

## Chapter 26

# Configuring IP Multicast Bandwidth Adjustment with QoS Parameters

This chapter provides information for configuring quality of service (QoS) parameters on E-series routers.

QoS parameters are discussed in the following sections:

- IP Multicast Bandwidth Adjustment for QoS Overview on page 263
- Guidelines for Configuring IP Multicast Adjustment for QoS on page 265
- Configuring a Parameter Definition for IP Multicast Bandwidth Adjustment on page 265
- Example: QoS Parameter Configuration for IP Multicast Bandwidth Adjustment on page 267

## IP Multicast Bandwidth Adjustment for QoS Overview

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You can associate the IP multicast bandwidth adjustment application (**ip-multicast**) with a parameter definition. Before you begin, you must define a multicast bandwidth map and the QoS adjustment for a virtual router.

You use the IP multicast bandwidth adjustment application to set the shared-shaping rate for a subscriber when a downstream DSLAM is replicating a multicast frame for multiple downstream transmissions on a subscriber circuit. In this case, the router does not schedule the multicast traffic on a subscriber VLAN, but limits the scheduled non-multicast traffic on the subscriber VLAN so that the total of non-multicast and multicast traffic at the DSLAM is less than the subscriber shared-shaping rate.

To implement this, the IP multicast bandwidth adjustment application tracks the bandwidth of multicast flows based on IGMP joins and leaves. When the QoS administrator configures a QoS parameter with the IP multicast bandwidth adjustment application, the application automatically configures an instance of that parameter for each subscriber that is receiving multicast traffic. The value of the parameter instance is equal to the multicast bandwidth for a subscriber at a specific time. The shared-shaping rate of the VLAN node can be configured using a parameter expression such as `max-subscriber-bandwidth - ip-multicast-bandwidth`.

In a typical IP multicast bandwidth adjustment configuration, the shaping rate or shared-shaping rate is determined by calculating the total subscriber bandwidth of the logical interface minus the ip-multicast bandwidth. To enable the IP multicast QoS adjustment, you must:

- Define a qos-parameter using the **qos-parameter-define** command with the application **ip-multicast** and the **hierarchical** keyword.

```
host1(config)# qos-parameter-define ipm application ip-multicast hierarchical
host1(config-qos-parameter-define)#
```

- Reference the ipm parameter within a scheduler profile. For example:

```
host1(config)#scheduler-profile totalSubscriberBw
host1(config-scheduler-profile)#shared-shaping-rate 10000000 - ipm auto
```

This scheduler profile contains an expression for the shared-shaping rate that limits the shared-shaping rate to 10 Mbps less the rate of any IP multicast traffic.

- Reference the scheduler profile within a QoS profile rule. For example:

```
host1(config)#qos-profile subscriber
host1(config-qos-profile)#vlan node scheduler-profile totalSubscriberBw
```

This QoS profile rule limits a subscriber with vlan to the rate specified in the totalSubscriberBw scheduler profile.

QoS clients do not need to create a parameter instance to activate the IP multicast bandwidth adjustment application. The system automatically creates explicit instances based on IGMP joins and leaves.

When a subscriber logs in, the QoS scheduler hierarchy is created with the vlan configured for shared shaping, based on the expression 10000000 - ipm. If no multicast traffic is being transmitted, there is no ipm parameter instance with the vlan.

To calculate the subscriber bandwidth from the total subscriber bandwidth, you must create a global parameter instance using the **ip-multicast** keyword and set the value to 0.

To ensure the system can locate an instance of the ipm parameter for subscribers that are not receiving multicast traffic, you must create a global parameter with a value of 0:

```
host1(config)# qos-parameter ipm 0
```

If you do not create the global parameter instance, the expression result is undefined for these subscribers and the shared shaping rate is not set.

By configuring a global parameter instance of 0, the value is applied to all the interfaces that reference the parameter. QoS overrides the global ipm parameter instance with the value specified in the bandwidth map for a specific IP interface on which IGMP joins.

## Related Topics

- Guidelines for Configuring IP Multicast Adjustment for QoS on page 265
- For more information about multicast bandwidth maps and QoS adjustment, see *JUNOS Multicast Routing Configuration Guide, Chapter 1, Configuring IPv4 Multicast* and *JUNOS Multicast Routing Configuration Guide, Chapter 5, Configuring IPv6 Multicast*
- For more information about configuring scheduler rates for QoS parameters, see *Scheduler Profiles and Parameter Expressions for QoS Administrators* on page 229

## Guidelines for Configuring IP Multicast Adjustment for QoS

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When you specify the IP multicast bandwidth adjustment application, the following considerations apply:

- You must specify a controlled-interface type.
- You cannot specify any instance-interface types or subscriber-interface types. By default, the system assigns a default instance-interface type of ip.
- When you specify the IP multicast bandwidth adjustment application, the parameter definition is hierarchical. You must specify the **hierarchical** keyword with the **application** keyword.
- The system prevents you from defining more than one parameter definition with the **ip-multicast** application specified. For example:

```
host1(config)#qos-parameter-define vpShaper application ip-multicast
hierarchical
host1(config-qos-parameter-define)#controlled-interface-type ip
host1(config-qos-parameter-define)#exit
host1(config)#qos-parameter-define bar application ip-multicast hierarchical
% there cannot be more than one parameter defined with this property
```

- Parameter instances associated with the IP multicast bandwidth adjustment application are not stored in non-volatile storage (NVS). (Parameter definitions are stored in NVS.) Because the application is activated based on IGMP joins and leaves received on an interface, the system removes the instances when you turn off or reset the router, then re-creates it based on new messages received on an interface.

## Configuring a Parameter Definition for IP Multicast Bandwidth Adjustment

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Before you configure a parameter definition for IP multicast bandwidth:

- Define a multicast bandwidth map and the QoS adjustment for a virtual router.

See *JUNOS Multicast Routing Configuration Guide, Chapter 1, Configuring IPv4 Multicast* and *JUNOS Multicast Routing Configuration Guide, Chapter 5, Configuring IPv6 Multicast*.

To associate a parameter instance with the IP multicast bandwidth adjustment application:

1. Configure traffic classes.

```
host1(config)#traffic-class voice
host1(config-traffic-class)#exit
host1(config)#traffic-class best-effort
host1(config-traffic-class)#exit
```

2. Create a parameter definition.

- a. Configure the QoS parameter name and the application.

```
host1(config)#qos-parameter-define ipm application ip-multicast hierarchical
```

- b. Configure a controlled-interface type.

```
host1(config-qos-parameter-define)#controlled-interface-type vlan
host1(config-qos-parameter-define)#exit
```

3. Create a parameter instance that globally defines the value of the IP multicast adjustment as 0.

```
host1(config)#qos-parameter ipm 0
```

4. Reference the parameter within a scheduler profile parameter expression.

```
host1(config)#scheduler-profile vlan-subscriber
host1(config-scheduler-profile)#shared-shaping-rate 1000000 - ipm burst 50
milliseconds auto
host1(config-scheduler-profile)#exit
```

5. Add the scheduler profile to a QoS profile.

```
host1(config)#qos-profile vlan-subscriber
host1(config-qos-profile)#vlan queue traffic-class best-effort
host1(config-qos-profile)#vlan queue traffic-class voice scheduler-profile 192k
host1(config-qos-profile)#vlan node scheduler-profile vlan-subscriber
host1(config-qos-profile)#exit
```

6. Attach the parameter definition to a logical interface.

```
host1(config)#interface gigabitEthernet 7/0
host1(config-if)#encapsulation vlan
host1(config-if)#exit
host1(config)#interface gigabitEthernet 7/0.1
host1(config-if)#vlan id 200
host1(config-if)#qos-profile vlan-subscriber
host1(config-if)#ip address 1.1.1.1 255.255.255.0
```

After the QoS profile is attached to the interface, the IP multicast bandwidth adjustment application begins to adjust rates based on IGMP joins and leaves received on that interface.

## Related Topics

- IP Multicast Bandwidth Adjustment for QoS Overview on page 263
- Example: QoS Parameter Configuration for IP Multicast Bandwidth Adjustment on page 267
- **controlled-interface-type** command
- **node** command
- **qos-parameter-define** command
- **qos-profile** command
- **queue** command
- **scheduler-profile** command
- **shared-shaping-rate** command
- **traffic-class** command

## Example: QoS Parameter Configuration for IP Multicast Bandwidth Adjustment

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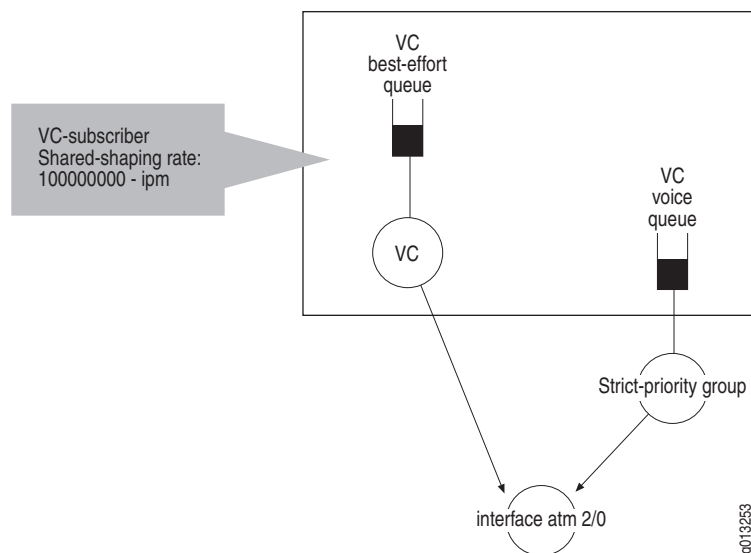
In this example, a QoS administrator configures a QoS parameter definition to associate with the IP multicast bandwidth adjustment application.

The QoS administrator configures the parameter definition to perform the QoS adjustment on an ATM VC subscriber. By specifying the **ip-multicast** keyword with the **qos-parameter-define** command, the IP parameter instances are created when the Internet Group Management Protocol (IGMP) joins and leaves.

When you specify a controlled-interface type for atm-vc, the system explicitly creates a parameter instance at the ATM VC with a value that is equal to the sum of the IP adjustments above this interface. This parameter value is referred by a scheduler profile and a QoS profile to create the QoS scheduler hierarchy that adjusts the shared-shaping rate when IGMP joins and leaves.

This subscriber has data, voice, and video service with total subscriber bandwidth of 10 Mbps. Voice traffic is shaped at 192 Kbps and belongs to the strict priority group. Video traffic is provided by the IP multicast bandwidth adjustment application and its rate is configured in the bandwidth map.

Figure 61 shows the scheduler hierarchy built in this configuration.

**Figure 61: Scheduler Hierarchy with QoS Adjustment for IP Multicast**

### Configuring Traffic Classes and Traffic-Class Groups

The QoS administrator configures the traffic classes and traffic-class groups for best-effort data and voice services. The QoS administrator does not need to configure a traffic class for the video service because it is transmitted through the IP multicast connection.

1. Configure the traffic classes.
  - a. Configure the traffic class named best-effort.
  - b. Configure the traffic class named voice.

```

host1(config)#traffic-class voice
host1(config-traffic-class)#exit

host1(config)#traffic-class best-effort
host1(config-traffic-class)#exit

```
2. Configure a traffic-class group for low-latency expedited forwarding (EF) and add the traffic class for voice service into the traffic-class group EF.
  - a. Configure the EF traffic-class group with strict-priority scheduling.
  - b. Add the traffic class voice to the traffic-class group.

```

host1(config)#traffic-class-group EF auto-strict-priority
host1(config-traffic-class-group)#traffic-class voice
host1(config-traffic-class-group)#exit

```

The remaining traffic class, best-effort, remains in the default traffic-class group.

#### Configuring the QoS Parameter Definition and Global Parameter Instance

The QoS administrator configures the QoS parameter definition and specifies the IP multicast bandwidth adjustment application. The QoS administrator must configure the parameter as hierarchical.

The QoS scheduler hierarchy is constructed when the subscriber logs on. However, because the parameter instance has not yet been created, the shared-shaping rate is undefined (that is, there is no shaping rate).

Therefore, the QoS administrator creates a global parameter instance to shape the subscriber to the desired bandwidth. The initial value is determined based on the application; in this example, the QoS administrator specifies 0 as the default.

1. Configure the QoS parameter definition ipm, associate it with the ip-multicast application, and assign it as a hierarchical parameter.
2. Configure a controlled-interface type of atm-vc.
3. Configure the global parameter instance.

```

host1(config)#qos-parameter-define ipm application ip-multicast hierarchical
host1(config-qos-parameter-define)#controlled-interface-type atm-vc
host1(config-qos-parameter-define)#exit
host1(config)#qos-parameter ipm 0

```

Therefore, the initial shared-shaping rate is 10 Mbps (10 Mbps - ipm value of 0).

#### Reference the Parameter Definition Within a Scheduler Profile

The QoS administrator configures the scheduler profile for the ATM VC subscriber and configures the shared-shaping rate. When a scheduler profile references the parameter instance, it enables the IP multicast bandwidth adjustment application to adjust the subscriber bandwidth to account for the video traffic.

The QoS administrator then configures the scheduler profile to shape voice traffic.

1. Configure the scheduler profile for the ATM VC subscriber.
  - a. Configure the scheduler profile named vc-subscriber.
  - b. Configure the shared-shaping rate by referencing an expression to limit the subscriber bandwidth to 10 Mbps.

```

host1(config)#scheduler-profile vc-subscriber
host1(config-scheduler-profile)#shared-shaping-rate 10000000 - ipm burst 50
milliseconds auto
host1(config-scheduler-profile)#exit

```

2. Configure the scheduler profile for shaping voice traffic.

- a. Configure the scheduler profile named 192K.

- b. Configure the shaping rate at 1920000.

```
host1(config)#scheduler-profile 192K
host1(config-scheduler-profile)#shaping rate 192000
host1(config-scheduler-profile)#exit
```

#### **Adding the Scheduler Profiles to a QoS Profile**

The IP multicast adjustment application is initialized when IGMP joins or leaves. The QoS administrator specifies the scheduler hierarchy by using a QoS profile rule that refers to a scheduler profile with a parameter expression.

1. Create the QoS profile named ipm-adjusted.
2. Configure a queue for ATM VC subinterfaces with the best-effort traffic class.
3. Configure a queue for ATM VC subinterfaces with the voice traffic class and reference the 192K scheduler profile.
4. Configure a node for ATM VC subinterfaces and reference the scheduler profile vc-subscriber.

```
host1(config)#qos-profile ipm-adjusted
host1(config-qos-profile)#atm-vc queue traffic-class best-effort
host1(config-qos-profile)#atm-vc queue traffic-class voice scheduler-profile 192k
host1(config-qos-profile)#atm-vc node scheduler-profile vc-subscriber
host1(config-qos-profile)#exit
```

#### **Attaching the Parameter Definition to an Interface**

The QoS administrator creates a logical interface and attaches the parameter definition. The scheduler hierarchy is created when the QoS administrator creates the interface.

1. Configure the ATM interface in slot 2, port 0 as a point-to-point ATM interface.
2. Configure the ATM PVC with aal5snap encapsulation.
3. Attach the QoS profile vc-subscriber to the subinterface.
4. Configure the IP address for the ATM subinterface.

```
host1(config)#interface atm 2/0
host1(config-if)#interface atm 2/0.1 point-to-point
host1(config-subif)#atm pvc 100 0 100 aal5snap
host1(config-subif)#qos-profile ipm-adjusted
host1(config-subif)#ip address 1.1.1.1 255.255.255.0
```

#### **IP Multicast Bandwidth Adjustment**

When an IGMP join occurs, the IP multicast bandwidth adjustment application creates the parameter instance ipm for the IP interface and the ATM VC subinterface. Because the shared-shaping rate of the ATM VC references the ipm parameter, the rate is recalculated. If the ipm parameter has a value of 2 Mbps, the resulting shared-shaping rate is 8 Mbps (10 Mbps - 2 = 8 Mbps).



When another IGMP join occurs, the IP multicast bandwidth adjustment application recalculates the value for parameter `ipm` and configures it to another value (for example, 7 Mbps). The system readjusts the `ipm` at the ATM VC and readjusts the shared-shaping rate. If the voice traffic is 100 Kbps, then the best-effort traffic is 2.9 Mbps.

When an IGMP leave occurs, the IP multicast bandwidth adjustment application configures the `ipm` parameter instance with a new value and readjusts the shared-shaping rate.

## Monitoring the Configuration

After completing the configuration, the QoS administrator can monitor it by issuing **show** commands.

1. To display the traffic classes for best-effort and voice, issue the **show traffic-class** command.

```
host1#show traffic-class
```

traffic class	fabric weight	fabric strict priority
best-effort	8	no
voice	8	no

2. To display the traffic-class group, issue the **show traffic-class-group** command.

```
host1#show traffic-class-group
traffic-class-group EF auto-strict-priority
traffic-class voice
```

3. To display the scheduler profile settings for vc-subscriber and 192K, issue the **show scheduler-profile** command.

```
host1#show scheduler-profile
```

scheduler	shaping rate	shaping burst	weight	strict priority	assured rate
default	<none>	<none>	8	no	<none>
vc-subscriber	<none>	<none>	8	no	<none>
192k	192000	default	8	no	<none>

scheduler	shared shaping rate	shared shaping burst	shared shaping constituent	shared shaping mode
default	<none>	<none>	<none>	<none>
vc-subscriber	10000000 - ipm	50 bytes	<none>	simple implicit
192k	<none>	<none>	<none>	<none>

4. To display the attachments on all QoS profiles, including ipm-adjust, issue the **show qos-profile references** command.

```
host1#show qos-profile references
      qos profile                               attachment
-----
atm-default      (qos-port-type-profile)
serial-default   (qos-port-type-profile)
ethernet-default (qos-port-type-profile)
server-default   (qos-port-type-profile)
ipm-adjust       atm-vc ATM2/0.1

Port attachments:      4
Interface attachments: 1
Not attached:          0
```

5. To display the settings for the ipm-adjust QoS profile, issue the **show qos-profile** command.

```
host1#show qos-profile ipm-adjust
qos-profile ipm-adjust:
t-class interface rule      traffic      scheduler      queue      drop      statistics
group      type      type      class      profile      profile      profile      profile
-----
          atm-vc      node          vc-subscriber
          atm-vc      queue best-effort default      default default default
EF        atm-vc      queue voice    192k        default      default default
```

6. To display the settings for the ipm QoS parameter definition, issue the **show qos-parameter-define** command.

```
host1#show qos-parameter-define
      controlled instance subscriber
parameter interface interface interface value
      name      types      types      types      range
-----
ipm      atm-vc      <none>      <none>      <none>

parameter
name      properties
-----
ipm      ip-multicast-adjustment, hierarchical
```

7. To display global and interface attachments on the ipm QoS parameter instance, issue the **show qos-parameter references** command.

```
host1#show qos-parameter references
      parameter
interface name      value
-----
global    ipm        0

Global parameter instances: 1
Parameter instances reported: 1
```

```
host1#show qos-parameter references interface atm 1/0.1
```

interface	parameter name	value	instance Type
atm-vc ATM1/0.1	ipm	200	hierarchical
ip ATM1/0.1	ipm	200	ip-multicast

```
Explicit parameter instances:      0
Heirarchical parameter instances: 1
IP multicast parameter instances: 1
Parameter instances reported:     2
```

8. To display the queue forwarding rates for the ATM VC and IP interfaces on the ATM interface in slot 2, port 0, issue the **show egress-queue rates** command.

```
host1#show egress-queue rates interface atm 2/0.1
```

interface	traffic class	forwarded rate	aggregate drop rate	minimum rate	maximum rate
atm-vc ATM2/0.1	voice	0	0	192000	192000
ip ATM2/0.1	best-effort	0	0	0	10000000

```
Queues reported:                2
Queues filtered (under threshold): 0
* Queues disabled (no rate period): 0
**Queues disabled (no resources): 0
Total queues:                   2
```

9. To display the shared shaper settings for the ATM VC on the ATM interface in slot 2, port 0, issue the **show qos shared-shaper** command.

```
host1#show qos shared-shaper interface atm 2/0.1
```

interface	resource	shared shaping rate	shaping rate	other
atm-vc ATM2/0.1	A atm-vc node	10000000		rate 10000000
	A atm-vc queue EF voice		192000	

```
Total shared shapers:      1
Total constituents:        2
Total shared shaper failovers: 0
Compound shared shapers are supported.
```

## Complete Configuration Example

You can use the complete configuration examples provided for each of the configurations in your own network. To customize the configuration example for your needs, copy the text into a text editor, and modify it.

To use the example for immediate use, copy it to the local console or Telnet session from which you access the router.

You can also save the example as a script (.scr) file that executes the commands as though they were entered at the terminal. For information about executing .scr files, see *JUNOS System Basics Configuration Guide, Chapter 2, Command-Line Interface*.

From Global Configuration mode:

```

! Create the voice traffic class.
traffic-class voice
exit
traffic-class best-effort
exit
traffic-class-group EF auto-strict-priority
traffic-class best-effort
exit
! Create the ipm QoS parameter definition.
qos-parameter-define ipm application ip-multicast hierarchical
controlled-interface-type atm-vc
exit
! Create a global parameter instance of the ipm QoS parameter.
qos-parameter ipm 0
! Configure the vc-subscriber and 192K scheduler profiles.
scheduler-profile vc-subscriber
shared-shaping-rate 10000000 - ipm burst 50 milliseconds auto
exit
scheduler-profile 192K
shaping-rate 192000
exit
! Add the scheduler profiles to the ipm-adjusted QoS profile.
qos-profile ipm-adjusted
atm-vc queue traffic-class best-effort
atm-vc queue traffic-class voice scheduler-profile 192k
atm-vc node scheduler-profile vc-subscriber
exit
! Attach the parameter definition to an interface.
interface atm 2/0.1 point-to-point
atm pvc 100 0 100 aal5snap
qos-profile ipm-adjusted
ip address 1.1.1.1 255.255.255

```

## Related Topics

- [IP Multicast Bandwidth Adjustment for QoS Overview on page 263](#)