



## **Avaya Solution & Interoperability Test Lab**

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# **Application Notes for HP ProCurve Switches connected to an Avaya Telephony Infrastructure using Avaya Aura™ Communication Manager and Avaya Aura™ SIP Enablement Services in a Converged VoIP and Data Network - Issue 1.0**

### **Abstract**

These Application Notes describe the configuration of a Voice over IP (VoIP) solution consisting of ProCurve 6600, 5400zl, 3500yl, 2910 and 2610 Series Switches by HP with an Avaya Telephony Infrastructure using Avaya Aura™ Communication Manager and Avaya Aura™ SIP Enablement Services in a Converged VoIP and Data Network. 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 ProCurve 6600, 5400zl, 3500yl, 2910 and 2610 Series Switches by HP with an Avaya Telephony Infrastructure consisting of Avaya Aura™ Communication Manager, Avaya Aura™ SIP Enablement Services (SES), Avaya Modular Messaging, Avaya IA 770 INTUITY AUDIX and Avaya IP telephones. 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 Aura™ Communication Manager and are enforced in the network by the ProCurve Switches. The 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 testing QoS, throughput, link aggregation, rapid spanning tree, load balancing, Open Shortest Path First (OSPF), and Direct IP Media connectivity while using G.711 and G.729 codecs.

## 1.1. Interoperability Compliance Testing

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

QoS testing verified that when the ProCurve 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 (802.1p). Voice and data traffic were segmented in the enterprise network using VLANs. At the end of the performance test, it was verified that the network devices continued to operate successfully.

The telephony features verified to operate correctly included attended/unattended transfer, conference call participation, conference call add/drop, multiple call appearances, caller ID operation, call forwarding unconditional, call forwarding on busy, call Park, call pick-up, bridged call appearances, voicemail using Avaya Modular Messaging and Avaya IA770 INTUITY AUDIX, Message Waiting Indicator (MWI), and hold and return from hold.

Serviceability testing was conducted to verify the ability of the Avaya/ProCurve 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.

## 1.2. Support

For technical support on ProCurve products, consult the support pages at: <http://www.procurve.com/customercare/support/manuals/index.htm>

## 2. Reference Configuration

The configuration in **Figure 1** shows a single site converged VoIP and data network with multiple closets and labs configured with link aggregation, rapid spanning tree, load balancing and OSPF.

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 ProCurve 6600 Switch, ProCurve 5406zl Switch, Communication Manager running on an Avaya S8300 Server with an Avaya G450 Media Gateway, SES, Avaya Modular Messaging, Avaya IA 770 INTUITY AUDIX, one Avaya 2400 Series Digital Telephone, one Avaya 9630G IP Telephone running Avaya one-X Deskphone Edition on VLAN Voice1, one Avaya 9620 IP Telephone running Avaya one-X Deskphone SIP on VLAN Voice1 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 ProCurve 5406zl Switch supplied Power over Ethernet (PoE) power for the Avaya IP telephones and was configured to support link aggregation, rapid spanning tree, load balancing, VLANs, enforce QoS policies, and OSPF with the peer ProCurve switches.

### 2.2. Lab-A

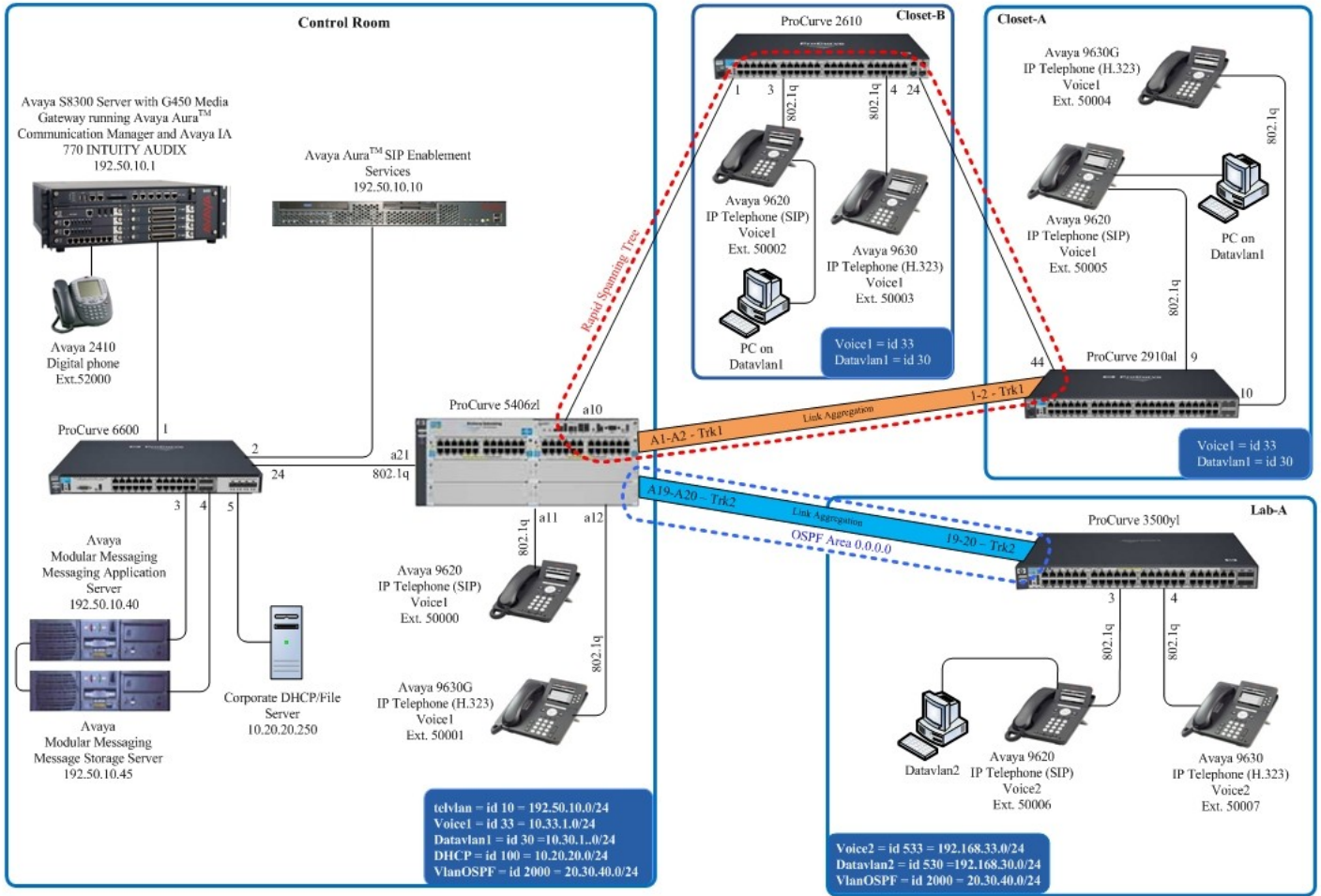
Lab-A consisted of a ProCurve 3500yl-PWR Switch, one Avaya 9630 IP Telephone running Avaya one-X Deskphone Edition and one Avaya 9620 IP Telephone running Avaya one-X Deskphone SIP on VLAN Voice2 and a PC on Datavlan2. The ProCurve 3500yl-PWR Switch supplied PoE power for the Avaya IP telephones and was configured to support link aggregation, rapid spanning tree, load balancing, VLANs, enforce QoS policies, and OSPF with the peer ProCurve switches.

### 2.3. Closet-A

Closet-A consisted of a ProCurve 2910al Switch, one Avaya 9620 IP Telephone running Avaya one-X Deskphone SIP and one Avaya 9630G IP Telephone running Avaya one-X Deskphone Edition on VLAN Voice1 and a PC on VLAN Datavlan1. The ProCurve 2910al Switch supplied PoE power for the Avaya IP telephones and was configured to support link aggregation, rapid spanning tree, enforce QoS policies, and load balancing.

### 2.4. Closet-B

Closet-B consisted of a ProCurve 2610-24-PWR, one Avaya 9620 IP Telephone running Avaya one-X Deskphone SIP and one Avaya 9630G IP Telephone running Avaya one-X Deskphone Edition on VLAN Voice1 and a PC on VLAN Datavlan1. The ProCurve 2610-24-PWR supplied PoE power for the Avaya IP telephones and was configured to support rapid spanning tree and enforce QoS policies.



**Figure 1: Avaya/ProCurve Network Diagram**

### 3. Equipment and Software Validated

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

Equipment	Software/Firmware
<b>Avaya PBX Products</b>	
Avaya S8300 Server running Avaya Aura™ Communication Manager	Avaya Aura™ Communication Manager 5.2 (*)
Avaya G450 Media Gateway MGP MM712 DCP Media Module	28.22.0 HW9
<b>Avaya SIP Enablement Services (SES)</b>	
Avaya Aura™ SIP Enabled Services (SES) Server	5.2 (*)
<b>Avaya Messaging (Voice Mail) Products</b>	
Avaya Modular Messaging - Messaging Application Server (MAS)	5.0
Avaya Modular Messaging - Message Storage Server (MSS)	5.0
Avaya IA 770 INTUITY AUDIX	5.1
<b>Avaya Telephony Sets</b>	
Avaya 9600 Series IP Telephones	Avaya one-X Deskphone Edition 3.0
Avaya 9600 Series IP Telephones	Avaya one-X Deskphone SIP 2.0.0
Avaya 2410 Digital Telephone	5.0
<b>ProCurve Products</b>	
ProCurve 6600ml-24G Switch	FW-K.14.09
ProCurve 5406zl by HP with J8705A module and RJ45 (J8177C Transceiver)	FW-K.14.09
ProCurve 3500yl-24-PWR by HP	FW-K.14.09
ProCurve 2910al by HP	W.14.28
ProCurve 2610-24-PWR by HP	R.11.25
<b>MS Products</b>	
Microsoft Windows 2003 Server	File/DHCP Service

(\*)Avaya Communication Manager 5.1.2 and Avaya SIP Enabled Services Server 5.1.2 were also compliance tested but will not be covered in this document.

## 4. Configure Avaya Aura™ Communication Manager

This section shows the steps used to configure Avaya Aura™ Communication Manager. For detailed information on the installation, maintenance, and configuration of Communication Manager, refer to [1] in Section 13.

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. QoS is now utilized to prioritize VoIP traffic 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 G450 Media Gateway, SIP Enablement Services and Avaya IP telephones support both 802.1p and 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 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 [1] in Section 13.

Use the **change ip-network-region 1** command to change the DIFFSERV/TOS PARAMETERS and 802.1P/Q PARAMETERS settings configured in Communication Manager.

```
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 will be used for both PHB values. DSCP 46 represents the traffic class of premium and the traffic type voice. Set the **Call Control PHB Value to 46** and the **Audio PHB Value to 46**. **Call Control 802.1p Priority** and **Audio 802.1p Priority** are set to **6**.

## 5. Configure the ProCurve 5406zl Switch

This section addresses how to configure the ProCurve 5406zl Switch. The ProCurve 5406zl Switch is used as the core Layer 2/Layer 3 router, enforces QoS policies and supports link aggregation, OSPF and spanning tree.

To configure the ProCurve 5406zl Switch, connect a PC or laptop to the serial port of the ProCurve 5406zl 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 ProCurve 5406zl Switch using the appropriate Login ID and Password.

```
Login:  
Password:  
ProCurve Switch 5406zl#
```

2. Enable the following features on the ProCurve 5406zl Switch.
  - Enable routing.
  - Enable spanning tree
  - Make the ProCurve 5406zl Switch the root bridge.
  - Enable QoS type-of-service
  - Set router IP
  - Assign priority 6 to DSCP CodePoint 101110
  - Assign a QoS value to ARP
  - Create trunks trk1 and trk2 using link aggregation protocol. Trunk trk1 goes to the ProCurve 2910al Switch and trunk trk2 goes to the ProCurve 3500yl-24G-PWR Switch.
  - Save the running configuration to the startup configuration.

```
ProCurve Switch 5406zl# configure  
ProCurve Switch 5406zl(config)# ip routing  
ProCurve Switch 5406zl(config)# spanning-tree  
ProCurve Switch 5406zl(config)# spanning-tree priority 1  
ProCurve Switch 5406zl(config)# qos type-of-service diff-services  
ProCurve Switch 5406zl(config)# ip router-id 20.30.40.1  
ProCurve Switch 5406zl(config)# qos protocol ARP priority 4  
ProCurve Switch 5406zl(config)# qos dscp-map 101110 priority 6  
ProCurve Switch 5406zl(config)# trunk a1-a2 trk1 lacp  
ProCurve Switch 5406zl(config)# trunk a19-a20 trk2 lacp  
ProCurve Switch 5406zl(config)# write memory
```

3. Create and configure the VLAN for OSPF.
  - Assign a VLAN ID for the OSPF VLAN.
  - Assign a name for the OSPF VLAN.
  - Assign an IP address for the OSPF VLAN.
  - Assign QoS to the VLAN
  - Assign ports to the OSPF VLAN.

```
ProCurve Switch 5406zl# configure
ProCurve Switch 5406zl(config)# vlan 2000
ProCurve Switch 5406zl (vlan-2000)# vlan 2000 name vlanOSPF
ProCurve Switch 5406zl (vlan-2000)# ip address 20.30.40.1/24
ProCurve Switch 5406zl (vlan-2000)# qos dscp 101110
ProCurve Switch 5406zl (vlan-2000)# tagged trk2
ProCurve Switch 5406zl (vlan-2000)# exit
```

4. Enable OSPF routing and set VLAN 2000 to ospf area 0.

```
ProCurve Switch 5406zl# configure
ProCurve Switch 5406zl(config)# router ospf
ProCurve Switch 5406zl(ospf)# area 0
ProCurve Switch 5406zl(ospf)# redistribute connected
ProCurve Switch 5406zl(ospf)# vlan 2000
ProCurve Switch 5406zl (vlan-2000)# ip ospf area 0
ProCurve Switch 5406zl (vlan-2000)# exit
```

5. Create and configure the telephony VLAN where all of the Avaya telephony equipment will run.
  - Assign a VLAN ID for the telephony VLAN.
  - Assign a name for the telephony VLAN.
  - Assign an IP address for the telephony VLAN.
  - Assign ports to the telephony VLAN.

```
ProCurve Switch 5406zl# configure
ProCurve Switch 5406zl(config)# vlan 1050
ProCurve Switch 5406zl (vlan-10)#vlan 1050 name vlan1050
ProCurve Switch 5406zl (vlan-10)#ip address 192.50.10.254/24
ProCurve Switch 5406zl (vlan-10)# tagged a21
ProCurve Switch 5406zl (vlan-10)# exit
```



6. Create and configure the voice VLAN that will run between the control room and closets.
  - Assign a VLAN ID for the voice VLAN.
  - Assign a name for the voice VLAN.
  - Assign an IP address for the voice VLAN.
  - Set an IP helper address for DHCP.
  - Assign ports to the voice VLAN.

```
ProCurve Switch 5406zl# configure
ProCurve Switch 5406zl(config)# vlan 33
ProCurve Switch 5406zl (vlan-33)#vlan 33 name Voice1
ProCurve Switch 5406zl (vlan-33)#ip address 10.33.1.254/24
ProCurve Switch 5406zl (vlan-33)# ip helper-address 10.20.20.250
ProCurve Switch 5406zl (vlan-33)# tagged a10-a12,trk1
ProCurve Switch 5406zl (vlan-33)# exit
```

7. Create and configure the data VLAN that will run between the control room and closets.
  - Assign a VLAN ID for the data VLAN.
  - Assign a name for the data VLAN.
  - Assign an IP address for the data VLAN.
  - Set an IP helper address for DHCP.
  - Assign ports to the data VLAN.

```
ProCurve Switch 5406zl# configure
ProCurve Switch 5406zl(config)# vlan 30
ProCurve Switch 5406zl (vlan-30)# vlan 30 name Datavlan1
ProCurve Switch 5406zl (vlan-30)# ip address 10.30.1.254/24
ProCurve Switch 5406zl (vlan-30)# ip helper-address 10.20.20.250
ProCurve Switch 5406zl (vlan-30)# tagged a10,trk1
ProCurve Switch 5406zl (vlan-30)# untagged a11-a12
ProCurve Switch 5406zl (vlan-30)# exit
```

8. Create and configure the VLAN that where the DHCP/File server runs.

- Assign a VLAN ID for the DHCP/File VLAN
- Assign a name for the DHCP/File VLAN
- Assign an IP address for the DHCP/File VLAN
- Assign ports to the DHCP/File VLAN

```
ProCurve Switch 5406zl# configure
ProCurve Switch 5406zl(config)# vlan 100
ProCurve Switch 5406zl (vlan-2)#vlan 100 name vlan100
ProCurve Switch 5406zl (vlan-2)#ip address 10.20.20.254/24
ProCurve Switch 5406zl (vlan-2)# tagged a21
ProCurve Switch 5406zl (vlan-2)# exit
```

9. Save the running configuration to the startup configuration.

```
ProCurve Switch 5406zl# configure
ProCurve Switch 5406zl(config)# write memory
```

## 6. Configure ProCurve 6600ml-24G Switch

This section addresses configuring the ProCurve 6600ml-24G Switch. The ProCurve 6600ml-24G Switch is used the primary datacenter switch in the company HQ. It was configured to run in Layer 2 and enforces QoS policies.

To configure the ProCurve 6600ml-24G Switch, connect a PC or laptop to the serial port of the ProCurve 6600ml-24G 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 ProCurve 6600ml-24G# Switch using the appropriate Login ID and Password.

```
Login:
Password:
ProCurve Switch 6600ml-24G#
```

2. Enable the following features on the ProCurve 6600ml-24G# Switch.

- Enable spanning tree
- Enable QoS type-of-service
- Assign priority 6 to DSCP CodePoint 101110
- Assign a QoS value to ARP

```
ProCurve Switch 6600ml-24G(# configure
ProCurve Switch 6600ml-24G(config)# spanning-tree
ProCurve Switch 6600ml-24G(config)# qos type-of-service diff-services
ProCurve Switch 6600ml-24G(config)# qos dscp-map 101110 priority 6
ProCurve Switch 6600ml-24G(config)# qos protocol ARP priority 4
```

3. Create and configure the telephony VLAN where all of the Avaya telephony equipment will run.

- Assign a VLAN ID for the voice VLAN.
- Assign a name for the voice VLAN.
- Assign ports to the voice VLAN.

```
ProCurve Switch 6600ml-24G(# configure
ProCurve Switch 6600ml-24G(config)# vlan 1050
ProCurve Switch 6600ml-24G(config)# vlan 1050 name vlan1050
ProCurve Switch 6600ml-24G(config)# untagged 1-4
ProCurve Switch 6600ml-24G(config)# tagged 24
ProCurve Switch 6600ml-24G(config)# exit
```

4. Create and configure the voice VLAN that will run between the control room and the closets.

- Assign a VLAN ID for the voice VLAN.
- Assign a name for the voice VLAN.
- Assign ports to the voice VLAN.

```
ProCurve Switch 6600ml-24G(# configure
ProCurve Switch 6600ml-24G(config)# vlan 100
ProCurve Switch 6600ml-24G(config)# vlan 100 name vlan100
ProCurve Switch 6600ml-24G(config)# untagged 5
ProCurve Switch 6600ml-24G(config)# tagged 24
ProCurve Switch 6600ml-24G(config)# exit
```

## 7. Configure Lab-A ProCurve 3500yl-24G-PWR Switch

This section addresses configuring the ProCurve 3500yl-24G-PWR Switch. The ProCurve 3500yl-24G-PWR Switch is used as the Lab-A Layer 2/ Layer 3 router, enforces QoS policies, and supports link aggregation, OSPF and spanning tree.

To configure the ProCurve 3500yl-24G-PWR Switch, connect a PC or laptop to the serial port of the ProCurve 3500yl-24G-PWR 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 ProCurve 3500yl-24G-PWR Switch using the appropriate Login ID and Password.

```
Login:  
Password:  
ProCurve Switch 3500yl-24G-PWR#
```

2. Enable the following features on the ProCurve 3500yl-24G-PWR Switch.
  - Enable routing.
  - Enable spanning tree
  - Enable QoS type-of-service
  - Set router IP
  - Assign a QoS value to ARP
  - Assign priority 6 to DSCP CodePoint 101110
  - Enable DHCP snooping.
  - Create trunk trk2. Trunk trk2 goes to ProCurve 5406zl Switch.
  - Save the running configuration to the startup configuration.

```
ProCurve Switch 3500yl-24G-PWR# configure  
ProCurve Switch 3500yl-24G-PWR(config)# ip routing  
ProCurve Switch 3500yl-24G-PWR(config)# spanning-tree  
ProCurve Switch 3500yl-24G-PWR(config)# qos type-of-service diff-services  
ProCurve Switch 3500yl-24G-PWR(config)# ip router-id 20.30.40.2  
ProCurve Switch 3500yl-24G-PWR(config)# qos protocol ARP priority 4  
ProCurve Switch 3500yl-24G-PWR(config)# qos dscp-map 101110 priority 6  
ProCurve Switch 3500yl-24G-PWR(config)# dhcp-snooping authorized-server 10.20.20.250  
ProCurve Switch 3500yl-24G-PWR(config)# trunk 19-20 trk2 lacp  
ProCurve Switch 3500yl-24G-PWR(config)# write memory
```

3. Create and configure the VLAN for OSPF.
  - Assign a VLAN ID for the OSPF VLAN.
  - Assign a name for the OSPF VLAN
  - Assign an IP address for the OSPF VLAN.
  - Assign QoS to the VLAN
  - Assign ports to the OSPF VLAN.

```
ProCurve Switch 3500yl-24G-PWR# configure
ProCurve Switch 3500yl-24G-PWR(config)# vlan 2000
ProCurve Switch 3500yl-24G-PWR (vlan-2000)# vlan 2000 name vlanOSPF
ProCurve Switch 3500yl-24G-PWR (vlan-2000)# ip address 20.30.40.2/24
ProCurve Switch 3500yl-24G-PWR (vlan-2000)# qos dscp 101110
ProCurve Switch 3500yl-24G-PWR (vlan-2000)# tagged trk2
ProCurve Switch 3500yl-24G-PWR (vlan-2000)# exit
```

4. Enable OSPF routing and set VLAN 2000 to ospf area 0.

```
ProCurve Switch 3500yl-24G-PWR# configure
ProCurve Switch 3500yl-24G-PWR(config)# router ospf
ProCurve Switch 3500yl-24G-PWR(ospf)# area 0
ProCurve Switch 3500yl-24G-PWR(ospf)# redistribute connected
ProCurve Switch 3500yl-24G-PWR(ospf)# vlan 2000
ProCurve Switch 3500yl-24G-PWR (vlan-2000)# ip ospf area 0
ProCurve Switch 3500yl-24G-PWR (vlan-2000)# exit
```

5. Create and configure the voice VLAN that will run in Lab-A.
  - Assign a VLAN ID for the voice VLAN.
  - Assign a name for the voice VLAN.
  - Assign an IP address for the voice VLAN.
  - Set an IP helper address for DHCP.
  - Assign ports to the voice VLAN.

```
ProCurve Switch 3500yl-24G-PWR# configure
ProCurve Switch 3500yl-24G-PWR(config)# vlan 533
ProCurve Switch 3500yl-24G-PWR (vlan-533)# vlan 533 name Voice2
ProCurve Switch 3500yl-24G-PWR (vlan-533)# ip address 192.168.33.254/24
ProCurve Switch 3500yl-24G-PWR (vlan-533)# ip helper-address 10.20.20.250
ProCurve Switch 3500yl-24G-PWR (vlan-533)# tagged 3-4
ProCurve Switch 3500yl-24G-PWR (vlan-533)# exit
```

6. Create and configure the data VLAN that will run in Lab-A.
  - Assign a VLAN ID for the data VLAN.
  - Assign a name for the data VLAN.
  - Assign an IP address for the data VLAN.
  - Set an IP helper address for DHCP.
  - Assign ports to the data VLAN.

```
ProCurve Switch 3500yl-24G-PWR# configure
ProCurve Switch 3500yl-24G-PWR(config)# vlan 30
ProCurve Switch 3500yl-24G-PWR (vlan-30)# vlan 30 name Datavlan2
ProCurve Switch 3500yl-24G-PWR (vlan-30)# ip address 192.168.30.254/24
ProCurve Switch 3500yl-24G-PWR (vlan-30)# ip helper-address 10.20.20.250
ProCurve Switch 3500yl-24G-PWR (vlan-30)# untagged 3-4
ProCurve Switch 3500yl-24G-PWR (vlan-30)# exit
```

7. Save the running configuration to the startup configuration.

```
ProCurve Switch 3500yl-24G-PWR# configure
ProCurve Switch 3500yl-24G-PWR(config)# write memory
```

## 8. Configure Closet-A ProCurve 2910al Switch

This section addresses configuring the Closet-A ProCurve 2910al Switch. The ProCurve 2910al Switch was used as an edge switch to supply PoE power, support VLANs and to enforce QoS policies.

To configure the ProCurve 2910al Switch, connect a PC or laptop to the serial port of the 2910al. 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 ProCurve 2910al Switch using the appropriate Login ID and Password.

```
Login:
Password:
ProCurve 2910al-48G-PoE Switch#
```

2. Enable the following features on the ProCurve 2910al Switch.

- Enable spanning tree
- Enable QoS type-of-service
- Assign priority 6 to DSCP CodePoint 101110
- Assign a QoS value to ARP
- Create trunk trk1 using link aggregation. Trunk trk1 goes to the ProCurve 5406zl Switch.

```
ProCurve 2910al-48G-PoE Switch# configure
ProCurve 2910al-48G-PoE Switch# (config)# spanning-tree
ProCurve 2910al-48G-PoE Switch# (config)# qos type-of-service diff-services
ProCurve 2910al-48G-PoE Switch# (config)# qos dscp-map 101110 priority 6
ProCurve 2910al-48G-PoE Switch# (config)# qos protocol ARP priority 4
ProCurve 2910al-48G-PoE Switch# (config)# trunk 1-2 trk1 lacp
```

3. Create and configure the voice VLAN that runs between the control room and the closet A.

- Assign a VLAN ID for the voice VLAN.
- Assign a name for the voice VLAN.
- Assign ports to the voice VLAN.

```
ProCurve 2910al-48G-PoE Switch(config)# vlan 33
ProCurve 2910al-48G-PoE Switch(vlan-33)# vlan 33 name Voice1
ProCurve 2910al-48G-PoE Switch(vlan-33)# tagged 9-10,44,trk1
ProCurve 2910al-48G-PoE Switch(vlan-33)# exit
```

4. Create and configure the data VLAN that runs between the control room and the closet A.

- Assign a VLAN ID for the data VLAN.
- Assign a name for the data VLAN.
- Assign ports to the data VLAN.

```
ProCurve 2910al-48G-PoE Switch# configure
ProCurve 2910al-48G-PoE Switch(config)# vlan 30
ProCurve 2910al-48G-PoE Switch(vlan-30)# vlan 30 name Datavlan1
ProCurve 2910al-48G-PoE Switch(vlan-30)# untagged 9-10
ProCurve 2910al-48G-PoE Switch(vlan-30)# tagged 44,trk1
ProCurve 2910al-48G-PoE Switch(vlan-30)# exit
```

5. Save the running configuration to the startup configuration.

```
ProCurve 2910al-48G-PoE Switch# write memory
```

## 9. Configure Closet-B ProCurve 2610-24-PWR Switch

This section addresses configuring the ProCurve 2610-24-PWR Switch. The ProCurve 2610-24-PWR Switch is used as an edge switch to supply PoE power, support VLANs and to enforce QoS policies.

To configure the ProCurve 2610-24-PWR Switch, connect a PC or laptop to the serial port of the ProCurve 2610-24-PWR 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 ProCurve 2610-24-PWR Switch using the appropriate Login ID and Password.

```
Login:  
Password:  
ProCurve Switch 2610-24-PWR#
```

2. Enable the following features on the ProCurve 2610-24-PWR Switch.

- Enable spanning tree
- Enable QoS type-of-service
- Assign priority 6 to DSCP CodePoint 101110

```
ProCurve Switch 2610-24-PWR# configure  
ProCurve Switch 2610-24-PWR(config)# spanning-tree  
ProCurve Switch 2610-24-PWR(config)# qos type-of-service diff-services  
ProCurve Switch 2610-24-PWR(config)# qos dscp-map 101110 priority 6  
ProCurve Switch 2610-24-PWR(config)#
```



3. Create and configure the voice VLAN that runs between the control room and the closet B.
  - Assign a VLAN ID for the voice VLAN.
  - Assign a name for the voice VLAN.
  - Assign ports to the voice VLAN.

```
ProCurve Switch 2610-24-PWR(config)# vlan 33  
ProCurve Switch 2610-24-PWR(vlan-33)# vlan 33 name Voice1  
ProCurve Switch 2610-24-PWR(vlan-33)# tagged 1,3-4,24  
ProCurve Switch 2610-24-PWR(vlan-33)# exit
```

4. Create and configure the data VLAN that runs between the control room and the closets B.
  - Assign a VLAN ID for the data VLAN.
  - Assign a name for the data VLAN.
  - Assign ports to the data VLAN.

```
ProCurve Switch 2610-24-PWR# configure  
ProCurve Switch 2610-24-PWR(config)# vlan 30  
ProCurve Switch 2610-24-PWR(vlan-30)# vlan 30 name Datavlan1  
ProCurve Switch 2610-24-PWR(vlan-30)# untagged 3,4  
ProCurve Switch 2610-24-PWR(vlan-30)# tagged 1,24  
ProCurve Switch 2610-24-PWR(vlan-30)# exit
```

5. Save the running configuration to the startup configuration.

```
ProCurve Switch 2610-24-PWR# write memory
```

## 10. General Test Approach and Test Results

### 10.1. Test Approach

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

- LAN connectivity between the Avaya and ProCurve products
- Registration of Avaya H.323 IP telephones with Avaya Aura™ Communication Manager
- Registration of Avaya SIP IP telephones with 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
- 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 voicemail and MWI work properly.
- Verifying that Avaya IA 770 INTUITY AUDIX voicemail and MWI work properly.
- Features Tested: attended/unattended transfer, conference call participation, conference call add/drop, multiple call appearances, caller ID operation, call forwarding unconditional, call forwarding on busy, call Park, call pick-up, bridged call appearances

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

### 10.2. Test Results

All feature functionality, serviceability, and performance test cases passed. The ProCurve implementation did prioritization of VoIP traffic and yielded good voice quality with no calls being lost. The Avaya/ProCurve 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 ProCurve 5406zl Switch. In general, the verification steps include:

1. Verify the DHCP relay on the ProCurve switches is functioning by confirming that the IP telephones receive their IP addresses from the DHCP server connected to the ProCurve 5406zl Switch.
2. Check that the Avaya IP telephones have successfully registered with 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 for integrating ProCurve Switches with an Avaya telephony infrastructure. For the configuration described in these Application Notes, the ProCurve Switches were responsible for enforcing QoS using Layer 3 Differentiated Services and Layer 2 (802.1p) as well as link aggregation, rapid spanning tree, load balancing and OSPF. Avaya Aura™ 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/ProCurve 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] *Administering Avaya Aura™ Communication Manager*, May 2009 , Issue 5.0, Document Number 03-300509..
- [2] *Administering Avaya Aura™ SIP Enablement Services*, May 2009, Issue 2.1, Document 03-602508.
- [3] *Avaya Aura™ SIP Enablement Services (SES) Implementation Guide*, May 2009, Issue 6, Document 16-300140.
- [4] *Avaya one-X Deskphone Edition for 9600 Series IP Telephones Administrator Guide Release 3.0*, Document Number 16-300698.
- [5] *Avaya one-X Deskphone SIP for 9600 Series IP Telephones Administrator Guide, Release 2.0*, Document Number 16-601944.
- [6] *Modular Messaging, Release 5.0 with the Avaya MSS Messaging Application Server (MAS) Administration Guide*, January 2009.
- [7] *Avaya IA 770 INTUITY AUDIX Messaging Application Release 5.1 Administering. Communication Manager Servers to Work with IA 770*, June 2008.

The HP product documentation can be found at:

<http://www.procurve.com/customercare/support/manuals/index.htm>

- [8] *Management and Configuration Guide for the HP ProCurve Series 6600 Switches.*
- [9] *Command Line Interface Reference Guide for the ProCurve Series 3500yl, 6200yl, 5400zl, and 8212zl Switches.*
- [10] *Management and Configuration Guide for the ProCurve Series 3500yl, 6200yl, 5400zl, and 8200zl Switches.*
- [11] *Management and Configuration Guide for the ProCurve Series 2910 Switches.*
- [12] *Management and Configuration Guide for the ProCurve Series 2610 Switches.*

## 14. Change History

Issue	Date	Reason
1.0	6/24/2009	Initial issue

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