



# CHAPTER 24

## Configuring Quality of Service

---

QoS refers to the ability of a network to provide improved service to selected network traffic over various underlying technologies including Frame Relay, ATM, Ethernet and 802.1 networks, SONET, and IP-routed networks. In particular, QoS features provide improved and more predictable network service by implementing the following services:

- Supporting guaranteed bandwidth
- Improving loss characteristics
- Avoiding and managing network congestion
- Shaping network traffic
- Setting traffic priorities across the network

The following sections describe how to configure Quality of Service on the Cisco MWR 2941:

- [Understanding Quality of Service](#)
- [Configuring Quality of Service](#)
- [Sample Quality of Service Configurations](#)

## Understanding Quality of Service

This section describes the Quality of Service (QoS) features on the Cisco MWR 2941. The Cisco MWR 2941 supports the following QoS features.

- [Traffic Classification](#)
- [Traffic Marking](#)
- [Traffic Queuing](#)
- [Traffic Shaping](#)



### Note

The Cisco MWR 2941 support for QoS varies based on the interface and traffic type. For more information about the QoS limitations, see [QoS Limitations](#).

For instructions on how to configure QoS on the Cisco MWR 2941, see [Configuring Quality of Service](#).

## Traffic Classification

Classifying network traffic allows you to organize packets into traffic classes based on whether the traffic matches specific criteria. Classifying network traffic is the foundation for enabling many QoS features on your network. For instructions on how to configure traffic classification, see [Configuring Classification](#).

## Traffic Marking

Marking network traffic allows you to set or modify the attributes for packets in a defined traffic class. You can use marking with traffic classification to configure variety of QoS features for your network. For instructions on how to configure traffic marking, see [Configuring Marking](#).

## Traffic Queuing

The Cisco MWR 2941 supports class-based WFQ (CBWFQ) for congestion management. CBWFQ extends the standard WFQ functionality to provide support for user-defined traffic classes. For CBWFQ, you define traffic classes based on match criteria such as input interface. Packets satisfying the match criteria for a class constitute the traffic for that class. For more instructions on how to configure traffic queuing, see [Configuring Congestion Management](#).

## Traffic Shaping

Regulating the packet flow on the network is also known as traffic shaping. Traffic shaping allows you to control the speed of traffic leaving an interface. This way, you can match the flow of the traffic to the speed of the interface receiving the packet.

The Cisco MWR 2941 supports Class-Based Traffic Shaping. Class-Based Traffic Shaping allows you to regulate the flow of packets leaving an interface on a per-traffic-class basis, matching the packet flow to the speed of the interface. For more instructions on how to configure traffic shaping, see [Configuring Shaping](#).

For more information about Quality of Service, see the [Quality of Service Solutions Configuration Guide, Cisco IOS Release 15.0S](#).

## Configuring Quality of Service

The following sections describe how to configure the Quality of Service (QoS) features supported by the Cisco MWR 2941 router.

- [QoS Limitations, page 24-3](#)
- [Sample QoS Configuration, page 24-8](#)
- [Configuring Classification, page 24-10](#)
- [Configuring Marking, page 24-12](#)
- [Configuring Congestion Management, page 24-16](#)
- [Configuring Shaping, page 24-18](#)

- [Configuring Ethernet Trusted Mode, page 24-20](#)

## QoS Limitations

The Cisco MWR 2941 offers different QoS support according to the physical interface and traffic type. The following sections describe the limitations for each QoS capability on the Cisco MWR 2941.

- [General QoS Limitations](#)
- [Statistics Limitations](#)
- [Propagation Limitations](#)
- [Classification Limitations](#)
- [Marking Limitations](#)
- [Congestion Management Limitations](#)
- [Shaping Limitations](#)

### General QoS Limitations

The following general QoS limitations apply to the Cisco MWR 2941.

- You can create a maximum of 32 class maps including the class-default class map.
- You can create a maximum of 32 policy-maps.
- Congestion Avoidance, including Weighted Random Early Detection (WRED) is not supported.
- The following limitations apply to MLPPP interfaces:
  - Input MLPPP interfaces do not support QoS service policies.
  - You can apply only one output QoS service policy to an MLPPP interface.
  - You can create a maximum of 8 **match** statements within a class map in a service policy applied to an MLPPP interface.
  - When applying or modifying any aspect of a service-policy on an MLPPP interface, you must shut down and re-enable the interface.
  - You can create a maximum of 8 classes within a policy-map that is applied to an MLPPP interface. This number includes the default-class.
  - You can have only 1 priority class within a policy-map applied to an MLPPP interface.
- The following limitations apply to GigabitEthernet interfaces:
  - You can apply a maximum of 3 different service policies to GigabitEthernet interfaces
  - You can only use the class-default class for HQoS parent service policies applied to egress GigabitEthernet interfaces.

### Statistics Limitations

- Input service policies on the GigabitEthernet interface support statistics based on class map and in terms of packets. Statistics based on filters and statistics in terms of bytes or rates are not supported.
- The **show policy-map** command displays inaccurate output for QoS counters due to ingress counter limitations on the router. The command displays a summary of QoS activity on the MWR 2941 that is limited as follows:

- The number of packets displayed below the Class-map name includes the number of packets matched and marked on the router.
- The Packets marked number for each QoS value always displays as 0.

The following example shows output for the **show policy-map** command:

```
Router# show policy-map interface gigabitethernet0/0 in
GigabitEthernet0/0
```

```
Service-policy input: INPUT-POLICY

Class-map: DSCP-IN (match-any)
  2857393 packets
  Match: ip dscp af43 (38) ef (46) cs6 (48) 62
  QoS Set
    cos 5
    Packets marked 0
  qos-group 5
    Packets marked 0
```

- Output MLPPP interfaces support QoS statistics.
- Output service policies on the GigabitEthernet interface do not support statistics.

## Propagation Limitations

The Cisco MWR 2941 has the following limitations when propagating QoS values between interfaces:

- The following limitations apply when traffic ingresses through a GigabitEthernet interface and egresses through a GigabitEthernet interface:
  - When traffic is routed at layer 3, the router maps the CoS bits to the QoS group value. The QoS group is not propagated through the L3 network processor.
  - When traffic is switched at layer 2, the QoS group is propagated through the router.
- The following limitations apply when traffic ingresses through any other interface type (host-generated, MLPPP, or HWIC) and egresses through the GigabitEthernet interface.
  - The Precedence bit value is propagated to the CoS bit. The CoS bit value is mapped 1:1 to the QoS group value.

See [Sample QoS Configuration, page 24-8](#) for a sample QoS configuration that accounts for propagation limitations on the Cisco MWR 2941.



### Note

For more information about QoS restrictions for individual interface cards, see the documentation for [Cisco Interface Cards](#).

## Classification Limitations

Table 24-1 summarizes the values that you can use to classify traffic based on interface type. The values are parameters that you can use with the **match** command.

**Table 24-1** QoS Classification Limitations by Interface

	GigabitEthernet		HWIC-9ESW		MLPPP		HWIC-1GE-SFP		HWIC-ADSL		HWIC-SHDSL	
Value	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress
access-group												
all												
any	X					X	X					
any												
class-map												
cos	X						X					
destination-address												
discard-class												
dscp	X					X	X					
flow pdp												
frde												
frdlci												
ip dscp	X						X					
ip precedence												
ip rtp												
mpls experimental						X	X					
not												
packet length												
precedence												
protocol												
qos-group		X										
source-address												
vlan	X											

The following limitations also apply when configuring classification on the Cisco MWR 2941.

- The following limitations apply to input Gigabit Ethernet interface QoS policies:
  - You can use a the **match vlan** command with a maximum of 4 VLANs.
  - You can use the **match dscp** command with a maximum of 4 DSCP values.
  - You cannot use the same match statement more than once in a single class map. For example, you cannot add two **match vlan** commands to a single class map.

- You cannot use the **match cos** and **match dscp** commands together in a single class map.
- Ingress VLAN classification is not supported on switchport interfaces configured as dot1q tunnels using the switchport mode dot1q-tunnel command. We recommend that you configure classification based on CoS, Exp bit, or DSCP.
- The following limitations apply to output Gigabit Ethernet interface QoS policies:
  - Class maps only support matching based on qos-group. This limitation does not apply to the class-default class map.
  - You cannot create two policy maps that match based on the same qos-group value.
- The following limitations apply to input MLPPP interfaces:
  - You can create up to 8 matches in a class-map using DSCP or MPLS Exp values.

## Marking Limitations

Table 24-2 summarizes the values that you can use to mark traffic based on interface type. The values are parameters that you can use with the **set** command.

**Table 24-2** QoS Marking Limitations by Interface

	GigabitEthernet		HWIC-9ESW		MLPPP		HWIC-1GE-SFP		HWIC-ADSL		HWIC-SHDSL	
Value	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress
atm-clp												
cos	X		X									
discard-class												
dscp												
dscp-transmit												
ip dscp	X											
ip precedence												
mpls experimental												
mpls experimental imposition												
mpls experimental imposition qos-group												
precedence												
prec-transmit												
qos-group	X											

## Congestion Management Limitations

The congestion management limitations for the Cisco MWR 2941 are described in the following sections:

- [Queuing Limitations](#)
- [Rate Limiting Limitations](#)

### Queuing Limitations

The Cisco MWR 2941 uses Class-based fair weighted queuing (CBFQ) for congestion management. [Table 24-3](#) summarizes the queuing commands that you can apply when using CBFQ according to interface type.

**Table 24-3** QoS Queuing Limitations by Interface

	GigabitEthernet		HWIC-9ESW		MLPPP		HWIC-1GE-SFP		HWIC-ADSL		HWIC-SHDSL	
Value	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress
bandwidth (kbps)												
bandwidth percent		X				X						
bandwidth remaining percent		X	X			X						
compression header ip												
drop												
fair-queue												
priority		X				X						
priority (kbps)												
priority (without queue-limit)												
priority percent		X				X						
queue-limit (cells)												
queue-limit (packets)		X				X						

### Rate Limiting Limitations

You can use rate limiting for congestion management on the Cisco MWR 2941. [Table 24-4](#) summarizes the rate limiting parameters that you can use with the **police** command according to interface type. The table uses the following terms:

- Rate—A speed of network traffic such as a committed information rate (CIR) or peak information rate (PIR).

- Actions—A defined action when traffic exceeds a rate, such as conform-action, exceed-action, or violate-action.

**Table 24-4** QoS Rate Limiting Limitations by Interface

	GigabitEthernet		HWIC-9ESW		MLPPP		HWIC-1GE-SFP		HWIC-ADSL		HWIC-SHDSL	
Policing with	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress
One rate												
One rate and two actions												
Two rates and two actions												
Two rates and three actions												

## Shaping Limitations

Table 24-5 summarizes the values that you can use to mark traffic based on interface type. The values are parameters that you can use with the **shape** command.

**Table 24-5** QoS Shaping Limitations by Interface

	GigabitEthernet		HWIC-9ESW		MLPPP		HWIC-1GE-SFP		HWIC-ADSL		HWIC-SHDSL	
Value	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress	Ingress	Egress
adaptive												
average		X						X				
fecn-adapt												
max-buffers												
peak												

The following limitations also apply to QoS shaping on the Cisco MWR 2941:

- The following limitations apply to input Gigabit Ethernet interfaces:
  - You cannot apply shaping to the class-default class unless you are using hierarchical policy maps and applying shaping to the parent policy map.
  - If you are using hierarchical policy maps, you can only apply the class-default class to the parent policy map.

## Sample QoS Configuration

The following configuration demonstrates how to apply QoS given the hardware limitations. The Cisco MWR 2941 processes traffic between interfaces as follows:

- For layer 2 traffic passing between the GigabitEthernet 0/2 interface and the GigabitEthernet 0/0 interface, the output queue is determined by the QoS Group assigned in the in-qos policy map.



- For layer 3 traffic passing between GigabitEthernet 0/2 interface and the GigabitEthernet 0/0 interface, the output queue is determined based on the CoS value assigned in the in-qos policy map. (the CoS value is mapped 1:1 to the QoS group value.)
- For traffic passing between other interfaces, the output queue is determined based on the CS fields (top three bits) of the IP DSCP bits; these bits are copied to the CoS bits, which are mapped 1:1 to the QoS group value.

```

!
class-map match-all q0
  match qos-group 0
class-map match-all q1
  match qos-group 1
class-map match-all q2
  match qos-group 2
class-map match-all q3
  match qos-group 3
class-map match-all q4
  match qos-group 4
class-map match-all q5
  match qos-group 5
class-map match-all q6
  match qos-group 6
class-map match-all q7
  match qos-group 7
class-map match-any Voice
  match dscp ef
class-map match-any Signaling
  match dscp af41
class-map match-any HSDPA
  match dscp af11 af12
!
policy-map in-qos
  class Voice
    set cos 5
    set qos-group 5
  class control_plane
    set cos 4
    set qos-group 4
  class HSDPA
    set cos 1
    set qos-group 1
!
policy-map out-child
  class q5
    priority percent 20
  class q4
    bandwidth remaining percent 20
  class q1
    bandwidth remaining percent 59
!
!
policy-map out-parent
  class class-default
    shape average 100000000
    service-policy out-child
!
interface GigabitEthernet 0/2
  switchport access vlan 20
  service-policy input in-qos
!
interface GigabitEthernet 0/0
  switchport trunk allowed vlan 1,10-30,1002-1005

```

```
switchport mode trunk
service-policy output out-parent
```

**Note**

This is a partial configuration intended to demonstrate the QoS feature.

To view other QoS sample configurations see [Sample Quality of Service Configurations](#).

## Configuring Classification

Classifying network traffic allows you to organize packets into traffic classes based on whether the traffic matches specific criteria. Classifying network traffic is the foundation for enabling many QoS features on your network.

### Creating a Class Map for Classifying Network Traffic

Class maps allow you to define classes of network traffic to apply QoS features to each class. Follow these steps to create a class map:

	Command	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"><li>Enter your password if prompted.</li></ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	Router(config)# <b>class-map class1</b>	Defines a new class map and enter class map configuration mode.
Step 4	Router(config-cmap)# <b>match qos-group 7</b>	Specifies the match criteria for the class map. You can define a variety of match criteria including CoS, DSCP, MPLS Exp, or QoS group value.
Step 5	<b>exit</b>  <b>Example:</b> Router(config)# exit Router#	Exits configuration mode.

### Creating a Policy Map for Applying a QoS Feature to Network Traffic

A policy map allows you to apply a QoS feature to network traffic based on the traffic classification. Follow these steps to create and configure a policy map that uses an existing class map:

	Command	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"><li>Enter your password if prompted.</li></ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	Router(config)# <b>policy-map</b> policy1 Router(config-pmap)#	Defines a new policy map and enter policy map configuration mode.
Step 4	Router(config-pmap)# <b>class</b> class1 Router(config-pmap-c)#	Specifies a traffic class to which the policy applies. This command enters policy-map class configuration mode, which allows you to define the treatment for the traffic class.
Step 5	Router(config-pmap-c)# <b>bandwidth</b> <b>percent 50</b>	(Optional) Specifies the bandwidth allocated for a traffic class attached to the policy map. You can define the amount of bandwidth in kbps, a percentage of bandwidth, or an absolute amount of bandwidth.  <b>Note</b> GigabitEthernet interfaces support only bandwidth defined as a percentage or remaining percent.
Step 6	<b>exit</b>  <b>Example:</b> Router(config)# <b>exit</b> Router#	Exits configuration mode.

**Note**

You can use the **show policy-map** command to verify your configuration.

## Attaching the Policy Map to an Interface

After you create the policy map, you must attach it to an interface. Policy maps can be attached to either the input or output direction of the interface. Follow these steps to attach a policy map to an interface:

	Command	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"><li>Enter your password if prompted.</li></ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	Router(config)# <b>interface</b> <b>gigabitEthernet0/1</b>	Specifies the interface to which you want to apply the policy map.

	Command	Purpose
Step 4	Router(config-if)# <b>service-policy</b> <b>output policy1</b>	Attaches the policy map to an interface. The <b>input</b> and <b>output</b> parameters specify the direction in which router applies the policy map.
Step 5	<b>exit</b>	Exits configuration mode.
	<b>Example:</b> Router(config)# exit Router#	

**Note**

You can use the **show policy map** interface command to verify your configuration.

For more information about configuring classification, see the [Quality of Service Solutions Configuration Guide, Cisco IOS Release 15.0S](#).

## Configuring Marking

Marking network traffic allows you to set or modify the attributes for packets in a defined traffic class. You can use marking with traffic classification to configure variety of QoS features for your network.

The Cisco MWR 2941 marking allows you to modify the following packet attributes:

- Differentiated services code point (DSCP) value
- Class of service (CoS) value
- MPLS Exp bit value
- Qos-group value (internal)

For instructions on how to configure marking for IP Precedence, DSCP, or CoS value, use the following sections:

- [Creating a Class Map for Marking Network Traffic, page 24-13](#)
- [Creating a Policy Map for Applying a QoS Feature to Network Traffic, page 24-13](#)
- [Attaching the Policy Map to an Interface, page 24-14](#)

For instructions on how to configure MPLS Exp bit marking, see [Configuring MPLS Exp Bit Marking Using a Pseudowire](#).

## Creating a Class Map for Marking Network Traffic

Class maps allow you to define classes of network traffic to apply QoS features to each class. Follow these steps to define a traffic class to mark network traffic.

	Command	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"><li>Enter your password if prompted.</li></ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	Router(config)# <b>class-map class1</b>	Defines a new class map and enter class map configuration mode.
Step 4	Router(config-cmap)# <b>match qos-group 7</b>	Specifies the match criteria for the class map. You can define a variety of match criteria including CoS, DSCP, MPLS Exp, or QoS group value.
Step 5	<b>exit</b>  <b>Example:</b> Router(config)# <b>exit</b> Router#	Exits configuration mode.

## Creating a Policy Map for Applying a QoS Feature to Network Traffic

Policy maps allow you to apply the appropriate QoS feature to the network traffic based on the traffic classification. The follow sections describe how to create and configure a policy map to use a class map or table map.

The following restrictions apply when applying a QoS feature to network traffic:

- A policy map containing the **set qos-group** command can be attached only as an output traffic policy.
- A policy map containing the **set cos** command can be attached only as an input traffic policy.

Follow these steps to create a policy map.

	Command	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"><li>Enter your password if prompted.</li></ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	Router(config)# <b>policy-map policy1</b> Router(config-pmap)#	Defines a policy map and enter policy map configuration mode.

	Command	Purpose
Step 4	Router(config-pmap)# class class1 Router(config-pmap-c)#	Specifies the traffic class for which you want to create a policy and enter policy map class configuration mode. You can also use the <b>class-default</b> parameter to define a default class.
Step 5	set cos set dscp set qos-group	Defines a QoS treatment type; use one of the <b>set</b> commands listed in <a href="#">Table 6</a> .
Step 6	exit	Exits configuration mode.
	<b>Example:</b> Router(config)# exit Router#	

Table 6 set Commands Summary

set Commands	Traffic Attributes	Network Layer	Protocol
set cos	Layer 2 CoS value of the outgoing traffic	Layer 2	ATM
set dscp	DSCP value in the ToS byte	Layer 3	IP
set qos-group	QoS group ID	Layer 3	IP, MPLS

**Note**

You can use the **show policy-map** or **show policy-map *policy-map* class *class-name*** commands to verify your configuration.

## Attaching the Policy Map to an Interface

Follow these steps to attach a policy map to an interface.

	Command	Purpose
Step 1	enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
	<b>Example:</b> Router> enable	
Step 2	configure terminal	Enters global configuration mode.
	<b>Example:</b> Router# configure terminal	
Step 3	Router(config)# interface gigabitEthernet0/1	Specifies the interface to which to apply the policy map.

	Command	Purpose
Step 4	Router(config-if)# <b>service-policy</b> <b>input</b> policy1	Attaches the policy map to an interface. The <b>input</b> and <b>output</b> parameters specify the direction in which router applies the policy map.
Step 5	<b>exit</b>  <b>Example:</b> Router(config)# exit Router#	Exits configuration mode.

**Note**

You can use the **show policy map** interface command to verify your configuration.

## Configuring MPLS Exp Bit Marking Using a Pseudowire

You can also configure MPLS Exp bit marking within an ATM over MPLS pseudowire interface using the **mpls experimental** command. Follow these steps to configure MPLS Exp bit marking using a pseudowire interface.

	Command	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	Router(config)# <b>pseudowire-class</b> <b>MPLS_3</b>	Creates a new pseudowire class.
Step 4	Router(config-pw-class)# <b>encapsulation mpls</b>	Configures MPLS encapsulation.
Step 5	Router(config-pw-class)# <b>mpls</b> <b>experimental 3</b>	Specifies the MPLS Exp bit value.
Step 6	Router(config-pw-class)# <b>exit</b> Router(config)#	Exits the pseudowire-class interface.
Step 7	Router(config)# <b>interface ATM0/IMA0</b> Router(config-if)#	Configures the ATM/IMA interface.
Step 8	Router(config-if)# <b>pvc 2/1</b> <b>l2transport</b> Router(cfg-if-atm-l2trans-pvc)#	Specifies a PVC.
Step 9	Router(cfg-if-atm-l2trans-pvc)# <b>encapsulation aal0</b>	Specifies an encapsulation type for the PVC.

	Command	Purpose
Step 10	Router(cfg-if-atm-l2trans-pvc)# <b>xconnect 10.10.10.1 121 pw-class MPLS_3</b>	Creates a pseudowire. Use the <b>pw-class</b> keyword to use the configuration defined in the pseudowire class.
Step 11	<b>exit</b>	Exits configuration mode.
	<b>Example:</b> Router(config)# exit Router#	

For more information about configuring marking, see the [Quality of Service Solutions Configuration Guide, Cisco IOS Release 15.0S](#).

**Note**

The Cisco MWR 2941 does not support all of the commands described in the IOS Release 15.0S documentation.

## Configuring Congestion Management

The following sections describe how to configure congestion management on the Cisco MWR 2941.

- [Configuring Low Latency Queueing \(LLQ\), page 24-16](#)
- [Configuring Class-Based Weighted Fair Queuing \(CBFQ\), page 24-17](#)

### Configuring Low Latency Queueing (LLQ)

Low latency queuing allows you to define a percentage of bandwidth to allocate to an interface or PVC as a percentage. You can define a percentage for priority or nonpriority traffic classes. Follow these steps to configure LLQ.

	Command	Purpose
Step 1	<b>enable</b>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
	<b>Example:</b> Router> enable	
Step 2	<b>configure terminal</b>	Enters global configuration mode.
	<b>Example:</b> Router# configure terminal	
Step 3	Router(config)# <b>policy-map policy1</b>	Use the <b>policy-map</b> command to define a policy map.
Step 4	Router(config-pmap)# <b>class class1</b> Router(config-pmap-c)#	Use the <b>class</b> command to reference the class map that defines the traffic to which the policy map applies.



	Command	Purpose
Step 5	Router(config-pmap-c)# <b>priority percent 10</b>	Use the <b>priority</b> command to specify the priority percentage allocated to the traffic class assigned to the policy map. You can use the <b>burst</b> parameter to configure the network to accommodate temporary bursts of traffic.
Step 6	Router(config-pmap-c)# <b>bandwidth percent 30</b>	Use the <b>bandwidth</b> command to specify the bandwidth available to the traffic class within the policy map. You can specify the bandwidth in kbps or by a percentage of bandwidth.
Step 7	<b>exit</b>	Exit configuration mode.
	<b>Example:</b> Router(config)# <b>exit</b> Router#	

**Note**

You can use the **show policy-map**, **show policy-map policy-map class class-name**, or **show policy-map interface** commands to verify your configuration.

## Configuring Class-Based Weighted Fair Queuing (CBWFQ)

The Cisco MWR 2941 supports class-based weighted fair queuing (CBWFQ) for congestion management. Follow these steps to configure CBWFQ.

**Note**

The Cisco MWR 2941 does not support the **queue-limit** and **random-detect** commands.

	Command	Purpose
Step 1	<b>enable</b>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
	<b>Example:</b> Router> <b>enable</b>	
Step 2	<b>configure terminal</b>	Enters global configuration mode.
	<b>Example:</b> Router# <b>configure terminal</b>	
Step 3	Router(config)# <b>class-map class1</b> Router(config-cmap)#	Creates a class map.  A class map contains match criteria against which a packet is checked to determine if it belongs to the class. You can use class maps to define criteria that are referenced in one or more policy maps.
Step 4	Router(config-cmap)# <b>match qos-group 7</b>	Specifies the match criteria for the class map. You can define a variety of match criteria including CoS, DSCP, MPLS Exp, or QoS group value.
Step 5	Router(config-cmap)# <b>exit</b> Router(config)#	Exits class map configuration.
Step 6	Router(config)# <b>policy-map policy1</b> Router(config-pmap)#	Defines a policy map.

	Command	Purpose
Step 7	Router(config-pmap) # <b>class class1</b> Router(config-pmap-c) #	References the class map that defines the traffic to which the policy map is applied.
Step 8	Router(config-pmap-c) # <b>bandwidth 3000</b>	Specifies the bandwidth allocated for the traffic class.
Step 9	Router(config-pmap) # <b>exit</b> Router(config) #	Exits the policy map configuration.
Step 10	Router(config) # <b>interface atm0/ima0</b>	Enters configuration for the interface to which you want to apply the policy map.
Step 11	Router(config-if) # <b>service-policy output policy1</b>	Applies the service policy to the interface.
Step 12	<b>exit</b>	Exits configuration mode.
	<b>Example:</b> Router(config) # <b>exit</b> Router#	

## Configuring Shaping

The Cisco MWR 2941 supports class-based traffic shaping.

Class-based traffic shaping is configured using a hierarchical policy map structure; you enable traffic shaping on a primary level (parent) policy map and other QoS features such as queuing and policing on a secondary level (child) policy map.

The following sections describe how to configure shaping:

- [Configuring Class-Based Traffic Shaping in a Primary-Level \(Parent\) Policy Map](#)
- [Configuring the Secondary-Level \(Child\) Policy Map](#)

### Configuring Class-Based Traffic Shaping in a Primary-Level (Parent) Policy Map

Follow these steps to configure a parent policy map for traffic shaping.

	Command	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	Router(config) # <b>policy-map output-policy</b>	Specifies the policy map for which you want to configure shaping and enter policy-map configuration mode.
Step 4	Router(config-pmap) # <b>class class1</b> Router(config-pmap-c) #	Specifies the traffic class to which the policy map applies.

	Command	Purpose
Step 5	Router(config-pmap-c)# <b>shape</b> [ <b>average</b>   <b>peak</b> ] <i>mean-rate</i> [[ <i>burst-size</i> ] [ <i>excess-burst-size</i> ]]	Defines the algorithm and rate used for traffic shaping.
Step 6	Router(config-pmap-c)# service-policy <i>policy-map</i>	Attaches the policy map to the class map.
Step 7	<b>exit</b>	Exits configuration mode.
	<b>Example:</b> Router(config)# exit Router#	

**Note**

You can use the **show policy-map** command to verify your configuration.

For more information about configuring shaping, see the [Quality of Service Solutions Configuration Guide, Cisco IOS Release 15.0S](#).

**Note**

The Cisco MWR 2941 does not support all of the commands described in the IOS Release 15.0S documentation.

## Configuring the Secondary-Level (Child) Policy Map

Follow these steps to create a child policy map for traffic shaping:

	Command	Purpose
Step 1	<b>enable</b>	Enables privileged EXEC mode. <ul style="list-style-type: none"><li>Enter your password if prompted.</li></ul>
	<b>Example:</b> Router> enable	
Step 2	<b>configure terminal</b>	Enters global configuration mode.
	<b>Example:</b> Router# <b>configure terminal</b>	
Step 3	Router(config)# <b>policy-map</b> <i>output-policy</i>	Specifies the policy map for which you want to configure shaping and enter policy-map configuration mode.
Step 4	Router(config-pmap)# <b>class class1</b> Router(config-pmap-c)#	Specifies the traffic class to which the policy map applies.

	Command	Purpose
Step 5	Router(config-pmap-c)# <b>bandwidth percent 50</b>	Specifies the bandwidth allocated to the policy map. You can specify the bandwidth in kbps, a relative percentage of bandwidth, or an absolute amount of bandwidth.
Step 6	<b>exit</b>	Exits configuration mode.
	<b>Example:</b> Router(config)# <b>exit</b> Router#	

For more information about configuring shaping, see the [Quality of Service Solutions Configuration Guide, Cisco IOS Release 15.0S](#).

**Note**

The Cisco MWR 2941 does not support all of the commands described in the IOS Release 15.0S documentation.

## Configuring Ethernet Trusted Mode

The Cisco MWR 2941 supports trusted and non-trusted mode for switch ports. Switch ports are set in non-trusted mode by default; if you want to set the Ethernet switch ports in trusted mode, use the global command **switch l2trust** to set all Ethernet ports to trusted mode.

```
Router(config)# switch l2trust
```

For more information about the **switch l2trust** command, see the [Cisco MWR 2941 Mobile Wireless Edge Router IOS Command Reference, Release 15.0\(1\)MR](#).

## Configuring Switchport Priority

Follow these steps to configure priority bit values on incoming traffic on 9ESW HWIC interfaces.

	Command	Purpose
Step 1	<b>enable</b>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
	<b>Example:</b> Router> <b>enable</b>	
Step 2	<b>configure terminal</b>	Enters global configuration mode.
	<b>Example:</b> Router# <b>configure terminal</b>	
Step 3	Router(config)# <b>interface FastEthernet 1/7</b>	Enter interface configuration.

	Command	Purpose
Step 4	<b>Router(config-if)# switchport priority default <i>priority</i></b>  <b>Example:</b> Router(config-if)# <b>switchport priority default 7</b>	Configures a default priority value to apply to incoming traffic on the interface.
Step 5	<b>Router(config-if)# switchport priority override</b>	(Optional) Configures the interface to override the priority value set on inbound traffic.
Step 6	<b>exit</b>  <b>Example:</b> Router(config)# <b>exit</b> Router#	Exits configuration mode.

## Sample Quality of Service Configurations

The following sample configurations demonstrate how you can apply QoS configurations on the Cisco MWR 2941.



### Note

This section provides partial configurations intended to demonstrate a specific feature.

The following sections provide sample configurations for QoS on the Cisco MWR 2941.

- [Switchport Priority](#)
- [Classification and Marking](#)
- [Priority Queuing](#)

For more information about configuring QoS, see “[Configuring Quality of Service](#)” section on [page 24-1](#).

## Switchport Priority

The following sample configuration demonstrates how to mark P-bit values on incoming traffic on the 9ESW HWIC interface.

```

.....
interface GigabitEthernet0/2
no ip address
  switchport stacking-partner interface FastEthernet1/8
.....
interface FastEthernet1/7
switchport mode trunk
switchport priority default 7 ! sets all ingress traffic to priority 7
switchport priority override

interface FastEthernet1/7
switchport mode access
switchport access vlan 100
switchport priority default 5    ! set all ingress traffic to priority 5

```

```

interface FastEthernet1/8
no IP address
switchport stacking-partner interface GigabitEthernet0/2

```

## Classification and Marking

The following configuration example marks the DSCP value of ingress Ethernet traffic and assigns it to a QoS group, and marks P-bits. Egress traffic is queued using WRR with bandwidth percentages allocated to each group.

```

! Note 1: these class-maps are applied on ingress
class-map match-any common-channels
  match dscp af31 af32 af33
class-map match-any HSDPA
  match dscp default
class-map match-any R99
  match dscp af21 af22 af23
class-map match-any synchronization
  match dscp ef cs6
class-map match-any signaling
  match dscp af41 af42 af43
!
! Note 2: these classsp-maps are applied on egress
class-map match-any group1
  match qos-group 1
class-map match-any group2
  match qos-group 2
class-map match-any group3
  match qos-group 3
class-map match-any group4
  match qos-group 4
class-map match-any group5
  match qos-group 5
class-map match-any group6
  match qos-group 6

! Note 3:The input policy performs the DSCP match and all marking
policy-map input-policy
  class synchronization
    set qos-group 6
    set cos 6
  class signaling
    set qos-group 5
    set cos 5
  class common-channels
    set qos-group 4
    set cos 4
  class R99
    set qos-group 3
    set cos 3
  class HSDPA
    set qos-group 1
  class default
    set qos-group 1
!
! Note 4: the hierarchical output policy handles WRR and shaping
policy-map QOS-child
  class group6
    priority percent 5

```

```

class group5
  bandwidth percent 20
class group4
  bandwidth percent 20
class group3
  bandwidth percent 20
class group1
  bandwidth percent 20
policy-map output-policy
class class-default
  shape average 38000000
  service-policy QoS-child
!
Interface GigabitEthernet 0/0
  service-policy input  input-policy
Interface GigabitEthernet 0/1
  service-policy output output-policy

```

## MPLS Bit Marking

The following configuration example marks MPLS Exp bits on traffic passing through pseudowire class UMTS\_3. You can map the Exp bit value to a QoS group on an MLPPP egress interface or an MLPPP or layer 2 Ethernet queue.

```

!
pseudowire-class UMTS_3
encapsulation mpls
mpls experimental 3
!
interface ATM0/IMA0
  pvc 2/1 12transport
  encapsulation aal0
  xconnect 10.10.10.1 121 pw-class UMTS_3
!
!

```

## Priority Queuing

The following sample configuration places any traffic with a DSCP value of **ef** into the priority queue of the MLPPP multilink interface.

```

class-map match-any gsm-abis
  match dscp ef
!
!
policy-map gsm-abis ? note that without multiclass up to 4 queues supported
class gsm-abis
  priority percent 99
class class-default
  bandwidth remaining percent 1
!

interface Multilink1
ip address 50.50.50.49 255.255.255.0
ip tcp header-compression ietf-format
load-interval 30
keepalive 1
ppp pfc local request

```

```
ppp pfc remote apply
ppp acfc local request
ppp acfc remote apply
ppp multilink
ppp multilink interleave
ppp multilink group 1
ppp multilink fragment delay 0 1
ppp multilink multiclass
ppp timeout multilink lost-fragment 1
max-reserved-bandwidth 100
service-policy output gsm-abis
hold-queue 50 out
ip rtp header-compression ietf-format
```