Avaya Solution & Interoperability Test Lab

Application Notes for a Hitachi Cable Apresia Switch solution with an Avaya Telephony Infrastructure using Avaya Communication Manager in a Converged VoIP and Data Network - Issue 1.0

Abstract

These Application Notes describe the configuration of a Voice over IP (VoIP) solution using Hitachi Cable Apresia Switches connected to an Avaya Telephony Infrastructure. The Hitachi Cable Apresia Switches were compliance tested with Avaya Communication Manager, Avaya SIP Enablement Services, Avaya Modular Messaging and Avaya IA770 INTUITY AUDIX. Emphasis was placed on verifying the prioritization of VoIP traffic and voice quality in a converged VoIP and data network scenario.

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.

1. Introduction

These Application Notes describe the configuration of a Voice over IP (VoIP) solution using Hitachi Cable Apresia Switches connected to an Avaya Communication Manager, Avaya SIP Enablement Services, Avaya Modular Messaging and Avaya IA770 INTUITY AUDIX. Compliance testing emphasis was placed on verifying the prioritization of VoIP traffic and voice quality in a converged VoIP and data network scenario. 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 the LAN. The Avaya IP Telephones get QoS priority settings from Avaya Communication Manager and are enforced in the network by the Hitachi Cable Apresia Switches. To verify VoIP traffic was given priority over data traffic 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. Compliance testing included QoS, throughput, spanning tree, Direct IP Media connectivity and the G.711 and G.729 codecs.

2. Hardware Configuration

The configuration shows a single site converged VoIP and data network with multiple closets and labs configured.

For compliance testing, a centralized corporate DHCP server was used. To better manage the different traffic types, the voice and data traffic were separated onto different VLANs.

2.1. Control Room

The control room consisted of a Hitachi Cable Apresia 13000-48X Switch, Avaya Communication Manager and Avaya IA770 INTUITY AUDIX, running on an Avaya S8300 Server with an Avaya G700 Media Gateway, one SIP Enablement Services server, one Avaya Modular Messaging Application Server, one Avaya Modular Messaging Storage Server, one Avaya 2400 Series Digital Telephone and one Corporate DHCP/File Server. The corporate site provided a DHCP/File server for assigning IP network parameters and to download settings to the Avaya IP telephones. The Hitachi Cable Apresia 13000-48X Switch enforced QoS policies and supported spanning tree.

2.2. Lab-A

Lab-A consisted of a Layer 3 router, one Hitachi Cable ApresiaLight 216T-PoE, one Avaya 9630 IP Telephone running Avaya one-X Deskphone Edition and one Avaya 9620 IP Telephone running Avaya one-X Deskphone SIP on VLAN Voice2 and a PC on Datavlan2. The Hitachi Cable ApresiaLight 216T-PoE supplied PoE power for the Avaya IP Telephones and enforced QoS policies.

2.3. Closet-A

Closet-A consisted of a Layer 2 Switch as an edge switch. As an edge switch, it was configured to support VLANs, enforce QoS policies and spanning tree.

2.4. Closet-B

Closet-B consisted of a Hitachi Cable Apresia 4328GT Switch, one Hitachi Cable ApresiaLight 209-PoE, one Avaya 9620G IP Telephone running Avaya one-X Deskphone SIP and one Avaya 9650 IP Telephone running Avaya one-X Deskphone Edition on VLAN Voice1 and a PC on VLAN Datavlan1. The Hitachi Cable Apresia 4328GT Switch enforced QoS policies and supported spanning tree. The Hitachi Cable ApresiaLight 209-PoE Switch supplied PoE power for the Avaya IP telephones and enforced QoS policies.
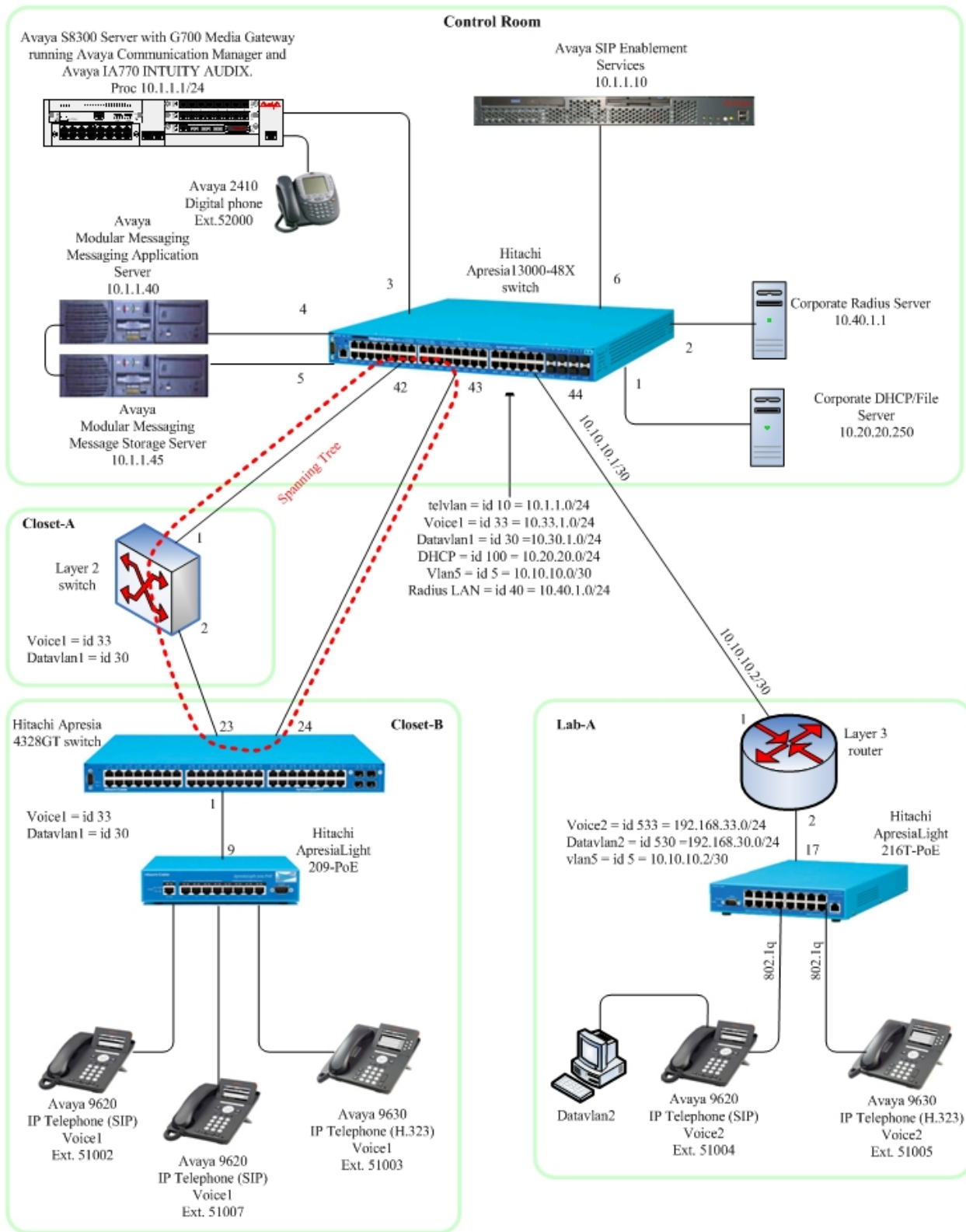
Figure 1: Network Configuration

3. Equipment and Software Validated

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

Equipment	Software/Firmware
Avaya S8300 Server	Avaya Communication Manager 5.1

Avaya G700 Media Gateway
    MGP
    MM712 DCP Media Module
	
	26.31.0
	HW05 / FW08

Avaya SIP Enabled Services (SES)	5.1
Avaya Modular Messaging - Messaging Application Server (MAS)	4.0
Avaya Modular Messaging - Message Storage Server (MSS)	4.0
Avaya IA 770 INTUITY AUDIX	5.0
Avaya 9600 Series IP Telephones	Avaya one-X Deskphone SIP 2.0.3 (SIP)
Avaya 9600 Series IP Telephones	Avaya one-X Deskphone Edition 2.0 (H.323)
Avaya 2410 Digital Telephone	5.0
Hitachi Cable Apresia 13000-48X	7.11.04
Hitachi Cable Apresia 4328GT	7.11.04
Hitachi Cable ApresiaLight 216T-PoE	1.06.02
Hitachi Cable ApresiaLight 209-PoE	1.00.03

4. Configure Avaya Communication Manager

This section shows the steps used to configure Avaya Communication Manager. For detailed information on the installation, maintenance, and configuration of Avaya Communication Manager, refer to [1].

4.1. Configure QoS on Avaya Communication Manager

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 prioritize VoIP traffic, QoS is utilized and should be implemented throughout the entire network.

In order to achieve prioritization of VoIP traffic, the VoIP traffic must be classified. The Avaya S8300 Server, Avaya G700 Media Gateway, Avaya SIP Enablement Services and Avaya IP telephones support both Layer 2 802.1.p/Q priority and Layer 3 DiffServ.

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 H.323 IP telephones via Avaya Communication Manager. Avaya SIP IP telephones will get QoS settings by downloading the 46xxsettings file from the HTTP server. For more information on QoS settings, please refer to **[3]**.

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. 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  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
```

The Differentiated Services Code Point (DSCP) value of 46 is used for both PHB values. DSCP 46 represents the Traffic Class of Premium and the Traffic Type Voice.

5. Configure the Hitachi Cable Apresia 13000-48X Switch

This section addresses how to configure the Hitachi Cable Apresia 13000-48X Switch. The Hitachi Cable Apresia 13000-48X Switch is used as the core Layer 2/Layer 3 router, enforces QoS policies and supports spanning tree.

To configure the Hitachi Cable Apresia 13000-48X Switch, connect a PC or laptop to the serial port of the Hitachi Cable Apresia 13000-48X. Run a terminal emulation program with the following configuration:

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

Log into the Hitachi Cable Apresia 13000-48X Switch using the appropriate Login ID and Password.

1. Enter config terminal mode.

```
Login: adpro
Password:
Apresia13000-48X> enable
Apresia13000-48X# config terminal
Apresia13000-48X(config)#
```

2. Create and configure the VLAN for Apresia 13000-48X Switch

```
Apresia13000-48X(config)# vlan database
Apresia13000-48X(config-vlan)# vlan 5 name vlan5
Apresia13000-48X(config-vlan)# vlan 10 name telvlan
Apresia13000-48X(config-vlan)# vlan 30 name Datavlan1
Apresia13000-48X(config-vlan)# vlan 33 name Voice1
Apresia13000-48X(config-vlan)# vlan 40 name RADIUS
Apresia13000-48X(config-vlan)# vlan 100 name DHCP
Apresia13000-48X(config-vlan)# exit
Apresia13000-48X(config)#
```

3. Assign ports to the VLANs

```
Apresia13000-48X(config)# interface port 1
Apresia13000-48X(config-if-port)# switchport access vlan 100
Apresia13000-48X(config-if-port)# exit
Apresia13000-48X(config)# interface port 2
Apresia13000-48X(config-if-port)# switchport access vlan 40
Apresia13000-48X(config-if-port)# exit
Apresia13000-48X(config)# interface port 3-6
Apresia13000-48X(config-if-port)# switchport access vlan 10
Apresia13000-48X(config-if-port)# exit
Apresia13000-48X(config)# interface port 42-43
Apresia13000-48X(config-if-port)# switchport mode trunk
Apresia13000-48X(config-if-port)# switchport trunk add 30,33
Apresia13000-48X(config-if-port)# exit
Apresia13000-48X(config)# interface port 44
Apresia13000-48X(config-if-port)# switchport access vlan 5
Apresia13000-48X(config-if-port)# exit
Apresia13000-48X(config)#
```

4. Set ports 41 through 44 for UTP

   (Ports 41 through 44 can be used as SFP ports and need to be set to UTP)

```
Apresia13000-48X(config)# interface port 41-44
Apresia13000-48X(config-if-port)# media utp
Apresia13000-48X(config-if-port)# exit
Apresia13000-48X(config)#
```

5. Configure port 43 going to the Apresia 4328GT in Closet-B to 100M/full fixed.

```
Apresia13000-48X(config)# interface port 43
Apresia13000-48X(config-if-port)# utp auto-negotiation disable
Apresia13000-48X(config-if-port)# utp link-speed-duplex 100m/full
Apresia13000-48X(config-if-port)# exit
Apresia13000-48X(config)#
```

5. Assign IP addresses to the VLANs

```
Apresia13000-48X(config)# interface vlan 5
Apresia13000-48X(config-if)# ip address 10.10.10.1/30
Apresia13000-48X(config-if)# exit
Apresia13000-48X(config)# interface vlan 10
Apresia13000-48X(config-if)# ip address 10.1.1.254/24
Apresia13000-48X(config-if)# exit
Apresia13000-48X(config)# interface vlan 30
Apresia13000-48X(config-if)# ip address 10.30.1.254/24
Apresia13000-48X(config-if)# exit
Apresia13000-48X(config)# interface vlan 33
Apresia13000-48X(config-if)# ip address 10.33.1.254/24
Apresia13000-48X(config-if)# exit
Apresia13000-48X(config)# interface vlan 40
Apresia13000-48X(config-if)# ip address 10.40.1.254/24
Apresia13000-48X(config-if)# exit
Apresia13000-48X(config)# interface vlan 100
```

```
Apresia13000-48X(config-if)# ip address 10.20.20.1/24
Apresia13000-48X(config-if)# exit
Apresia13000-48X(config)#
```

6. Configure static routes for the IP address for Layer 3 router of Lab-A

```
Apresia13000-48X(config)# ip route 192.168.0.0/16 10.10.10.2
Apresia13000-48X(config)#
```

7. Configure Spanning Tree

  1. Set Spanning Tree mode to stp

```
Apresia13000-48X(config)# spanning-tree mode stp
Apresia13000-48X(config)#
```

  2. Disable ports that will not be running Spanning Tree

```
Apresia13000-48X(config)# interface port 1-41,44
Apresia13000-48X(config-if-port)# spanning-tree disable
Apresia13000-48X(config-if-port)# exit
Apresia13000-48X(config)#
```

  3. Enable Spanning Tree

```
Apresia13000-48X(config)# spanning-tree enable
Apresia13000-48X(config)#
```

8. Configure DHCP relay

Assign DHCP server, assign VLANs for DHCP relay and enable DHCP relay

```
Apresia13000-48X(config)# dhcp relay server 10.20.20.250
Apresia13000-48X(config)# dhcp relay vlan add 5,10,30,33,100
Apresia13000-48X(config)# dhcp relay enable
Apresia13000-48X(config)#
```

9. Configure Setting QoS

The Apresia 13000-48X is capable for setting Layer2-based 802.1p and Layer3-based DSCP for QoS setting which holds up to 8 queues.

   1. Enable QoS

```
Apresia13000-48X(config)# qos enable
Apresia13000-48X(config)#
```

   2. Assign DSCP value 46 for the Avaya IP Telephones to queue level 7

```
Apresia13000-48X(config)# packet-filter2
Apresia13000-48X(config-filter)# 1 1 condition ipv4 tos-dscp 46
Apresia13000-48X(config-filter)# 1 1 action qos qp7
Apresia13000-48X(config-filter)# 1 1 action permit
Apresia13000-48X(config-filter)# exit
Apresia13000-48X(config)#
```

   3. Configure destination IP address of 10.1.1.1/32 packet to queue level 8

```
Apresia13000-48X(config)# packet-filter2
Apresia13000-48X(config-filter)# 1 2 condition ipv4 dst ip 10.1.1.1/32
Apresia13000-48X(config-filter)# 1 2 action qos qp8
Apresia13000-48X(config-filter)# 1 2 action permit
Apresia13000-48X(config-filter)# exit
Apresia13000-48X(config)#
```

   4. Assign port 1 through 44 to the above QoS setting

```
Apresia13000-48X(config)# packet-filter2
Apresia13000-48X(config-filter)# 1 assign port 1-44
Apresia13000-48X(config-filter)# exit
Apresia13000-48X(config)#
```

10. Save the running configuration to the startup configuration

```
Apresia13000-48X(config)# exit
Apresia13000-48X# write memory
```

6. Configure Lab-A Hitachi Cable Apresia 4328GT Switch

This section addresses configuring the Hitachi Cable Apresia 4328GT Switch. The Hitachi Cable Apresia 4328GT Switch is used to enforce QoS policies, and spanning tree.

Note: Hitachi's Access Defender on the Hitachi Cable Apresia 4328GT Switch was verified and the configuration for this optional step is covered in **section 9.**

To configure the Hitachi Cable Apresia 4328GT Switch, connect a PC or laptop to the serial port of the Hitachi Cable Apresia 4328GT 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

Log into Hitachi Cable Apresia 4328GT Switch using the appropriate Login ID and Password.

1. Enter config terminal mode.

```
Login: adpro
Password:
Apresia4328GT> enable
Apresia4328GT# config terminal
Apresia4328GT(config)#
```

2. Create and configure the VLANs for Apresia 4328GT Switch

```
Apresia4328GT(config)# vlan database
Apresia4328GT(config-vlan)# vlan 30 name Datavlan1
Apresia4328GT(config-vlan)# vlan 33 name Voice1
Apresia4328GT(config-vlan)# exit
Apresia4328GT(config)#
```

3. Assign ports to the VLANs

```
Apresia4328GT(config)# interface port 1
Apresia4328GT(config-if-port)# switchport mode trunk
Apresia4328GT(config-if-port)# switchport trunk native 30
Apresia4328GT(config-if-port)# switchport trunk add 33
Apresia4328GT(config-if-port)# exit
Apresia4328GT(config)# interface port 23-24
Apresia4328GT(config-if-port)# switchport mode trunk
Apresia4328GT(config-if-port)# switchport trunk add 30,33
Apresia4328GT(config-if-port)# exit
Apresia4328GT(config)#
```

4. Configure port 24 going from the Apresia 13000-48X in the Control Room to 100M/full fixed

```
Apresia4328GT(config)# interface port 24
Apresia4328GT(config-if-port)# utp auto-negotiation disable
Apresia4328GT(config-if-port)# utp link-speed-duplex 100m/full
Apresia4328GT(config-if-port)# exit
Apresia4328GT(config)#
```

5. Configure Spanning Tree

    1. Configure Spanning Tree mode for STP

```
Apresia4328GT(config)# spanning-tree mode stp
Apresia4328GT(config)#
```

    2. Assign priority for Spanning Tree

```
Apresia4328GT(config)# spanning-tree priority 4192
Apresia4328GT(config)#
```

    3. Configure disable ports for Spanning Tree

```
Apresia4328GT(config)# interface port 1
Apresia4328GT(config-if-port)# spanning-tree disable
Apresia4328GT(config-if-port)# exit
Apresia4328GT(config)#
```

    4. Enable Spanning Tree

```
Apresia4328GT(config)# spanning-tree enable
Apresia4328GT(config)#
```

6. Configure QoS

Apresia 4328GT is capable for setting Layer2-based 802.1p and Layer3-based DSCP for QoS setting which holds up to 8 queues.

    1. Enable QoS

```
Apresia4328GT(config)# qos enable
Apresia4328GT(config)#
```

    2. Assign DSCP value 46 for the Avaya IP Telephones to queue level 7

```
Apresia4328GT(config)# packet-filter2
Apresia4328GT(config-filter)# 1 1 condition ipv4 tos-dscp 46
Apresia4328GT(config-filter)# 1 1 action qos qp7
Apresia4328GT(config-filter)# 1 1 action permit
Apresia4328GT(config-filter)# exit
Apresia4328GT(config-filter)#
```

    3. Configure destination IP address of 10.1.1.1/32 packet to queue level 8

```
Apresia4328GT(config)# packet-filter2
Apresia4328GT(config-filter)# 1 2 condition ipv4 dst ip 10.1.1.1/32
Apresia4328GT(config-filter)# 1 2 action qos qp8
Apresia4328GT(config-filter)# 1 2 action permit
```

```
Apresia4328GT(config-filter)# exit
Apresia4328GT(config)#
```

4. Assign ports 1 through 24 to above QoS setting

```
Apresia4328GT(config)# packet-filter2
Apresia4328GT(config-filter)# 1 assign port 1-24
Apresia4328GT(config-filter)# exit
Apresia4328GT(config)#
```

5. Save the running configuration to the startup configuration.

```
Apresia4328GT(config)# exit
Apresia4328GT# write memory
Current running-config is saved to flash-config.
Writing to flash memory...
[OK]
Apresia4328GT#
```

7. Configure Hitachi Cable ApresiaLight 209-PoE Switch attached to the Hitachi Cable Apresia 4328GT Switch

This section addresses configuring the Closet-A Hitachi Cable ApresiaLight 209-PoE Switch. The Hitachi Cable ApresiaLight 209-PoE Switch was used as an edge switch to supply PoE power, support VLANs and to enforce QoS policies.

To configure the Hitachi Cable ApresiaLight 209-PoE Switch, connect a PC or laptop to the serial port of the Hitachi Cable ApresiaLight 209-PoE 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

1. Log into Hitachi Cable ApresiaLight 209-PoE Switch using the appropriate Login ID and Password.

```
login : adpro
Password :
[adpro]#
```

2. QoS setting

ApresiaLight209-PoE is capable for setting Layer2-based 802.1p for QoS and has 2 queues, either high or low.

   1. Enable QoS

```
[adpro]# config qos state enable
Command: config qos state enable
Configuration of Port QoS may affect Ports flow and trunking state.
Are you sure? (yes/no) yes
Executed.
[*adpro]#
```

   2. Enable QoS 802.1p based priority setting. (802.1p based priority level above 6 is High)

```
[*adpro]# config qos tag_threshold 6
Command: config qos tag_threshold 6
Executed.
[*adpro]#
```

   3. Save the running configuration to the startup configuration.

```
[*adpro]# save
Command: save
Writing to eeprom ... done.
[adpro]#
```

8. Configure Hitachi Cable ApresiaLight 216T-PoE Switch attached to the Layer 3 Switch in Lab-A

This section addresses configuring the Hitachi Cable ApresiaLight 216T-PoE Switch. The Hitachi Cable ApresiaLight 216T-PoE Switch is used to supply PoE power, support VLANs and to enforce QoS policies.

To configure the Hitachi Cable ApresiaLight 216T-PoE switch, connect a PC or laptop to the serial port of the Hitachi Cable ApresiaLight 216T-PoE 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

1. Log into the Hitachi Cable ApresiaLight 216T-PoE Switch using the appropriate Login ID and Password.

```
login : adpro
Password :
[adpro]#
```

2. Create and configure the VLANs for ApresiaLight 216T-PoE Switch

Configure VLAN for tag group mode

```
[admin]# config vlan mode tag-group
Command: config vlan mode tag-group
Executed.
[admin]#
```

3. Create Voice-VLAN and Data-Vlan

Configure VLAN for tag group mode

```
[*admin]# create vlan group Datavlan1 vid 530
Command: create vlan group Datavlan1 vid 530
Executed.
[*admin]# create vlan group Voicevlan1 vid 533
Command: create vlan group Voicevlan1 vid 533
Executed.
[*admin]#
```

4. Assign ports to the VLANs

```
[*admin]# config vlan group default add ports 1-17 tagged
Command: config vlan group default add ports 1-17 tagged
Executed.
[*admin]# config vlan group Datavlan1 add ports 17 tagged
Command: config vlan group Datavlan1 add ports 17 tagged
Executed.
[*admin]# config vlan group Voicevlan1 add ports 1-17 tagged
Command: config vlan group Voicevlan1 add ports 1-17 tagged
Executed.
[*admin]# config vlan group Datavlan1 add ports 1-16 untagged
Command: config vlan group Datavlan1 add ports 1-16 untagged
Executed.
[*admin]#
```

5. Setting QoS

ApresiaLight216T-PoE is Layer 3-based DSCP for QoS which holds up to 4 queues.

1. Enable QoS

```
[*adpro]# config qos mode ieee802.1p(dscp)
Command: config qos mode ieee802.1p(dscp)
Executed.
[*adpro]#
```

2. Configure DSCP46 of IP-phone to queue level 4

```
[*adpro]# config qos queue-level 4 mapping dscp 46
Command: config qos queue-level 4 mapping dscp 46
Executed.
[*adpro]#
```

3. Save the running configuration to the startup configuration.

```
[*adpro]# save
Command: save
Save flash configuration ? (yes/no) yes
Saving to flash memory.....done.
[adpro]#
```

9. Access Defender (Network Authentication)

Apresia 4328GT is capable of network authentication for the terminals connected beneath the switch, and can access-control each terminal by several modes.

The modes are MAC authentication, Web authentication, and IEEE802.1x, and the mode is not limited to each port but by each terminal. Apresia allows holding authentication database either on a RADIUS server or Apresia itself. Hitachi Cable calls their Apresia authentication system ''Access Defender''.

Closet-B consisted of a Hitachi Cable Apresia 4328GT Switch, one Hitachi Cable ApresiaLight209-PoE, three Avaya IP Telephones, and one user PC under the Avaya IP Telephone. Apresia 4328GT Switch port 1 enforced network authentication policies and allows the access of IP Telephones trying to access via ApresiaLight209-PoE by MAC authentication, and user PC trying to access via IP Telephone's PC port by web authentication. Moreover, Apresia 4328GT Switch enforces Authentication-Bypass allowing IP Telephones unnecessary for access control, and the limited access by DHCP access.
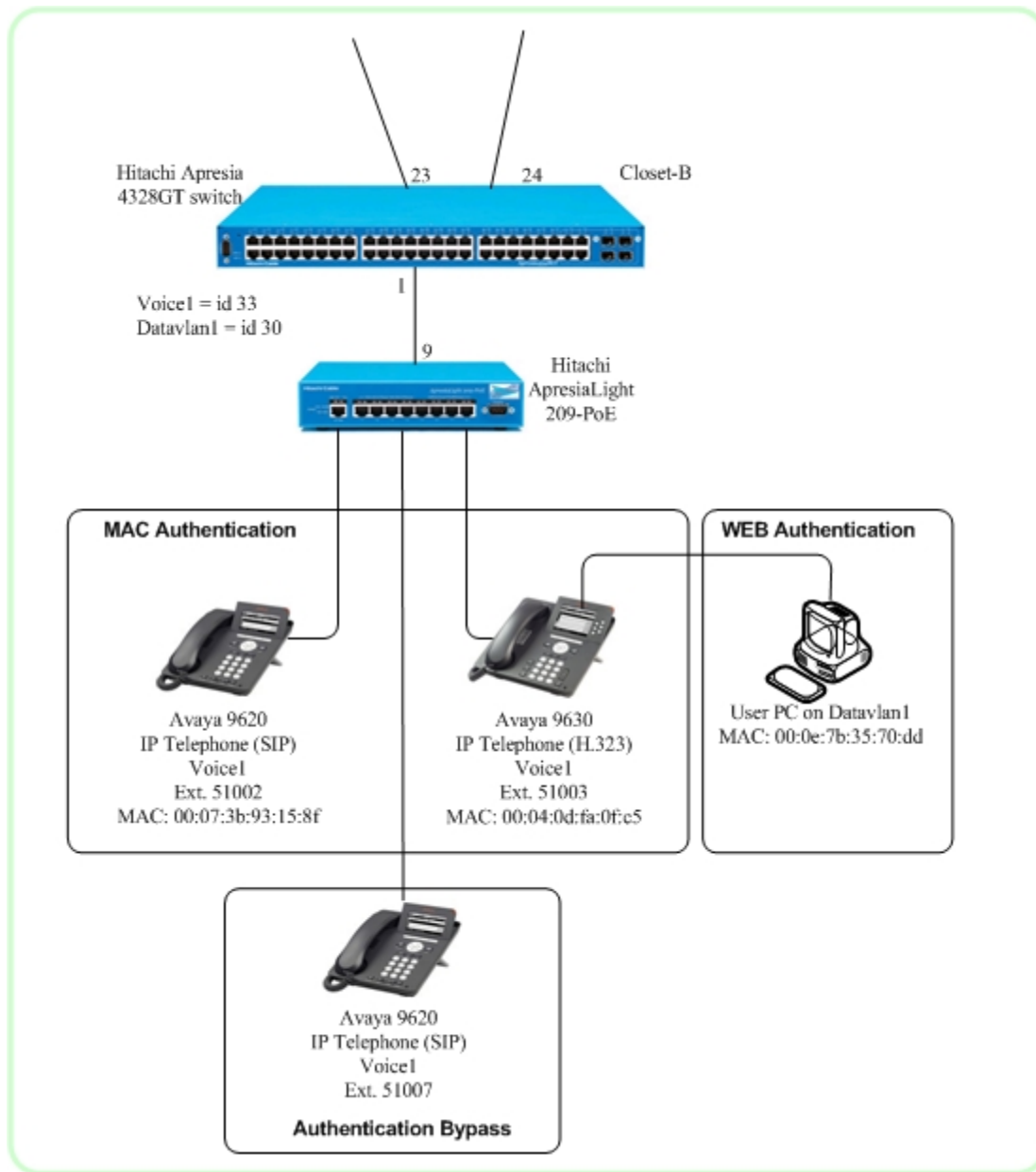
Figure 2: Access Defender Network Configuration

1. Setting Network Authentication

   1. Configure RADIUS for network authentication

```
Apresia4328GT(config)# aaa radius 1 host 10.40.1.1 key apresia
Apresia4328GT(config)# aaa authentication web radius 1
Apresia4328GT(config)# aaa authentication mac radius 1
Apresia4328GT(config)#
```

2. Configure authentication terminals up to maximum of 128

```
Apresia4328GT(config)# access-defender
Apresia4328GT(config-a-def)# packet-filter2 max-rule 128
Apresia4328GT(config-a-def)#
```

2. Setting MAC Authentication

   1. Configure MAC authentication for port1 of Apresia 4328GT, and set password for RADIUS used through MAC authentication

```
Apresia4328GT(config-a-def)# mac-authentication port 1
Apresia4328GT(config-a-def)# mac-authentication password apresia
Apresia4328GT(config-a-def)#
```

   2. Apresia 4328GT sends MAC address as a UserID and password set as mac-authentication password when calling RADIUS for its MAC address. For example, the following setting is used for #1(MAC addr.= 00:04:0d:fa:0f:c5) and IP Phone #2 (MAC addr.= 00:07:3b:93:15:8f) for registering to authentication database(user file) of RADIUS(freeradius)

```
00040dfa0fc5        Cleartext-Password := "apresia"

00073b93158f        Cleartext-Password := "apresia"

.....
```

Note: Internet Authentication Service on Windows Server 2003 was used as the RADIUS server. The same authentication database is used as the above setting.

3. Setting WEB Authentication

Apresia 4328GT Switch port 1 enforces web authentication policies, and settings procedures are the following.

   1. Configure Web authentication page for (http://1.1.1.1:8080) as User's web access redirecting page
   2. Configure redirect http access (80/tcp) of User's web access to web authentication page
   3. Configure redirect https access (443/tcp) of User's web access to web authentication page
   4. Configure redirect web access via proxy server (10080/tcp) to web authentication page
   5. Configure virtual IP address of web authentication page to 1.1.1.1
   6. Configure http port of web authentication page to 8080/tcp

```
Apresia4328GT(config-a-def)# web-authentication port 1
Apresia4328GT(config-a-def)# web-authentication redirect url
http://1.1.1.1:8080
Apresia4328GT(config-a-def)# web-authentication redirect http
Apresia4328GT(config-a-def)# web-authentication redirect https
Apresia4328GT(config-a-def)# web-authentication redirect proxy-port 10080
Apresia4328GT(config-a-def)# web-authentication ip 1.1.1.1
Apresia4328GT(config-a-def)# web-authentication http-port 8080
```

For example, the setting for registering the user account of User PC connected to IP Phone #1 to database(users file) of RADIUS(freeradius) is the following.

```
user001      Cleartext-Password := "user001-password"


user002      Cleartext-Password := "user002-password"
```

Note: Internet Authentication Service on Windows Server 2003 was used as RADIUS server. The same authentication database is used as the above setting.

4. Enable Web authentication and MAC authentication

```
Apresia4328GT(config-a-def)# exit
Apresia4328GT(config)# web-authentication enable
Apresia4328GT(config)# mac-authentication enable
Apresia4328GT(config)#
```


5. Setting Authentication Bypass

   1. The Authentication Bypass setting is used if Authentication is not wanted for specific IP Telephones. For example, the following bypass is used to allow IP Phone #3 (Mac addr. = 00:04:0d:4e:e9:c5) onto the network without having to authenticate..

```
Apresia4328GT(config)# packet-filter2
Apresia4328GT(config-filter)# 2 assign port 1-24
Apresia4328GT(config-filter)# 2 1 condition src mac 00:04:0d:4e:e9:c5 mask
ff:ff:ff:ff:ff:ff
Apresia4328GT(config-filter)# 2 1 action authentication-bypass
Apresia4328GT(config-filter)# exit
Apresia4328GT(config)#
```

2. For terminals without authentication policies, the setting for minimum access by DHCP access is necessary. The following setting is used because User PC needs to get IP address from DHCP when opening web authentication page before it is authenticated.

```
Apresia4328GT(config)# packet-filter2
Apresia4328GT(config-filter)# 3 assign port 1-24
Apresia4328GT(config-filter)# 3 1 condition ipv4 dst tcp/udp 67 udp
Apresia4328GT(config-filter)# 3 1 action authentication-bypass
Apresia4328GT(config-filter)# exit
Apresia4328GT(config)#
```

6. **Save the running configuration to the startup configuration**

```
Apresia4328GT(config)# exit
Apresia4328GT# write memory
Current running-config is saved to flash-config.
Writing to flash memory...
[OK]
Apresia4328GT#
```

10. Interoperability Compliance Testing

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

Feature functionality testing focused on the QoS and VLAN implementation in the Avaya/Hitachi configuration. Specifically, compliance testing verified that when the Hitachi Switch interfaces are over subscribed 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.

QoS and performance testing was verified by making voice calls while a traffic generator generated low priority data traffic to simulate a converged network. 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/Hitachi VoIP solution to recover from adverse conditions, such as power cycling network devices and disconnecting cables between the LAN interfaces. In all cases, the ability to recover after the network normalized was verified.

10.1. 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 Hitachi products.
- Registration of Avaya H.323 IP Telephones with Avaya Communication Manager.
- Registration of Avaya SIP IP Telephones with Avaya SIP Enablement Services.
- 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, 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.
- Verifying that Avaya Modular Messaging & Avaya IA770 INTUITY AUDIX voicemail and MWI works properly.
- Verifying that network authentication (AccessDefender) for IP Phones and User PC works properly.

The performance tests were performed by over subscribing the lines with low priority data and verifying that VoIP traffic was prioritized and that good voice quality was achieved when calls were routed over all of the LAN interfaces.

10.2. Test Results

All feature functionality, serviceability, and performance test cases passed. The Hitachi implementation did prioritize VoIP traffic and yielded good voice quality with no calls being lost. The stability of the Avaya/Hitachi solution was successfully verified through performance and serviceability testing.

11. Verification Steps

This section provides the steps for verifying end-to-end network connectivity and QoS in the field from the perspective of the Hitachi Cable Apresia 13000-48X Switch. In general, the verification steps include:

1. Verify the DHCP relay on the Hitachi switches is functioning by confirming that the IP telephones receive their IP addresses from the DHCP server connected to the Hitachi Cable Apresia 13000-48X Switch.

2. Check that the Avaya IP telephones have successfully registered with Avaya Communication Manager by using the **list registered-ip-stations** command.

3. Place internal and external calls between the digital telephone and IP telephones at each site.

12. Conclusion

These Application Notes describe the configuration steps required for integrating Hitachi Cable Apresia switches with an Avaya telephony infrastructure. For the configuration described in these Application Notes, the Hitachi Cable Apresia switches were responsible for enforcing QoS using Diffserv and 802.1p, spanning tree and network authentication. Avaya Communication Manager delivered the voice traffic to the routers for transmission over the LAN together with data traffic. Prioritization of VoIP traffic and good voice quality was successfully achieved in the Avaya/Hitachi configuration described herein.

13. 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] *Administrator Guide for Avaya Communication Manager, Document Number* 03-300509.
[2] *Installing and Administering SIP Enablement Services*, March 2007, Issue 2.1, Document Number 03-600768.
[3] *Avaya one-X Deskphone Edition for 9600 Series IP Telephones Administrator Guide Release 2.0,* Document Number 16-300698.
[4] *Avaya one-X Deskphone SIP for 9600 Series IP Telephones Installation and Maintenance Guide Release 2.0,* Document Number 16-601943.
[5] *Messaging Application Server (MAS) Administration Guide,* Release 3.1, February 2007.
[6] *Avaya IA 770 INTUITY AUDIX Messaging Application Release* 5.0 Administering. Communication Manager Servers to Work with IA 770 November 2007.

Product documentation for Hitachi Cable Apresia products may be found at http://www.apresia.jp/en/index.html and detail documentation such as user manuals, administrator manuals, etc, can be obtained directly by contacting Hitachi Cable, at +81-3-6381-1434 or any authorized distributors and resellers.

Additional Reference
[7] *Hitachi Cable Switching HUB Apresia13000 Series – Apresia 13000-48X Installation Guide,* TD61-3031
[8] *Hitachi Cable Switching HUB Apresia4328 Series – Apresia 4328GT Installation Guide*, TD61-3615
[9] Hitachi *Cable Switching HUB ApresiaLight Series - ApresiaLight209-PoE Installation Guide,* TD61-2663A
[10] *Hitachi Cable Switching HUB ApresiaLight Series - ApresiaLight216T-PoE Installation Guide,* TD61-3724
[11] *Hitachi Cable Switching HUB Apresia 4300/13000 Series - AEOS Ver.7.11 Command Reference Manual,* TD61-3753B
[12] *Hitachi Cable Switching HUB ApresiaLight Series - ApresiaLight209-PoE Command Reference Manual,* TD61-2544C
[13] *Hitachi Cable Switching HUB ApresiaLight Series - ApresiaLight216T-PoE Command Reference Manual,* TD61-3612