Low-latency Queuing

Low-latency Queuing and QoS Maps for Routers

This Configuration Guide explains the concepts behind configuring your ProCurve Secure Router Operating System (SROS) product to use low-latency queuing, defines related commands, and provides sample configurations. For detailed information regarding specific command syntax, refer to the SROS Command Line Interface Reference Guide on your ProCurve SROS Documentation CD.

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Understanding Low-latency Queuing

Low-latency queuing is used to give specific traffic classes higher priority when transmitting on the router’s WAN interface. This is accomplished with QoS mapping. QoS maps are used to set up traffic definitions and to specify actions applied to traffic that matches the definitions. Based on QoS map settings, traffic can be enqueued to a low-latency queue or assigned a new DSCP/IP precedence value.

You can have more than one QoS map with the same name, but a unique sequence number is required to differentiate each entry.

For example:
```
(config)#qos map VOICEMAP 10
(config-qos-map)#match ip precedence 5
(config-qos-map)#priority 256
(config-qos-map)#set dscp 46
(config-qos-map)#exit
(config)#qos map VOICEMAP 20
(config-qos-map)#match ip rtp 2000 2100
(config-qos-map)#priority 128
```

Once the QoS map is configured, apply it (by map name) to a Frame Relay or PPP port interface with the `qos-policy out` command. The `out` keyword indicates that this is an outbound policy.

For example:
```
(config)#interface fr 1
(config-fr 1)#qos-policy out VOICEMAP
```

Traffic leaving the WAN interface that is not specified in the QoS map is sent using weighted-fair-queueing (WFQ). As with WFQ, all queueing and QoS packet reorganization takes place on the output WAN interface.

What is a QoS Map?

A QoS map is a named list with sequenced entries, similar in construction to a crypto map. An entry contains a single match reference and one or more actions (e.g., `priority` or `set`). The actions are performed on traffic matching the QoS policy criteria.

Multiple map entries for the QoS map are differentiated by sequence number. The sequence number is also used to assign match order. The router searches maps with the lowest number first. Once created, a QoS map must be applied to an interface (using the `qos-policy out <map-name>` command) in order to actively process traffic.
Basic Requirements of Setup

There are four basic requirements when setting up low-latency queuing:

**Step 1: Create the QoS Map**
To create the QoS map, use the `qos map` command at the Global command prompt. Please note that the map name (VOICE in the example below) and the sequence number (10 in this example) can be replaced with entries of your choosing. Each map can have the same name with different sequence numbers. The router checks the QoS maps for a match, beginning with the lowest sequence number.

```
(config)#qos map VOICE 10
```

**Step 2: Define Matches**
The following command matches this QoS map to traffic using the ACL My_Voice:

```
(config-qos-map)#match list MY_VOICE
```

**Step 3: Define Actions**
The following command prioritizes matching traffic using 64 kbps of bandwidth:

```
(config-qos-map)#priority 64
```

**Step 4: Assign Map to WAN Interface**
The following command applies the QoS map to the output WAN interface:

```
(config-qos-map)#exit
(config)#interface fr 1
(config-fr 1)#qos-policy out VOICE
```

**Note**
Apply a map name (not a sequence number) to the WAN interface. All maps with the same name are searched by the interface in order, based on the sequence number (from lowest to highest).

The same QoS map may be applied to multiple WAN interfaces.
Command Definitions

Now that you have a basic understanding of the setup involved, refer to the following tables to further your understanding of QoS commands.

**Match Commands**

Use the `match` commands to specify which traffic the QoS map prioritizes. Possible variations of this command are shown in Table 1.

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>match dscp &lt;0-63&gt;</code></td>
<td>Matches IP packets with the specified DSCP value.</td>
</tr>
<tr>
<td><code>match list &lt;ACL listname&gt;</code></td>
<td>Matches an extended access control list (ACL) which contains definitions of traffic to be matched.</td>
</tr>
<tr>
<td><code>match precedence &lt;0-7&gt;</code></td>
<td>Matches IP packets with the specified IP precedence value.</td>
</tr>
<tr>
<td><code>match ip rtp &lt;starting-port# ending-port#&gt; [all]</code></td>
<td>Matches RTP packets with even UDP port numbers in the specified range. If <code>all</code> is specified, even and odd ports are matched in the specified range.</td>
</tr>
<tr>
<td><code>match protocol bridge</code></td>
<td>Matches frames being bridged by the router.</td>
</tr>
<tr>
<td><code>match protocol bridge netbeui</code></td>
<td>Matches only NetBEUI frames being bridged by the router.</td>
</tr>
</tbody>
</table>
Action Commands

A QoS map entry contains one or more actions to be performed on matched traffic. The **priority** commands provide a low-latency queue, prioritizing matching traffic above all others. If no traffic is present in any other queue, high-priority traffic is allowed to burst up to the interface rate. Otherwise, high-priority traffic above the specified bandwidth is dropped. An optional burst rate can be specified limiting the matching traffic burst rate when traffic is present in another queue. The **set** commands set the IP precedence or DSCP byte to the specified value on matching traffic. Possible variations of these commands are shown in Table 2.

### Table 2. Action Command Definitions

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
</table>
| **priority** `<bandwidth> <burst>` | This sets an upper limit for how much high-priority traffic should be expected. If the high priority traffic exceeds this amount, the excess packets can be dropped. Specify `<bandwidth>` in kbps. The optional parameter `<burst>` can be specified to set the maximum burst size in bytes. Not specifying the `<burst>` value and leaving it at the default value is usually the best choice.  

*NOTE:* The low-latency queue is recommended for constant bit rate (CBR) traffic such as voice (due to the rate-limiting). The sum of the bandwidths reserved by **priority** commands for all entries of a **qos map** cannot exceed 75 percent of the total bandwidth of any interface to which the map is applied. |

| **priority unlimited** | If the unlimited keyword is specified for a **priority** queue bandwidth, then no rate-limiting is done on that traffic class.  

*Use with caution! Excessive traffic that matches the map will potentially use all available bandwidth on the WAN port.* |

| **set dscp ** `<0-63>` | Sets the DSCP byte on matching packets with the specified value. This is recommended for variable bit rate (VBR) traffic. |

| **set precedence** `<0-7>` | Sets the IP precedence bits on matching packets with the specified value. This is recommended for VBR traffic. |
Statistic Commands

Use the following commands to view information on QoS functionality.

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show qos map</code></td>
<td>Displays information and number of packet matches for all configured QoS maps.</td>
</tr>
<tr>
<td><code>show qos map &lt;mapname&gt; &lt;sequence#&gt;</code></td>
<td>Displays information and packet matches for a specific map (using mapname) or map entry (using mapname and sequence number).</td>
</tr>
<tr>
<td><code>show qos map interface &lt;interface&gt;</code></td>
<td>If a low-latency queue is rate-limited to a configured bandwidth, discards are shown here. A count for the number of QoS map packet matches that are specific to this interface is also displayed. The packet match count will always increment for all matched traffic, regardless of whether rate-limiting (by dropping packets or interface congestion) occurs.</td>
</tr>
</tbody>
</table>
Sample Script

The following script example creates a QoS map with two entries. The first entry matches traffic using the ACL MY_VOICE and prioritizes this traffic using 64 kbps of bandwidth.

The second entry has a sequence number of 20. This matches real-time protocol traffic on all ports from 2000 to 4000 and prioritizes this traffic using 256 kbps of bandwidth. The QoS map VOICE is then applied to the PPP 1 interface.

```
qos map VOICE 10
  match list MY_VOICE
  priority 64
!
qos map VOICE 20
  match ip rtp 2000 4000 all
  priority 256
!
ip access-list extended MY_VOICE
  permit tcp host 192.168.1.100 any eq 2000
!
interface ppp 1
  ip address 10.10.10.1 255.255.255.0
  qos-policy out VOICE
!
```

Additional examples of possible setups are shown below:

```
qos map TEST 10
  match precedence 2
  set dscp 60
!
qos map TEST 20
  match list MY_DATA
  set precedence 7
!
qos map TEST 30
  match ip rtp 1024 3000
  priority 256
!
ip access-list extended MY_DATA
  permit ip host 192.168.100.10 any
!
interface fr 1
  qos-policy out TEST
!
```