ffff-ff00-0000 description Avaya phone
voice vlan track lldp

3. Save the configuration.

[HP-7503E] **save configuration**

11.3. Configure PoE

Power over Ethernet (PoE) allows both power and data to be simultaneously carried over standard Ethernet cables. PoE-enabled Ethernet switches can supply power directly to Ethernet devices, thereby simplifying installation and removing the need for separate power supplies for those devices. The IEEE 802.3af-2003 standard defines the mechanisms for Power Sourcing Equipment (PSE), such as PoE-enabled Ethernet switches, to detect, classify, and supply up to 15.4W of power per port to Powered Devices (PDs), such as PoE-enabled IP telephones. In the compliance-tested configuration described in these Application Notes, the HP Networking Switches were configured to supply inline PoE to Avaya PDs. Many HP Networking Switches also support the IEEE 802.3at-2009 standard for Power over Ethernet Plus (PoE+), which can provide up to 30W per port.

The default configuration for the HP Networking switches has PoE/PoE+ enabled. If you need to make modifications or disable PoE or control per-port PoE priority please refer to the HP Networking Switch manuals for more information.

12. Verification Steps

12.1. Verify QoS

The following steps may be used to verify the configuration:

- From the HP switch CLI, verify the QoS configuration for packets being sent to and from the Avaya Telephony Infrastructure devices.
- From the HP switch CLI, verify the QoS configuration for the Voice VLAN.
- During the compliance testing wireshark was used to capture packets and verify the proper setting for L2/L3 QoS parameters.

12.2. Verify LLDP

- From the HP switch CLI, display and verify the list of devices that are discovered by the HP Networking switches via LLDP.

12.3. Verify PoE

- From the HP switch CLI, display and verify PoE information on each port.

13. Conclusion

These Application Notes describe a compliance-tested configuration comprised of Avaya Aura® Telephony Infrastructure connected to HP Networking Switches. The HP Networking Switches enforced L2/L3 QoS parameters that were configured via settings files and LLDP. Additionally HP Networking Switches provided Power over Ethernet for the Avaya Telephones. Prioritization of VoIP traffic and good voice quality was successfully achieved in the Avaya/HP Networking configuration described in **Figure 1**. HP Networking successfully passed the compliance test. Refer to **Section 2.2** for more details and listed observations.

14. Additional References

The documents referenced below were used for additional support and configuration information.

The following Avaya product documentation can be found at http://support.avaya.com.

[1] *Administering Avaya* Aura® *Communication Manager*, December 2012 Release 6.2, Issue 7.0, Document Number 03-300509

[2] *Administering Avaya* Aura® *Session Manager*, July 2012, Release 6.2, Document Number 03-603324

[3] *Avaya one-X® Deskphone Edition for 9600 Series IP Telephones Administrator Guide Release 3.1,* November 2009, Document Number 16-300698

[4] *Administering Avaya one-X® Communicator*, October 2011

[5] *Avaya 1010 and 1020 User and Administrator Guide*, May 2011

[6] *Avaya 1030, 1040, and 1050 Video Conferencing Systems User and Administrator Guide*, February, 2011

[7] *Implementing and Administering the Avaya A175 Desktop Video Device with the Avaya Flare® Experience Release 1.1,* Document Number 16-603739, Issue 2, March 2012

Product information for the HP Networking Switches may be found at
http://h17007.www1.hp.com/us/en/products/switches/index.aspx

15. Appendix – HP configuration Files

15.1. HP 7503E Configuration file

```
#
 version 5.20, Feature 6705
#
 sysname HP-7503E
#
 voice vlan mac-address 0004-0d00-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan mac-address 0009-6e00-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan mac-address 001b-4f00-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan mac-address b4b0-1700-0000 mask ffff-ff00-0000 description Avaya phone
#
 dhcp relay server-group 0 ip 10.64.21.162
#
 irf mac-address persistent always
 undo irf auto-update enable
 undo irf link-delay
 irf member 1 priority 20
 irf member 2 priority 10
#
 domain default enable system
#
 lldp enable
#
 poe max-power 806 pse 10
 poe enable pse 10
 poe max-power 806 pse 64
 poe enable pse 64
#
switch-mode standard-routing chassis 1
switch-mode normal chassis 1 slot 2
switch-mode normal chassis 1 slot 3
switch-mode normal chassis 1 slot 4
switch-mode standard-routing chassis 2
switch-mode normal chassis 2 slot 2
switch-mode normal chassis 2 slot 3
switch-mode normal chassis 2 slot 4
#
irf-pbr enable
#
acl number 3100
 rule 10 permit ip source 10.64.21.42 0
 rule 20 permit ip source 10.64.21.31 0
 rule 30 permit ip source 10.64.21.41 0
#
vlan 1
#
vlan 21
 name Telephony Infrastructure
#
vlan 22
 name Voice
#
vlan 23
 name inband-mgt
#
vlan 25
#
```

```
domain system
 access-limit disable
 state active
 idle-cut disable
 self-service-url disable
#
traffic classifier avaya_servers operator or
 if-match acl 3100
#
traffic behavior avaya_servers
 remark dscp ef
 remark local-precedence 5
#
qos policy avaya_servers
 classifier avaya_servers behavior avaya_servers
#
qos map-table dot1p-lp
 import 0 export 0
 import 1 export 1
 import 2 export 2
#
user-group system
 group-attribute allow-guest
#
local-user admin
 password cipher $c$3$MSRAsEwmESagFKLyYLJCL8090R9xzqi4HtM=
 authorization-attribute idle-cut 120
 authorization-attribute level 3
 service-type ssh telnet
#
 stp mode rstp
 stp enable
#
interface Bridge-Aggregation28
 description To-5500-28C
 port link-type trunk
 port trunk permit vlan all
 link-aggregation mode dynamic
#
interface Bridge-Aggregation52
 description To-5500-52C
 port link-type trunk
 port trunk permit vlan all
 link-aggregation mode dynamic
#
interface NULL0
#
interface Vlan-interface1
 ip address dhcp-alloc client-identifier mac Vlan-interface1
#
interface Vlan-interface21
 ip address 10.64.21.1 255.255.255.0
 dhcp select relay
 dhcp relay server-select 0
#
interface Vlan-interface22
 ip address 10.64.22.1 255.255.255.0
 dhcp select relay
 dhcp relay server-select 0
#
interface Vlan-interface23
 ip address 10.64.23.254 255.255.255.0
```

```
 dhcp select relay
 dhcp relay server-select 0
#
interface GigabitEthernet1/3/0/1
 port link-mode bridge
 port access vlan 21
 poe enable
 poe priority high
 qos trust dscp
#
interface GigabitEthernet1/3/0/2
 port link-mode bridge
 port access vlan 21
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/3
 port link-mode bridge
 port access vlan 21
 poe enable
 qos apply policy avaya_servers inbound
 qos trust dscp
#
interface GigabitEthernet1/3/0/4
 port link-mode bridge
 port access vlan 21
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/5
 port link-mode bridge
 port access vlan 21
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/6
 port link-mode bridge
 port access vlan 21
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/7
 port link-mode bridge
 port access vlan 21
 poe enable
 qos apply policy avaya_servers inbound
 qos trust dscp
#
interface GigabitEthernet1/3/0/8
 port link-mode bridge
 port access vlan 21
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/9
 port link-mode bridge
 port access vlan 21
 poe enable
 qos apply policy avaya_servers inbound
 qos trust dscp
#
interface GigabitEthernet1/3/0/10
```

```
 port link-mode bridge
 port access vlan 21
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/11
 port link-mode bridge
 port access vlan 21
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/12
 port link-mode bridge
 port access vlan 21
 poe enable
 qos apply policy avaya_servers inbound
 qos trust dscp
#
interface GigabitEthernet1/3/0/13
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/14
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/15
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/16
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/17
 port link-mode bridge
 port access vlan 22
 poe enable
 qos priority 6
 qos trust dscp
#
interface GigabitEthernet1/3/0/18
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/19
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/20
```

```
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/21
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/22
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/23
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/24
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/25
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/26
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/27
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/28
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/29
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/30
 port link-mode bridge
 port access vlan 23
```

```
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/31
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/32
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/33
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan 1 22 to 23
 port trunk pvid vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/34
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/35
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/36
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/37
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/38
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/39
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/40
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/41
```

```
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/42
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/43
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/44
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/45
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/46
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/3/0/47
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan all
 poe enable
 qos priority 6
 qos trust dscp
 port link-aggregation group 52
#
interface GigabitEthernet1/3/0/48
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan all
 poe enable
 qos priority 6
 qos trust dscp
 port link-aggregation group 28
#
interface GigabitEthernet2/3/0/1
 port link-mode bridge
 poe enable
 poe priority high
 qos trust dscp
#
interface GigabitEthernet2/3/0/2
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/3
 port link-mode bridge
 poe enable
```

```
 qos trust dscp
#
interface GigabitEthernet2/3/0/4
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/5
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/6
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/7
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/8
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/9
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/10
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/11
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/12
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/13
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/14
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/15
 port link-mode bridge
 poe enable
 qos trust dscp
#
```

```
interface GigabitEthernet2/3/0/16
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/17
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/18
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/19
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/20
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/21
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/22
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/23
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/24
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/25
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/26
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/27
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/28
 port link-mode bridge
```

```
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/29
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/30
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/31
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/32
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/33
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/34
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/35
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/36
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/37
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/38
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/39
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/40
 port link-mode bridge
 poe enable
 qos trust dscp
```

```
#
interface GigabitEthernet2/3/0/41
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/42
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/43
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/44
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/45
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/46
 port link-mode bridge
 poe enable
 qos trust dscp
#
interface GigabitEthernet2/3/0/47
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan all
 poe enable
 qos trust dscp
 port link-aggregation group 28
#
interface GigabitEthernet2/3/0/48
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan all
 poe enable
 qos priority 6
 qos trust dscp
 port link-aggregation group 52
#
interface M-Ethernet1/0/0/0
 ip address 10.64.25.5 255.255.255.0
#
interface Ten-GigabitEthernet1/4/0/1
 port link-mode bridge
 qos trust dscp
#
interface Ten-GigabitEthernet1/4/0/2
 port link-mode bridge
 qos trust dscp
#
interface Ten-GigabitEthernet2/4/0/1
 port link-mode bridge
 qos trust dscp
```

```
#
interface Ten-GigabitEthernet2/4/0/2
 port link-mode bridge
 qos trust dscp
#
interface Ten-GigabitEthernet1/2/0/1
#
interface Ten-GigabitEthernet1/2/0/2
#
interface Ten-GigabitEthernet2/2/0/1
#
interface Ten-GigabitEthernet2/2/0/2
#
 ip route-static 0.0.0.0 0.0.0.0 10.64.25.1
#
 dhcp enable
#
 ssh server enable
#
 load xml-configuration
#
 load tr069-configuration
#
user-interface aux 1/0
user-interface aux 2/0
user-interface vty 0 15
 authentication-mode scheme
 user privilege level 3
 idle-timeout 0 0
 protocol inbound ssh
#
irf-port 1/2
 port group interface Ten-GigabitEthernet1/2/0/1 mode normal
 port group interface Ten-GigabitEthernet1/2/0/2 mode normal
#
irf-port 2/1
 port group interface Ten-GigabitEthernet2/2/0/1 mode normal
 port group interface Ten-GigabitEthernet2/2/0/2 mode normal
#
return
```

15.2. HP 5500 (48 port) Configuration file

```
#
 version 5.20, Release 2215
#
 sysname HP-5500-52C
#
 voice vlan mac-address 0004-0d00-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan mac-address 0009-6e00-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan mac-address 001b-4f00-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan mac-address b4b0-1700-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan track lldp
#
 irf mac-address persistent timer
 irf auto-update enable
 undo irf link-delay
#
 domain default enable system
#
 telnet server enable
#
 mirroring-group 1 local
#
vlan 1
#
vlan 22 to 23
#
radius scheme system
 server-type extended
 primary authentication 127.0.0.1 1645
 primary accounting 127.0.0.1 1646
 user-name-format without-domain
#
domain system
 access-limit disable
 state active
 idle-cut disable
 self-service-url disable
#
qos map-table dot1p-lp
 import 0 export 0
 import 1 export 1
 import 2 export 2
#
user-group system
 group-attribute allow-guest
#
local-user admin
 password cipher $c$3$Z1zIrkz90lRdPADqe7perTBXLYTNW28Ljrc=
 authorization-attribute idle-cut 120
 authorization-attribute level 3
 service-type ssh telnet
local-user frank
 password cipher $c$3$RNP/ecas0g9HL9mUhCExxKFAOzZGNr4OEftuBXw=
 authorization-attribute level 3
 service-type ssh
#
 stp mode rstp
 stp enable
#
interface Bridge-Aggregation75
```

```
 description To-7503E
 port link-type trunk
 port trunk permit vlan all
 link-aggregation mode dynamic
#
interface NULL0
#
interface Vlan-interface1
 ip address 15.234.180.254 255.255.255.0
#
interface Vlan-interface22
#
interface Vlan-interface23
 ip address 10.64.23.5 255.255.255.0
#
interface GigabitEthernet1/0/1
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/2
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/3
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan 1 22 to 23
 port trunk pvid vlan 23
 poe enable
 qos priority 6
 qos trust dscp
 mirroring-group 1 mirroring-port both
#
interface GigabitEthernet1/0/4
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan 1 22 to 23
 port trunk pvid vlan 23
 poe enable
 qos priority 6
 qos trust dscp
#
interface GigabitEthernet1/0/5
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/6
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/7
 port link-mode bridge
 port access vlan 22
 poe enable
```

```
 qos trust dscp
#
interface GigabitEthernet1/0/8
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/9
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/10
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/11
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/12
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/13
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/14
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/15
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/16
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/17
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
```

```
interface GigabitEthernet1/0/18
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan 1 22 to 23
 port trunk pvid vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/19
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/20
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan 1 22 to 23
 port trunk pvid vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/21
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/22
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan 1 22 to 23
 poe enable
 qos trust dscp
 mirroring-group 1 monitor-port
#
interface GigabitEthernet1/0/23
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/24
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/25
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/26
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/27
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/28
 port link-mode bridge
```

```
 qos trust dscp
#
interface GigabitEthernet1/0/29
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/30
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/31
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/32
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/33
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/34
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/35
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/36
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/37
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/38
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/39
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/40
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/41
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/42
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/43
 port link-mode bridge
 qos trust dscp
#
```

```
interface GigabitEthernet1/0/44
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/45
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/46
 port link-mode bridge
 qos trust dscp
#
interface GigabitEthernet1/0/47
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan all
 qos priority 6
 qos trust dscp
 mirroring-group 1 mirroring-port both
 port link-aggregation group 75
#
interface GigabitEthernet1/0/48
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan all
 qos priority 6
 qos trust dscp
 port link-aggregation group 75
#
interface GigabitEthernet1/0/49
 port link-mode bridge
 shutdown
 qos trust dscp
#
interface GigabitEthernet1/0/50
 port link-mode bridge
 shutdown
 qos trust dscp
#
interface GigabitEthernet1/0/51
 port link-mode bridge
 shutdown
 qos trust dscp
#
interface GigabitEthernet1/0/52
 port link-mode bridge
 shutdown
 qos trust dscp
#
nqa entry imclinktopologypleaseignore ping
 type icmp-echo
  destination ip 15.234.180.253
  frequency 270000
#
 ip route-static 0.0.0.0 0.0.0.0 10.64.23.1
#
 snmp-agent
 snmp-agent local-engineid 800063A2033822D66146E4
 snmp-agent community read public
 snmp-agent community write private
 snmp-agent sys-info contact Frank Santos
 snmp-agent sys-info location Littleton, MA
```

```
 snmp-agent sys-info version all
 snmp-agent target-host trap address udp-domain 15.234.178.112 params securityname
public
 snmp-agent target-host trap address udp-domain 15.234.178.115 params securityname
public
 snmp-agent target-host trap address udp-domain 15.234.180.134 params securityname
public
 snmp-agent target-host trap address udp-domain 15.234.180.254 params securityname
public
 snmp-agent target-host trap address udp-domain 50.0.10.10 params securityname public
 snmp-agent trap if-mib link extended
#
 nqa schedule imclinktopologypleaseignore ping start-time now lifetime 630720000
#
 ssh server enable
 sftp server enable
#
 load xml-configuration
#
 load tr069-configuration
#
user-interface aux 0
user-interface vty 0 4
 authentication-mode scheme
 user privilege level 3
 idle-timeout 0 0
 protocol inbound ssh
user-interface vty 5 15
#
return
```

15.3. HP-5500 (24 port) Configuration File

```
#
 version 5.20, Release 2215
#
 sysname HP-5500-28C
#
 voice vlan mac-address 0004-0d00-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan mac-address 0009-6e00-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan mac-address 001b-4f00-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan mac-address b4b0-1700-0000 mask ffff-ff00-0000 description Avaya phone
 voice vlan track lldp
#
 irf mac-address persistent timer
 irf auto-update enable
 undo irf link-delay
#
 domain default enable system
#
 telnet server enable
#
vlan 1
#
vlan 22 to 23
#
radius scheme system
 server-type extended
 primary authentication 127.0.0.1 1645
 primary accounting 127.0.0.1 1646
 user-name-format without-domain
#
domain system
 access-limit disable
 state active
 idle-cut disable
 self-service-url disable
#
qos map-table dot1p-lp
 import 0 export 0
 import 1 export 1
 import 2 export 2
#
user-group system
 group-attribute allow-guest
#
local-user admin
 password cipher $c$3$Z2SLFwXAT85E0/95xqzSD0DlLPHTNSRd2y8=
 authorization-attribute idle-cut 120
 authorization-attribute level 3
 service-type ssh telnet
#
interface Bridge-Aggregation75
 description To-7503E
 port link-type trunk
 port trunk permit vlan all
 link-aggregation mode dynamic
#
interface NULL0
#
interface Vlan-interface22
#
```

```
interface Vlan-interface23
 ip address 10.64.23.6 255.255.255.0
#
interface GigabitEthernet1/0/1
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/2
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/3
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/4
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan 1 22 to 23
 port trunk pvid vlan 23
 poe enable
 qos priority 6
 qos trust dscp
#
interface GigabitEthernet1/0/5
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/6
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan 1 22 to 23
 port trunk pvid vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/7
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/8
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/9
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
```

```
interface GigabitEthernet1/0/10
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/11
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/12
 port link-mode bridge
 port access vlan 22
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/13
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/14
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/15
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/16
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/17
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/18
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/19
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/20
 port link-mode bridge
```

```
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/21
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/22
 port link-mode bridge
 port access vlan 23
 poe enable
 qos trust dscp
#
interface GigabitEthernet1/0/23
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan all
 poe enable
 qos priority 6
 qos trust dscp
 port link-aggregation group 75
#
interface GigabitEthernet1/0/24
 port link-mode bridge
 port link-type trunk
 port trunk permit vlan all
 poe enable
 qos priority 6
 qos trust dscp
 port link-aggregation group 75
#
interface GigabitEthernet1/0/25
 port link-mode bridge
 shutdown
 qos trust dscp
#
interface GigabitEthernet1/0/26
 port link-mode bridge
 shutdown
 qos trust dscp
#
interface GigabitEthernet1/0/27
 port link-mode bridge
 shutdown
 qos trust dscp
#
interface GigabitEthernet1/0/28
 port link-mode bridge
 shutdown
 qos trust dscp
#
interface Ten-GigabitEthernet1/1/1
 port link-mode bridge
 qos trust dscp
#
interface Ten-GigabitEthernet1/1/2
 port link-mode bridge
 qos trust dscp
#
```

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```
 ip route-static 0.0.0.0 0.0.0.0 10.64.23.1
#
 ssh server enable
 sftp server enable
#
 load xml-configuration
#
 load tr069-configuration
#
user-interface aux 0
user-interface vty 0 4
 authentication-mode scheme
 user privilege level 3
 idle-timeout 0 0
 protocol inbound ssh
user-interface vty 5 15
 idle-timeout 0 0
#
return
```

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