6

Quality of Service (QoS): Managing Bandwidth More Effectively

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As the term suggests, *network policy* refers to the network-wide controls you can implement to:

- Ensure uniform and efficient traffic handling throughout your network, while keeping the most important traffic moving at an acceptable speed, regardless of current bandwidth usage.
- Exercise control over the priority settings of inbound traffic arriving in and travelling through your network.

Adding bandwidth is often a good idea, but it is not always feasible and does not completely eliminate the potential for network congestion. There will always be points in the network where multiple traffic streams merge or where network links will change speed and capacity. The impact and number of these congestion points will increase over time as more applications and devices are added to the network.

When (not *if*) network congestion occurs, it is important to move traffic on the basis of relative importance. However, without *Quality of Service* (QoS) prioritization, less important traffic can consume network bandwidth and slow down or halt the delivery of more important traffic. That is, without QoS, most traffic received by the switch is forwarded with the same priority it had upon entering the switch. In many cases, such traffic is “normal” priority and competes for bandwidth with all other normal-priority traffic, regardless of its relative importance to your organization’s mission.

This section gives an overview of QoS operation and benefits, and describes how to configure QoS in the console interface.

Quality of Service is a general term for classifying and prioritizing traffic throughout a network. That is, QoS enables you to establish an end-to-end traffic priority policy to improve control and throughput of important data. You can manage available bandwidth so that the most important traffic goes first. For example, you can use Quality of Service to:

- Upgrade or downgrade traffic from various servers.
- Control the priority of traffic from dedicated VLANs or applications.
- Change the priorities of traffic from various segments of your network as your business needs change.
- Set priority policies in edge switches in your network to enable traffic-handling rules across the network.

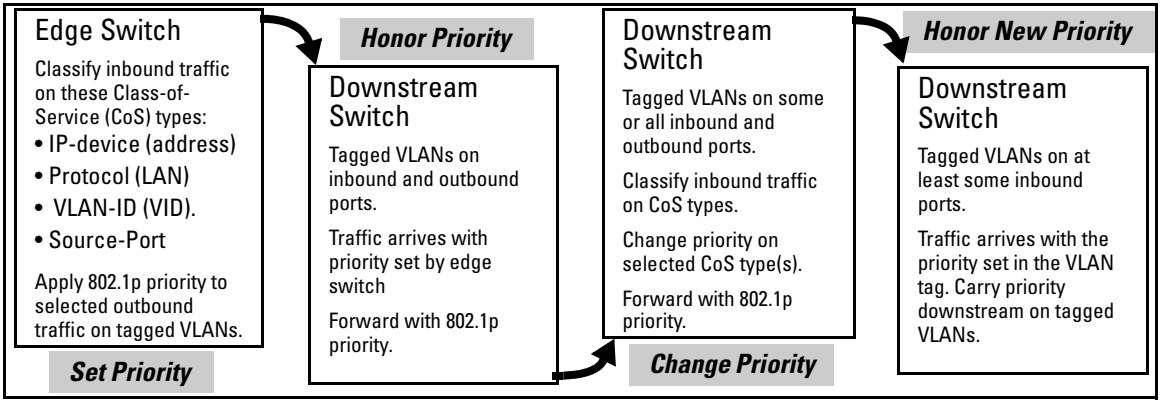

Figure 6-1. Example of 802.1p Priority Based on CoS (Class-of-Service) Types and Use of VLAN Tags

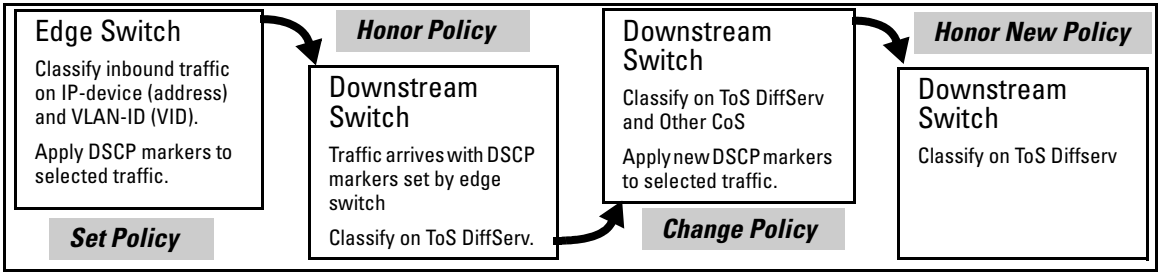

Figure 6-2. Example Application of Differentiated Services Codepoint (DSCP) Policies

At the edge switch, QoS classifies certain traffic types and in some cases applies a DSCP policy. At the next hop (downstream switch) QoS honors the policies established at the edge switch. Further downstream, another switch may reclassify some traffic by applying new policies, and yet other downstream switches can be configured to honor the new policies.

QoS is implemented in the form of rules or policies that are configured on the switch. While you can use QoS to prioritize only the outbound traffic while it is moving through the switch, you derive the maximum benefit by using QoS in an 802.1Q VLAN environment (with 802.1p priority tags) or in an untagged VLAN environment (with DSCP policies) where QoS can set priorities that downstream devices can support without re-classifying the traffic.

By prioritizing traffic, QoS supports traffic growth on the network while optimizing the use of existing resources—and delaying the need for further investments in equipment and services. That is, QoS enables you to:

- Specify which traffic has higher or lower priority, regardless of current network bandwidth or the relative priority setting of the traffic when it is received on the switch.
- Change (upgrade or downgrade) the priority of outbound traffic.
- Override "illegal" packet priorities set by upstream devices or applications that use 802.1Q VLAN tagging with 802.1p priority tags.
- Avoid or delay the need to add higher-cost NICs (network interface cards) to implement prioritizing. (Instead, control priority through network policy.)

QoS on the switches covered in this guide support these types of traffic marking:

- **802.1p prioritization:** Controls the outbound port queue priority for traffic leaving the switch, and (if traffic exits through a VLAN-tagged port) sends the priority setting with the individual packets to the downstream devices.
- **IP Type-of-Service (ToS):** Enables the switch to set, change, and honor prioritization policies by using the Differentiated Services (diffserv) bits in the ToS byte of IPv4 packet headers.

Terminology

Term	Use in This Document
802.1p priority	A traffic priority setting carried by a VLAN-tagged packet moving from one device to another through ports that are tagged members of the VLAN to which the packet belongs. This setting can be from 0 - 7. The switch handles an outbound packet on the basis of its 802.1p priority. However, if the packet leaves the switch through a VLAN on which the port is an untagged member, this priority is dropped, and the packet arrives at the next, downstream device without an 802.1p priority assignment.
802.1Q field	A four-byte field that is present in the header of Ethernet packets entering or leaving the switch through a port that is a tagged member of a VLAN. This field includes an 802.1p priority setting, a VLAN tag, or ID number (VID), and other data. A packet entering or leaving the switch through a port that is an untagged member of the outbound VLAN does not have this field in its header and thus does not carry a VID or an 802.1p priority. See also "802.1p priority".
codepoint	Refer to DSCP, below.
downstream device	A device linked directly or indirectly to an outbound switch port. That is, the switch sends traffic to downstream devices.
DSCP	***Differentiated Services Codepoint.*** (Also termed ***codepoint***.) A DSCP is comprised of the upper six bits of the ToS (Type-of-Service) byte in IP packets. There are 64 possible codepoints. In the default QoS configuration for the switches covered in this guide, some codepoints are configured with default 802.1p priority settings for Assured-Forwarding and Expedited Forwarding. All other codepoints are unused (and listed with **No-override** for a priority).
DSCP policy	A DSCP configured with a specific 802.1p priority (0- 7). (Default: **No-override**). Using a DSCP policy, you can configure the switch to assign priority to IP packets. That is, for an IP packet identified by the specified classifier, you can assign a new DSCP and an 802.1p priority (0-7). For more on DSCP, refer to "Details of QoS IP Type-of-Service" on page 6-40. For the DSCP map, see figure 6-20 on page 6-41.
edge switch	In the QoS context, this is a switch that receives traffic from the edge of the LAN or from outside the LAN and forwards it to devices within the LAN. Typically, an edge switch is used with QoS to recognize packets based on classifiers such as TCP/UDP application type, IP-device (address), Protocol (LAN), VLAN-ID (VID), and Source-Port (although it can also be used to recognize packets on the basis of ToS bits). Using this packet recognition, the edge switch can be used to set 802.1p priorities or DSCP policies that downstream devices will honor.
inbound port	Any port on the switch through which traffic enters the switch.
IP Options	In an IPv4 packet, optional, these are extra fields in the packet header.
IP-precedence bits	The upper three bits in the Type of Service (ToS) field of an IP packet.
IPv4	Version 4 of the IP protocol.
outbound packet	A packet leaving the switch through any LAN port.
outbound port	Any port on the switch through which traffic leaves the switch.

Term	Use in This Document
outbound port queue	For any port, a buffer that holds outbound traffic until it can leave the switch through that port. By default, there are eight outbound queues for each port in the switch. Queue 8 is the highest priority queue; queue 1 is the lowest priority queue. Traffic in a port's high priority queue leaves the switch before any traffic in the port's medium or low priority queues.
re-marking (DSCP re-marking)	Assigns a new QoS policy to an outbound packet by changing the DSCP bit settings in the ToS byte.
tagged port membership	Identifies a port as belonging to a specific VLAN and enables VLAN-tagged packets belonging to that VLAN to carry an 802.1p priority setting when outbound from that port. Where a port is an untagged member of a VLAN, outbound packets belonging to that VLAN do not carry an 802.1p priority setting.
Type-of-Service (ToS) byte	Comprised of a three-bit (high-order) precedence field and a five-bit (low-order) Type-of-Service field. Later implementations may use this byte as a six-bit (high-order) Differentiated Services field and a two-bit (low-order) reserved field. See also "IP-precedence bits" and DSCP elsewhere in this table.
upstream device	A device linked directly or indirectly to an inbound switch port. That is, the switch receives traffic from upstream devices.

Overview

QoS settings operate on two levels:

- **Controlling the priority of outbound packets moving through the switch:** Each switch port has eight outbound traffic queues; the queue with a priority value of one has the lowest priority, and priority value seven has the highest priority. Packets leave the switch port on the basis of their queue assignment and whether any higher queues are empty:

Table 6-1. Port Queue Exit Priorities

Port Queue and 802.1p Priority Values	Priority for Exiting From the Port
Low (1)	Eighth
Low (2)	Seventh
Normal (0)	Sixth
Normal (3)	Fifth
Medium (4)	Fourth
Medium (5)	Third
High (6)	Second
High (7)	First

A QoS configuration enables you to set the outbound priority queue to which a packet is sent. (In an 802.1Q VLAN environment with VLAN-tagged ports, if QoS is *not* configured on the switch, but *is* configured on an upstream device, the priorities carried in the packets determine the forwarding queues in the switch.)

- **Configuring a priority for outbound packets and a service (priority) policy for use by downstream devices:**
  - **DSCP Policy:** This feature enables you to set a priority policy in outbound IP packets. (You can configure downstream devices to read and use this policy.) This method is not dependent on VLAN-tagged ports to carry priority policy to downstream devices, and can:
    – Change the codepoint (the upper six bits) in the ToS byte.
    – Set a new 802.1p priority for the packet.

    (Setting DSCP policies requires IPv4 inbound packets. Refer to the "IPv4" entry under "Terminology" on page 6-6.)
  - **802.1p Priority Rules:** An outbound, VLAN-tagged packet carries an 802.1p priority setting that was configured (or preserved) in the switch. This priority setting ranges from 0 to 7, and can be used by downstream devices having up to eight outbound port queues. Thus, while packets within the switch move at the eight priority levels shown in table 6-1, above, they still can carry an 802.1p priority that can be used by downstream devices having more or less than the eight priority levels in the switches covered in this guide. Also, if the packet enters the switch with an 802.1p priority setting, QoS can override this setting if configured with an 802.1p priority rule to do so.

Notes

If your network uses only one VLAN (and therefore does not require VLAN-tagged ports) you can still preserve 802.1p priority settings in your traffic by configuring the ports as tagged VLAN members on the links between devices you want to honor traffic priorities.

You can configure a QoS priority of 0 through 7 for an outbound packet. When the packet is then sent to a port, the QoS priority determines which outbound queue the packet uses:

Table 6-2. QoS Priority Settings and Operation

QoS Priority Setting	Outbound Port Queue
1 - 2	low priority (1, 2)
0 - 3	normal priority (3, 4)

QoS Priority Setting	Outbound Port Queue
4 - 5	medium priority (5, 6)
6 - 7	high priority (7, 8)

If a packet is not in a VLAN-tagged port environment, then the QoS settings in table 6-2 control only to which outbound queue the packet goes. Without VLAN tagging, no 802.1p priority is added to the packet for downstream device use. But if the packet is in a VLAN-tagged environment, then the above setting is also added to the packet as an 802.1p priority for use by downstream devices and applications (shown in table 6-3). In either case, an IP packet can also carry a priority policy to downstream devices by using DSCP-marking in the ToS byte.

Table 6-3. Mapping Switch QoS Priority Settings to Device Queues

Priority Setting	Outbound Port Queues in the Switch	802.1p Priority Setting Added to Tagged VLAN Packets Leaving the Switch	Queue Assignment in Downstream Devices With:		
			8 Queues	3 Queues	2 Queues
1	Queue 1	1 (low priority)	Queue 1	Queue 1	
2	Queue 2	2	Queue 2		Queue 1
0	Queue 3	0 (normal priority)	Queue 3	Queue 2	
3	Queue 4	3	Queue 4		
4	Queue 5	4 (medium priority)	Queue 5	Queue 3	
5	Queue 6	5	Queue 6		Queue 2
6	Queue 7	6 (high priority)	Queue 7		
7	Queue 8	7	Queue 8		

Note

The QoS queue configuration feature can change the number of outbound port queues in the switch from eight (the default) to four queues or two queues. For more information, see “QoS Queue Configuration” on page 6-64.

Classifiers for Prioritizing Outbound Packets

Note On Using Multiple Criteria

ProCurve recommends that you configure a minimum number of the available QoS classifiers for prioritizing any given packet type. Increasing the number of active classifier options for a packet type increases the complexity of the possible outcomes and consumes switch resources.

Packet Classifiers and Evaluation Order

The switches covered in this guide provide seven QoS classifiers (packet criteria) you can use to configure QoS priority.

Table 6-4. Classifier Search Order and Precedence

Search Order	Precedence	QoS Classifier Type
1	1 (highest)	UDP/TCP Application Type (port)
2	2	Device Priority (destination or source IP address)
3	3	IP Type of Service (ToS) field (IP packets only)
4	4	Protocol Priority (IP, IPX, ARP, AppleTalk, SNA, and NetBeui)
5	5	VLAN Priority
6	6	Incoming source-port on the switch
7	7 (lowest)	Incoming 802.1p Priority (present in tagged VLAN environments)

Where multiple classifier types are configured, a switch uses the highest-to-lowest search order shown in table 6-4 to identify the highest-precedence classifier to apply to any given packet. When a match between a packet and a classifier is found, the switch applies the QoS policy configured for that classifier and the packet is handled accordingly.

Note that on the switches covered in this guide, if the switch is configured with multiple classifiers that address the same packet, the switch uses only the QoS configuration for the QoS classifier that has the highest precedence. In this case, the QoS configuration for another, lower-precedence classifier that may apply is ignored. For example, if QoS assigns high priority to packets belonging to VLAN 100, but normal priority to all IP protocol packets, since protocol priority (4) has precedence over VLAN priority (5), IP protocol packets on VLAN 100 will be set to normal priority.

Preparation for Configuring QoS

Preserving 802.1p Priority

QoS operates in VLAN-tagged and VLAN-untagged environments. If your network does not use multiple VLANs, you can still implement the 802.1Q VLAN capability for packets to carry their 802.1p priority to the next downstream device. To do so, configure ports as VLAN-tagged members on the links between switches and routers in your network infrastructure.

Table 6-5. Summary of QoS Capabilities

Outbound Packet Options	Port Membership in VLANs	
	Tagged	Untagged
Control Port Queue Priority for Packet Types	Yes	Yes
Carry 802.1p Priority Assignment to Next Downstream Device	Yes	No
Carry DSCP Policy to Downstream Devices. The policy includes:	Yes[1]	Yes[1]
Assigning a ToS Codepoint		
Assigning an 802.1p Priority [2] to the Codepoint		

[1] Except for non-IPv4 packets or packets processed using either the Layer 3 Protocol or QoS IP-Precedence methods, which do not include the DSCP policy option. Also, to use a service policy in this manner, the downstream devices must be configured to interpret and use the DSCP carried in the IP packets.

[2] This priority corresponds to the 802.1p priority scheme and is used to determine the packet's port queue priority. When used in a VLAN-tagged environment, this priority is also assigned as the 802.1p priority carried outbound in packets having an 802.1Q field in the header.

Steps for Configuring QoS on the Switch

1. Determine the QoS policy you want to implement. This includes analyzing the types of traffic flowing through your network and identifying one or more traffic types to prioritize. In order of QoS precedence, these are:
   a. UDP/TCP applications
   b. Device Priority—destination or source IP address (Note that destination has precedence over source. See Table 6-6.)
   c. IP Type-of-Service Precedence Bits (Leftmost three bits in the ToS field of IP packets)
   d. IP Type-of-Service Differentiated Service bits (Leftmost six bits in the ToS field of IP packets)
   e. Protocol Priority

f. VLAN Priority (requires at least one tagged VLAN on the network)

g. Source-Port

h. Incoming 802.1p Priority (requires at least one tagged VLAN on the network)

2. Select the QoS option you want to use. Table 6-6 lists the traffic types (QoS classifiers) and the QoS options you can use for prioritizing or setting a policy on these traffic types:

Table 6-6. Applying QoS Options to Traffic Types Defined by QoS Classifiers

QoS Options for Prioritizing Outbound Traffic		QoS Classifiers						
		UDP/ TCP	IP Device	IP-ToS Precedence	IP-DiffServ	L3 Protocol	VLAN -ID	Source -Port
Option 1: Configure 802.1p Priority Rules Only	Prioritize traffic by sending specific packet types (determined by QoS classifier) to different outbound port queues on the switch. Rely on VLAN-tagged ports to carry packet priority as an 802.1p value to downstream devices.	Yes	Yes	Yes[1]	Yes	Yes	Yes	Yes
Option 2: Configure ToS DSCP Policies with 802.1p Priorities	Prioritize traffic by sending specific packet types (determined by QoS classifier) to different outbound port queues on the switch. Propagate a service policy by reconfiguring the DSCP in outbound IP packets according to packet type. The packet is placed in an outbound port queue according to the 802.1p priority configured for that DSCP policy. (The policy assumes that downstream devices can be configured to recognize the DSCP in IP packets and implement the service policy it indicates.) Use VLAN-tagged ports to include packet priority as an 802.1p value to downstream devices.	Yes	Yes	No	Yes	No	Yes	Yes

[1] In this mode the configuration is fixed. You cannot change the automatic priority assignment when using IP-ToS Precedence as a QoS classifier.

3. If you want 802.1p priority settings to be included in outbound packets, ensure that tagged VLANs are configured on the appropriate downstream links.

4. Determine the actual QoS configuration changes you will need to make on each QoS-capable device in your network in order to implement the desired policy. Also, if you want downstream devices to read and use DSCPs in IP packets from the switch, configure them to do so by enabling ToS Differentiated Service mode and making sure the same DSCP policies are configured.

Viewing the QoS Configuration

```
ProCurve(config)# qos dscp-map 001111 priority 5
ProCurve(config)# qos type-of-service diff-services 001010 dscp 001111
ProCurve(config)# show qos resources
QoS/ACL Resource Usage

 Port | Rules Available | Masks Available
 -----+-----------------+----------------
   1  | 117             |  7
   2  | 117             |  7
   3  | 117             |  7
   .      .                .
   .      .                .
   .      .                .
  24  | 117             |  7

Maximum Rules per-port : 120
Maximum Masks per-port : 8
```

Assigning inbound packets with 001010 in the ToS byte to the newly created 001111 policy enables ToS Diff-Services mode. Because the default DSCP map already includes the Expedited Delivery (101110) policy, enabling ToS Diff- Services uses three rules on each port; one for each configured codepoint (101110, 001010, and 001111). As a result, the available rule count drops by 3 to 117.

The following show commands are available on the switches covered in this guide. Examples of the **show qos** output are included with the example for each priority type.

Syntax: show qos < *priority-classifier* >

tcp-udp-port-priority

Displays the current TCP/UDP port priority configuration. Refer to figure 6-7 on page 6-22.

device-priority

Displays the current device (IP address) priority configuration. Refer to figure 6-9 on page 6-26.

type-of-service

Displays the current type-of-service priority configuration. The display output differs according to the ToS option used:

- *IP Precedence: Refer to figure 6-13 on page 6-32.*
- *Diffserve: Refer to figure 6-15 on page 6-36.*

protocol-priority

Displays the current protocol priority configuration.

vlan-priority

Displays the current VLAN priority configuration. Refer to figure 6-23 on page 6-47.

port-priority

Displays the current source-port priority configuration. Refer to figure 6-28 on page 6-52.

No Override

By default, the IP ToS, Protocol, VLAN-ID, and (source) port **show** outputs automatically list **No-override** for priority options that have not been configured. This means that if you do not configure a priority for a specific option, QoS does not prioritize packets to which that option applies, resulting in the **No override** state. In this case, IP packets received through a VLAN-tagged port receive whatever 802.1p priority they carry in the 802.1Q tag in the packet's header. VLAN-Tagged packets received through an untagged port are handled in the switch with "normal" priority. For example, figure 6-3 below shows a qos VLAN priority output in a switch where non-default priorities exist for VLANs 22 and 33, while VLAN 1 remains in the default configuration.

```
ProCurve(config)# show qos vlan-priority

  VLAN priorities

  VLAN ID Apply rule   | DSCP   Priority
  ------- ------------ + ------ ------------
  1       No-override  |        No-override
  22      Priority     |        0
  33      DSCP         | 000010 6
```

This output shows that VLAN 1 is in the default state, while VLANs 22 and 33 have been configured for 802.1p and DSCP Policy priorities respectively.

Figure 6-3. Example of the Show QoS Output for VLAN Priority

Using QoS Classifiers to Configure Quality of Service for Outbound Traffic

QoS Feature	Default	Reference
UDP/TCP Priority	Disabled	page 6-15
IP-Device Priority	Disabled	page 6-25
IP Type-of-Service Priority	Disabled	page 6-31
VLAN-ID Priority	Disabled	page 6-45
Source-Port Priority	Disabled	page 6-51

Note

In addition to the information in this section on the various QoS classifiers, refer to "QoS Operating Notes and Restrictions" on page 6-68.

QoS UDP/TCP Priority

QoS Classifier Precedence: 1

When you use UDP or TCP and a layer 4 Application port number as a QoS classifier, traffic carrying the specified UDP/TCP port number(s) is marked with the UDP/TCP classifier's configured priority level, without regard for any other QoS classifiers in the switch. You can have up to 50 UDP/TCP application port numbers as QoS classifiers.

Note

UDP/TCP QoS applications are supported for IPv4 packets only. For more information on packet-type restrictions, refer to "Details of Packet Criteria and Restrictions for QoS Support" on page 6-68.

Options for Assigning Priority. Priority control options for TCP or UDP packets carrying a specified TCP or UDP port number include:

- 802.1p priority
- DSCP policy (Assigning a new DSCP and an associated 802.1p priority; inbound packets must be IPv4.)

For a given TCP or UDP port number, you can use only one of the above options at a time. However, for different port numbers, you can use different options.

TCP/UDP Port Number Ranges. There are three ranges:

- Well-Known Ports: 0 - 1023
- Registered Ports: 1024 - 49151
- Dynamic and/or Private Ports: 49152 - 65535

For more information, including a listing of UDP/TCP port numbers, go to the *Internet Assigned Numbers Authority* (IANA) website at:

www.iana.org

Then click on:

Protocol Number Assignment Services

P (Under "Directory of General Assigned Numbers" heading)

Port Numbers

Assigning an 802.1p Priority Based on TCP or UDP Port Number or Range of Port Numbers

This option assigns an 802.1p priority to (IPv4) TCP or UDP packets as described below.

Syntax: qos < udp-port | tcp-port > < *tcp or udp port number* > priority < 0 - 7 >

Configures an 802.1p priority for outbound packets having the specified TCP or UDP application port number. This priority determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device.

A port range can be from 1 to 65535 (inclusive) ports or any subset thereof. See "Operating Notes on Using Port Ranges" below. The minimum port number must precede the maximum port number in the range.

(Default: Disabled)

The **no** *form of the command deletes the specified UDP or TCP port number or range of port numbers as a QoS classifier.*

Note: *If you have specified a range of port numbers, you must specify the entire range in the* **no** *command; you cannot remove part of a range.*

show qos tcp-udp-port-priority

Displays a listing of all TCP and UDP QoS classifiers currently in the running-config file.

Operating Notes on Using Port Ranges

- You can only have 6 concurrent policies when using unique ranges. The number of policies allowed is lower if ACLs are also using port ranges.
- You cannot have ranges that include any port numbers that have been configured as part of another QoS application port number policy.
- An error message is generated if there are not enough hardware resources available when configuring a policy.
- You must specify the entire range of configured port numbers when using the **no** form of the command, for example:

```
ProCurve(config)# qos udp-port range 1300 1399
                    dscp 001110

ProCurve(config)# no qos range 1300 1399
```

The following example shows the 802.1p priority for the UDP and TCP port prioritization:

TCP/UDP Port	802.1p Priority for TCP	802.1p Priority for UDP
TCP Port 23 (Telnet)	7	7
UDP Port 23 (Telnet)	7	7
TCP Port 80 (World Wide Web HTTP)	2	2
UDP Port 80 (World Wide Web HTTP)	1	1

```
ProCurve(config)# qos tcp-port 23 priority 7
ProCurve(config)# qos udp-port 23 priority 7
ProCurve(config)# qos tcp-port 80 priority 2
ProCurve(config)# qos udp-port 80 priority 1
ProCurve(config)# qos udp-port range 100 199 priority 3

ProCurve(config)# show qos tcp-udp-port-priority

  TCP/UDP port based priorities

            | Application              |
  Protocol  | Port         Apply rule  | DSCP   Priority
  --------- + ------------ ----------- + ------ ------------
  TCP       | 23           Priority    |        7
  UDP       | 23           Priority    |        7
  TCP       | 80           Priority    |        2
  UDP       | 80           Priority    |        1
  UDP       | 100-199      Priority    |        3
```

Values in these two columns define the QoS classifiers to use for identifying packets to prioritize.

Indicates 802.1p priority assignments are in use for packets with 23, 80 or 100-199 as a TCP or UDP Application port numbers.

Shows the 802.1p priority assignment for packets with the indicated QoS classifiers.

Figure 6-4. Example of Configuring and Listing 802.1p Priority Assignments on TCP/UDP Ports

Assigning a DSCP Policy Based on TCP or UDP Port Number or Range of Port Numbers

Note

The switches covered in this guide do not support DSCP policies on IPv4 packets with IP options. For more information on packet-type restrictions, refer to “Details of Packet Criteria and Restrictions for QoS Support” on page 6-68.

This option assigns a previously configured DSCP policy (codepoint and 802.1p priority) to (IPv4) TCP or UDP packets having the specified port number or range of port numbers. That is, the switch:

1. Selects an incoming IP packet if the TCP or UDP port number it carries matches the port number specified in the TCP or UDP classifier (as shown in figure 6-4, above).

2. Overwrites (re-marks) the packet's DSCP with the DSCP configured in the switch for such packets.
3. Assigns the 802.1p priority configured in the switch for the new DSCP. (Refer to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)
4. Forwards the packet through the appropriate outbound port queue.

For more on DSCP, refer to "Terminology" on page 6-6.

Steps for Creating a DSCP Policy Based on TCP/UDP Port Number Classifiers. This procedure creates a DSCP policy for IPv4 packets carrying the selected UDP or TCP port-number classifier.

1. Identify the TCP or UDP port-number classifier you want to use for assigning a DSCP policy.
2. Determine the DSCP policy for packets carrying the selected TCP or UDP port number or range of port numbers.
   a. Determine the DSCP you want to assign to the selected packets. (This codepoint will be used to overwrite (re-mark) the DSCP carried in packets received from upstream devices.)
   b. Determine the 802.1p priority you want to assign to the DSCP.
3. Configure the DSCP policy by using **qos dscp-map** to configure the priority to the codepoint you selected in step 2a. (For details, refer to the example later in this section, and to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)

Note

A codepoint must have an 802.1p priority assignment (0 - 7) before you can configure a policy for prioritizing packets by TCP or UDP port numbers or a range of port numbers. If a codepoint you want to use shows **No-override** in the **Priority** column of the DSCP map (**show qos dscp-map**), then you must assign a 0 - 7 priority before proceeding.

4. Configure the switch to assign the DSCP policy to packets with the specified TCP or UDP port number or range of port numbers.

Syntax: [no] qos <udp-port | tcp-port> <1-65535> [dscp <*codepoint*> | priority < 0 - 7 >

This command is optional if a priority has already been assigned to the <**codepoint**>. *The command creates a DSCP policy by assigning an 802.1p priority to a specific DSCP. When the switch applies this policy to a packet, the priority determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. For IPv4 packets, the DSCP will be replaced by the codepoint specified in this command. (Default:* **No-override** *for most codepoints. See table 6-9 on page 6-58.)*

Syntax: [no] qos < udp-port | tcp-port > < portnum |<range <*start*><*end*>>> <priority < 0-7 > | dscp <*codepoint*>>

Assigns a DSCP policy to outbound packets having the specified TCP or UDP application port number and overwrites the DSCP in these packets with the assigned **<**`codepoint`**>** *value. This policy includes an 802.1p priority and determines the packet's queue in the outbound port to which it is sent. (The* **<codepoint>** *must be configured with an 802.1p setting. See step 3 on page 6-19.) If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. (Default:* **No-override)**

A port range can be from 1 to 65535 (inclusive) ports or any subset thereof. See "Operating Notes on Using Port Ranges" on page 6-17. The minimum port number must precede the maximum port number in the range.

The **no** *form of the command deletes the specified UDP or TCP port number or range of port numbers as a QoS classifier.*

Note: *If you have specified a range of port numbers, you must specify the entire range in the* **no** *command; you cannot remove part of a range.*

show qos tcp-udp-port-priority

Displays a listing of all TCP and UDP QoS classifiers currently in the running-config file.

For example, suppose you wanted to assign these DSCP policies to the packets identified by the indicated UDP and TDP port applications:

Port Applications	DSCP Policies	
	DSCP	Priority
23-UDP	000111	7
80-TCP	000101	5
914-TCP	000010	1
1001-UDP	000010	1

1. Determine whether the DSCPs already have priority assignments, which could indicate use by existing applications. (Also, a DSCP must have a priority configured before you can assign any QoS classifiers to use it.)

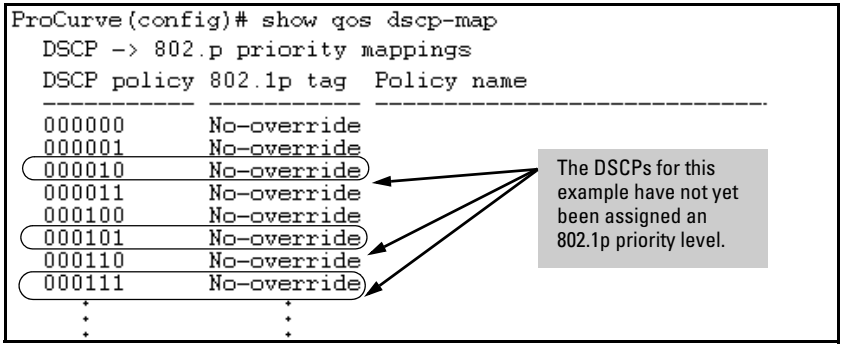

Figure 6-5. Display the Current DSCP-Map Configuration

2. Configure the DSCP policies for the codepoints you want to use.

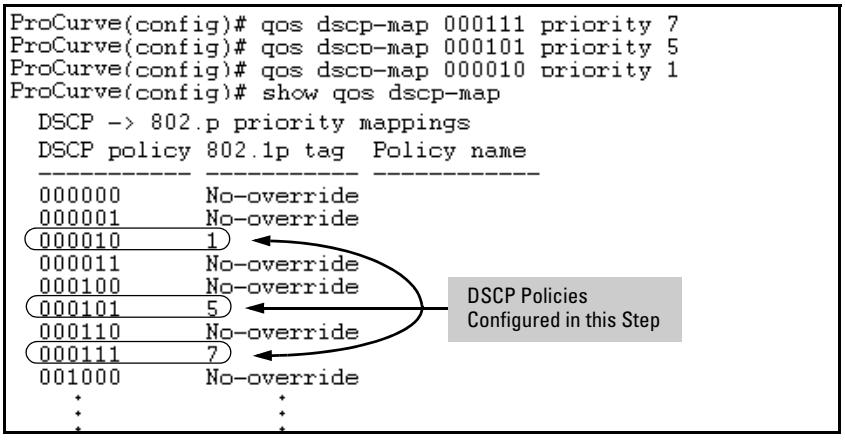

Figure 6-6. Assign Priorities to the Selected DSCPs

3. Assign the DSCP policies to the selected UDP/TCP port applications and display the result.

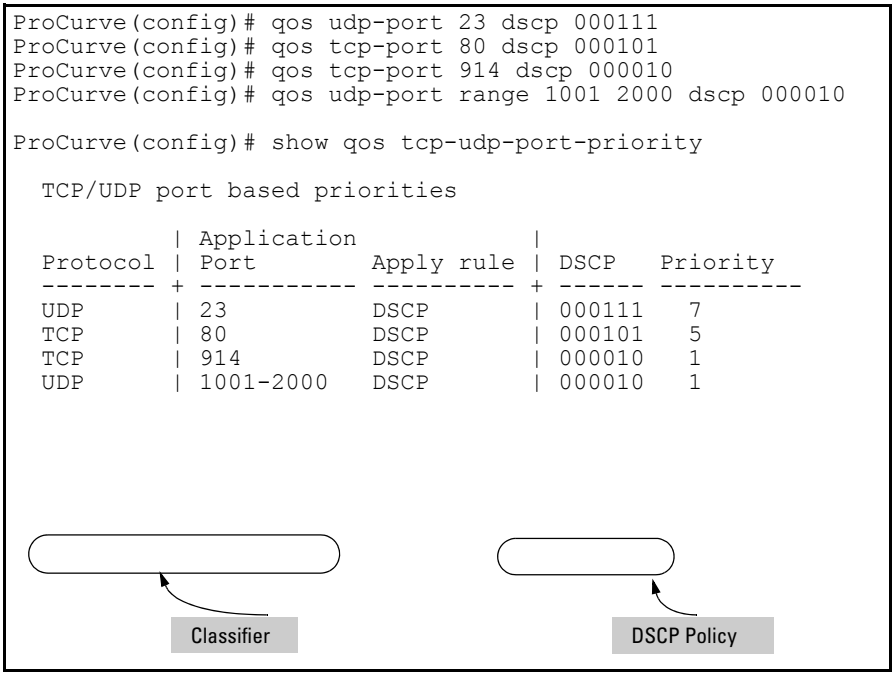

Figure 6-7. The Completed DSCP Policy Configuration for the Specified UDP/TCP Port Applications

The switch will now apply the DSCP policies in figure 6-7 to IPV4 packets received in the switch with the specified UDP/TCP port applications. This means the switch will:

- Overwrite the original DSCPs in the selected packets with the new DSCPs specified in the above policies.
- Assign the 802.1p priorities in the above policies to the selected packets.

Displaying the QoS Resources

When creating QoS classifiers using UDP or TCP and a layer 4 Application port number or port range, the switch automatically assigns two QoS resources for each policy—one for traffic to the UDP/TCP destination port and one for traffic to the UDP/TCP source port.

The show qos resources command displays the QoS resources used in addition to the ACL and IDM resources used.

```
ProCurve(config)# show qos resources

 Resource usage in Policy Enforcement Engine

        |   Rules   |                Rules Used
 Slots  | Available | ACL   | QoS   | IDM   |  VT   | ICMP  | Other |
 -------+-----------+-------+-------+-------+-------+-------+-------+
   A    |      3034 |    0  |   10  |    0  |    0  |    0  |     0 |
   B    |      3034 |    0  |   10  |    0  |    0  |    0  |     0 |

        | Application |       Application        |
        | Port Ranges |     Port Ranges Used     |
 Slots  |  Available* |   ACL   |   IDM   |  QoS  |
 -------+-------------+---------+---------+-------
   A    |          14 |       0 |       0 |   0
   B    |          14 |       0 |       0 |   0

 * If insufficient port ranges are available, additional rules will be used.

 1 of 8 Policy Engine management resources used.

 Key:
 ACL = Access Control Lists;  QoS = Host or application port QoS policies;
 IDM = Identity Driven Management; VT = Virus Throttling;
```

Figure 6-8. Displaying the QoS Resources Available

Note

The same port ranges are shared between ACLs and QoS policies. If a new QoS feature specifies a port range that is the same as one already configured by one or more ACLs, the QoS column will increase by one, but the "Application Port Ranges Available" column remains unchanged. Likewise, if an ACL specifies the same port range as that of an existing QoS policy, the ACLs column will increment, but the "Available" column remains unchanged.

Similarly, when removing ranges, the "Available" column only increments when all ACLs and any QoS policies do not specify the same range of ports.

QoS IP-Device Priority

QoS Classifier Precedence: 2

The IP device option, which applies only to IPv4 packets, enables you to use up to 300 IP addresses (source or destination) as QoS classifiers.

Where a particular device-IP address classifier has the highest precedence in the switch for traffic addressed to or from that device, then traffic received on the switch with that address is marked with the IP address classifier's configured priority level. Different IP device classifiers can have differing priority levels.

Note

The switch does not allow a QoS IP-device priority for the Management VLAN IP address, if configured. If there is no Management VLAN configured, then the switch does not allow configuring a QoS IP-device priority for the Default VLAN IP address.

Ip address QoS does not support layer-2 SAP encapsulation. For more information on packet-type restrictions, refer to table 6-13, "Details of Packet Criteria and Restrictions for QoS Support" on page 6-68.

Options for Assigning Priority. Priority control options for packets carrying a specified IP address include:

- 802.1p priority
- DSCP policy (Assigning a new DSCP and an 802.1p priority; inbound packets must be IPv4.)

(For operation when other QoS classifiers apply to the same traffic, refer to "Classifiers for Prioritizing Outbound Packets" on page 6-10.)

For a given IP address, you can use only one of the above options at a time. However, for different IP addresses, you can use different options.

Assigning a Priority Based on IP Address

This option assigns an 802.1p priority to all IPv4 packets having the specified IP address as either a source or destination. (If both match, the priority for the IP destination address has precedence.)

Syntax: qos device-priority < *ip-address* > priority < 0 - 7 >

Configures an 802.1p priority for outbound packets having the specified IP address. This priority determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. (Default: Disabled)

no qos device-priority < *ip-address* >

Removes the specified IP device-priority QoS classifier and resets the priority for that VLAN to **No-override**.

show qos device-priority

Displays a listing of all IP device-priority QoS classifiers currently in the running-config file.

For example, configure and list the 802.1p priority for packets carrying the following IP addresses:

IP Address	802.1p Priority
10.28.31.1	7
10.28.31.130	5
10.28.31.100	1
10.28.31.101	1

```
ProCurve(config)# qos device-priority 10.28.31.1 priority 7
ProCurve(config)# qos device-priority 10.28.31.130 priority 5
ProCurve(config)# qos device-priority 10.28.31.100 priority 1
ProCurve(config)# qos device-priority 10.28.31.101 priority 1

ProCurve(config)# show qos device-priority
  Device priorities
  Device Address  Apply rule | DSCP   Priority
  --------------  ---------- + ------ -----------
  10.28.31.1      Priority   |        7
  10.28.31.130    Priority   |        5
  10.28.31.100    Priority   |        1
  10.28.31.101    Priority   |        1
```

Figure 6-9. Example of Configuring and Listing 802.1p Priority Assignments for Packets Carrying Specific IP Addresses

Assigning a DSCP Policy Based on IP Address

Note

On the switches covered in this guide, DSCP policies cannot be applied to IPv4 packets having IP options. For more information on packet criteria and restrictions, refer to table 6-13 on page 6-68.

This option assigns a previously configured DSCP policy (codepoint and 802.1p priority) to outbound IP packets having the specified IP address (either source or destination). That is, the switch:

1. Selects an incoming IPv4 packet on the basis of the source or destination IP address it carries.
2. Overwrites the packet's DSCP with the DSCP configured in the switch for such packets, and assigns the 802.1p priority configured in the switch for the new DSCP. (Refer to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)
3. Forwards the packet through the appropriate outbound port queue.

For more on DSCP, refer to "Terminology" on page 6-6.

Steps for Creating a Policy Based on IP Address. This procedure creates a DSCP policy for IPv4 packets carrying the selected IP address (source or destination).

1. Identify the IP address to use as a classifier for assigning a DSCP policy.
2. Determine the DSCP policy for packets carrying the selected IP address:
   a. Determine the DSCP you want to assign to the selected packets. (This codepoint will be used to overwrite the DSCP carried in packets received from upstream devices.)
   b. Determine the 802.1p priority you want to assign to the DSCP.
3. Configure the DSCP policy by using **dscp-map** to configure the priority to the codepoint you selected in step 2a. (For details, refer to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)

Notes

A codepoint must have an 802.1p priority assignment (0 - 7) before you can configure a policy for prioritizing packets by IP address. If a codepoint you want to use shows **No-override** in the **Priority** column of the DSCP map (**show qos dscp-map**), then you must assign a 0 - 7 priority before proceeding.

On the switches covered in this guide, DSCP policies cannot be applied to IPv4 packets having IP options. For more information on packet criteria and restrictions, refer to 6-13 on page 6-68.

4. Configure the switch to assign the DSCP policy to packets with the specified IP address.

Syntax: qos dscp-map < *codepoint* > priority < 0 - 7 >

This command is optional if a priority is already assigned to the < ***codepoint*** >*. The command creates a DSCP policy by assigning an 802.1p priority to a specific DSCP. When the switch applies this policy to a packet, the priority determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. If the packet is IPv4, the packet's DSCP will be replaced by the codepoint specified in this command. (Default: For most codepoints,* **No-override**. *See figure 6-9 on page 6-58.)*

Syntax: qos device-priority < *ip-address* > dscp < *codepoint* >

Assigns a DSCP policy to packets carrying the specified IP address, and overwrites the DSCP in these packets with the assigned **< *codepoint* >** *value. This policy includes an 802.1p priority and determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. (Default:* **No-override***)*

no qos device-priority < *ip-address* >

Deletes the specified IP address as a QoS classifier.

show qos device-priority

Displays a listing of all QoS Device Priority classifiers currently in the running-config file.

For example, suppose you wanted to assign these DSCP policies to the packets identified by the indicated IP addresses:

IP Address	DSCP Policies	
	DSCP	Priority
10.28.31.1	000111	7
10.28.31.130	000101	5
10.28.31.100	000010	1
10.28.31.101	000010	1

1. Determine whether the DSCPs already have priority assignments, which could indicate use by existing applications. This is not a problem if the configured priorities are acceptable for all applications using the same DSCP. (Refer to the "Notes on Changing a Priority Setting" on page 6-60. Also, a DSCP must have a priority configured before you can assign any QoS classifiers to use it.)

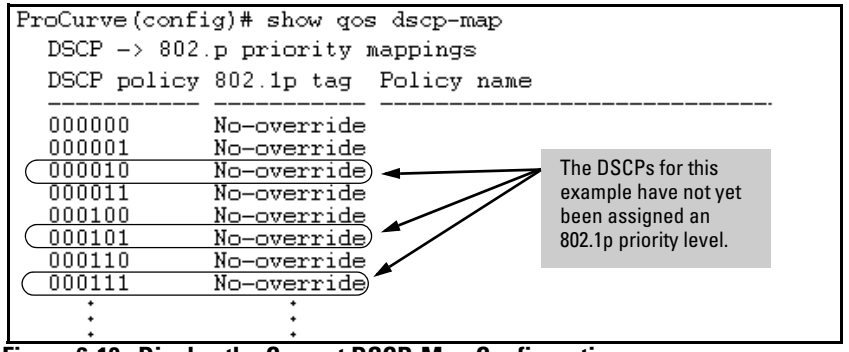

Figure 6-10. Display the Current DSCP-Map Configuration

2. Configure the priorities for the DSCPs you want to use.

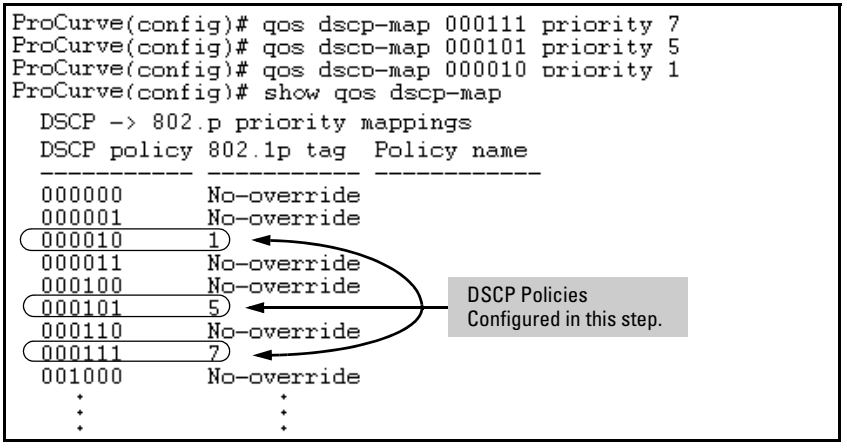

Figure 6-11. Assigning 802.1p Priorities to the Selected DSCPs

3. Assign the DSCP policies to the selected device IP addresses and display the result.

```
ProCurve(config)# qos device-priority 10.28.31.1 dscp 000111
ProCurve(config)# qos device-priority 10.28.31.130 dscp 000101
ProCurve(config)# qos device-priority 10.28.31.100 dscp 000010
ProCurve(config)# qos device-priority 10.28.31.101 dscp 000010

ProCurve(config)# show qos device-priority
  Device priorities
  Device Address  Apply rule | DSCP   Priority
  --------------- ---------- + ------ ------------
  10.28.31.1      DSCP       | 000111 7
  10.28.31.130    DSCP       | 000101 5
  10.28.31.100    DSCP       | 000010 1
  10.28.31.101    DSCP       | 000010 1
```

Figure 6-12. The Completed Device-Priority/Codepoint Configuration

The switch will now apply the DSCP policies in figure 6-11 to IPv4 packets received on the switch with the specified IP addresses (source or destination). This means the switch will:

- Overwrite the original DSCPs in the selected packets with the new DSCPs specified in the above policies.
- Assign the 802.1p priorities in the above policies to the appropriate packets.

QoS IP Type-of-Service (ToS) Policy and Priority

QoS Classifier Precedence: 3

This feature applies only to IPv4 traffic and performs either of the following:

- **ToS IP-Precedence Mode:** All IP packets generated by upstream devices and applications include precedence bits in the ToS byte. Using this mode, the switch uses these bits to compute and assign the corresponding 802.1p priority.
- **ToS Differentiated Services (Diffserv) Mode:** This mode requires knowledge of the codepoints set in IP packets by the upstream devices and applications. It uses the ToS codepoint in IP packets coming from upstream devices and applications to assign 802.1p priorities to the packets. You can use this option to do both of the following:
  - **Assign a New Prioritization Policy:** A "policy" includes both a codepoint and a corresponding 802.1p priority. This option selects an incoming IPv4 packet on the basis of its codepoint and assigns a new codepoint and corresponding 802.1p priority. (Use the **qos dscp-map** command to specify a priority for any codepoint—page 6-57.)
  - **Assign an 802.1p Priority:** This option reads the DSCP of an incoming IPv4 packet and, without changing this codepoint, assigns the 802.1p priority to the packet, as configured in the DSCP Policy Table (page 6-57). This means that a priority value of 0 - 7 must be configured for a DSCP before the switch will attempt to perform a QoS match on the packet's DSCP bits.

  Before configuring the ToS Diffserv mode, you must use the **dscp-map** command to configure the desired 802.1p priorities for the codepoints you want to use for either option. This command is illustrated in the following examples and is described under "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.

Unless IP-Precedence mode and Diffserv mode are both disabled (the default setting), enabling one automatically disables the other. For more on ToS operation, refer to "Details of QoS IP Type-of-Service" on page 6-40.

Assigning an 802.1p Priority to IPv4 Packets on the Basis of the ToS Precedence Bits

If a device or application upstream of the switch sets the precedence bits in the ToS byte of IPv4 packets, you can use this feature to apply that setting for prioritizing packets for outbound port queues. If the outbound packets are in a tagged VLAN, this priority is carried as an 802.1p value to the adjacent downstream devices.

Syntax: qos type-of-service ip-precedence

Causes the switch to automatically assign an 802.1p priority to all IPv4 packets by computing each packet's 802.1p priority from the precedence bits the packet carries. This priority determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. (ToS IP Precedence Default: Disabled)

no qos type-of-service

Disables all ToS classifier operation, including prioritization using the precedence bits.

show qos type-of-service

When ip-precedence is enabled (or if neither ToS option is configured), shows the ToS configuration status. If diff-services is enabled, lists codepoint data as described under "Assigning a DSCP Policy on the Basis of the DSCP in IPv4 Packets Received from Upstream Devices" on page 6-37.

With this option, prioritization of outbound packets relies on the IP-Precedence bit setting that IP packets carry with them from upstream devices and applications. To configure and verify this option:

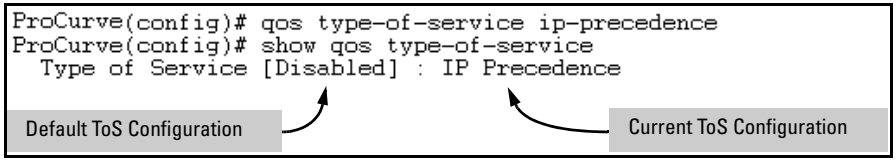

Figure 6-13. Example of Enabling ToS IP-Precedence Prioritization

To replace this option with the ToS diff-services option, configure **diff-services** as described below, which automatically disables IP-Precedence. To disable IP-Precedence without enabling the diff-services option, use this command:

```
ProCurve(config)# no qos type-of-service
```

Assigning an 802.1p Priority to IPv4 Packets on the Basis of Incoming DSCP

One of the best uses for this option is on an interior switch where you want to honor (continue) a policy set on an edge switch. That is, it enables you to select incoming packets having a specific DSCP and forward these packets with the desired 802.1p priority. For example, if an edge switch "A" marks all packets received on port A5 with a particular DSCP, you can configure a downstream (interior) switch "B" to handle such packets with the desired priority (regardless of whether 802.1Q tagged VLANs are in use).

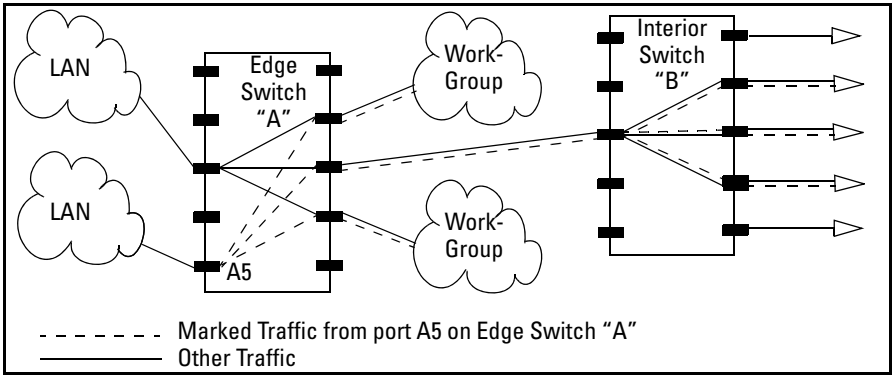

Figure 6-14. Interior Switch "B" Honors the Policy Established in Edge Switch "A"

To do so, assign the desired 802.1p priority to the same codepoint that the upstream or edge switch assigns to the selected packets. When the downstream switch receives an IPv4 packet carrying one of these codepoints, it assigns the configured priority to the packet and sends it out the appropriate priority queue. (The packet retains the codepoint it received from the upstream or edge switch). You can use this option concurrently with the diffserv DSCP Policy option (described later in this section), as long as the DSCPs specified in the two options do not match.

Operating Notes

Different applications may use the same DSCP in their IP packets. Also, the same application may use multiple DSCPs if the application originates on different clients, servers, or other devices. Using an edge switch enables you to select the packets you want and mark them with predictable DSCPs that can be used by downstream switches to honor policies set in the edge switch.

When enabled, the switch applies direct 802.1p prioritization to all packets having codepoints that meet these criteria:

- The codepoint is configured with an 802.1p priority in the DSCP table. (Codepoints configured with **No-override** are not used.)
- The codepoint is not configured for a new DSCP policy assignment.

Thus, the switch does not allow the same incoming codepoint (DSCP) to be used simultaneously for directly assigning an 802.1p priority and also assigning a DSCP policy. For a given incoming codepoint, if you configure one option and then the other, the second overwrites the first.

To use this option:

1. Identify a DSCP used to set a policy in packets received from an upstream or edge switch.
2. Determine the 802.1p priority (0 - 7) you want to apply to packets carrying the identified DSCP. (You can either maintain the priority assigned in the upstream or edge switch, or assign a new priority.)
3. Use **qos dscp-map < *codepoint* > priority < 0 - 7 >** to assign the 802.1p priority you want to the specified DSCP. (For more on this topic, refer to “Differentiated Services Codepoint (DSCP) Mapping” on page 6-57.)
4. Enable **diff-services**

.

Syntax: qos type-of-service diff-services < *codepoint* >

Causes the switch to read the **< *codepoint* >** (*DSCP) of an incoming IPv4 packet and, when a match occurs, assign a corresponding 802.1p priority, as configured in the switch's DSCP table (page 6-58).*

no qos type-of-service

Disables all ToS classifier operation.

no qos dscp-map < *codepoint* >

Disables direct 802.1p priority assignment to packets carrying the < ***codepoint*** > *by reconfiguring the codepoint priority assignment in the DSCP table to* **No-override**. *Note that if this codepoint is in use as a DSCP policy for another diffserv codepoint, you must disable or redirect the other diffserv codepoint's DSCP policy before you can disable or change the codepoint. For example, in figure 6-15 you cannot change the priority for the 000000 codepoint until you redirect the DSCP policy for 000001 away from using 000000 as a policy. (Refer to "Notes on Changing a Priority Setting" on page 6-60. Refer also to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)*

show qos type-of-service

Displays current Type-of-Service configuration. In diffserv mode it also shows the current direct 802.1p assignments and the current DSCP assignments covered later in this section.

For example, an edge switch "A" in an untagged VLAN assigns a DSCP of 000110 on IP packets it receives on port A6, and handles the packets with high priority (7). When these packets reach interior switch "B" you want the switch to handle them with the same high priority. To enable this operation you would

configure an 802.1p priority of 7 for packets received with a DSCP of **000110**, and then enable **diff-services**:

```
ProCurve(config)# show qos type-of-service
 Type of Service [Disabled] : Disabled
 Codepoint DSCP Policy | Priority
 --------- ----------- + -----------
 000000                | 1
 000001    000000      | 1
 000010                | No-override
 000011                | No-override
 000100    001001      | 5
 000101                | No-override
 000110                | No-override
 000111                | No-override
 001000                | No-override
 001001                | 5
 001010                | 1
 001011                | No-override
   .          .          .
   .          .          .
   .          .          .
```

Executing this command displays the current ToS configuration and shows that the selected DSCP is not currently in use.

The **000110** codepoint is unused, and thus available for directly assigning an 802.1p priority without changing the packet's DSCP.

Note: All codepoints without a "DSCP Policy" entry are available for direct 802.1p priority assignment.

Figure 6-15. Example Showing Codepoints Available for Direct 802.1p Priority Assignments

```
ProCurve(config)# qos dscp-map 000110 priority 7
ProCurve(config)# qos type-of-service diff-services

ProCurve(config)# show qos type-of-service
  Type of Service [Disabled] : Differentiated Services
  Codepoint DSCP Policy | Priority
  --------- ----------- + -----------
  000000                | 1
  000001    000000      | 1
  000010                | No-override
  000011                | No-override
  000100    001001      | 5
  000101                | No-override
  000110                | 7
  000111                | No-override
  001000                | No-override
  001001                | 5
    .          .          .
    .          .          .
    .          .          .
```

Outbound IP packets with a DSCP of **000110** will have a priority of **7**.

Notice that codepoints **000000** and **001001** are named as DSCP policies by other codepoints (**000001** and **000110** respectively). This means they are not available for changing to a different 802.1p priority.

Figure 6-16. Example of a Type-of-Service Configuration Enabling Both Direct 802.1p Priority Assignment and DSCP Policy Assignment

Assigning a DSCP Policy on the Basis of the DSCP in IPv4 Packets Received from Upstream Devices

The preceding section describes how to forward a policy set by an edge (or upstream) switch. This option changes a DSCP policy in an IPv4 packet by changing its IP ToS codepoint and applying the priority associated with the new codepoint. (A DSCP policy consists of a differentiated services codepoint and an associated 802.1p priority.) You can use this option concurrently with the diffserv 802.1p priority option (above), as long as the DSCPs specified in the two options do not match.

To use this option to configure a change in policy:

1. Identify a DSCP used to set a policy in packets received from an upstream or edge switch.
2. Create a new policy by using **qos dscp-map < *codepoint* > priority < 0 - 7 >** to configure an 802.1p priority for the codepoint you will use to overwrite the DSCP the packet carries from upstream. (For more on this topic, refer to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)
3. Use **qos type-of-service diff-services < *incoming-DSCP* > dscp < *outgoing-DSCP* >** to change the policy on packets coming from the edge or upstream switch with the specified incoming DSCP.

   (Figure 6-14 on page 6-33 illustrates this scenario.)

Note

On the switches covered in this guide, DSCP policies (codepoint re-marking) cannot be applied to outbound IPv4 packets having IP options. (The 802.1p priority in the VLAN tag is applied.) For more information on packet criteria and restrictions, refer to 6-13 on page 6-68.

.

Syntax: qos type-of-service diff-services

Enables ToS diff-services.

Syntax: qos type-of-service diff-services < *current-codepoint* > dscp < *new-codepoint* >

*Configures the switch to select an incoming IP packet carrying the <**current-codepoint**> and then use the <**new-codepoint**> to assign a new, previously configured DSCP policy to the packet. The policy overwrites the <**current-codepoint**> with the < **new-codepoint**> and assigns the 802.1p priority specified by the policy. (Use the* **qos dscp-map** *command to define the priority for the DSCPs—page 6-57.)*

Syntax: no qos type-of-service

Disables all ToS classifier operation. Current ToS DSCP policies and priorities remain in the configuration and will become available if you re-enable ToS diff-services.

Syntax: no qos type-of-service [diff-services < *codepoint* >]

*Deletes the DSCP policy assigned to the < **codepoint**> and returns the < **codepoint**> to the 802.1p priority setting it had before the DSCP policy was assigned. (This will be either a value from 0 - 7 or* **No-override***.)*

Syntax: show qos type-of-service

Displays a listing of codepoints, with any corresponding DSCP policy re-assignments for outbound packets. Also lists the (802.1p) priority for each codepoint that does not have a DSCP policy assigned to it.

For example, suppose you want to configure the following two DSCP policies for packets received with the indicated DSCPs.

Received DSCP	Policy DSCP	802.1p Priority	Policy Name (Optional)
001100	000010	6	Level 6
001101	000101	4	Level 4

1. Determine whether the DSCPs already have priority assignments, which could indicate use by existing applications. This is not a problem as long as the configured priorities are acceptable for all applications using the

same DSCP. (Refer to the "Notes on Changing a Priority Setting" on page 6-60. Also, a DSCP must have a priority configured before you can assign any QoS classifiers to use it.)

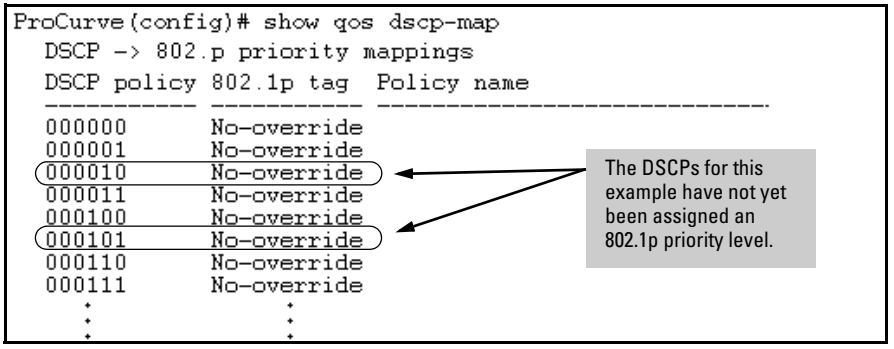

Figure 6-17. Display the Current DSCP-Map Configuration

2. Configure the policies in the DSCP table:

```
ProCurve(config)# qos dscp-map 000010 priority 6 name 'Level 6'
ProCurve(config)# qos dscp-map 000101 priority 4 name 'Level 4'

ProCurve(config)# show qos dscp-map
  DSCP -> 802.p priority mappings
  DSCP policy 802.1p tag  Policy name
  ----------- ----------- --------------------------------
  000000      No-override
  000001      No-override
  000010      6           Level 6
  000011      No-override
  000100      No-override
  000101      4           Level 4
  000110      No-override
  000111      No-override
```

Figure 6-18. Example of Policies Configured (with Optional Names) in the DSCP Table

3. Assign the policies to the codepoints in the selected packet types.

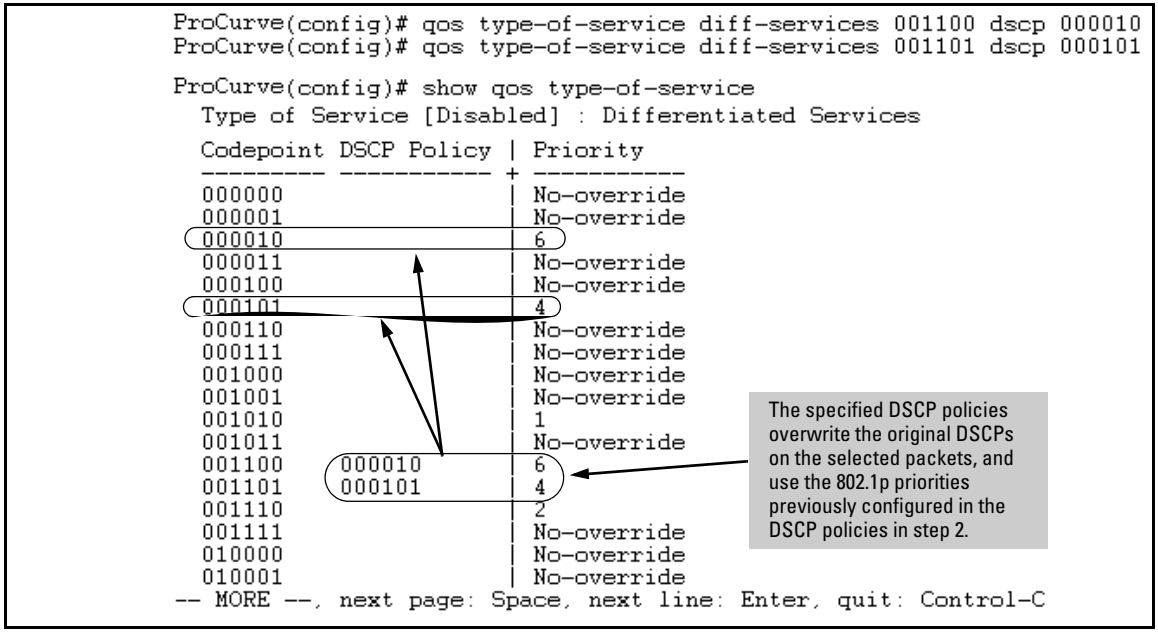

Figure 6-19. Example of Policy Assignment to Outbound Packets on the Basis of the DSCP in the Packets Received from Upstream Devices

Details of QoS IP Type-of-Service

IP packets include a Type of Service (ToS) byte. The ToS byte includes:

- **A Differentiated Services Codepoint (DSCP):** This element is comprised of the upper six bits of the ToS byte). There are 64 possible codepoints.
  - In the switches covered in this guide, the default **qos** configuration includes some codepoints with 802.1p priority settings for Assured-Forwarding and Expedited Forwarding (codepoint 101110), while others are unused (and listed with **No-override** for a Priority).

  Refer to figure 6-9 on page 6-58 for an illustration of the default DSCP policy table.

  Using the **qos dscp map** command, you can configure the switch to assign different prioritization policies to IPv4 packets having different codepoints. As an alternative, you can configure the switch to assign a new codepoint to an IPv4 packet, along with a corresponding 802.1p priority (0-7). To use this option in the simplest case, you would:

a. Configure a specific DSCP with a specific priority in an edge switch.

b. Configure the switch to mark a specific type of inbound traffic with that DSCP (and thus create a policy for that traffic type).

c. Configure the internal switches in your LAN to honor the policy.

(For example, you could configure an edge switch to assign a codepoint of 000001 to all packets received from a specific VLAN, and then handle all traffic with that codepoint at high priority.)

For a codepoint listing and the commands for displaying and changing the DSCP Policy table, refer to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.

- **Precedence Bits:** This element is a subset of the DSCP and is comprised of the upper three bits of the ToS byte. When configured to do so, the switch uses the precedence bits to determine a priority for handling the associated packet. (The switch does not change the setting of the precedence bits.) Using the ToS Precedence bits to prioritize IPv4 packets relies on priorities set in upstream devices and applications.

Figure 6-20 shows an example of the ToS byte in the header for an IPv4 packet, and illustrates the diffserv bits and precedence bits in the ToS byte. (Note that the Precedence bits are a subset of the Differentiated Services bits.)

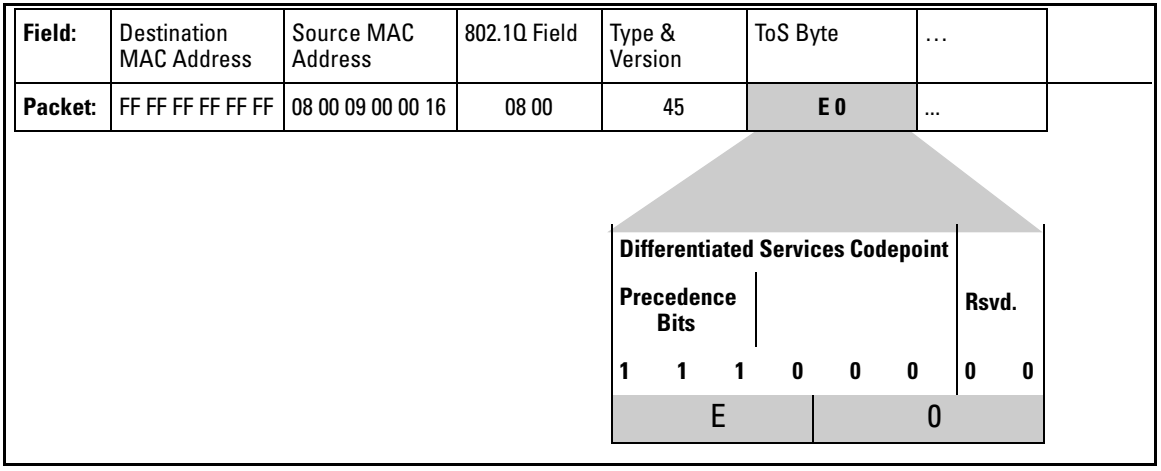

Figure 6-20. The ToS Codepoint and Precedence Bits

Table 6-7. How the Switch Uses the ToS Configuration

Outbound Port	ToS Option:	
	802.1p (Value = 0 - 7)	Differentiated Services
IP Packet Sent Out an Untagged Port in a VLAN	Depending on the value of the IP Precedence bits in the packet's ToS field, the packet will go to one of eight outbound port queues in the switch: 1 - 2 = low priority (queue 1, 2) 0 - 3 = normal priority (queue 3, 4) 4 - 5 = medium priority (queue 5, 6) 6 - 7 = high priority (queue 7, 8)	For a given packet carrying a ToS codepoint that the switch has been configured to detect: • Change the codepoint according to the configured policy and assign the 802.1p priority specified for the new codepoint in the DSCP Policy Table (page 6-57). • Do not change the codepoint, but assign the 802.1p priority specified for the existing codepoint in the DSCP Policy Table (page 6-57). Depending on the 802.1p priority used, the packet will leave the switch through one of the following queues: 1 - 2 = low priority (queue 1, 2) 0 - 3 = normal priority (queue 3, 4) 4 - 5 = medium priority (queue 5, 6) 6 - 7 = high priority (queue 7, 8) If **No-override** (the default) has been configured for a specified codepoint, then the packet is not prioritized by ToS and, by default, is sent to the "normal priority" queue.
IP Packet Sent Out an Untagged Port in a VLAN	Same as above, plus the IP Precedence value (0 - 7) will be used to set a corresponding 802.1p priority in the VLAN tag carried by the packet to the next downstream device. Refer to table 6-8, below.	Same as above, plus the Priority value (0 - 7) will be used to set a corresponding 802.1p priority in the VLAN tag carried by the packet to the next downstream device. Where **No-override** is the assigned priority, the VLAN tag carries a "0" (normal priority) 802.1p setting if not prioritized by other QoS classifiers.

Table 6-8. ToS IP-Precedence Bit Mappings to 802.1p Priorities

ToS Byte IP Precedence Bits	Corresponding 802.1p Priority	Service Priority Level
000	1	Lowest
001	2	Low
002	0	Normal
003	3	
004	4	
005	5	
006	6	
007	7	Highest

QoS Protocol Priority

QoS Classifier Precedence: 4

When QoS on the switch is configured with a Layer-3 protocol as the highest-precedence classifier and the switch receives traffic carrying that protocol, then this traffic is assigned the priority configured for this classifier. (For operation when other QoS classifiers apply to the same traffic, refer to "Classifiers for Prioritizing Outbound Packets" on page 6-10.)

Assigning a Priority Based on Layer-3 Protocol

This option assigns an 802.1p priority to outbound packets having the specified Layer-3 protocol.

Syntax: qos protocol

< ip | ipx | arp | appletalk | sna | netbeui > priority < 0 - 7 >

Configures an 802.1p priority for outbound packets having the specified protocol. This priority determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. You can configure one QoS classifier for each protocol type. (Default: **No-override***)*

no qos protocol

< ip | ipx | arp | appletalk | sna | netbeui >

Disables use of the specified protocol as a QoS classifier and resets the protocol priority to **No-override**.

show qos protocol

Lists the QoS protocol classifiers with their priority settings.

For example:

1. Configure QoS protocol classifiers with IP at 0 (normal), ARP at 5 (medium), and AppleTalk at 7 (high) and display the QoS protocol configuration.
2. Disable the QoS IP protocol classifier, downgrade the ARP priority to 4, and again display the QoS protocol configuration.

Figure 6-21 shows the command sequence and displays for the above steps.

```
ProCurve(config)# qos protocol ip priority 0
ProCurve(config)# qos protocol appletalk priority 7
ProCurve(config)# qos protocol arp priority 5

ProCurve(config)# show qos protocol

   Protocol priorities

   Protocol  Priority
   --------  --------
   IP        0
   IPX       No-override
   ARP       5
   AppleTalk 7
   SNA       No-override
   Net BEUI  No-override

ProCurve(config)# no qos protocol ip
ProCurve(config)# qos protocol arp priority 4

ProCurve(config)# show qos protocol

Protocol priorities

   Protocol  Priority
   --------  --------
   IP        No-override
   IPX       No-override
   ARP       4
   AppleTalk 7
   SNA       No-override
   Net BEUI  No-override
```

Configures IP, Appletalk, and ARP as QoS classifiers.

Removes IP as QoS classifier.

Changes the priority of the ARP QoS classifier.

Displays the results of these changes.

Figure 6-21. Adding, Displaying, Removing, and Changing QoS Protocol Classifiers

QoS VLAN-ID (VID) Priority

QoS Classifier Precedence: 5

The QoS protocol option enables you to use up to 256 VIDs as QoS classifiers. Where a particular VLAN-ID classifier has the highest precedence in the switch for traffic in that VLAN, then traffic received in that VLAN is marked with the VID classifier's configured priority level. Different VLAN-ID classifiers can have differing priority levels.

Options for Assigning Priority. Priority control options for packets carrying a specified VLAN-ID include:

- 802.1p priority
- DSCP policy (Assigning a new DSCP and an associated 802.1p priority; inbound packets must be IPv4.)

(For operation when other QoS classifiers apply to the same traffic, refer to "Classifiers for Prioritizing Outbound Packets" on page 6-10.)

Note

QoS with VID priority applies to static VLANs only, and applying QoS to dynamic VLANs created by GVRP operation is not supported. A VLAN must exist while a subject of a QoS configuration, and eliminating a VLAN from the switch causes the switch to clear any QoS features configured for that VID.

Assigning a Priority Based on VLAN-ID

This option assigns a priority to all outbound packets having the specified VLAN-ID (VID). You can configure this option by either specifying the VLAN-ID ahead of the **qos** command or moving to the VLAN context for the VLAN you want to configure for priority.

Syntax: vlan < *vid* > qos priority < 0 - 7 >

Configures an 802.1p priority for outbound packets belonging to the specified VLAN. This priority determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. You can configure one QoS classifier for each VLAN-ID. (Default: **No-override***)*

Syntax: no vlan < *vid* > qos

Removes the specified VLAN-ID as a QoS classifier and resets the priority for that VLAN to **No- override**.

Syntax: show qos vlan-priority

Displays a listing of the QoS VLAN-ID classifiers currently in the running-config file, with their priority data.

1. For example, suppose that you have the following VLANs configured on the switch and want to prioritize them as shown:

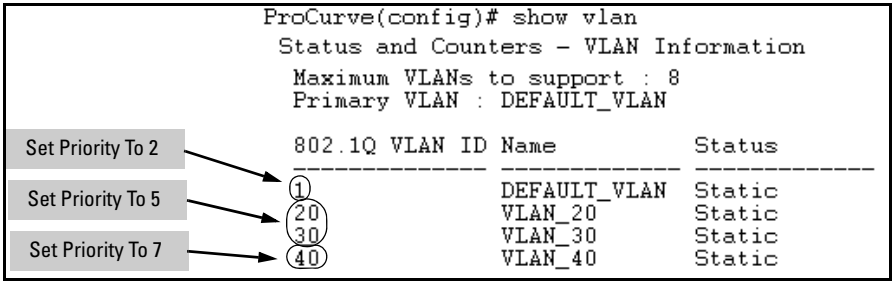

Figure 6-22. Example of a List of VLANs Available for QoS Prioritization

2. You would then execute the following commands to prioritize the VLANs by VID:

```
ProCurve(config)# vlan 1 qos priority 2
ProCurve(config)# vlan 20 qos priority 5
ProCurve(config)# vlan 30 qos priority 5
ProCurve(config)# vlan 40 qos priority 7

ProCurve(config)# show qos vlan

  VLAN priorities

  VLAN ID Apply rule  | DSCP   Priority
  ------- ----------- + ------ -----------
  1       Priority    |        2
  20      Priority    |        5
  30      Priority    |        5
  40      Priority    |        7
```

Figure 6-23. Configuring and Displaying QoS Priorities on VLANs

If you then decided to remove VLAN_20 from QoS prioritization:

```
ProCurve(config)# no vlan 20 qos
ProCurve(config)# show qos vlan

  VLAN priorities

  VLAN ID Apply rule  | DSCP   Priority
  ------- ----------- + ------ -----------
  1       Priority    |        2
  20      No-override |        No-override
  30      Priority    |        5
  40      Priority    |        7
```

In this instance, **No- override** indicates that VLAN 20 is not prioritized by QoS.

Figure 6-24. Returning a QoS-Prioritized VLAN to "No-override" Status

Assigning a DSCP Policy Based on VLAN-ID (VID)

This option assigns a previously configured DSCP policy (codepoint and 802.1p priority) to outbound IP packets having the specified VLAN-ID (VID). That is, the switch:

1. Selects an incoming IP packet on the basis of the VLAN-ID it carries.
2. Overwrites the packet's DSCP with the DSCP configured in the switch for such packets.
3. Assigns the 802.1p priority configured in the switch for the new DSCP. (Refer to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)
4. Forwards the packet through the appropriate outbound port queue.

For more on DSCP, refer to "Terminology" on page 6-6.

Steps for Creating a Policy Based on VLAN-ID Classifier.

1. Determine the VLAN-ID classifier to which you want to assign a DSCP policy.
2. Determine the DSCP policy for packets carrying the selected VLAN-ID:
   a. Determine the DSCP you want to assign to the selected packets. (This codepoint will be used to overwrite the DSCP carried in packets received from upstream devices.)
   b. Determine the 802.1p priority you want to assign to the DSCP.
3. Configure the DSCP policy by using **qos dscp-map** to configure the priority for each codepoint. (For details, see the example later in this section, and to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)

Note

A codepoint must have an 802.1p priority (0 - 7) before you can configure the codepoint for use in prioritizing packets by VLAN-ID. If a codepoint you want to use shows **No-override** in the **Priority** column of the DSCP Policy table (**show qos dscp-map**), then assign a priority before proceeding.

4. Configure the switch to assign the DSCP policy to packets with the specified VLAN-ID.

Syntax: qos dscp-map < *codepoint* > priority < 0 - 7 >

This command is optional if a priority has already been assigned to the < ***codepoint*** >*. The command creates a DSCP policy by assigning an 802.1p priority to a specific DSCP. When the switch applies this priority to a packet, the priority determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. If the packet is IPv4, the packet's DSCP will be replaced by the codepoint specified in this command. (Default: For most codepoints,* **No-override**. *See figure 6-9 on page 6-58 on page 6-58.)*

Syntax: vlan < *vid* > qos dscp < *codepoint* >

Assigns a DSCP policy to packets carrying the specified VLAN-ID, and overwrites the DSCP in these packets with the assigned < ***codepoint*** > *value. This policy includes an 802.1p priority and determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. (Default:* **No-override***)*

Syntax: no vlan < *vid* > qos

Removes QoS classifier for the specified VLAN.

Syntax: show qos device-priority

Displays a listing of all QoS VLAN-ID classifiers currently in the running-config file.

For example, suppose you wanted to assign this set of priorities:

VLAN-ID	DSCP	Priority
40	000111	7
30	000101	5
20	000010	1
1	000010	1

1. Determine whether the DSCPs already have priority assignments, which could indicate use by existing applications. This is not a problem as long as the configured priorities are acceptable for all applications using the same DSCP. (Refer to the "Notes on Changing a Priority Setting" on page 6-60. Also, a DSCP must have a priority configured before you can assign any QoS classifiers to use it.)

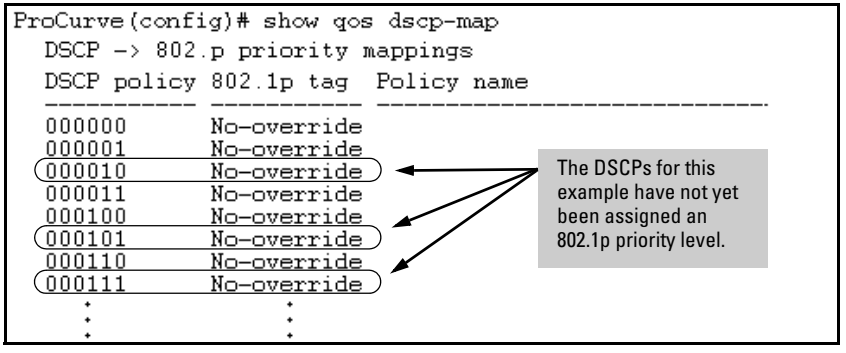

Figure 6-25. Display the Current Configuration in the DSCP Policy Table

2. Configure the priorities for the DSCPs you want to use.

```
ProCurve(config)# qos dscp-map 000111 priority 7
ProCurve(config)# qos dscp-map 000101 priority 5
ProCurve(config)# qos dscp-map 000010 priority 1
ProCurve(config)# show qos dscp-map
  DSCP -> 802.p priority mappings
  DSCP policy 802.1p tag  Policy name
  ----------- ----------- ------------
  000000      No-override
  000001      No-override
  000010      1
  000011      No-override
  000100      No-override
  000101      5
  000110      No-override
  000111      7
  001000      No-override
    .           .
    .           .
    .           .
```

Priorities Configured in this step.

Figure 6-26. Assign Priorities to the Selected DSCPs

3. Assign the DSCP policies to the selected VIDs and display the result.

```
ProCurve(config)# vlan 1 qos dscp 000010
ProCurve(config)# vlan 20 qos dscp 000010
ProCurve(config)# vlan 30 qos dscp 000101
ProCurve(config)# vlan 40 qos dscp 000111

ProCurve(config)# show qos vlan-priority

  VLAN priorities

  VLAN ID Apply rule  | DSCP   Priority
  ------- ----------- + ------ -----------
  1       DSCP        | 000010 1
  20      DSCP        | 000010 1
  30      DSCP        | 000101 5
  40      DSCP        | 000111 7
```

Figure 6-27. The Completed VID-DSCP Priority Configuration

The switch will now apply the DSCP policies in figure 6-27 to packets received on the switch with the specified VLAN-IDs. This means the switch will:

- Overwrite the original DSCPs in the selected packets with the new DSCPs specified in the above policies.
- Assign the 802.1p priorities in the above policies to the appropriate packets.

QoS Source-Port Priority

QoS Classifier Precedence: 6

The QoS source-port option enables you to use a packet's source-port on the switch as a QoS classifier. Where a particular source-port classifier has the highest precedence in the switch for traffic entering through that port, then traffic received from the port is marked with the source-port classifier's configured priority level. Different source-port classifiers can have different priority levels.

Options for Assigning Priority on the Switch. Priority control options for packets from a specified source-port include:

- 802.1p priority
- DSCP policy (Assigning a new DSCP and an associated 802.1p priority; inbound packets must be IPv4.)

(For operation when other QoS classifiers apply to the same traffic, refer to "Classifiers for Prioritizing Outbound Packets" on page 6-10.)

Options for Assigning Priority From a RADIUS Server. You can use a RADIUS server to impose a QoS source-port priority during an 802.1X port-access authentication session. Refer to the RADIUS chapter in the *Access Security Guide* for your switch.

Assigning a Priority Based on Source-Port

This option assigns a priority to all outbound packets having the specified source-port. You can configure this option by either specifying the source-port ahead of the **qos** command or moving to the port context for the port you want to configure for priority. (If you are configuring multiple source-ports with the same priority, you may find it easier to use the **interface < *port-list* >** command to go to the port context instead of individually configuring the priority for each port.)

Syntax: interface < *port-list* > qos priority < 0 - 7 >

Configures an 802.1p priority for packets entering the switch through the specified (source) ports. This priority determines the packet queue in the outbound port(s) to which traffic is sent. If a packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. You can configure one QoS classifier for each source-port or group of source-ports. (Default: **No-override***)*

Syntax: no interface < *port-list* > qos

Disables use of the specified source-port(s) for QoS classifier(s) and resets the priority for the specified source-port(s) to **No-override**.

Syntax: show qos port-priority

Lists the QoS port-priority classifiers with their priority data.

For example, suppose that you want to prioritize inbound traffic on the following source-ports:

Source-Port	Priority
A1 - A3	2
A4	3
B1, B4	5
C1-C3	6

You would then execute the following commands to prioritize traffic received on the above ports:

```
ProCurve(config)# interface e c1-c3 qos priority 6
ProCurve(config)# interface e b1,b4 qos priority 5
ProCurve(config)# interface e a4 qos priority 3
ProCurve(config)# interface e a1-a3 qos priority 2

ProCurve(config)# show qos port-priority
  Port priorities
  Port  Apply rule   | DSCP   Priority    Radius Override
  ----  -----------  + ------ ----------- ---------------
  A1    Priority     |        2           No-override
  A2    Priority     |        2           No-override
  A3    Priority     |        2           No-override
  A4    Priority     |        3           No-override
  B1    Priority     |        5           No-override
  B2    No-override  |        No-override No-override
  B3    No-override  |        No-override No-override
  B4    Priority     |        5           No-override
  C1    Priority     |        6           No-override
  C2    Priority     |        6           No-override
  C3    Priority     |        6           No-override
  C4    No-override  |        No-override No-override
  C5    No-override  |        No-override No-override
   .         .                   .
   .         .                   .
   .         .                   .
```

Figure 6-28. Configuring and Displaying Source-Port QoS Priorities

If you then decided to remove port A1 from QoS prioritization:

```
ProCurve(config)# no interface e a1 qos
ProCurve(config)# show qos port-priority
  Port priorities

  Port Apply rule   | DSCP   Priority     Radius Override
  ---- ------------ + ------ ------------ ---------------
  A1   No-override  |        No-override  No-override
  A2   Priority     |        2            No-override
  A3   Priority     |        2            No-override
  A4   Priority     |        3            No-override
```

In this instance, **No-override** indicates that port A1 is not prioritized by QoS.

Figure 6-29. Returning a QoS-Prioritized VLAN to "No-override" Status

Assigning a DSCP Policy Based on the Source-Port

This option assigns a previously configured DSCP policy (codepoint and 802.1p priority) to outbound IP packets (received from the specified source-ports). That is, the switch:

1. Selects an incoming IP packet on the basis of its source-port on the switch.
2. Overwrites the packet's DSCP with the DSCP configured in the switch for such packets.
3. Assigns the 802.1p priority configured in the switch for the new DSCP. (Refer to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)
4. Forwards the packet through the appropriate outbound port queue.

For more on DSCP, refer to "Terminology" on page 6-6.

Steps for Creating a Policy Based on Source-Port Classifiers.

Note

You can select one DSCP per source-port. Also, configuring a new DSCP for a source-port automatically overwrites (replaces) any previous DSCP or 802.1p priority configuration for that port.)

1. Identify the source-port classifier to which you want to assign a DSCP policy.
2. Determine the DSCP policy for packets having the selected source-port:
   a. Determine the DSCP you want to assign to the selected packets. (This codepoint will be used to overwrite the DSCP carried in packets received through the source-port from upstream devices.)
   b. Determine the 802.1p priority you want to assign to the DSCP.

3. Configure the DSCP policy by using **qos dscp-map** to configure the priority for each codepoint. (For details, refer to the example later in this section and to "Differentiated Services Codepoint (DSCP) Mapping" on page 6-57.)

Note

A codepoint must have an 802.1p priority assignment (0 - 7) before you can configure that codepoint as a criteria for prioritizing packets by source-port. If a codepoint shows **No-override** in the **Priority** column of the DSCP Policy Table (**show qos dscp-map**), then you must assign a 0 - 7 priority before proceeding.

4. Configure the switch to assign the DSCP policy to packets from the specified source-port.

Syntax: qos dscp-map < *codepoint* > priority < 0 - 7 >

This command is optional if a priority has already been assigned to the < ***codepoint*** >*. The command creates a DSCP policy by assigning an 802.1p priority to a specific DSCP. When the switch applies this priority to a packet, the priority determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. (Default: For most codepoints,* **No-override**. *See figure 6-9 on page 6-58 on page 6-58.)*

Syntax: interface < *port-list* > qos dscp < *codepoint* >

Assigns a DSCP policy to packets from the specified source-port(s), and overwrites the DSCP in these packets with the assigned < ***codepoint*** > *value. This policy includes an 802.1p priority and determines the packet's queue in the outbound port to which it is sent. If the packet leaves the switch on a tagged port, it carries the 802.1p priority with it to the next downstream device. (Default:* **No-override***)*

Syntax: no interface [e] < *port-list* > qos

Removes QoS classifier for the specified source-port(s).

Syntax: show qos source-port

Displays a listing of all source-port QoS classifiers currently in the running-config file.

For example, suppose you wanted to assign this set of priorities:

Source-Port	DSCP	Priority
A2	000111	7
B1-B3	000101	5
B4, C2	000010	1

1. Determine whether the DSCPs already have priority assignments, which could indicate use by existing applications. This is not a problem as long as the configured priorities are acceptable for all applications using the same DSCP. (Refer to the "Notes on Changing a Priority Setting" on page 6-60. Also, a DSCP must have a priority configured before you can assign any QoS classifiers to use it.)

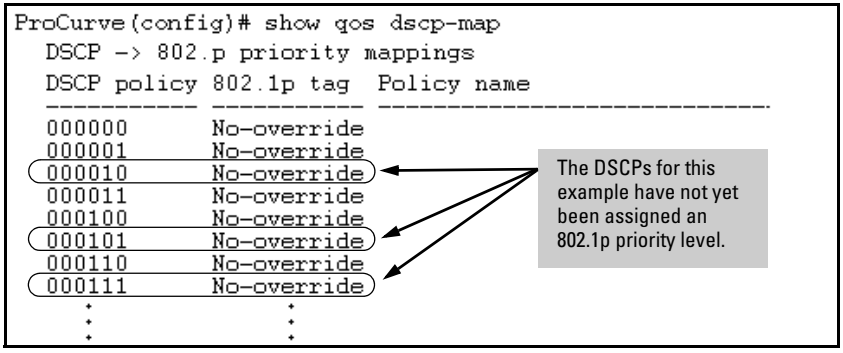

Figure 6-30. Display the Current Configuration in the DSCP Policy Table

2. Configure the priorities for the DSCPs you want to use.

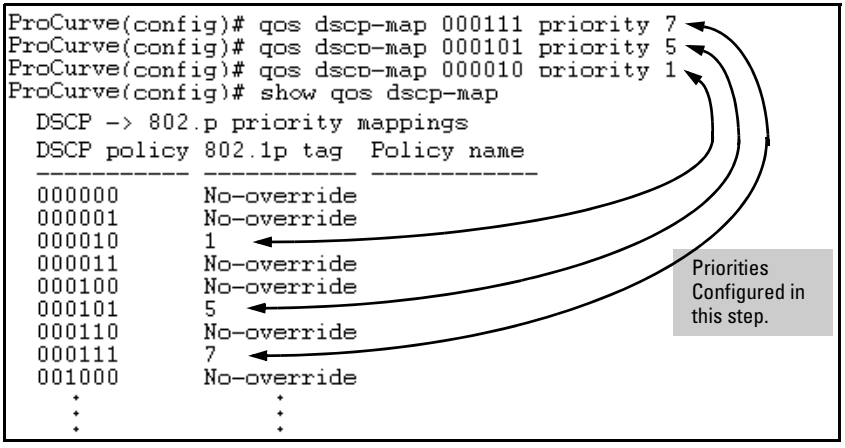

Figure 6-31. Assign Priorities to the Selected DSCPs

3. Assign the DSCP policies to the selected source-ports and display the result.

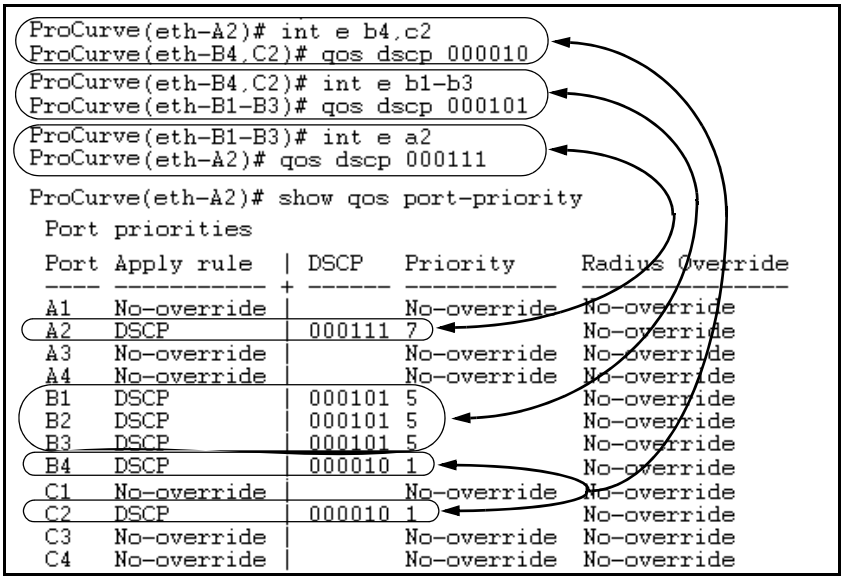

Figure 6-32. The Completed Source-Port DSCP-Priority Configuration

Radius Override Field. During a client session authenticated by a RADIUS server, the server can impose a port priority that applies only to that client session. Refer to the RADIUS chapter in the *Access Security Guide* for your switch.

Differentiated Services Codepoint (DSCP) Mapping

The DSCP Policy Table associates an 802.1p priority with a specific ToS byte codepoint in an IPv4 packet. This enables you to set a LAN policy that operates independently of 802.1Q VLAN-tagging.

In the default state, most of the 64 codepoints do not assign an 802.1p priority, as indicated by **No-override** in table 6-9 on page 6-58.

You can use the following command to list the current DSCP Policy table, change the codepoint priority assignments, and assign optional names to the codepoints.

Syntax: show qos dscp-map

Displays the DSCP Policy Table.

qos dscp-map **< *codepoint* >** priority < 0 - 7 > [name **< *ascii-string* >**]

Configures an 802.1p priority for the specified codepoint and, optionally, an identifying (policy) name.

no qos dscp-map **< *codepoint* >**

Reconfigures the 802.1p priority for <***codepoint***> *to* **No-override**. *Also deletes the codepoint policy name, if configured.*

no qos dscp-map < *codepoint* > name

Deletes only the ***policy name, if*** *configured, for* < ***codepoint*** >.

Table 6-9. The Default DSCP Policy Table

DSCP Policy	802.1p Priority	DSCP Policy	802.1p Priority	DSCP Policy	802.1p Priority
000000	No-override	010110	3*	101011	No-override
000001	No-override	010111	No-override	101100	No-override
000010	No-override	011000	No-override	101101	No-override
000011	No-override	011001	No-override	101110	7**
000100	No-override	011010	4*	101111	No-override
000101	No-override	011011	No-override	110000	No-override
000110	No-override	011100	4*	110001	No-override
000111	No-override	011101	No-override	110010	No-override
001000	No-override	011110	5*	110011	No-override
001001	No-override	011111	No-override	110100	No-override
001010	1*	100000	No-override	110101	No-override
001011	No-override	100001	No-override	110110	No-override
001100	1*	100010	6*	110111	No-override
001101	No-override	100011	No-override	111000	No-override
001110	2*	100100	6*	111001	No-override
001111	No-override	100101	No-override	111010	No-override
010000	No-override	100110	7*	111011	No-override
010001	No-override	100111	No-override	111100	No-override
010010	0 *	101000	No-override	111101	No-override
010011	No-override	101001	No-override	111110	No-override
010100	0 *	101010	No-override	111111	No-override
010101	No-override				

*Assured Forwarding codepoints; configured by default on the switches covered in this guide. These codepoints are configured as "No-override" in the Series 3400cl, Series 6400cl and Series 2600/2800 switches.

**Expedited Forwarding codepoint configured by default.

Default Priority Settings for Selected Codepoints

In a few cases, such as 001010 and 001100, a default policy (implied by the DSCP standards for Assured-Forwarding and Expedited-Forwarding) is used. You can change the priorities for the default policies by using **qos dscp-map < *codepoint* > priority < 0 - 7 >)**.(These policies are not in effect unless you have either applied the policies to a QoS classifier or configured QoS Type-of-Service to be in **diff-services** mode.)

Quickly Listing Non-Default Codepoint Settings

Table 6-9 lists the switch's default codepoint/priority settings. If you change the priority of any codepoint setting to a non-default value and then execute **write memory**, the switch will list the non-default setting in the show config display.

For example, in the default configuration, the following codepoint settings are true:

Codepoint	Default Priority
001100	1
001101	No-override
001110	2

If you change all three settings to a priority of 3, and then execute **write memory**, the switch will reflect these changes in the show config listing:

```
ProCurve(config)# qos dscp-map 001100 priority 3
ProCurve(config)# qos dscp-map 001101 priority 3
ProCurve(config)# qos dscp-map 001110 priority 3
ProCurve(config)# write memory

ProCurve(config)# show config
Startup configuration:

; J8697A Configuration Editor; Created on release #K.11.00

hostname "ProCurve"
time daylight-time-rule None
cdp run
qos dscp-map 001100 priority 3
qos dscp-map 001101 priority 3
qos dscp-map 001110 priority 3
module 2 type J4821A
module 3 type J4820A
   .    .    .      .
   .    .    .      .
   .    .    .      .
```

Configure these three codepoints with non-default priorities.

Show config lists the non default codepoint settings.

Figure 6-33. Example of Show Config Listing with Non-Default Priority Settings in the DSCP Table

Effect of "No-override". In the QoS Type-of-Service differentiated services mode, a **No-override** assignment for the codepoint of an outbound packet means that QoS is effectively disabled for such packets. That is, QoS does not

affect the packet queuing priority or VLAN tagging. In this case, the packets are handled as follows (as long as no other QoS feature creates priority assignments for them):

802.1Q Status	Outbound 802.1p Priority
Received and Forwarded on a tagged port member of a VLAN.	Unchanged
Received on an Untagged port member of a VLAN; Forwarded on a tagged port member of a VLAN.	0 (zero)—"normal"
Forwarded on an Untagged port member of a VLAN.	None

Notes on Changing a Priority Setting

If a QoS classifier is using a policy (codepoint and associated priority) in the DSCP Policy table, you must delete or change this usage before you can change the priority setting on the codepoint. Otherwise the switch blocks the change and displays this message:

```
Cannot modify DSCP Policy < codepoint > - in use by
other qos rules.
```

In this case, use **show qos < *classifier* >** to identify the specific classifiers using the policy you want to change; that is:

```
show qos device-priority
show qos port-priority
show qos tcp-udp-port-priority
show qos vlan-priority
show qos type-of-service
```

For example, suppose that the 000001 codepoint has a priority of 6, and several classifiers use the 000001 codepoint to assign a priority to their respective types of traffic. If you wanted to change the priority of codepoint 000001 you would do the following:

1. Identify which QoS classifiers use the codepoint.
2. Change the classifier configurations by assigning them to a different DSCP policy, or to an 802.1p priority, or to **No-override**.
3. Reconfigure the desired priority for the 000001 codepoint.
4. Either reassign the classifiers to the 00001 codepoint policy or leave them as they were after step 2, above.

Error Messages caused by DSCP Policy Changes

Refer to the following table on ways to fix errors that may be generated when configuring DSCP policy changes.

Message	Meaning
DSCP Policy < ***decimal-codepoint*** > not configured	You have attempted to map a QoS classifier to a codepoint for which there is no configured priority (**No-override**). Use the **qos dscp-map** command to configure a priority for the codepoint, then map the classifier to the codepoint.
Cannot modify DSCP Policy < ***codepoint*** > - in use by other qos rules.	You have attempted to map a QoS classifier to a codepoint that is already in use by other QoS classifiers. Before remapping the codepoint to a new priority, you must reconfigure the other QoS classifiers so that they do not use this codepoint. You can have multiple QoS classifiers use this same codepoint as long as it is acceptable for all such classifiers to use the same priority.

Table 6-10. Error Messages Generated by DSCP Policy Changes

Example of Changing the Priority Setting on a Policy When One or More Classifiers Are Currently Using the Policy

Suppose that codepoint 000001 is in use by one or more classifiers. If you try to change its priority, you see a result similar to the following:

```
ProCurve(config)# qos dscp-map 000001 priority 2
Cannot modify DSCP Policy 000001 - in use by other qos rules.
```

Figure 6-34. Example of Trying To Change the Priority on a Policy In Use by a Classifier

In this case, you would use steps similar to the following to change the priority.

1. Identify which classifiers use the codepoint you want to change.

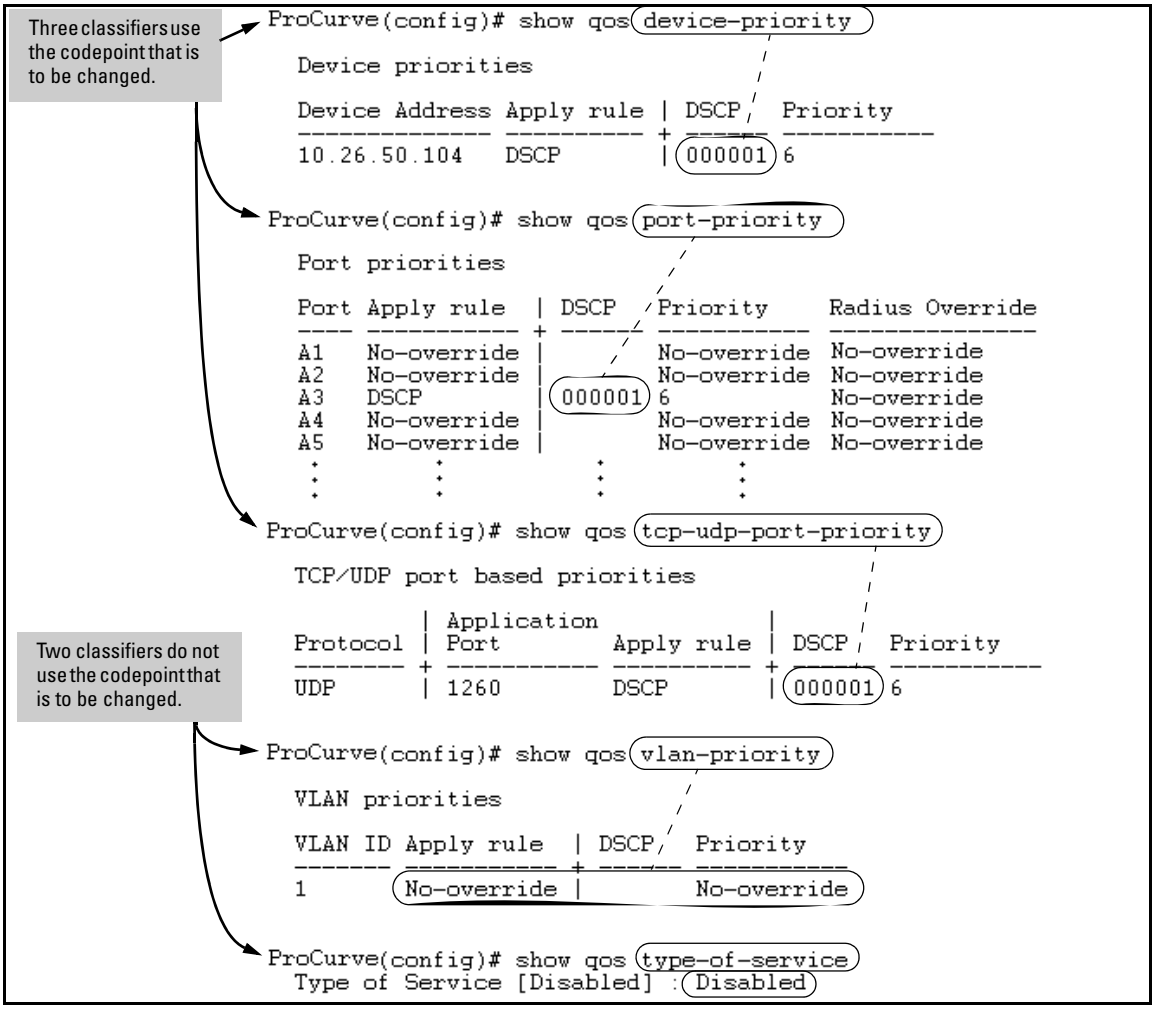

Figure 6-35. Example of a Search to Identify Classifiers Using a Codepoint You Want To Change

2. Change the classifier configurations by assigning them to a different DSCP policy, or to an 802.1p priority, or to **No-override**. For example:
   a. Delete the policy assignment for the **device-priority** classifier. (That is, assign it to **No-override**.)
   b. Create a new DSCP policy to use for re-assigning the remaining classifiers.
   c. Assign the **port-priority** classifier to the new DSCP policy.
   d. Assign the **udp-port 1260** classifier to an 802.1p priority.

```
(a) ProCurve(config)# no qos device-priority 10.26.50.104
(b) ProCurve(config)# qos dscp-map 000100 priority 6
(c) ProCurve(config)# int e a3 qos dscp 000100
(d) ProCurve(config)# qos udp-port 1260 priority 2
```

3. Reconfigure the desired priority for the 000001 codepoint.

```
ProCurve(config)# qos dscp-map 000001 priority 4
```

4. You could now re-assign the classifiers to the original policy codepoint or leave them as currently configured.

QoS Queue Configuration

QoS queue configuration allows you to reduce the number of outbound queues that all switch ports will use to buffer packets for 802.1p user priorities. By default, there are eight priority queues or traffic classes. Using this feature, you can reconfigure the switch to four-queue mode or two-queue mode to increase the available bandwidth per queue.

Use the following commands to change the number of queues per port and display the current priority queue configuration on the switch.

Syntax: qos queue-config < 2-queues | 4-queues | 8-queues >

Configures the number of outbound priority queues for all ports on the switch using one of the following options: **2-queues**, **4-queues**, *or* **8-queues**. *(Default: 8-queues)*

Caution: *This command will execute a "write memory" followed by an immediate reboot, replacing the Startup configuration with the content of the current Running configuration.*

The new configuration will:

1. *Remove any previously configured "bandwidth-min output" settings*
2. *Set the new number of outbound port queues*

If you select anything but "yes" for this operation, the operation is aborted and a message stating "Operation aborted" appears.

show qos queue config

Displays the current qos queue configuration.

Mapping of Outbound Port Queues. The mapping of 802.1p priorities to outbound port queues is shown in Table 6-11.

Table 6-11. Mapping of 802.1p Priorities to Outbound Port Queues

802.1p Priority	8 Queues (default)	4 Queues	2 Queues
1 (lowest)	1	1	1
2	2		
0 (normal)	3	2	
3	4		
4	5	3	2
5	6		
6	7	4	
7 (highest)	8		

Impact of QoS Queue Configuration on Guaranteed Minimum Bandwidth (GMB). Changing the number of queues removes any **bandwidth-min output** settings in the startup configuration, and automatically re-allocates the GMB per queue as shown in Table 6-12.

Table 6-12. Default GMB Percentage Allocations per QoS Queue Configuration

802.1p Priority	8 Queues (default)	4 Queues	2 Queues
1 (lowest)	2%	10%	90%
2	3%		
0 (normal)	30%	70%	
3	10%		
4	10%	10%	10%
5	10%		
6	15%	10%	
7 (highest)	20%		

Note

For more information on configuring GMB, refer to the chapter titled "*Port Traffic Controls*" in the *Management and Configuration Guide*.

Configuring the Number of Priority Queues

To change the number of outbound priority queues for all ports on the switch, use the **qos queue-config** command.

Caution

This command will execute a **write memory** followed by an immediate reboot, replacing the Startup configuration with the contents of the current Running configuration. In addition to setting the number of outbound port queues, the new configuration will remove any previously configured **bandwidth-min output** settings.

For example, to change the number of outbound priority queues for all ports on the switch from eight queues (the default) to four:

1. Specify the number of outbound priority queues to be configured using the **qos queue-config** command.

   ```
   ProCurve(config)# qos queue-config 4-queues
   ```

   A caution message appears (see Caution above for details) concluding with the following prompt.

   ```
   Do you wish to proceed? [Proceed/Cancel]
   ```

2. Type **Proceed** to continue.

   A second confirmation prompt appears:

   ```
   Please confirm reset. [Yes/Cancel]
   ```

3. Type **Yes** to initiate a write memory followed by an immediate reboot (entering **Cancel** at either of the two prompts will cancel the command and maintain the current queue configuration on the switch).

   The changes will be committed to the startup configuration and the switch will reboot automatically with the new priority queue changes in effect (see Table 6-12 on page 6-65 for a listing of the default GMB percentages that are allocated per queue).

Viewing the QoS Queue Configuration

To display the current priority queue configuration and memory allocations per queue, use the **show qos queue-config** command.

```
ProCurve#: show qos queue-config

         802.1p
Queue    Priority    Memory %
-----    --------    --------
   1        1-2         10
   2        0,3         70
   3        4-5         10
   4        6-7         10
```

Figure 6-36. Displaying QoS Queue Configuration

QoS Operating Notes and Restrictions

QoS support based on packet type is shown below.

Table 6-13. Details of Packet Criteria and Restrictions for QoS Support

Packet Criteria or Restriction	QoS Classifiers							DSCP Overwrite (Re-Marking)
	UDP/TCP	Device Priority (IP Address)	IP Type-of-Service	Layer 3 Protocol	VLAN	Source Port	Incoming 802.1p	
Restricted to IPv4 Packets Only	Yes	Yes	Yes	No	No	No	No	Yes
Allow Packets with IP Options[1]	Yes	Yes[2]	Yes[2]	Yes[2]	Ye2[3]	Yes[2]	Yes[2]	No
Support IPv6 Packets[1]	No	No	No	Yes	Yes	Yes	Yes	No
Support Layer-2 SAP Encapsulation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

[1]For explicit QoS support of IPv6 packets, force IPv6 traffic into its own set of VLANs and then configure VLAN-based classifiers for those VLANs.

[2]On IPv4 packets with IP options, the switches covered in this guide support QoS for 802.1p priority policies, but does **not** do any DSCP re-marking for DSCP policies.

- **All Switches:** For explicit QoS support of IP subnets, ProCurve recommends forcing IP subnets onto separate VLANs and then configuring VLAN-based classifiers for those VLANs.
- **For Devices that Do Not Support 802.1Q VLAN-Tagged Ports:** For communication between these devices and the switch, connect the device to a switch port configured as **Untagged** for the VLAN in which you want the device's traffic to move.
- **Port Tagging Rules:** For a port on the switch to be a member of a VLAN, the port must be configured as either **Tagged** or **Untagged** for that VLAN. A port can be an untagged member of only one VLAN of a given protocol type. Otherwise, the switch cannot determine which VLAN should receive untagged traffic. For more on VLANs, refer to chapter 2, "Static Virtual LANs (VLANs)".
- **Maximum QoS Configuration Entries:** The switches covered in this guide accept the maximum outbound priority and/or DSCP policy configuration entries shown in table 6-14.

Table 6-14. Maximum QoS Entries.

Switch	Software Version	Maximum QoS Entries	Notes
Switch 8212zl Series 5400zl Series 5300yl Switch 6200yl		250*	• Each device (IP address) QoS configuration uses two entries. • Each TCP/UDP port QoS configuration uses two entries. • All other classifier configurations use one entry each.
*Configuring device (IP address) or TCP/UDP QoS entries reduces this maximum. See the "Notes" column.			

Attempting to exceed the above limits generates the following message in the CLI:

```
Unable to add this QoS rule. Maximum number (entry-#)
already reached.
```

- **8212zl Switches—Non-Supported IP Packets:** The DSCP policy code-point-remarking operation is not supported in any QoS classifier for packets carrying IP options in the packet header.
- **Not Supported:** Use of an inbound 802.1p packet priority as a classifier for remapping a packet's outbound priority to different 802.1p priority. For example, where inbound packets carry an 802.1p priority of 1, QoS cannot be configured use this priority as a classifier for changing the outbound priority to 0.
- **Monitoring Shared Resources:** The QoS feature shares internal switch resources with several other features. The switch provides ample resources for all features. However, if the internal resources become fully subscribed, additional QoS provisions cannot be configured until the necessary resources are released from other uses. For information on determining the current resource availability and usage, refer to the appendix titled "Monitoring Resources" in the *Management and Configuration Guide* for your switch.

IP Multicast (IGMP) Interaction with QoS

IGMP high-priority-forward causes the switch to service the subscribed IP multicast group traffic at high priority, even if QoS on the switch has relegated the traffic to a lower priority. This does not affect any QoS priority settings, so the QoS priority is honored by downstream devices. However, QoS does take precedence over IGMP normal-priority traffic.

The switch's ability to prioritize IGMP traffic for either a normal or high priority outbound queue overrides any QoS criteria, and does not affect any 802.1p priority settings the switch may assign. For a given packet, if both IGMP high priority and QoS are configured, the QoS classification occurs and the switch marks the packet for downstream devices, but the packet is serviced by the high-priority queue when leaving the switch.

IGMP High Priority	QoS Configuration Affects Packet	Switch Port Output Queue	Outbound 802.1p Setting (Requires Tagged VLAN)
Not Enabled	Yes	Determined by QoS	Determined by QoS
Enabled	See above paragraph.	High	As determined by QoS if QoS is active.