Chapter 22

Quality of Service (QoS)

Introduction

Quality of Service (QoS) enables you to prioritise traffic and/or limit the bandwidth available to it. The concept of QoS is a departure from the original networking protocols, which treated all traffic on the Internet or within a LAN the same. Without QoS, every different traffic type is equally likely to be dropped if a link becomes oversubscribed. This approach is now inadequate in many networks, because traffic levels have increased and networks transport time-critical applications such as streams of video data. QoS also enables service providers to easily supply different customers with different amounts of bandwidth.

Configuring Quality of Service involves two separate stages:

1. Classifying traffic into flows, according to a wide range of criteria.

   Classification is performed by the switch's packet classifier and is not described in this chapter, but in Chapter 21, Generic Packet Classifier.

2. Acting on these traffic flows.

   Approaches, methods and commands for this are described in this chapter.

Quality of Service (QoS)

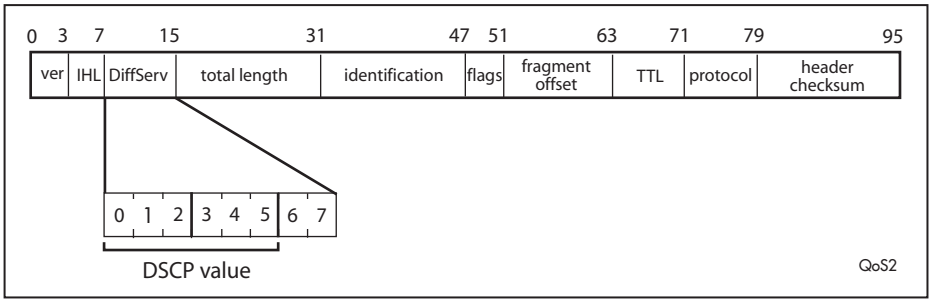
Quality of Service is a broadly used term that encompasses as a minimum both Layer 2 and Layer 3 in the OSI model. QoS is typically demonstrated by how the switch:

- assigns priority to incoming frames, if they do not carry priority information
- maps prioritised frames to traffic classes, or maps frames to traffic classes based upon other criteria
- maps traffic classes to egress queues, or maps prioritised frames to egress queues
- provides maximum bandwidth limiting for traffic classes, egress queues and/or ports
- schedules frames in egress queues for transmission (for example, empty queues in strict priority or sample each queue)
- relabels the priority of frames
- determines which frames to drop if the network becomes congested
- reserves memory for switching/routing or QoS operation (e.g. reserving buffers for egress queues, or buffers to store packets with particular characteristics)

QoS is performed only on packets that are switched at wirespeed. This includes IP, IP multicast, IPX and Appletalk traffic at Layer 3, and Layer 2 traffic within VLANs.

The switch has many QoS features, which comprise a tool set for performing a range of QoS applications. These applications include configuring a Differentiated Services (DiffServ) domain. Routers within a DiffServ domain process traffic on the basis of the DSCP (DiffServ Code Point) value in the IP header's Differentiated Services field[1] (Figure 22-1 on page 22-4).

Figure 22-1: The DSCP field of the TOS byte in the IP header



Configuring QoS

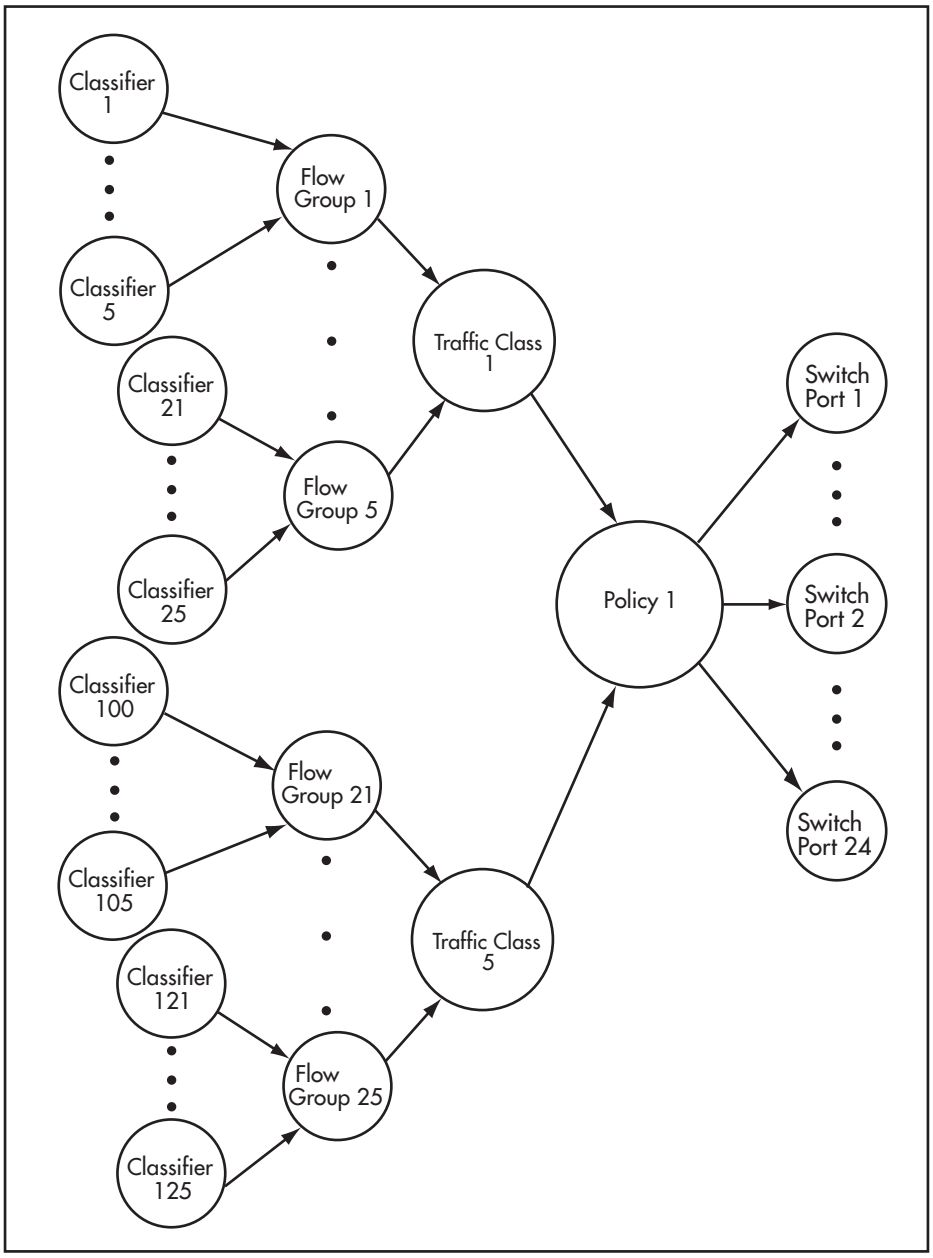
The QoS functionality sorts packets into various flows, according to the QoS policy that applies to the port the traffic is received on. The switch then allocates resources to direct this traffic according to bandwidth or priority settings in the policy. Each policy is built up out of traffic classes, flow groups and classifiers, as shown in Figure 22-2 on page 22-5. In summary, to configure QoS:

- Create *classifiers* to sort packets into traffic flows.
- Create *flow groups* and add classifiers to them. Flow groups are groups of classifiers that group together similar traffic flows. You can apply QoS prioritisation to flow groups and/or replace the traffic's DiffServ Code Point.
- Create *traffic classes* and add flow groups to them. Traffic classes are groups of flow groups and are central to QoS. You can apply bandwidth limits and QoS prioritisation to traffic classes, and/or replace the traffic's DiffServ Code Point.
- Create *policies* and add traffic classes to them. Policies are groups of traffic classes. A policy defines a complete QoS solution for a port or group of ports.
- Associate policies with ports.

The steps are listed in a conceptually logical order, but the switch cannot check a policy for errors until the policy is attached to a port. You can simplify error diagnosis by determining your QoS configuration on paper first, and then entering it into the switch in the reverse order, starting with policies.

1. The Differentiated Services field supersedes the Type of Service (TOS) field

Figure 22-2: QoS policy model



Policies, traffic classes, and flow groups are created as individual entities. When a traffic class is added to a policy, a logical link is created between the two entities. Destroying the policy unlinks the traffic class, leaving the traffic class in an unassigned state. Destroying a policy does not destroy any underlying entities. Similarly, destroying traffic classes simply unlinks flow groups and destroying flow groups unlinks classifiers.

Alternative Methods of Configuring QoS Functionality

Hardware packet filters also provide a range of QoS functionality, particularly the **add switch hwfilter classifier** command on page 8-54 of Chapter 8, Switching. Table 22-1 summarises the functionality available within different command sets on the switch, and what they are best used for.

Table 22-1: The QoS-type controls available in different command sets on the switch

Command set	Use for	Do not use for
QoS	Bandwidth limiting of classified traffic flows. Priority queuing of classified traffic flows. Replacing TOS or DSCP byte of IP header. Replacing User Priority in VLAN tag header. Providing a coordinated QoS solution for a port or ports, using the QoS policy model. Configuring a DiffServ domain.	Limiting total bandwidth on a port, unless other QoS controls are also required.
Hardware packet filters	Priority queuing of classified traffic flows. Replacing TOS or DSCP byte of IP header. Replacing User Priority in VLAN tag header. Forwarding a flow that is marked to be dropped (for example, because bandwidth allocation is exceeded). Specifying actions for packets that match the ingress and egress ports of a classifier (if set), but do not match the classifier's other parameters. Configuring a simple DiffServ domain.	Bandwidth limiting. Configuring most DiffServ domains.
Layer 3 switch filters	Priority queuing of up to 16 distinctly different types of traffic flow. Replacing TOS or DSCP byte of IP header. Replacing User Priority in VLAN tag header.	QoS for non-IP traffic (e.g. IPX). QoS based on VLANs. Bandwidth limiting.
set switch port	Limiting total ingress and/or egress bandwidth on ports.	Limiting bandwidth of particular types of traffic. Limiting egress bandwidth if priority queuing is also required.

Classifiers

Classifiers are used to identify a particular traffic flow, and range from general to specific. Chapter 21, Generic Packet Classifier describes classifiers and their commands.

Note that a single classifier should not be used in different flows that end up, via traffic classes, assigned to the same policy. A classifier should be used only once per policy. Traffic is matched in the order that the classifiers are added to the flow group. For example, if you add classifiers 1, 4, 3, 2 and 5 to a flow group in that order, that is the order in which the packets are matched.

To create a classifier, use the command:

create classifier in Chapter 21, Generic Packet Classifier

To assign classifiers to a flow group, use the command:

```
add qos flowgroup=flowgroup-id classifier=classifier-list
```

Flow Groups

Flow groups are used to group similar traffic flows together, and allow more specific QoS controls to be used, in preference to those specified by the traffic class. Flow groups consist of a small set of QoS parameters and a group of c*lassifiers*. Once a flow group has been added to a traffic class it cannot be added to another traffic class. A traffic class may have many flow groups. Traffic is matched in the order that the flow groups are added to the traffic class. For example, if you add flow groups 1, 4, 3, 2 and 5 to the traffic class in this order, then packets are matched in the same order.

QoS controls at the flow group level provide a QoS hierarchy. Non-default flow group settings are always used, but if no setting is specified for a flow group, the flow group uses the settings for the traffic class to which it belongs. For example, you can use a traffic class to limit the bandwidth available to web and FTP traffic combined. Within that traffic class, you can create two different flow groups with different priorities, to give web traffic a higher priority than FTP. Web traffic would then be given preferential access to bandwidth, but would be limited to the bandwidth limit of the traffic class.

To create a flow group, use the command:

```
create qos flowgroup=flowgroup-list [description=description]
   [markvalue={dscp-value|none}] [priority={priority|none}]
   [remarkpriority={yes|no|on|off|true|false}]
```

To assign flow groups to a traffic class, use the command:

```
add qos trafficclass=tcid flowgroup=flowgroup-list
```

Traffic Classes

Traffic classes are the central component of the QoS solution. They provide most of the controls in QoS. Traffic classes consist of a set of QoS parameters and a group of QoS *flow groups*. Traffic can be prioritised, marked (IP TOS or DSCP field set), and bandwidth limited.

A traffic class can be assigned to only one policy, and other policies cannot use it. Traffic is matched in the order that the traffic classes are added to the policy. For example, if you add traffic classes 1, 4, 3, 2 and 5 to the policy in this order, then this is the order in which the packets are matched.

To create a traffic class, use the command:

```
create qos trafficclass=id-list [description=description]
   [exceedaction={drop|remark}]
   [exceedremarkvalue=dscp-value}] [markvalue={dscp-value|
   none}] [maxbandwidth=bandwidth] [priority={priority|none}]
   [remarkpriority={yes|no|on|off|true|false}]
```

Memory resources are allocated to traffic classes when the QoS policy is set on the port.

To assign traffic classes to a policy, use the command:

```
add qos policy=id trafficclass=tcid-list
```

Policies

QoS policies consist of a collection of user-defined traffic classes. A policy can be assigned to more than one port, but a port can have only one policy. To create a policy, use the command:

```
create qos policy=id-list [description=description]
   [indscpoverwrite=dscp-value|none] [remarkindscp=zero|all|
   none]
```

To assign a policy to a port or ports, use the command:

```
set qos port={port-list|all} policy={id|none}
```

QoS controls are applied to traffic ingressing ports. Therefore, to control a particular type of traffic, an appropriate QoS policy must be attached to each port that type of traffic ingresses. In most situations, the same policy can be applied to all ports, unless the traffic is classified by a port-specific classifier. It is also possible to classify according to an egress port, as long as the egress port is within the same port block as the ingress ports. On switches with 24 ports (plus uplinks), ports 1-26 form a port block. On switches with 48 ports (plus uplinks), ports 1-24 and 49 form one port block and ports 25-48 and 50 form a second port block. See the **eport** parameter of the **create classifier** command on page 21-4 of Chapter 21, Generic Packet Classifier for more information.

Note that the switch can perform only error checking of parameters and parameter values for the policy, and its traffic classes and flow groups when the policy is set on a port.

QoS Policy Configuration Rules

- A classifier may be assigned to many flow groups. However, assigning a classifier more than once within the same policy may lead to undesirable results. A classifier may be used successfully in many different policies.
- A flow group may have many classifiers.
- A flow group may be assigned to only one traffic class.
- A traffic class may have many flow groups.
- A traffic class may be assigned to only one policy.
- A policy may have many traffic classes.
- A policy may be assigned to many ports.
- A port may have only one policy.

Packet Processing

The switch's QoS tools can be used to perform any combination of the following functions on a packet flow:

- limiting bandwidth
- prioritising packets, to determine the level of precedence the switch gives to the packet for processing
- replacing the VLAN tag User Priority, to enable the next switch in the network to process the packet correctly
- replacing the TOS precedence or DSCP value, to enable the next switch in the network to process the packet correctly.

These functions are detailed in the following sections, and in Table 22-2.

Table 22-2: The QoS tools used at each stage of packet processing

	Packet arrives	Packet is processed	Packet is queued
DSCP value of IP header's TOS field	Incoming DSCP value replaced with **indscpoverwrite**, if **remarkindscp** is set in the policy to a value other than **none**.	1. In DiffServ domains, classification (and therefore any bandwidth limiting) is based on DSCP value, and/or 2. DSCP value replaced with **markvalue**, if **markvalue** specified in traffic class or flow group, and/or 3. DSCP value is replaced with **exceedremarkvalue**, if **exceedaction** is **remark** for the traffic class, and traffic class bandwidth is exceeded.	No effect.
Flow group PRIORITY parameter	No effect.	VLAN tag User Priority field replaced with flow group **priority**, if traffic class or flow group **remarkpriority** is **yes**.	Placed in queue appropriate for **priority**, if traffic class or flow group **priority** parameter not equal to **none**. Priorities can be mapped to non-default CoS queues, using **set qos hwpriority**.
User Priority value of VLAN tag header	No effect.	VLAN tag User Priority field replaced with flow group **priority**, if traffic class or flow group **remarkpriority** is **yes**.	Placed in queue appropriate for User Priority, unless **priority** specified for flow group or traffic class. User Priorities can be mapped to non-default CoS queues, using **set qos hwpriority**.

Bandwidth Allocation

Bandwidth limiting is configured at the level of traffic classes, and encompasses the flow groups contained in the traffic class. Traffic classes can be assigned maximum bandwidths, specified in kbps, Mbps or Gbps.

To create a traffic class or classes and set bandwidth limiting, use the command:

```
create qos trafficclass=id-list maxbandwidth=bandwidth
   [other-options...]
```

To modify bandwidth limiting for an existing traffic class or classes, use the command:

```
set qos trafficclass=id-list maxbandwidth=bandwidth
   [other-options...]
```

To share bandwidth equally among all classifiable traffic classes in a policy, give all traffic classes the same **maxbandwidth**. The default settings achieve this.

To limit bandwidth on a port, use the **set switch port** command on page 8-108 of Chapter 8, Switching.

Packet Prioritisation

The switch has four Class of Service (CoS) egress queues, numbered from 0 to 3. Queue 3 has the highest priority. When the switch becomes congested, it gives high priority queues precedence over lower-priority queues. When the switch has information about a packet's priority, it sends the packet to the appropriate queue. You can specify the queue where the switch sends traffic, how much precedence each queue has, and whether priority remapping is written into the packet's header for the next hop to use.

Prioritising packets cannot improve your network's performance when bandwidth is sufficiently over-subscribed so that egress queues are always full. If one type of traffic is causing the congestion, you can limit its bandwidth (see *"Bandwidth Allocation" on page 22-9*). Other solutions in this situation are to increase bandwidth or decrease traffic.

You can set a packet's priority by configuring a priority in the flow group or traffic class to which the packet belongs. The packet is put in the appropriate CoS queue for that priority. If the flow group and traffic class do not include a priority, the switch can determine the priority from the VLAN tag User Priority field of incoming tagged packets. The packet is put in the appropriate CoS queue for its VLAN tag User Priority field. If neither the traffic class / flow group priority nor the VLAN tag User Priority is set, the packet is sent to the default queue, queue 1.

By default, flow groups and traffic classes do not include a priority. To set the queue priority of matching traffic, create the flow group or traffic class using the commands:

```
create qos flowgroup=flowgroup-list priority=0..7
   [other-options...]

create qos trafficclass=id-list priority=0..7
   [other-options...]
```

or modify an existing flow group or traffic class using the commands:

```
set qos flowgroup=flowgroup-list priority=0..7
   [other-options...]

set qos trafficclass=id-list priority=0..7
   [other-options...]
```

Both the VLAN tag User Priority and the traffic class / flow group priority setting allow eight different priority values (0-7). These eight priorities are mapped to the switch's four CoS queues. The switch's default mapping is 1,0,0,1,2,2,3,3, as shown in Table 22-3 on page 22-11. This is the mapping recommended in Table 8.2 of IEEE Standard 802.1Q, *Virtual Bridged Local Area*

Networks. Note that priority 0 is mapped to CoS queue 1 instead of CoS queue 0 because tagged traffic that has never been prioritised has a VLAN tag User Priority of 0. If priority 0 was mapped to CoS queue 0, this default traffic goes to the lowest queue, which is probably undesirable. This mapping also makes it possible to give some traffic a lower priority than the default traffic.

Table 22-3: Default priority level to queue mapping for four QOS egress queues

Priority level	Queue
0	1
1	0
2	0
3	1
4	2
5	2
6	3
7	3

You can change the queue mapping using either of the commands:

```
set qos hwpriority queue=p0,p1,p2,p3,p4,p5,p6,p7

set switch qos=p0,p1,p2,p3,p4,p5,p6,p7
   in Chapter 8, Switching
```

where *P0* to *P7* are integers indicating the CoS queue to be used for a priority value of 0 to 7, in that order. For example, to map priority values of 0 to CoS queue 1, 1 to CoS queue 0; 2 and 3 to CoS queue 1; 4, 5 and 6 to CoS queue 2; and 7 to CoS queue 3, use either of the commands:

```
set qos hwpriority queue=1,0,1,1,2,2,2,3

set switch qos=1,0,1,1,2,2,2,3
```

Class of Service (CoS) Queue Scheduling

The switch empties the CoS queues using one of the following scheduling mechanisms:

- Strict Priority-Based Scheduling

  This is the default scheduling method. Any packets in the higher priority queues are transmitted first. Packets of lower priority are transmitted when these queues are empty. The disadvantage of this scheme is that packets in low priority queues may never be transmitted, so this method is not suitable in congested networks if most traffic is high-priority.

- Weighted Round-Robin Scheduling

  This scheduling method provides each queue with a certain amount of bandwidth. This ensures that low priority queues are processed as well as high priority queues. To use weighted round-robin scheduling, specify the maximum number of frames for each CoS queue, using the command:

  ```
  set qos hwqueue=queue-list maxpackets=0..255
  ```

  Once a queue reaches that number of packets, it is cleared.

- Weighted Round-Robin Scheduling with Bounded Delay

  This scheduling method allows you to specify the maximum allowable delay between transmission of frames from a particular CoS queue (in increments of 16 microseconds). It is useful for real-time applications, such as video streaming. To specify the maximum delay between packets, use the command:

  ```
  set qos hwqueue=queue-list maxlatency=16..4080
  ```

Replacing Priorities

The traffic class or flow group priority (if set) determines the queue a packet is sent to when it egresses this switch, but by default has no effect on how the rest of the network processes the packet. To permanently change the packet's priority, you need to replace one of two priority fields in the packet header:

- the User Priority field of the VLAN tag header. Replacing this field relabels VLAN-tagged traffic, so that downstream switches can process it appropriately. Replacing this field is most useful outside DiffServ domains.
- the DSCP value of the IP header's TOS byte (Figure 22-1 on page 22-4). Replacing this field may be required as part of the configuration of a DiffServ domain. See *"DiffServ Domains" on page 22-13* for information on using the QoS policy model and the DSCP value to configure a DiffServ domain.

VLAN Tag User Priorities

Within a flow group or traffic class, the VLAN tag User Priority value of incoming packets can be replaced with the priority specified in the flow group or traffic class, using the commands:

```
create qos flowgroup=id-list priority=priority
   remarkpriority={yes|on|true} [other-options...]

create qos trafficclass=id-list priority=priority
   remarkpriority={yes|on|true} [other-options...]
```

Replacement occurs before the packet is queued, so this priority also sets the queue priority.

DSCP Values

There are three methods of replacing the DSCP byte of an incoming packet. You can use these methods together or separately. They are described in the order in which the switch performs them.

1. The DSCP value can be overwritten at ingress, for all traffic in a policy, or for all traffic with an incoming DSCP value of zero, using the command:

   ```
   create qos policy=id-list indscpoverwrite=dscp-value
      remarkindscp={zero|all} [other-options...]
   ```

2. The DSCP value in the packet can be replaced at the traffic class or flow group level, using one of the commands:

   ```
   create qos flowgroup=flowgroup-list markvalue=dscp-num
      [other-options...]

   create qos trafficclass=id-list markvalue=dscp-num
      [other-options...]
   ```

   You can use these two replacements together at the edge of a DiffServ domain, to initialise incoming traffic.

3. The DSCP value in a flow of packets can replaced if the bandwidth allocated to that traffic class is exceeded, using the command:

```
create qos trafficclass=id-list exceedaction=remark
   exceedremarkvalue=dscp-value [other-options...]
```

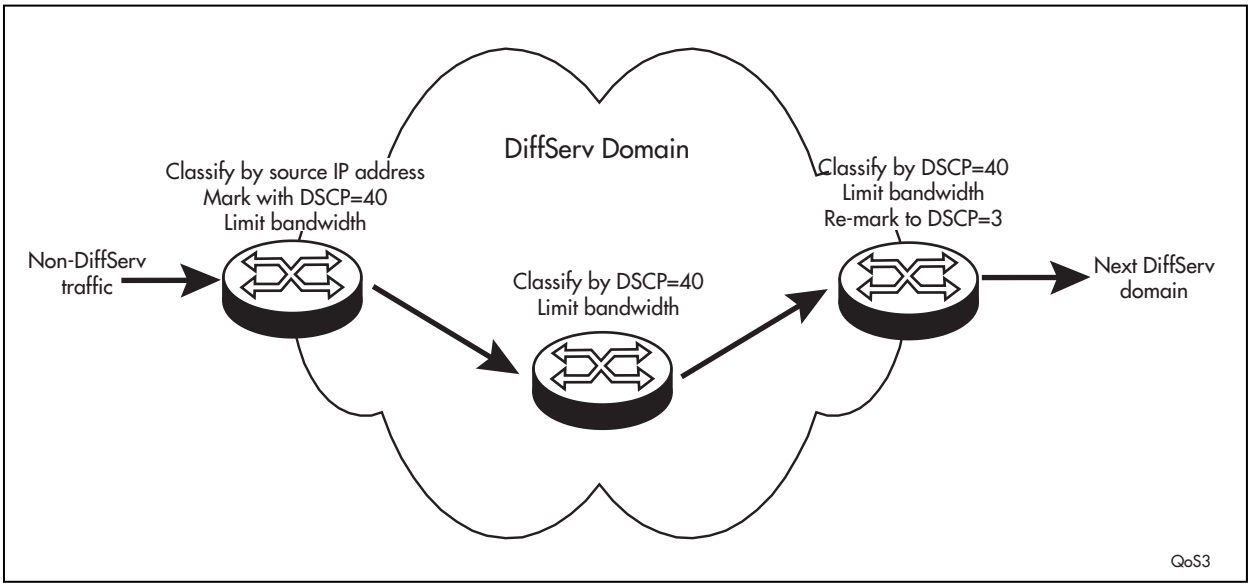
This option allows the next switch in the network to identify traffic that exceeded the bandwidth allocation.

DiffServ Domains

Differentiated Services (DiffServ) is a method of dividing IP traffic into classes of service, without requiring that every router in a network remember detailed information about traffic flows. DiffServ operates within a *DiffServ domain*, a network or subnet is managed as a single QoS unit. Packets are classified according to user-specified criteria at the edge of the network, divided into classes, and assigned the required class of service. Then packets are marked with a Differentiated Services Code Point (DSCP) tag to indicate the class of service to which they belong. The DSCP value is written into the TOS field of the IP header. Routers within the network then use this DSCP value to classify packets, and assign QoS appropriately. When a packet leaves the DiffServ domain, the DSCP value can be replaced with a value appropriate for the next DiffServ domain.

A simple example of this process is shown in Figure 22-3 on page 22-13, for limiting the amount of bandwidth used by traffic from a particular IP address. In the domain shown, this bandwidth limit is supplied by the class of service represented by a DSCP value of 40. In the next DiffServ domain, this traffic is assigned to the class of service represented by a DSCP value of 3.

Figure 22-3: An example of a DiffServ domain



To use the QoS tool set to configure a DiffServ domain:

1. As packets come into the domain at edge switches, replace their DSCP value, if required, using the **indscpoverwrite** and **remarkindscp** parameters of the **create policy** or **set policy** commands.

   Classify the packets according to the required characteristics, using the **create classifier** command.

   Assign the classifiers to flow groups and the flow groups to traffic classes, with a different traffic class for each DiffServ code point grouping within the DiffServ domain.

   Give each traffic class the priority and/or bandwidth limiting controls that are required for that type of packet within this part of the domain.

   Assign a DSCP value to each traffic class, to be written into the TOS field of the packet header, using the **markvalue** parameter of the **create traffic class** or **set traffic class** commands.

2. On switches and routers within the DiffServ domain, classify packets according to the DSCP values that were assigned to traffic classes on the edge switches.

   Assign the classifiers to flow groups and the flow groups to traffic classes, with a different traffic class for each DiffServ code point grouping within the DiffServ domain.

   Give each traffic class the priority and/or bandwidth limiting controls that are required for that type of packet within this part of the domain. These QoS controls need not be the same for each switch.

3. As packets leave the DiffServ domain, classify them according to the DSCP values.

   Assign the classifiers to flow groups and the flow groups to traffic classes, with a different traffic class for each DiffServ code point grouping within the DiffServ domain.

   Give each traffic class the priority and/or bandwidth limiting controls required for transmission of that type of packet to its next destination, in accordance with any Service Level Agreement (SLA) with the providers of that destination.

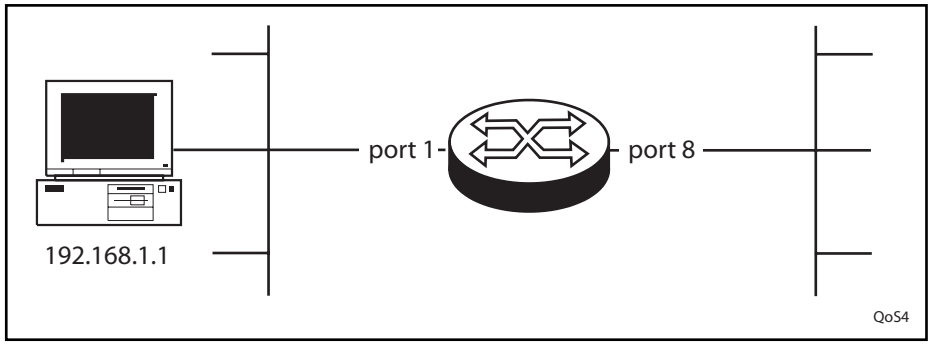
   If necessary, assign a different DSCP value to each traffic class, to be written into the TOS field of the packet header, to match the DSCP or TOS priority values of the destination network.

Examples of QoS Applications

Different applications require different types of QoS and bandwidth sizes. The most common applications requiring prioritising are voice, video, critical database applications, file server applications and service differentiation.

Figure 22-4 shows the configuration that the following examples are based on. Note that each policy is applied to the switch port that receives the selected traffic.

Figure 22-4: Example configuration for QoS applications



Voice Applications

Voice applications typically require a small bandwidth but it must be consistent. They are sensitive to *latency* (interpacket delay) and *jitter* (delivery delay). Voice applications can be set up to have the highest priority.

To create policies with very low latency for a user with an IP address of 192.168.1.1

This configuration ensures very low latency for all traffic the user receives and sends.

1. **Create a policy for traffic coming from 192.168.1.1.**

```
create qos poli=1
create qos tra=1
create qos flo=1 priority=7
create classifier=1 ipsadd=192.168.1.1
add qos flo=1 class=1
add qos tra=1 flo=1
add qos poli=1 tra=1
set qos port=1 poli=1
```

2. **Create a policy for traffic received on switch port 8 and destined for 192.168.1.1.**

```
create qos poli=2
create qos tra=2
create qos flo=2 priority=7
create classifier=2 ipdadd=192.168.1.1
add qos flo=2 class=2
add qos tra=2 flo=2
add qos poli=2 tra=2
set qos port=8 poli=2
```

Video Applications

Video applications typically require a larger bandwidth than voice applications. Video applications can be set up to have a high priority and buffering, depending on the application.

To create policies with low latency and jitter for video streams (for example, net conference calls)

In this example, the video traffic is also limited to 5 Mbps.

1. **Create a policy for traffic coming from 192.168.1.1.**

```
create qos poli=1
create qos tra=1 maxbandwidth=5mbps
create qos flo=1 priority=4
create classifier=1 ipsadd=192.168.1.1
add qos flo=1 class=1
add qos tra=1 flo=1
add qos poli=1 tra=1
set qos port=1 poli=1
```

2. **Create a policy for traffic received on switch port 8 and destined for 192.168.1.1.**

```
create qos poli=2
create qos tra=1 maxbandwidth=5mbps
create qos flo=2 priority=4
create classifier=2 ipdadd=192.168.1.1
add qos flo=2 class=2
add qos tra=2 flo=2
add qos poli=2 tra=2
set qos port=8 poli=2
```

Critical Databases

Critical databases typically require a high bandwidth. They also typically require a lower priority than either voice or video.

To create policies with very high bandwidth and no priority

1. **Create a policy for traffic coming from 192.168.1.1.**

```
create qos poli=1
create qos tra=1 maxbandwidth=50mbps
create qos flo=1
create classifier=1 ipsadd=192.168.1.1
add qos flo=1 class=1
add qos tra=1 flo=1
add qos poli=1 tra=1
set qos port=1 poli=1
```

2. Create a policy for traffic received on switch port 8 and destined for 192.168.1.1.

```
create qos poli=2
create qos tra=2 maxbandwidth=50mbps
create qos flo=2
create classifier=2 ipdadd=192.168.1.1
add qos flo=2 class=2
add qos tra=2 flo=2
add qos poli=2 tra=2
set qos port=8 poli=2
```

Command Reference

This section describes the commands available to configure and manage the QoS functions on the switch.

See "Conventions" on page xxxviii of About this Software Reference in the front of this manual for details of the conventions used to describe command syntax. See Appendix A, Messages for a complete list of messages and their meanings.

add qos flowgroup

Syntax `ADD QOS FLowgroup=`*`flowgroup-id`* `CLASSifier=`*`classifier-list`*

where:

- *flowgroup-id* is an integer from 0 to 1023.
- *classifier-list* is either an integer from 1 to 9999; a range of integers (specified as 0-4), or a comma-separated list of classifier numbers and/or ranges (0, 3, 4-9).

Description This command adds one or more classifiers to a QoS flow group.

The **flowgroup** parameter specifies the flow group that the classifiers are to be added to. The specified flow group must already exist.

The **classifier** parameter specifies a single classifier or list of classifiers. The specified classifiers must already exist.

Examples To add classifiers 2, 3, 4, 5 and 6 to flow group 42 use the command:

```
add qos fl=42 class=2-6
```

Related Commands

create qos flowgroup
delete qos flowgroup
destroy qos flowgroup
set qos flowgroup
show qos flowgroup

add qos policy

Syntax `ADD QOS POLIcy=`*`id`* `TRafficclass=`*`tcid-list`*

where:

- *id* is an integer from 0 to 255.
- *tcid-list* is either an integer from 0 to 511; a range of integers (specified as 0-4), or a comma-separated list of traffic class ID numbers and/or ranges (0, 3, 4-9).

Description This command adds one or more traffic classes to a policy.

The **policy** parameter specifies the policy to which to add the traffic classes.

The **trafficclass** parameter specifies the traffic class or classes that make up the policy. The specified traffic class or classes must exist and a traffic class cannot appear in the list more than once.

Examples To add the traffic classes 1, 2, 3, 4 and 8 to policy 8, use the command:

```
add qos poli=8 tr=1-4,8
```

Related Commands

create qos policy
delete qos policy
destroy qos policy
set qos policy
set qos port
show qos policy

add qos trafficclass

Syntax `ADD QOS TRafficclass=`*`tcid`* `FLowgroup=`*`flowgroup-list`*

where:

- *tcid* is an integer from 0 to 511.
- *flowgroup-list* is either an integer from 0 to 1023; a range of integers (specified as 0-4), or a comma-separated list of flow numbers and/or ranges (0, 3, 4-9).

Description This command adds one or more QoS data flows to a traffic class.

The **trafficclass** parameter specifies the traffic classes that the flows are to be added to. The specified traffic class must already exist.

The **flow** parameter specifies one or more flows that are to be added to the specified traffic class. The specified flows must already exist. Once a flow group has been added to a traffic class it cannot be added to another traffic class.

Examples To add flows 1, 2, 3, 4 and 9 to the traffic class 42, use the command:

```
add qos tr=42 fl=1-4,9
```

Related Commands

create qos trafficclass
delete qos trafficclass
destroy qos trafficclass
set qos trafficclass
show qos trafficclass

create qos flowgroup

Syntax

```
CREate QOS FLowgroup=flowgroup-list
   [DESCription=description] [MArkvalue={dscp-value|NONE}]
   [PRIOrity={priority|NONE}] [REMARKPRIORITY={YES|NO|ON|
   OFF|TRUE|FALSE}]
```

where:

- *description* is a character string 1 to 15 characters long. Valid characters are any printable characters. If the value contains spaces, it must be in double quotes.
- *dscp-value* is an integer from 0 to 63.
- *flowgroup-list* is either an integer from 0 to 1023; a range of integers (specified as 0-4), or a comma-separated list of flow numbers and/or ranges (0, 3, 4-9).
- *priority* is an integer from 0 to 7.

Description

This command creates one or more QoS flow groups with the given identifier(s). None of the specified flow groups should already exist.

The **description** parameter specifies an optional description for the flow group.

The **markvalue** parameter specifies a replacement value to write into the DSCP (TOS) field for all packets. If **none** is specified, the existing DSCP (TOS) value does not change. This parameter takes precedence over the **markvalue** specified for a traffic class to which the flowgroup belongs, but not the **remarkvalue**. The default is **none**.

The **priority** parameter specifies the priority that traffic belonging to these flow groups has. Priority values range from 0 to 7 with 0 being the lowest priority and 7 being the highest priority. This parameter takes precedence over the **priority** specified for any traffic class the flowgroup belongs to. If **none** is specified, the packet is prioritised on the basis of its ingressing VLAN tag user priority, if this is set. The default is **none**.

The **remarkpriority** parameter specifies whether the value of the **priority** parameter is used to set the egress queue selection for a frame and also to replace the 802.1p priority value in the frame, or just to select the egress queue for the frame. This value is ignored if the **priority** parameter is **none**. If **yes** is specified, in addition to determining the egress queue, the 802.1p value in the frame changes; however, this value is discarded when the port is not set to transmit tagged frames. The default is **no**.

Examples

To create QoS flows 1, 4, 5 and 6 with a DSCP (TOS) replacement value of 20, use the command:

```
cr qos fl=1,4-6 ma=20
```

Related Commands

add qos flowgroup
delete qos flowgroup
destroy qos flowgroup
set qos flowgroup
show qos flowgroup

create qos policy

Syntax

```
CREate QOS POLIcy=id-list [DESCription=description]
   [INDSCPOVERWRITE={dscp-value|NONE}]
   [REMARKINDSCP={ZERO|ALL|NONE}]
```

where:

- *description* is a character string 1 to 15 characters long. Valid characters are any printable characters. If the value contains spaces, it must be in double quotes.
- *dscp-value* is an integer from 0 to 63.
- *id-list* is either an integer from 0 to 255; a range of integers (specified as 0-4), or a comma-separated list of policy numbers and/or ranges (0, 3, 4-9).

Description

This command creates one or more QoS policies with the given identifier(s). None of the specified policies can already exist.

The **description** parameter specifies an optional description for the policy.

The **indscpoverwrite** parameter specifies the DSCP value used to overwrite the DSCP value on the ingress queue. The default is **none**.

The **remarkindscp** parameter specifies the conditions under which the ingress DSCP value is overwritten. If **zero** is specified, incoming DSCP values of zero are overwritten. If **all** is specified, all packets are remarked. If **none** is specified, the function is disabled. The default is **none**.

Examples

To create QoS policy 42 with a description "*ppp1-out*", use the command:

```
cr qos poli=42 desc=ppp1-out
```

Related Commands

add qos policy
delete qos policy
destroy qos policy
set qos policy
set qos port
show qos policy

create qos trafficclass

Syntax

```
CREate QOS TRafficclass=id-list [DESCription=description]
   [EXCEEDAction={DROP|REMARK}]
   [EXCEEDRemarkvalue=dscp-value}] [MArkvalue={dscp-value|
   NONE}] [MAXbandwidth=bandwidth] [PRIOrity={priority|
   NONE}] [REMarkpriority={YES|NO|ON|OFF|True|False}]
```

where:

- *bandwidth* is a value from 0 to 16000000 kbps. This value may be specified in kbps, Mbps or Gbps (in uppercase or lowercase). If no unit suffix is specified, the value is read as kbps. If Mbps or Gbps is specified, the value may contain a decimal fraction, for example, 1.25 Mbps.
- *description* is a character string 1 to 15 characters long. Valid characters are any printable characters. If the value contains spaces, it must be in double quotes.
- *dscp-value* is an integer from 0 to 63.
- *id-list* is either an integer from 0 to 511; a range of integers (specified as 0-4), or a comma-separated list of traffic class ID numbers and/or ranges (0, 3, 4-9).
- *priority* is an integer from 0 to 7.

Description

This command creates a new traffic class with the given identifier.

The **description** parameter lets you describe the traffic class with text.

The **exceedaction** parameter specifies the action to take if the traffic classes **maxbandwidth** is exceeded. There are two possible values: **drop** and **remark**. If **drop** is specified, the packet is discarded. If **remark** is specified, the packet is forwarded after replacing the DSCP value with the **exceedremarkvalue** value specified. The default is **drop**.

The **exceedremarkvalue** parameter specifies the DSCP replacement value for traffic that exceeds the **maxbandwidth**. This parameter takes precedence over the **markvalue** parameter. The default is 0.

The **markvalue** parameter specifies a replacement value to write into the DSCP (TOS) field for all packets. If the value is **none**, the existing value does not change. The default is **none**.

The **maxbandwidth** parameter specifies the maximum bandwidth available to the traffic class. This parameter determines the maximum rate at which the ingress port accepts data belonging to this traffic class before either dropping or remarking occurs, depending on the **exceedaction** specified. If the sum of **maxbandwidth** for all traffic classes on a policy exceeds the (ingress) bandwidth of the port to which the policy is assigned, the bandwidth for the port takes precedence and the port discards packets before they can be classified. **maxbandwidth** is rounded up to the nearest Mbps value when this traffic class is assigned to a policy on a 10/100 port, and up to the nearest 8 Mbps value when assigned to a policy on a gigabit port (for example, on a gigabit port, 1 Mbps is rounded to 8 Mbps, and 9 is rounded to 16). The default maximum bandwidth is **none**.

*If **maxbandwidth** is set to 0 (zero), all traffic that matches that traffic class is dropped. However, a hardware packet filter can be created to match the traffic that is marked for dropping, or a subset of it, and given an **action** of **nodrop**, to override this. This functionality can be used to discard all but a certain type of traffic. For more information about configuring hardware filters, see "Hardware Packet Filters" on page 8-34 of Chapter 8, Switching.*

The **priority** parameter specifies the priority value in the IEEE Standard 802.1p tag control field that traffic belonging to this traffic class is assigned. Priority values range from 0 to 7 with 0 being the lowest priority and 7 being the highest priority. Incoming frames are mapped into one of four Class of Service (CoS) queues based on the priority value. If the **priority** is **none**, the frame is queued according to the priority it already has. The default is **none**.

The **remarkpriority** parameter specifies whether the value of the **priority** parameter is used to set the egress queue selection for a frame and also to replace the 802.1p priority value in the frame, or just to select the egress queue for the frame. This value is ignored if the **priority** parameter is **none**. If **yes** is specified, in addition to determining the egress queue, the 802.1p value in the frame changes; however, this value is discarded when the port is not set to transmit tagged frames. The default is **no**.

Examples

To create traffic class 1 with a maximum bandwidth of 1000 kbps, use the command:

```
cr qos tr=1 max=1000kbps
```

Related Commands

add qos trafficclass
delete qos trafficclass
destroy qos trafficclass
set qos trafficclass
show qos trafficclass

delete qos flowgroup

Syntax

```
DELete QOS FLowgroup=flowgroup-id
   CLASSifier={classifier-list|ALL}
```

where:

- *flowgroup-id* is an integer from 0 to 1023.
- *classifier-list* is either an integer from 1 to 9999; a range of integers (specified as 0-4), or a comma-separated list of classifier numbers and/or ranges (0, 3, 4-9).

Description

This command deletes one or more classifiers from a QoS flow group.

The **flowgroup** parameter specifies the flow group that the classifiers are to be deleted from. The specified flow group must already exist.

The **classifier** parameter specifies a single classifier or list of classifiers to be deleted.

Examples

To delete classifiers 2, 3, 4, 5 and 6 from flow group 42 use the command:

```
del qos fl=42 class=2-6
```

Related Commands

add qos flowgroup
create qos flowgroup
destroy qos flowgroup
set qos flowgroup
show qos flowgroup

delete qos policy

Syntax `DELete QOS POLIcy=`*`id`* `TRafficclass={`*`tcid-list`*`|ALL}`

where:

- *id* is an integer from 0 to 255.
- *tcid-list* is either an integer from 0 to 511, a range of integers (specified as 0-4), or a comma-separated list of traffic class ID numbers and/or ranges (0, 3, 4-9).

Description This command deletes one or more traffic classes from a QoS policy.

The **policy** parameter specifies the policy that the traffic classes are to be deleted from.

The **trafficclass** parameter specifies a single traffic class or a list of traffic classes. The specified traffic classes must already exist, and must belong to the QoS policy.

Examples To delete the traffic classes 1, 2, 3, 4 and 8 from policy 8, use the command:

```
del qos poli=8 tr=1-4,8
```

Related Commands

add qos policy
create qos policy
destroy qos policy
set qos policy
show qos policy
set qos port

delete qos trafficclass

Syntax

```
DELete QOS TRafficclass=tcid FLowgroup={flowgroup-list|
   ALL}
```

where:

- *tcid* is an integer from 0 to 511.
- *flowgroup-list* is either an integer from 0 to 1023; a range of integers (specified as 0-4), or a comma-separated list of flow numbers and/or ranges (0, 3, 4-9).

Description

This command deletes one or more QoS flow groups from a traffic class.

The **trafficclass** parameter specifies an existing traffic class to be deleted.

The **flowgroup** parameter specifies the flow group that the classifiers are to be deleted from. The specified flow group must already exist.

Examples

To delete the flow groups 3, 4, 5, 6 and 9 from traffic class 42, use the command:

```
del qos tr=42 fl=3-6,9
```

To delete all flows from traffic class 42, use the command:

```
del qos tr=42 fl=all
```

Related Commands

add qos trafficclass
create qos trafficclass
destroy qos trafficclass
set qos trafficclass
show qos trafficclass

destroy qos flowgroup

Syntax `DESTroy QOS FLowgroup={`*`flowgroup-list`*`|ALL}`

where *flowgroup-list* is either an integer from 0 to 1023; a range of integers (specified as 0-4), or a comma-separated list of flow numbers and/or ranges (0, 3, 4-9).

Description This command destroys the specified flow group or flow groups. The specified flow groups must exist. If **all** is specified, all flow groups are destroyed. User-defined classifiers attached to the flow groups are not destroyed.

Examples To destroy the Flow 42 use the command:

```
dest qos fl=42
```

To destroy the flow groups 2, 4, 7, 8, 9 and 10 use the command:

```
dest qos fl=2,4,7-10
```

To destroy all flow groups, use the command:

```
dest qos fl=all
```

Related Commands
add qos flowgroup
create qos flowgroup
set qos flowgroup
show qos flowgroup

destroy qos policy

Syntax `DESTroy QOS POLIcy={`*`id-list`*`|ALL}`

where *id-list* is either an integer from 0 to 255; a range of integers (specified as 0-4), or a comma-separated list of policy numbers and/or ranges (0, 3, 4-9).

Description This command destroys an existing QoS policy. A QoS policy that is used by a port cannot be destroyed.

If **all** is specified, all QoS policies are destroyed.

Examples To destroy QoS policy 42, use the command:

```
dest qos poli=42
```

To destroy the QoS policies 1, 5, 6, 7, 8 and 42, use the command:

```
dest qos poli=1,5-8,42
```

To destroy all user-created QoS Policies, use the command:

```
dest qos poli=all
```

Related Commands
add qos policy
create qos flowgroup
delete qos policy
set qos policy
set qos port
show qos policy

destroy qos trafficclass

Syntax `DESTroy QOS TRafficclass={`*`id-list`*`|ALL}`

where *id-list* is either an integer from 0 to 511; a range of integers (specified as 0-4), or a comma-separated list of traffic class ID numbers and/or ranges (0, 3, 4-9)

Description This command destroys the specified traffic class or traffic classes. The specified traffic class(es) must exist.

If **all** is specified, all traffic classes are destroyed.

Examples To destroy the traffic class 42 use the command:

```
dest qos tr=42
```

To destroy the traffic classes 2,4,7,8,9,10 use the command:

```
dest qos tr=2,4,7-10
```

To destroy all traffic classes, use the command:

```
dest qos tr=all
```

Related Commands
add qos trafficclass
create qos trafficclass
delete qos trafficclass
set qos trafficclass
show qos trafficclass

disable qos debug

Syntax `DISable QOS DEBug={COMMAND|DETAIL|TRACE|ALL}`

Description This command is used to disable the output of QoS debug messages. The output of all QoS debug messages is disabled by default.

If **all** is specified all QoS debugging is turned off. If **command** is specified, command handler trace debugging is turned off. If **detail** is specified, additional low level debugging is turned off. If **trace** is specified, all QoS trace debugging is turned off.

Examples To disable command debugging, use the command:

```
dis qos deb=command
```

Related Commands **enable qos debug**

enable qos debug

Syntax `ENAble QOS DEBug={COMMAND|DETAIL|TRACE|ALL}`

Description This command is used to enable the output of QoS debug messages. The output of all QoS debug messages is disabled by default.

If **all** is specified all QoS debugging is turned on. If **command** is specified, command handler trace debugging is turned on. If **detail** is specified, additional low level debugging is turned on. If **trace** is specified, all QoS trace debugging is turned on.

Examples If any QoS commands fail, enable trace debugging to trace the error using the command:

```
ena qos deb=trace
```

Related Commands **disable qos debug**

purge qos

Syntax `PURge QOS`

Description Purges the current QoS configuration.

Example To purge the current QoS configuration, use the command:

```
pur qos
```

set qos flowgroup

Syntax

```
SET QOS FLowgroup=flowgroup-list [DESCription=description]
   [MArkvalue={dscp-value|NONE}] [PRIOrity={priority|
   NONE}] [REMarkpriority={YES|NO|ON|OFF|True|False}]
```

where:

- *description* is a character string 1 to 15 characters long. Valid characters are any printable characters. If the value contains spaces, it must be in double quotes.
- *dscp-value* is an integer from 0 to 63.
- *flowgroup-list* is either an integer from 0 to 1023; a range of integers (specified as 0-4), or a comma-separated list of flow numbers and/or ranges (0, 3, 4-9).
- *priority* is an integer from 0 to 7.

Description

This command sets the parameters on one or more QoS flow groups. All of the specified flow groups must already exist.

The **description** parameter specifies an optional description for the flow group.

The **markvalue** parameter specifies a replacement value to write into the DSCP (TOS) field for all packets. If **none** is specified, the existing value does not change. This parameter takes precedence over the **markvalue** specified for any traffic class the flowgroup belongs to, but not the **remarkvalue**. The default is **none**.

The **priority** parameter specifies the priority that traffic belonging to these flow groups has. Priority values range from 0 to 7 with 0 being the lowest priority and 7 being the highest priority.

The **remarkpriority** parameter specifies whether the value of the **priority** parameter is used to set the egress queue selection for a packet and also to replace the 802.1p priority value in the packet, or just to select the egress queue for the packet. This value is ignored if the **priority** value is **none**. If **yes** is specified, in addition to determining the egress queue, the 802.1p value in the packet changes; however, this value is discarded when the port is not set to transmit tagged packets. The default is **no**.

Examples

To set QoS flow groups 1, 4, 5 and 6 with a priority of 5, use the command:

```
set qos fl=1,4-6 pri=5
```

Related Commands

add qos flowgroup
create qos flowgroup
delete qos flowgroup
destroy qos flowgroup
show qos flowgroup

set qos hwpriority

Syntax `SET QOS HWPRIORITY Queue=`*`P0,P1,P2,P3,P4,P5,P6,P7`*

where *P0-P7* are each integers from 0 to 4

Description This command maps VLAN tag User Priorities and therefore traffic class / flow group priorities to the four CoS queues.

The **queue** parameter specifies the CoS queue that the priority is to be mapped to. It is a comma separated list of eight values, all of which must be present. The first value, *P0*, represents the queue priority corresponding to a priority of 0, and similarly values *P1* to *P7* represent the queue priority corresponding to a priority of 1 to 7. Changes made to the priority mapping using this command are saved into the configuration file under the command **set switch qos**. See Table 22-3 on page 22-11 for the default priority mapping.

Examples To set priorities 0, 1, and 2 to use CoS queue 0; 3 and 4 to use CoS queue 1; 5 and 6 to use CoS queue 2; and 7 to use CoS queue 3, use the command:

```
set qos hwpriority queue=0,0,0,1,1,2,2,3
```

Related Commands **set switch qos** in Chapter 8, Switching
set qos hwqueue
show qos hwpriority
show qos hwqueue

set qos hwqueue

Syntax

```
SET QOS HWQueue=queue-list [MAXPackets={0..255|NONE}]
   [MAXLatency={0|16..4080|NONE}]
```

where *queue-list* is either an integer from 0 to 3; or multiple integers described with either a comma-separated list, a range (specified as 0-4), or a combination of the two.

Description

This command sets the maximum number of packets and/or bounded latency on transmission of packets from the specified egress Class of Service (CoS) queues.

The **maxpackets** parameter specifies the maximum packet count for the specified CoS queue. The CoS scheduling algorithm starts from the highest CoS queue, sends **maxpackets**, then moves on to the next lower CoS queue (weighted round robin queuing). If **maxpackets** is set to **none**, then it continues processing packets until there are no more in the transaction queue for this queue (strict priority queuing). The default is **none**.

The **maxlatency** parameter specifies the maximum latency in microseconds between packet transmissions for the specified CoS queue. This value must be set in 16 microsecond increments. Setting unreasonable values for **maxlatency** across several CoS queues may result in a race condition where the requested maximum delays cannot be met. If zero or **none** is specified, bounded latency scheduling is disabled. This value takes precedence over **maxpackets**. The default is **none**.

Example

To set the maximum number of packets for queue “1”, use the command:

```
set qos hwq=1 maxp=240
```

Related Commands

set switch qos in Chapter 8, Switching
set qos hwpriority
show qos hwpriority
show qos hwqueue

set qos policy

Syntax

```
SET QOS POLIcy=id-list [DESCription=description]
   [INDScpoverwrite=dscp-value] [REMarkindscp=ZERO|ALL|
   NONE]
```

where:

- *description* is a character string 1 to 15 characters long. Valid characters are any printable characters. If the value contains spaces, it must be in double quotes.
- *dscp-value* is an integer from 0 to 63.
- *id-list* is either an integer from 0 to 255; a range of integers (specified as 0-4) or a comma separated list of policy numbers and/or ranges (0, 3, 4-9).

Description

This command sets parameters on one or more QoS policies.

The **policy** parameter specifies an existing policy to which to add the changes. If the value is a single identifier, changes are applied to the specified policy. If the value is a group of identifiers, changes are applied to all policies in the group. If the value is **all**, changes are applied to all QoS policies.

The **description** parameter specifies an optional description.

The **indscpoverwrite** parameter specifies the DSCP value used to overwrite the DSCP value at ingress. The default is **none**.

The **remarkindscp** parameter specifies the conditions under which the ingress DSCP value is overwritten. If **zero** is specified, incoming DSCP values of zero are overwritten. If **all** is specified, all packets are remarked. If **none** is specified, the function is disabled. The default is **none**.

Examples

To set the description of policy 1 to "*all ports*", use the command:

```
set qos policy=1 description="all ports"
```

Related Commands

add qos policy
create qos policy
delete qos policy
destroy qos policy
set qos port
show qos policy

set qos port

Syntax `SET QOS POrt={`*`port-list`*`|ALL} POLIcy={`*`id`*`|NONE}`

where:

- *id* is an integer from 0 to 255.
- *port-list* is a single port of group of ports; a range of integers (specified as 0-4) or a comma separated list of policy numbers and/or ranges (0, 3, 4-9).

Description This command configures the given QoS policy to be applied to all packets ingressing the specified switch port or ports.

The **policy** parameter specifies the QoS policy number. If the value **none** is specified, no QoS policy is applied to the port(s).

Examples To set switch port number 1 to use the QoS policy 1, use the command:

```
set qos po=1 poli=1
```

Related Commands **show qos policy**

set qos trafficclass

Syntax

```
SET QOS TRafficclass=id-list [DESCription=description]
   [EXCEEDACTION={DROP|REMARK}]
   [EXCEEDREMARKVALUE=dscp-value}] [MArkvalue={dscp-value|
   NONE}] [MAXbandwidth=bandwidth] [PRIOrity={priority|
   NONE}] [REMARKPRIORITY={YES|NO|ON|OFF|TRUE|FALSE}]
```

where:

- *bandwidth* is a value from 0 to 16000000 kbps. This value may be specified in kbps, Mbps or Gbps (in upper or lower case). If no unit suffix is specified, the value is read as kbps. If Mbps or Gbps is specified, the value may contain a decimal fraction, for example, 1.25 Mbps.
- *description* is a character string 1 to 15 characters long. Valid characters are any printable characters. If the value contains spaces, it must be in double quotes.
- *dscp-value* is an integer from 0 to 63.
- *id-list* is either an integer from 0 to 511; a range of integers (specified as 0-4), or a comma-separated list of policy numbers and/or ranges (0, 3, 4-9).
- *priority* is an integer from 0 to 7.

Description

This command sets parameters on one or more QoS traffic classes. The traffic classes must already exist.

The **description** parameter specifies an optional description for the traffic class.

The **exceedaction** parameter specifies the action to be taken if the traffic classes **maxbandwidth** is exceeded. There are two possible exceed action values, drop and **remark**. If **drop** is specified, the packet is discarded. If **remark** is specified, the packet is forwarded after replacing the DSCP value with the **exceedremarkvalue** value specified.

The **exceedremarkvalue** parameter specifies the DSCP replacement value for traffic that exceeds the **maxbandwidth**. This parameter takes precedence over the **markvalue** parameter. The default is 0.

The **markvalue** parameter specifies a replacement value to write into the DSCP (TOS) field for all packets. If the value is **none**, the existing value does not change. The default is **none**.

The **maxbandwidth** parameter specifies the maximum bandwidth available to the traffic class. This parameter determines the maximum rate at which the ingress port accepts data belonging to this traffic class before either dropping or remarking occurs, depending on the **exceedaction** specified. If the sum of **maxbandwidth** for all traffic classes on a policy exceeds the (ingress) bandwidth of the port to which the policy is assigned, the bandwidth for the port takes precedence and the port discards packets before they can be classified. **maxbandwidth** is rounded up to the nearest Mbps value when this traffic class is assigned to a policy on a 10/100 port, and up to the nearest 8 Mbps value when assigned to a policy on a gigabit port (for example, on a gigabit port, 1 Mbps is rounded to 8 Mbps, and 9 is rounded to 16). The default maximum bandwidth is **none**.

*If **maxbandwidth** is set to 0 (zero), all traffic that matches that traffic class is dropped. However, a hardware packet filter can be created to match the traffic that is marked for dropping, or a subset of it, and given an **action** of **nodrop**, to override this. This functionality can be used to discard all but a certain type of traffic. For more information about configuring hardware filters, see "Classifier-Based Packet Filters" on page 8-34 of Chapter 8, Switching.*

The **maxbandwidth** parameter specifies the maximum bandwidth available to the traffic class. This parameter determines the maximum rate at which the ingress port accepts data belonging to this traffic class before either dropping or remarking occurs, depending on the **exceedaction** specified. If the sum of **maxbandwidth** for all traffic classes on a policy exceeds the (ingress) bandwidth of the port to which the policy is assigned, the bandwidth for the port takes precedence and the port discards packets before they can be classified. **maxbandwidth** is rounded up to the nearest Mbps value when this traffic class is assigned to a policy on a 10/100 port, and up to the nearest 8 Mbps value when assigned to a policy on a gigabit port (for example, on a gigabit port, 1 Mbps is rounded to 8 Mbps, and 9 is rounded to 16). The default maximum bandwidth is **none**.

*If **maxbandwidth** is set to 0 (zero), all traffic that matches that traffic class is dropped. However, a hardware packet filter can be created to match the traffic that is marked for dropping, or a subset of it, and given an **action** of **nodrop**, to override this. This functionality can be used to discard all but a certain type of traffic. For more information about configuring hardware filters, see "Classifier-Based Packet Filters" on page 8-34 of Chapter 8, Switching.*

The **priority** parameter specifies the priority value in the IEEE Standard 802.1p tag control field that traffic belonging to this traffic class is assigned. Priority values range from 0 to 7 with 0 being the lowest priority and 7 being the highest priority. Incoming frames are mapped into one of four Class of Service (CoS) queues based on the priority value, if this is **none**, the frame is queued according to the priority it already has. The default is **none**.

The **remarkpriority** parameter specifies whether the value of the **priority** parameter is used to set the egress queue selection for a frame and also to replace the 802.1p priority value in the frame, or just to select the egress queue for the frame. This value is ignored if the **priority** parameter is **none**. If **yes** is specified, in addition to determining the egress queue, the 802.1p value in the frame changes; however, this value is discarded when the port is not set to transmit tagged frames. The default is **no**.

Examples

To set traffic class 1 with a maximum bandwidth of 7 Mbps, use the command:

```
set qos tr=1 max=7mbps
```

Related Commands

add qos trafficclass
create qos trafficclass
destroy qos trafficclass
show qos trafficclass

show qos flowgroup

Syntax `SHow QOS FLowgroup [={id|ALL}]`

where *id* is an integer from 0 to 1023

Description This command displays configuration information for one or more QoS flow groups (Figure 22-5, Figure 22-6, Table 22-4 on page 22-38).

If no value is specified for the **flowgroup** parameter, summary information about all traffic classes is displayed.

If a value is specified, detailed information about either a specified flow group or all flow groups is displayed.

Figure 22-5: Example output from the **show qos flowgroup** command

```
Flow Group Information
 Id   Description     Assigned TC   Classifiers
-------------------------------------------------------------
1      Bobs Video      2             1
2      all FTP         None          3,6-9
9      Janes Video     5             8
```

Figure 22-6: Example output from the **show qos flowgroup** =9 command.

```
Identifier ................. 9
Description ............... Janes Video
TC Assigned to ............. 5
Classifiers ................ 8
Priority ................... 1
Remark Priority ............ YES
Mark Value ................. 0
```

Table 22-4: Parameters in output of the **show qos flowgroup** command

Parameter	Meaning
Identifier	The numerical identifier of the flow group.
Description	The description for the traffic group.
TC Assigned to	The numerical identifiers of the traffic class to which the flow group is assigned.
Classifiers	The numerical identifiers of the classifiers assigned to this flow group.
Mark Value	Specifies a replacement value to write into the Differentiated Services value for all packets.

Examples To display summary information for all Flows, use the command:

```
sh qos fl
```

To display detailed configuration information for traffic class 12, use the command:

```
sh qos fl=12
```

Related Commands

add qos flowgroup
create qos flowgroup
delete qos flowgroup
destroy qos flowgroup
set qos flowgroup

show qos hwpriority

Syntax

```
SHow QOS HWPriority
```

Description

This command displays the mapping of IEEE Standard 802.1p user priority values onto the four egress CoS queues. For example output and parameter descriptions see Figure 22-7 on page 22-39, Table 22-5 on page 22-39.

Figure 22-7: Example output from the **show qos hwpriority** command

```
QOS PRIORITY MAPPING
Priority Value        Class of Service
-------------------------------------------------------------
0                     1
1                     0
2                     0
3                     1
4                     2
5                     2
6                     3
7                     3
-------------------------------------------------------------
```

Table 22-5: Parameters in output of the **show qos hwpriority** command

Parameter	Meaning
Priority Value	Value in the IEEE Standard 802.1p user priority field for a packet.
Class of Service	A number representing the Class of Service queue selected at egress for a given packet based on its priority.

Examples

To display the mapping of VLAN tag User Priorities to Class of Service queues, use the command:

```
sh qos hwp
```

Related Commands

set qos hwpriority
set qos hwqueue
set switch qos in Chapter 8, Switching
show qos hwqueue

show qos hwqueue

Syntax `SHow QOS HWQueue`

Description This command displays information about the configuration of the Class of Service queues. For example output and parameter descriptions see Figure 22-8 on page 22-40, Table 22-6 on page 22-40.

Figure 22-8: Example output from the **show qos hwqueue** command

```
QOS Egress Queue Configuration
Queue Number     Max Packets     Max Latency (microseconds)
-------------------------------------------------------------
0                4               None
1                4               None
2                8               None
3                2               1024
-------------------------------------------------------------
```

Table 22-6: Parameters in output of the **show qos hwqueue** command

Parameter	Meaning
Queue Number	A number representing an individual Class of Service queue.
Max Packets	The maximum number of packets able to be transmitted from this queue before the control is passed to the next queue.
Max Latency	The maximum permissible elapsed time between packets transmitted from this queue.

Examples To display information on the Class of Service queue configuration, use the command:

```
sh qos hwq
```

Related Commands

set qos hwpriority
set qos hwqueue
set switch qos in Chapter 8, Switching
show qos hwpriority

show qos policy

Syntax `SHow QOS POLIcy[={id|ALL}]`

where *id* is an integer from 0 to 255

Description This command displays configuration information for one or more QoS Policies. For example output and parameter descriptions see Figure 22-9, Table 22-7 on page 22-41, Figure 22-10 on page 22-41 and Table 22-8 on page 22-41.

If no value is given on the **policy** parameter summary information about all policies are displayed.

If a value is given detailed information about either a specified policy or all policies are displayed.

Figure 22-9: Example output from the **show qos policy** command

```
QOS Policy Information
Id    Description    Trafficclasses     Ports Assigned to
-------------------------------------------------------------
1     all ports      3,5-7              port: 1-24
12    special        1,4                NONE
-------------------------------------------------------------
```

Table 22-7: Parameters in output of the **show qos policy** command

Parameter	Meaning
Id	Numerical identifier of the policy.
Description	Description for the policy.
Trafficclasses	Numerical identifiers of the traffic classes assigned to this policy.
Ports Assigned to	Ports to which the policy is assigned, or **none** if a policy is not assigned.

Figure 22-10: Example output from the **show qos policy=1** command.

```
Identifier ................ 1
TCs Assigned .............. 1
Default Traffic Class
   Percent ................ 10
```

Table 22-8: Parameters in output of the **show qos policy** command

Parameter	Meaning
Identifier	Numerical identifier of the policy.
Description	Description for the policy.
TCs Assigned	Numerical identifiers of the traffic classes assigned to this policy.

Examples To display summary information about all QoS policies, use the command:

```
sh qos poli
```

To display detailed information about QoS policy 112, use the command:

```
sh qos poli=112
```

Related Commands

add qos policy
create qos policy
delete qos policy
destroy qos policy
set qos policy
set qos port

show qos trafficclass

Syntax `SHow QOS TRafficclass[={id|ALL}]`

where *id* is an integer from 0 to 511

Description This command displays configuration information for one or more QoS traffic classes. For example output and parameter descriptions see Figure 22-11 on page 22-43, Table 22-9 on page 22-43, Figure 22-12 on page 22-43 and Table 22-10 on page 22-44.

If no value is given on the **trafficclass** parameter summary, information about all traffic classes is displayed.

If a traffic class is specified, information about that traffic class is displayed. If **all** is specified, all traffic classes are displayed.

Figure 22-11: Example output from the **show qos trafficclass** command

```
QOS Traffic Class Information
 Id    Description      Policy   FlowGroups
-----------------------------------------------
1      FTP Traffic      3        1-3,16
13     Telnet Traffic   None     None
18     Interactive Voi  1        8-11
23     TCP/IP Traffic   6        12,14,17-18
```

Table 22-9: Parameters in output of the **show qos trafficclass** command

Parameter	Meaning
Id	Numerical identifier for the traffic class.
Description	Description for the traffic class.
Policy Assigned to	Numerical identifiers of the policy to which the traffic class is assigned.
FlowGroups	Numerical identifiers of the flow groups assigned to this traffic class.

Figure 22-12: Example output from the **show qos trafficclass=18** command

```
Identifier ................ 18
Description ............... Interactive Voice
Policy Assigned to ........ 1
Flow Groups ............... 8-11
Max Bandwidth ............. 1.25Gbps
Priority .................. 3
Remark Priority ........... YES
DSCP Markvalue ............ 10
Exceed Action ............. REMARK
Exceed Remark Value ....... 11
```

Table 22-10: Parameters in output of the **show qos trafficclass** command

Parameter	Meaning
Identifier	Numerical identifier of the traffic class.
Description	Description for the traffic class.
Policy Assigned to	Numerical identifiers of the policy to which the traffic class is assigned.
Flow Groups	Numerical identifiers of the flow groups assigned to this traffic class.
Priority	Priority for traffic belonging to this traffic class or flow.
Remark Priority	Whether the Priority value is changed in the frame, or whether it determines the forwarding treatment for the frame.
DSCP Markvalue	Replacement value to write into the IP DSCP field for all frames.
Exceed Action	Action to take if the traffic classes maximum bandwidth is exceeded.
Exceed Remark Value	Replacement value to write into the DSCP field for frames if Exceed Action is **remark**.

Examples

To display summary information for all traffic classes, use the command:

```
sh qos tr
```

To display detailed configuration information for traffic class 12, use the command:

```
sh qos tr=12
```

Related Commands

add qos trafficclass
create qos trafficclass
delete qos trafficclass
destroy qos trafficclass
set qos trafficclass