IP videoconferencing solution with ProCurve switches and Tandberg terminals

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1. Introduction
This application note presents an IP videoconferencing solution that uses TANDBERG high-definition videoconference terminals and ProCurve switches and routers.

2. Architecture
The platform used in this videoconferencing solution contains:
- A ProCurve Secure Router 7102dl at one site and a ProCurve Secure Router 7203dl at the other site, separated by an E1 (2 Mbps) WAN link.
- A ProVision Switch 3500yl and a ProCurve Switch 2610-PWR with the latest firmware version.
- Latest version of ProCurve Manager Plus (PCM+).
- A TANDBERG Profile 3000 MXP high-definition videoconferencing terminal at each site.

3. Videoconferencing traffic and best practices
Following are some general characteristics and best practices for traffic through the video teleconferencing solution.

3.1 Voice traffic characteristics in the videoconference
Voice traffic flow through the videoconference exhibits these characteristics:
- **Bandwidth**: Narrow (approximately 50 kbps)
- **Sensitivity**:
  - **Sensitivity to latency**: High. (Latency is defined as the time between the moment a packet is sent and the moment it is received.)
  - **Sensitivity to jitter**: High. (Jitter is defined as variations of the signal amplitude and frequency; for best results in a videoconference, jitter must remain <100 ms.)
  - **Sensitivity to packet loss**: High. (Packet loss is the percentage of packets that were sent but never received; for best results in a videoconference, packet loss must remain under 10%).
3.2 Video traffic characteristics in the videoconference
Video flow in the videoconference has these characteristics:

- **Bandwidth**: High. (From approximately 128 kbps to 1.5 Mbps, depending on quality—that is, depending on video resolution.)
- **Sensitivity**:
  - **Sensitivity to latency**: High.
  - **Sensitivity to jitter**: High.
  - **Sensitivity to packet loss**: Average. (Packet loss for video is less critical than for voice traffic.)

3.3 Best practices for successful videoconferencing
Here are some best practices for maintaining voice and video quality across an IP network:

- Correctly provision the WAN links, and ensure enough bandwidth via service level agreements (SLAs) with telecom providers.
- Separate voice, video and data traffic. Use dedicated VLANs for voice and video, and prioritize the flows at the VLAN level.
- Use standard, non-proprietary protocols.
- Implement quality of service (QoS) on switches and routers to control the flows end-to-end.

4. Configuration
This section details how to configure the ProCurve edge switches, the routers, and the TANDBERG terminals.

4.1 Classify, mark, and prioritize traffic
Begin by classifying and marking the network traffic flows.

**Classifying traffic**: Traffic can be classified according to:
- Protocol: IP, IPX, ARP,…
- TCP or UDP port
- Source IP address
- VLAN

**Marking and prioritizing packets**: Once you have chosen the classification, you need to mark the video and voice packets and assign them priority. You can mark traffic with:
- **802.1p** (layer 2 priority)
- **DSCP** (layer 3 priority)

For example, you could decide to mark with priority 6 all traffic coming from VLAN 10. Or to mark with DSCP value 46 all traffic coming from IP address 10.1.10.10.

You can also classify the traffic by the priority value it has before entering the switch. For example, suppose the videoconferencing terminal has marked its packets with priority 7. You can take all packets marked with this priority (that is, use the priority as a classifier) and mark them with a DSCP of 46.

**Layer 2**: At layer 2, use the Ethernet 802.1p priority, which corresponds to 3 bits located in the 802.1Q header of the VLAN and can take values 0 to 7. By default these values are associated with different queues on the switches:
- **Low** (1-2)
- **Normal** (0-3)
- **Medium** (4-5)
- **High** (6-7)

Layer 2 priority is specified on the switches. This priority will be maintained from one layer 2 equipment to another across the LAN or VLAN, but will not be routed. Layer 2 priority is specified with the command-line interface (CLI) using the either the **qos priority command** or the **qos device-priority command**.
For example, to assign a priority to the traffic of VLAN 10:

```
Vlan 10 qos priority <0-7>
```

To assign a priority to the traffic coming from source IP address 10.1.10.10:

```
Qos device-priority 10.1.10.10 priority <0-7>
```

**Layer 3:** At layer 3, use the DSCP (Differentiated Services Code Point) field, 6 bits contained in the IP header, to mark traffic. This value is maintained even when the packets are routed from one LAN or VLAN to another. Voice and video traffic are usually allocated the DSCP value 46 (101110), which is associated with a priority value of 7, and sent to the queue with highest priority (Expedited Forwarding) on switches.

Layer 3 priority is specified using the CLI on routers or layer 3 switches. For example, to assign a DSCP value of 46 to the traffic of VLAN 10:

```
Vlan 10 qos dscp 101110
```

To assign a DSCP value of 46 to the traffic coming from source IP address 10.1.10.10:

```
Qos device-priority 10.1.10.10 priority 101110
```

After the packets have been marked, they can be associated with different actions:

- **Bandwidth allocation:**
  - Unlimited: The risk of using unlimited bandwidth allocation is that low-priority flows may be completely blocked.
  - Limited: Bandwidth allocation can be based on bandwidth % or on value + burst value.

- **Modification of DSCP or priority**

### 4.2 Configure the edge switches

In the setup shown in Figure 1, on the edge switches (ProCurve Switch 3500yl and ProCurve Switch 2610-PWR), the packets corresponding to the video flow are marked with DSCP value 46 corresponding to Expedited Forwarding class. You can configure the switches using commands, as shown below:

- **Per-VLAN configuration:** For example, here VLAN 40 is dedicated to video:

```
(vlan=40)# qos dscp 101110
```

- **Per-source-IP-address configuration:** For example, here the source IP address (10.1.10.50) is dedicated to video:

```
(config)# qos device-priority 10.1.10.50 dscp 101110
```
4.3 Configure the routers
The ProCurve Secure Routers 7102dl and 7203dl can either be configured from the CLI or from their web interfaces.

Using the CLI: To modify the DSCP on a Secure Router using the CLI, create the QoS map entry:

```
ProCurve(config)# qos map ppp1Qos
ProCurve(config-qos-map)# match precedence 7
ProCurve(config-qos-map)# priority 1500 512
ProCurve(config-qos-map)# set dscp 46
```

This QoS map sets a DSCP value of 46 for all DSCP packets with a priority of 7, and assigns a bandwidth of 1,500 kbps with a burst value of 512 bytes.

Using the router's Web interface: To configure a QoS map from the router’s Web interface:
1. Connect to the router at http://<router_ip_address>. Use the login and password you entered when first setting up the equipment.
2. Go to Router / Bridge and then QoS Maps:
   
   ![QoS Map Configuration Interface]

3. To add a new QoS map, enter a name for this map and a sequence number between 0 and 65535, then click Add. You see the QoS Map Setup window for this map.
4. In the QoS Map Setup window, configure the QoS map as follows:

- **IP RTP**
  - Start Port: 10000
  - End Port: 10048
  - Enable Even and Odd Ports

- **DSCP**
  - Value: 46

- **precedence**
  - Value: 7

- **Packet Marking**
  - DSCP
    - Field Value: (0-63)
  - Precedence
    - Field Value: (0-7)

- **Priority Queue**
  - Limit: 1500
  - Burst: 512

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5. Next, the new QoS map needs to be assigned to a WAN interface. From the QoS Map page, choose a WAN interface (ppp 2 in this example), and assign the QoS map:

![Assign a QoS-policy to an Interface](image)

4.4 Marking priority on the TANDBERG terminals

Endpoints such as the TANDBERG terminals can also mark layer 2 and layer 3 priority. Thus, you can either mark the priority on the endpoint directly, or leave the endpoint traffic at its default and mark it at the switch level.

In this example, the ProCurve switches are used to prioritize traffic. So it is not necessary to modify the priority settings on the Tandberg terminals.

5. Tested scenarios

To test the configuration, a video call was initiated between two TANDBERG terminals separated by a 2 Mbps WAN link. To simulate other traffic, additional flows were applied to the same WAN link as the teleconference, including:

- A large, 2-GB file transfer was sent over the WAN link.
- Streaming video: a movie was streamed between a video server and a client using the WAN link.

The following scenarios were tested:

- **Scenario 1, no QoS, video flow only on the WAN link**: In this scenario, the teleconference video remained in high resolution mode.
- **Scenario 2, no QoS, heavy traffic on the WAN link**: In this scenario, the teleconference video traffic adopted a lower resolution mode.
- **Scenario 3, QoS set for unlimited bandwidth allocated to the teleconference video flow**: In this scenario, the teleconference video traffic was able to use high resolution mode. Other flows starved; the file transfer was much slower and the video stream stopped.
- **Scenario 4, QoS set for limited bandwidth reserved for the teleconference video flow**: This was the optimum scenario. It allowed good resolution for the teleconference video, and enough bandwidth for file transfer and video streaming.

6. Firmware versions

Firmware versions of the switches used for this application note are as follows:

- K.13.09 for the ProCurve Switch 3500yl
- R.11.07 for the ProCurve Switch 2610-PWR
- J.08.03 for ProCurve Secure Routers 7102dl and 7203dl
7. Reference documents

For further information about how to configure ProCurve switches to support convergence, please refer to the following links:

- For user manuals for ProCurve 3500yl-5400zl-8212zl switches:
  
  http://www.hp.com/rnd/support/manuals/3500-6200-5400-ChapterFiles.htm

- For ProCurve Switch 2610 series manuals:
  
  http://www.hp.com/rnd/support/manuals/2610.htm

- For ProCurve Secure Routers 7102dl and 7203dl:
  
  http://www.hp.com/rnd/support/manuals/7000dl.htm

- For PCM+ and IDM manuals:
  
  http://www.hp.com/rnd/support/manuals/ProCurve-Manager.htm
  
  http://www.hp.com/rnd/support/manuals/IDM.htm

- For TANDBERG products:
  
  http://www.tandberg.com/products/index.jsp
  

For further information, please visit www.procurve.eu

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