Chapter 9

Shared Shaping Overview

This chapter provides information for configuring shared shaping of traffic on the E-series router.

QoS topics are discussed in the following sections:

Shared Shaping Overview

In the JUNOSe software QoS implementation, you configure a traffic-class group to create a separate scheduler hierarchy. Traffic classes in a traffic-class group are queued through a scheduler hierarchy dedicated to that group. QoS supports up to five user-configurable, named traffic-class groups. Traffic classes that do not belong to any named group belong to the default traffic-class group. With the factory default configuration, the best-effort traffic class is in the default traffic-class group.

Shared shaping is a mechanism for shaping a logical interface's aggregate traffic to a rate when the traffic for that logical interface is queued through more than one scheduler hierarchy. For example, a service provider can configure QoS for voice, video, and data traffic on a single ATM VC. The video traffic and the voice traffic are placed in separate scheduler hierarchies from the data traffic to provision the low latency that is required for voice traffic and the higher bandwidth that is required for video traffic.

In this scenario, the data traffic needs to be dynamically shaped so that its rate matches the bandwidth available after the voice and video bandwidth requirements are met. When less voice and video traffic is being forwarded, then the data traffic can expand to fill the line rate.

When determining a shared shaping rate, the system includes all bytes in Layer 2 encapsulations. The packets that are included in the rate depend on the node specified. For example, rates for an Ethernet node include the Ethernet and VLAN encapsulations.

Shared shaping is typically enabled on the access-facing line module, but you can enable the feature for any interface type recognized by QoS, on any line module and any E-series router.

Related Topics

- Simple Shared Shaping Overview on page 81
- Compound Shared Shaping Overview on page 103

Shared Shaper Terms

Table 7 defines terms used in this discussion of shared shaping.

Table 7: Shared Shaper Terminology Used in This Chapter

Term	Description
Constituent	Scheduler node or queue associated with a logical interface. A shared shaper is configured for a logical interface; all queues and scheduler nodes associated with that logical interface are constituents of the shared shaper.
Active constituent	Constituent that is monitored or controlled by the shared shaper mechanism.
Inactive constituent	Constituent that is ignored by the shared shaper mechanism. Inactive constituents can be indirectly controlled; for example, queues stacked above a node that is an active constituent.
Shared Shaping	Mechanism for shaping a logical interface's aggregate traffic to a rate when the traffic for that logical interface is queued through more than one scheduler hierarchy.
Implicit shared shaper	Shared shaper where the system automatically selects the active constituents. The system selects scheduler nodes as active; queues above nodes remain inactive.
Explicit shared shaper	Shared shaper where you select the active constituents by issuing the **shared-shaping-constituent** command in a scheduler profile.
Compound shared shaping	Hardware-assisted mechanism that controls bandwidth for all active constituents.
Simple shared shaping	Software-assisted mechanism that measures the rate of active constituents, and shapes the rate of the best-effort node or queue to the residual shared-shaping rate.

Related Topics

- For definitions of other common QoS terms, see *QoS Terms* on page 5

How Shared Shaping Works

You can configure the shared-shaping rate on either the best-effort scheduler node or the best-effort queue for the logical interface. The router also locates the queues in named traffic-class groups that are associated with the logical interface and shapes that set of queues to the shared rate. The shared-shaping rate is the total bandwidth for the logical interface.

A typical configuration places the low-latency voice traffic in the auto-strict-priority traffic-class group and video traffic in a separate extended traffic-class group. The data traffic is usually queued in the best-effort traffic class in the default traffic-class group.

The constraints of both the legacy hierarchical scheduler and the shared shaper affect the bandwidth of scheduler objects. The shared shaper limits the bandwidth even when the port or VP is not congested. When the port or VP is congested, the legacy scheduler is dominant. For example, when a heavily oversubscribed VP becomes congested, the legacy hierarchical scheduler may limit the VP bandwidth to a lower rate, so that shared shaping of excess bandwidth does not apply.

When determining the shared-shaping rate, the system includes all bytes in Layer 2 encapsulations. The packets that are included in the rate depend on the Layer 2 node that is specified in the QoS profile. For example, the shaping rate for an Ethernet node includes bytes from the Ethernet and VLAN encapsulations.

Two types of shared shaping are available, depending on your hardware. *Simple* shared shaping can shape the best-effort node or queue associated with a logical interface to a shared rate. *Compound* shared shaping is a hardware-assisted mode that controls bandwidth for all scheduler objects associated with the subscriber logical interface.

Table 8 compares the two types of shared shaping that are available.

Table 8: Comparison of Simple and Compound Shared Shaping

Shared Shaper	Advantages
Simple	■ Simple shared shaping is useful for triple-play configurations, because it manages voice and video queues in addition to data queues so that the shared rate cannot be exceeded. ■ You can use line modules that have any ASIC hardware.
Compound	■ Compound shared shaping is useful for triple-play configurations, because it manages voice and video queues in addition to data queues so that the shared rate cannot be exceeded. ■ Compound shared shaping responds to changes in traffic rates more rapidly than simple shared shaping, in the order of milliseconds. ■ You can use line modules with the EFA2 ASIC or the TFA ASIC.

Active Constituents for Shared Shaping

When you specify a shared-shaping rate on a best-effort node or queue, QoS shapes the aggregate of traffic for the logical interface that owns the best-effort queue or node. QoS locates the queues and nodes owned by that logical interface and applies the shared shaper to them. The nodes and queues owned by the interface are called the *constituents* of the shared-shaper instance. For example, if the logical interface type is VC, the constituents are all VC objects: VC nodes and VC queues. A shared-shaping rule in a profile can apply to up to eight constituents.

Active constituents are actively controlled by the shared-shaper mechanism. *Inactive* constituents are indirectly controlled. For example, when ATM VC queues are stacked above an ATM VC node, the ATM VC node might be an active constituent. In this case, the queues stacked above the node are shaped to the shared rate indirectly by the hierarchical scheduler. If the ATM VC queues are the active constituents, then the ATM VC node is inactive.

Related Topics

- Simple Shared Shaping Overview on page 81
- Compound Shared Shaping Overview on page 103
- Constituent Selection for Shared Shaping Overview on page 113

Guidelines for Configuring Simple and Compound Shared Shaping

When you configure shared shaping, be sure to consider the following behaviors.

Shared Shaping and Individual Shaping

You can use both the **shared-shaping-rate** command and the **shaping-rate** command in a single scheduler profile. For example, you can shape the best-effort node or queue to accept less than the remainder of the shared-shaping rate as in the following commands:

```
(config)#scheduler-profile shared-1mbps
(config-scheduler-profile)#shared-shaping-rate 1000000 simple
(config-scheduler-profile)#shaping-rate 500000
```

If you configure a shaping rate higher than the shared-shaping rate, the rate never exceeds the shared rate, so the router issues the following error message:

```
% shaping-rate cannot be greater than the shared-shaping-rate
```

Although you can configure a shared-shaping rate and a shaping rate in the same scheduler profile, the shaping rate must not exceed the shared-shaping rate. A scheduler profile that includes a shaping rate must not contain a shared-shaping rate that specifies a constituent as weighted.

Shared Shaping and Best-Effort Queues and Nodes

A scheduler profile that includes a shared-shaping rate cannot be associated with a queue other than the best-effort queue or a node other than the best-effort node.

A scheduler profile that is referenced by nodes or queues that are not best effort cannot be modified to include a **shared-shaping rate** command. A scheduler profile that includes a **shared-shaping rate** command cannot be associated with a group node.

ATM and Shared Shaping

When you configure shared shaping with ATM, be sure to consider the following behaviors.

Sharing Bandwidth with the SAR

On ATM line modules, providers can use the SAR to implement bandwidth sharing for VCs. When the SAR is operating in default mode (that is, when the **no qos-mode-port** command is in effect), the SAR backpressures the VC node in the default traffic-class group, but traffic that is queued through a named traffic-class group is unaffected by VC backpressure. In the absence of voice and video traffic, the VC runs data traffic at the shared rate. When voice and video traffic start streaming, the SAR backpressures just the VC node in the default traffic-class group, thus sharing the bandwidth.

However, providers need to configure shared shaping on more than just ATM VCs. The SAR cannot support shared shaping per virtual path on ATM, and there is no SAR on Ethernet line modules. The shared shaper implemented in the HRR scheduler can support shared shaping for all these different configurations.

Shared Shaping and Low-CDV Mode

JUNOSe releases before Release 6.0.0 implemented a *carve-out* scheduling model. If you configured multiple scheduler nodes for a VC or VP, the router added together the shaping rates for each scheduler node and shaped the corresponding VC or VP tunnel in the SAR to the sum of the rates. This implementation forced a strict-priority carve-out model for a logical interface, because the best-effort traffic cannot share unused bandwidth from the strict-priority traffic-class group.

Beginning with JUNOSe Release 6.0.0, the router synchronizes the SAR rate for a VC or VP to the shared-shaping rate for the best-effort scheduler node for the VC or VP, so that the default behavior for low-CDV mode becomes shared shaping. Applying shared shaping to the best-effort queue does not synchronize the rate for the corresponding VC or VP in the SAR.

JUNOSe releases before Release 6.1.0 had a different behavior than the current shared shaping model when multiple traffic-class groups were configured in low-CDV mode. In those releases, the shaping rates of the VC nodes in each group were added together, and the corresponding VC queue in the SAR was shaped to the sum. The same algorithm was used for shaping VP tunnels in the SAR—the shaping rates of all VP nodes in the hierarchical scheduler were added together to shape the VP tunnel in the SAR. This behavior implements a carve-out model for scheduling into VPs and VCs and generally is not as desirable as the shared shaping model supported in JUNOSe Release 6.1.0 and later releases.

Beginning with JUNOSe Release 6.1.0, low-CDV mode causes SAR shaping of VCs and VPs only when you specify the **shared-shaping-rate** command for the best-effort VC or VP node in the HRR scheduler.

For more information about configuring low-CDV mode, see *Chapter 19, Configuring an Integrated Scheduler to Provide QoS for ATM*.

Logical Interface Traffic Carried in Other Queues

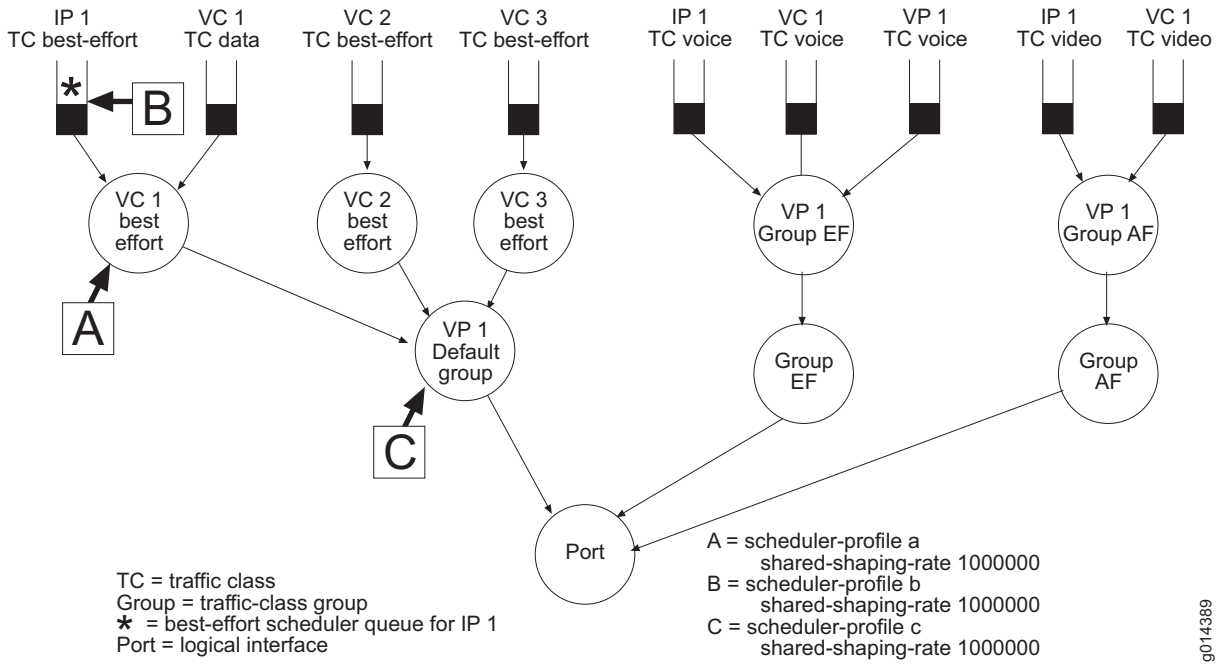
A shared shaper affects only the queues and nodes for a single interface. Queues associated with other interfaces are not constrained by the shared shaper. This behavior should cause no problems if you configure all queues for a single logical interface type. However, if you configure queues for multiple interface types, you may have problems with shared shaping.

For example, a shared shaper for VC 1 does not directly constrain the rate for a queue for IP 1 unless that queue is stacked above a node for VC 1 in the scheduler hierarchy. If the IP queue is stacked above a node for VC 1, then the shared shaper indirectly controls the queue bandwidth through the VC 1 node. But if the IP 1 queue is not stacked above a VC 1 node, it is immune to the shared shaper, and the total bandwidth for VC 1 can exceed the shared rate.

As another example, if a shared queue exists for VP 1 where VC 1 is contained within VP 1, the shared shaper for VC 1 does not constrain the bandwidth of a VP queue. The total bandwidth for VC 1 can again exceed the shared rate.

Figure 17 illustrates an example of mixed interface shaping and its implications for implicit constituent selection for compound shared shaping.

Figure 17: Implicit Constituent Selection for Compound Shared Shaper: Mixed Interface Types



Traffic Starvation and Shared Shaping

Traffic in the strict-priority traffic-class group can starve out other traffic competing within the shared shaper. You might want to configure an individual shaping rate for strict-priority queues, thus reserving the remaining shared bandwidth for nonstrict traffic.

For example, the following scheduler profiles limit the subscriber's strict priority traffic to 1.0 Mbps and limits the subscriber's aggregate traffic to 1.5 Mbps. If scheduler profile strictOne specified a shaping rate greater than or equal to 1.5 Mbps, nonstrict traffic might face starvation.

```
host1(config)#scheduler-profile strictOne
host1(config-scheduler-profile)#shaping-rate 1000000
host1(config-scheduler-profile)#exit
host1(config)#scheduler-profile nonStrictOne
host1(config-scheduler-profile)#shared-shaping-rate 1500000
```

Oversubscription and Shared Shaping

Many providers configure voice and video queues that combine to oversubscribe the shared rate. An external admission control agent, such as RADIUS, controls traffic flows such that the offered load does not ever really oversubscribe the shared rate. The static oversubscribed configuration on the router removes the need for the provider to signal voice or video traffic to the router.

Burst Size and Shared Shaping

The burst size for constituents is typically shaped by the burst value that you specify in the scheduler profile with the **shared-shaping-rate** command. You can override this burst for a particular constituent by applying another scheduler profile to that constituent and specifying the burst value with the **shaping-rate** command.

The following commands configure a VC shared shaper with two constituents, best effort and voice. The best-effort constituent has a burst of 30000 and the voice constituent has a burst of 16384.

```
host1(config)#scheduler-profile bestEffortBurst
host1(config-scheduler-profile)#shared-shaping-rate 1000000 burst 30000
host1(config-scheduler-profile)#exit
host1(config)#scheduler-profile voiceBurst
host1(config-scheduler-profile)#shaping-rate 300000 burst 16384
host1(config-scheduler-profile)#exit
```

Configure the QoS profile that applies the scheduler profiles:

```
host1(config)#qos-profile burstExample
host1(config-qos-profile)#atm-vc node
host1(config-qos-profile)#atm-vc node group EF
host1(config-qos-profile)#atm-vc queue traffic-class best-effort scheduler-profile
bestEffortBurst
host1(config-qos-profile)#atm-vc queue traffic-class voice scheduler-profile
voiceBurst
```

Related Topics

- For a list of shared shaper terms, see *Shared Shaper Terms* on page 74
- Configuring Simple Shared Shaping on page 84
- Configuring Compound Shared Shaping on page 104
- Configuring Implicit Constituents for Simple or Compound Shared Shaping on page 121
- Configuring Explicit Constituents for Simple or Compound Shared Shaping on page 126