



Avaya Solution & Interoperability Test Lab

Application Notes for HP ProCurve Switches connected to an Avaya Aura™ Telephony Infrastructure using Avaya Aura™ System Platform running Avaya Aura™ Midsize Business Template 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 HP ProCurve 6600, 5400zl, 3500yl, 2910 and 2610 Series Switches with an Avaya Aura™ Telephony Infrastructure using Avaya Aura™ System Platform running Avaya Aura™ Midsize Business Template in a Converged VoIP and Data Network.

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 consisting of HP ProCurve 6600, 5400zl, 3500yl, 2910 and 2610 Series Switches with an Avaya Aura™ Telephony Infrastructure using Avaya Aura™ System Platform virtualization technology running Avaya Aura™ Midsize Business Template with Media Services. Avaya Aura™ Midsize Business Template offers unified communication solutions to midsize enterprises that reside on one physical server box. The single server deployment makes the solution affordable, easy to deploy and manage, and energy efficient using Avaya Aura™ System Platform virtualization technology. Midsize Business Template appears as single product on a single server providing the following applications:

- Avaya Aura™ Communication Manager
- Avaya Aura™ Communication Manager Messaging
- Avaya Aura™ Application Enablement Services (AE Services)
- Avaya Aura™ SIP Enablement Services
- Avaya Utility Services
- Avaya Media Services (software IP media gateway)

1.1. Interoperability Compliance Testing

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

Compliance testing emphasis was placed on verifying the prioritization of VoIP traffic and voice quality in a converged VoIP and Data network scenario.

Feature functionality tested:

- QoS - Layer 3 DiffServ-based QoS and Layer 2 priority (802.1p)
- Open Shortest Path First (OSPF)
- Load balancing
- VLANs
- Link Layer Discovery Protocol Media Endpoint Devices (LLDP-MED) (This assigns the voice vlan tag to the Avaya IP Telephones)
- link aggregation
- Rapid Spanning Tree
- DHCP relay

The telephony features verified to operate correctly included:

- Attended/Unattended transfer
- Conference call add/drop/participation
- Multiple call appearances
- Caller ID operation
- Call forwarding
- Call Park./Call pick-up
- Bridged call appearances
- Voicemail using Avaya Aura™ Communication Manager Messaging
- Message Waiting Indicator (MWI)
- Hold/Return from hold
- Direct IP Media (Shuffling)
- G.711 and G.729 codecs

Serviceability testing:

- 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/customer-care/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: ProCurve 6600 Switch, ProCurve 5406zl Switch, Avaya S8510 server running Avaya Aura™ System Platform with Avaya Aura™ Midsize Business Template consisting of Avaya Aura™ Communication Manager, Avaya Aura™ Communication Manager Messaging, Avaya Aura™ Application Enablement Services, Avaya Aura™ SIP Enablement Services, Utility Service, Media Services, 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, LLDP, 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, LLDP 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, LLDP, 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, LLDP and enforce QoS policies.

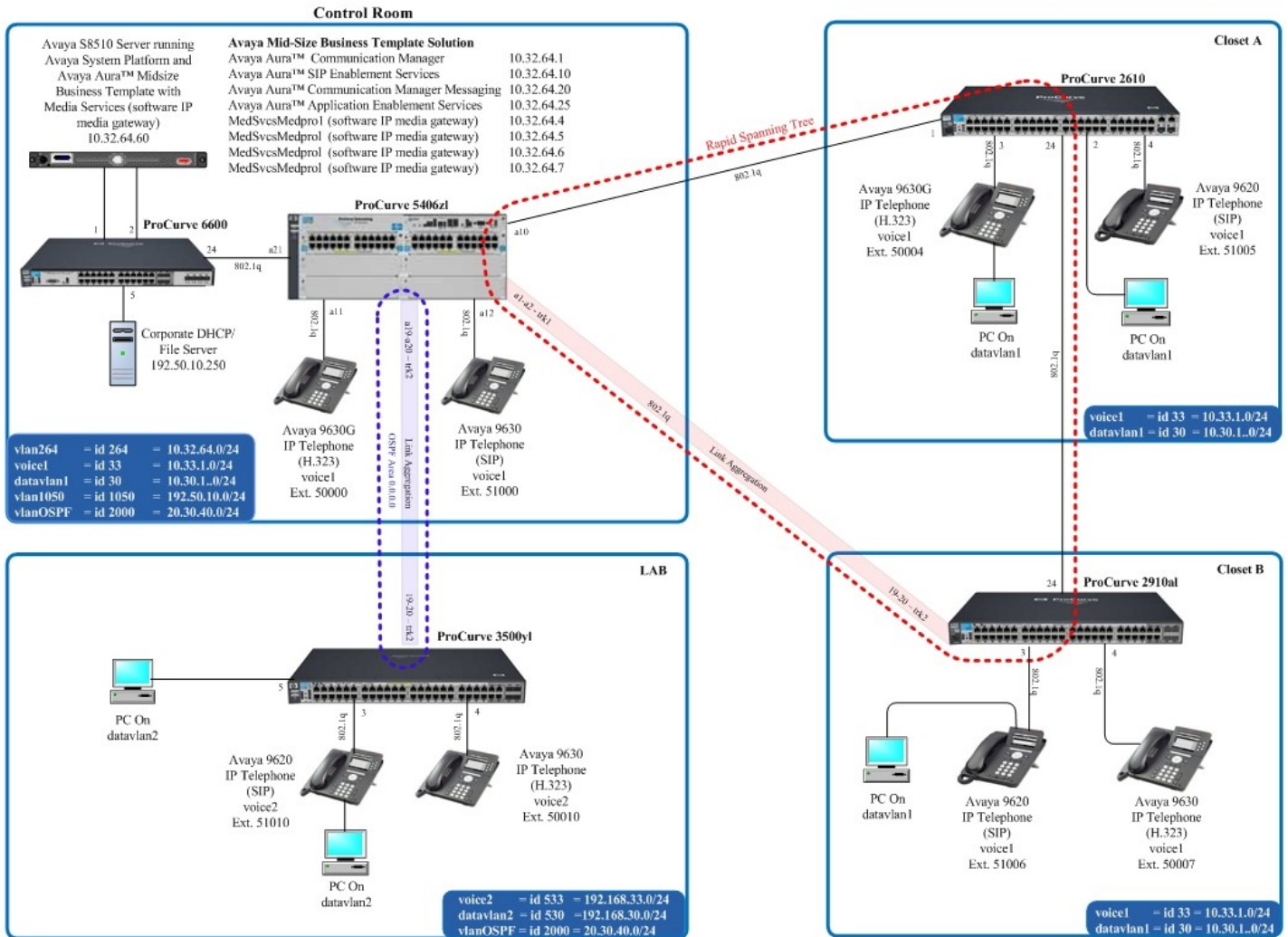


Figure 1: Avaya/ProCurve Network Diagram

3. Equipment and Software Validated

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

Equipment	Software/Firmware
Avaya PBX Products	
Avaya Aura™ System Platform (running on an Avaya S8510 server)	SP: vsp-1.1.0.0.10
Avaya Aura™ Midsize Business Template	MBT 5.2.1.2.5
Avaya Aura™ Communication Manager	5.2.1
Avaya Aura™ SIP Enablement Services	5.2.1
Avaya Aura™ Application Enablement Services	5.2
Avaya Aura™ Communication Manager Messaging	5.2.1
Avaya Telephony Sets	
Avaya 9600 Series IP Telephones	Avaya one-X Deskphone Edition (H.323 3.0)
Avaya 9600 Series IP Telephones	Avaya one-X Deskphone SIP (SIP 2.4)
ProCurve Products	
ProCurve 6600ml-24G Switch	FW-K.14.41
ProCurve 5406zl by HP with J8705A module	FW-K.14.41
ProCurve 3500yl-24-PWR by HP	FW-K.14.41
ProCurve 2910al by HP	W.14.30
ProCurve 2610-24-PWR by HP	R.11.30
MS Products	
Microsoft Windows 2003 Server	File/DHCP Service

4. Configure Avaya System Aura™ Platform with Avaya Aura™ Midsize Business Template

For detailed information on the installation, maintenance, and configuration of Avaya Aura™ System Platform (Shown Below) with Avaya Aura™ Midsize Business Template, refer to **Section 11, [2]**. The screenshot below shows the virtual machines running on Avaya Aura™ System Platform.

The screenshot shows the Avaya Aura™ System Platform admin interface. The top navigation bar includes the Avaya logo and the text "Avaya Aura™ System Platform admin". A red banner at the top right indicates "Failover status: Not configured" with links for "About | Help | Log Out".

The main content area is titled "Virtual Machine Management" and includes a "Virtual Machine List" link. Below this, it shows the "System Domain Uptime: 7 days, 20 hours, 37 minutes, 13 seconds". A "Current template installed" section lists: "MBT 5.2.1.2.5 (cm R015x.02.1.016.4, aes r5-2-0-98, ses SES-5.2.1.0-016.4, utility_server 5.2.1.2.5, cobar 1.1.0.2.1)" with a "Refresh" button.

Name	Version	IP Address	Maximum Memory	Maximum Virtual CPUs	CPU Time	State	Application State
Domain-0	1.1.0.0.10	10.32.64.65	512.0 MB	4	17h 34m 30s	Running	N/A
Utility Server	5.2.1.2.5	10.32.64.25	512.0 MB	1	1h 8m 3s	Running	Running
Media Services	1.1.0.2.1	10.32.64.30	512.0 MB	1	5h 20m 25s	Running	N/A
aes	r5-2-0-98	10.32.64.15	1024.0 MB	1	7h 42m 40s	Running	Running
cm	R015x.02.1.016.4	10.32.64.1	1024.0 MB	1	8h 50m 47s	Running	Running
cdom	1.1.0.0.10	10.32.64.60	1024.0 MB	1	7h 9m 9s	Running	N/A
ses	SES-5.2.1.0-016.4	10.32.64.10	1024.0 MB	1	1h 56m 48s	Running	Running

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5. 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 **Section 11, [4] & [5]**.

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 Aura™ Telephony Infrastructure supports 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 Avaya Aura™ Communication Manager. Avaya SIP IP Telephones will get QoS settings by downloading the 46xxsettings file from the HTTP server (not shown in this document). For more information on QoS settings please refer to **Section 11, [4]**.

Use the **change ip-network-region h** command, where “h” is a number between 1 and 250, inclusive, to change the DIFFSERV/TOS PARAMETERS and 802.1P/Q PARAMETERS settings configured in Communication Manager.

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**.

```
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
```


6. Configure ProCurve Switches

6.1. 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. It enforces QoS policies, supports link aggregation, OSPF, LLDP 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.
- Enable LLDP.

```
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)# lldp run
```

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 264
ProCurve Switch 5406zl (vlan-264)# vlan 264 name vlan264
ProCurve Switch 5406zl (vlan-264)# ip address 10.32.64.254/24
ProCurve Switch 5406zl (vlan-264)# tagged a21
ProCurve Switch 5406zl (vlan-264)# 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.
 - Enable voice/LLDP option (This assigns the voice vlan tag to the Avaya IP Telephones)
 - 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)# voice
ProCurve Switch 5406zl (vlan-33)# ip helper-address 192.50.10.250
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 192.50.10.250
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 1050
ProCurve Switch 5406zl (vlan-1050)# vlan 1050 name vlan1050
ProCurve Switch 5406zl (vlan-1050)# ip address 192.50.10.254/24
ProCurve Switch 5406zl (vlan-1050)# tagged a21
ProCurve Switch 5406zl (vlan-1050)# exit
```

9. Save the running configuration to the startup configuration.

```
ProCurve Switch 5406zl# write memory
```

6.2. 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 telephony VLAN.
- Assign a name for the telephony VLAN.
- Assign ports to the telephony VLAN.

```
ProCurve Switch 6600ml-24G# configure  
ProCurve Switch 6600ml-24G(config)# vlan 264  
ProCurve Switch 6600ml-24G (264)# name vlan264  
ProCurve Switch 6600ml-24G (264)# untagged 1-2  
ProCurve Switch 6600ml-24G (264)# tagged 24  
ProCurve Switch 6600ml-24G (264)# exit
```

4. Create and configure the VLAN for the DHCP/fileserver.

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

```
ProCurve Switch 6600ml-24G# configure  
ProCurve Switch 6600ml-24G(config)# vlan 1050  
ProCurve Switch 6600ml-24G (1050)# vlan 1050 name vlan1050  
ProCurve Switch 6600ml-24G (1050)# untagged 5  
ProCurve Switch 6600ml-24G (1050)# tagged 24  
ProCurve Switch 6600ml-24G (1050)# exit
```

5. Save the running configuration to the startup configuration.

```
ProCurve Switch 6600ml-24G#write memory
```

6.3. 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. It enforces QoS policies, link aggregation, OSPF, spanning tree and LLDP.

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.
- Enable LLDP.

```
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)# lldp run
```

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.
- Enable voice/LLDP option (This assigns the voice vlan tag to the Avaya IP Telephones).
- 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)# voice
ProCurve Switch 3500yl-24G-PWR (vlan-533)# ip helper-address 192.50.10.250
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 192.50.10.250
ProCurve Switch 3500yl-24G-PWR (vlan-30)# untagged 3-5
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
```

6.4. 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, LLDP, provide VLAN support and 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.
- Enable LLDP.

```
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  
ProCurve 2910al-48G-PoE Switch# (config)# run lldp
```

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.
- Enable voice/LLDP option (This assigns the voice vlan tag to the Avaya IP Telephones)
- 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)# voice
ProCurve 2910al-48G-PoE Switch(vlan-33)# tagged 3-4,24,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 3-4
ProCurve 2910al-48G-PoE Switch(vlan-30)# tagged 24,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
```

7. 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, LLDP, provide VLAN support and 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.

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

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

- Enable spanning tree.
- Assign priority 6 to DSCP CodePoint 101110.
- Enable LLDP.

```
ProCurve Switch 2610-24-PWR# configure  
ProCurve Switch 2610-24-PWR(config)# spanning-tree  
ProCurve Switch 2610-24-PWR(config)# qos dscp-map 101110 priority 6  
ProCurve Switch 2610-24-PWR(config)# lldp run
```

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.
- Enable QoS for Vlan (**See Observations in Section 8, [8.3]**)
- Enable voice/LLDP option (This assigns the voice vlan tag to the Avaya IP Telephones)
- 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)# qos priority 6  
ProCurve Switch 2610-24-PWR(vlan-33)# voice  
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
```

8. General Test Approach and Test Results

8.1. 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 Avaya Aura™ SIP Enablement Services.
- Verification of LLDP-MED advertisement to assign VLAN ID to Avaya IP Telephones.
- 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 Aura™ Communication Manager Messaging 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 QoS performance tests were performed by over subscribing the LAN Interfaces with low priority data and verifying that the prioritization of VoIP traffic and voice quality was achieved when calls are routed over all of the LAN interfaces.

8.2. Test Results

All feature functionality, serviceability, and QoS 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.

8.3. Observations

Under heavy traffic load, (150% over subscribed in both directions), some calls from the Avaya IP Telephones connected to the ProCurve Switches experienced problems with Dynamic Layer 2 and Dynamic Layer 3 QoS due to the fact that the ARP traffic has a priority value of 0 and is not directed to the high priority queue. For all but the ProCurve 2610-24-PWR Switch this problem is resolved with the **qos protocol ARP priority 4** command. The ProCurve 2610-24-PWR Switch does not support the **qos protocol ARP priority 4** command. To resolve this problem, QoS was assigned to the voice vlan as shown in **Section 7, Step 3**.

9. 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 all IP telephones at each site.
4. Use the **show lldp status** to verify that LLDP is running. If LLDP is not running, run the **lldp run** command.
5. Use the **show lldp info remote-device** command to verify LLDP neighbors.

10. Conclusion

These Application Notes describe the configuration steps for integrating ProCurve Switches with an Aura™ Telephony Infrastructure using Avaya Aura™ System Platform virtualization technology running Avaya Aura™ Midsize Business Template. 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, LLDP 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.

11. 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] *Avaya Aura™ Solution for Midsize Enterprises Overview*
- [2] *Installing and Configuring Avaya Aura™ System Platform*
- [3] *Administering Avaya Aura™ Solution for Midsize Enterprises*
- [4] *Administering Avaya Aura™ Communication Manager Number 03-300509*
- [5] *Administering Avaya Aura™ SIP Enablement Services*
- [6] *Avaya Aura™ SIP Enablement Services (SES) Implementation Guide*
- [7] *Avaya one-X Deskphone Edition for 9600 Series IP Telephones Administrator Guide*
- [8] *Avaya one-X Deskphone SIP for 9600 Series IP Telephones Administrator Guide*
- [9] *Avaya Aura™ Communication Manager Messaging Administrator Guide*

The HP product documentation can be found at:

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

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

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