Chapter 11

Configuring Variables in the Simple Shared Shaping Algorithm

This chapter provides information for configuring variables within the simple shared shaper algorithm on the E-series router.

QoS topics are discussed in the following sections:

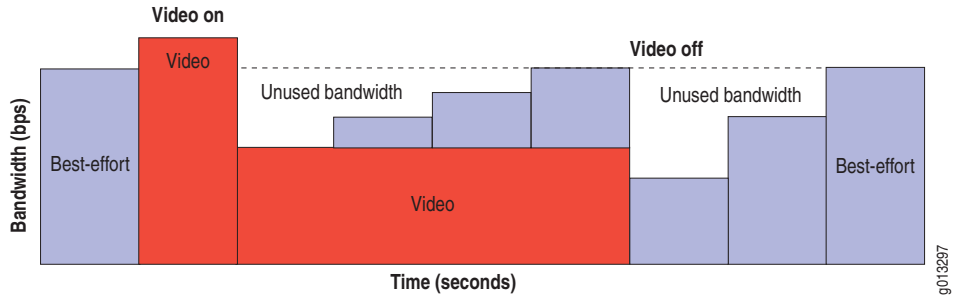
Simple Shared Shaping Algorithm Overview

You can configure variables within the simple shared shaper algorithm to control the minimum dynamic rate for all simple shared shapers on the router.

Configuring variables in the simple shared shaper algorithm is useful for IPTV configurations. Without limiting the dynamic rate, best-effort data traffic can be starved for a few seconds when a video stream starts. The minimum dynamic rate defined by shared shaper algorithm variables applies to best-effort traffic only.

Figure 22 shows a two-constituent simple shared shaper consisting of best-effort and video traffic. The sum of the best-effort and video traffic is shaped to the configured shared-shaping rate.

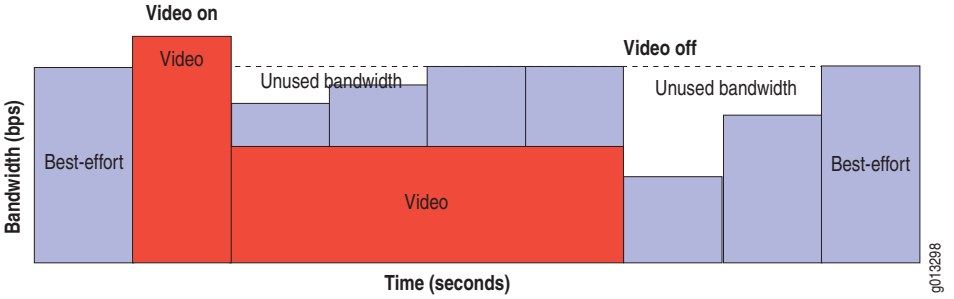
Figure 22: Simple Shared Shaper Behavior Without Algorithm Controls



When the video stream starts in the example displayed by Figure 22, the shared shaper reacts by drastically reducing best-effort traffic because it must avoid saturating downstream queues. In some cases, best-effort traffic is throttled for a few seconds. When the video stream stops, best-effort traffic can continually consume more bandwidth, up to the shared-shaping rate.

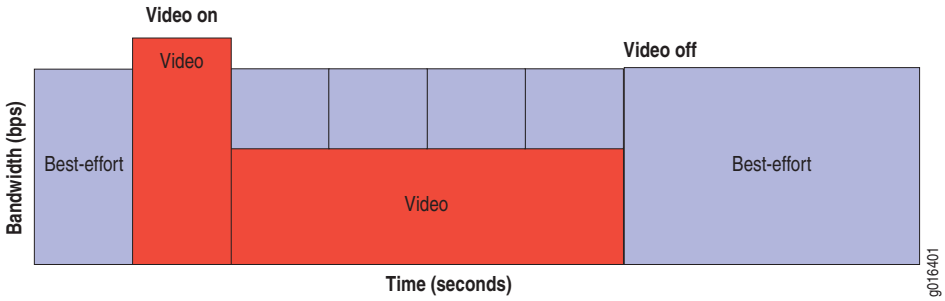
By controlling the minimum dynamic rate in the simple shared shaper algorithm, you can configure the less conservative simple shared shaping behavior displayed in Figure 23. In this example, as the video traffic starts, the best-effort rate is reduced less drastically, and best-effort traffic is not starved.

Figure 23: Less Conservative Simple Shared Shaper Behavior



You can also configure the more liberal simple shared shaper behavior that is displayed in Figure 24. In this example, the initial over-limit video traffic is ignored. When the video traffic stops, the system immediately allows best-effort traffic to consume the available bandwidth.

Figure 24: More Liberal Simple Shared Shaper Behavior



Simple Shared Shaper Algorithm Calculations

The simple shared shaper algorithm performs the following tasks to calculate the dynamic rate:

1. Calculates the new measured rate.
2. Calculates the virtual output queue length (VOQL).
3. Calculates the new dynamic rate.
4. Uses the larger value of the new dynamic rate (from Step 3) and a minimum dynamic rate.

Related Topics

- Variables of the Simple Shared Shaper Algorithm on page 93
- Configuring Simple Shared Shaper Algorithm Variables on page 96

Variables of the Simple Shared Shaper Algorithm

The formulas the simple shared shaper uses contain values maintained by the simple shared shaper algorithm, and variables that you configure.

The following factors are maintained by the simple shared shaper algorithm:

- newMeasuredRate—Sum of bytes enqueued to non-best-effort constituent queues, in bps.
- oldDynamicRate—Dynamic shaping rate from the previous rate period, in bits-per-second.
- sharedShapingRate—Configured shared shaper rate, in bps. The shared shaping rate is the total rate of all constituents of the shared shaper.

You can configure the following variables, which correspond to the commands described in *Configuring Simple Shared Shaper Algorithm Variables* on page 96.

- convergenceFactor—Controls the convergence of the dynamic shaping rate to the calculated shaping rate, expressed as a percentage of the available bandwidth.

  The default value of 50 percent causes the dynamic shaping rate to converge by half of the available rate each period. For example, when the dynamic rate of a 5 Mbps simple shared shaper is 1 Mbps, and the measured rate goes from 4 Mbps to 0 Mbps, 4 Mbps of bandwidth becomes available. The simple shared shaper converges from 1 Mbps to 5 Mbps by half of the available bandwidth per period. In this example, the dynamic shaping rates for several periods are 1 Mbps, 3 Mbps, 4 Mbps, 4.5 Mbps, 4.75 Mbps, and so on.

- maximumVOQL—Sets the maximum virtual output queue length (VOQL), expressed in milliseconds (ms) of the shared shaping rate.

  The default value of 4000 indicates that a 5 Mbps shared shaper does not allow the VOQL to exceed 20 Mbps. Smaller values reduce the effect of the VOQL in the simple shared shaper algorithm.

  A maximum VOQL of 0 indicates that the shared shaper ignores the VOQL. This setting is appropriate for configurations where exceeding the shared shaping rate for brief periods of time does not cause downstream queuing.

- minimumDynamicRate—Sets the minimum value for the dynamic shaping rate, expressed as a percentage of the shared shaping rate. For example, a value of 25 for a 20 Mbps shared shaper specifies that the dynamic shaping rates never be set to a value less than 5 Mbps. The default value is 0.

- reactionFactor—Controls how the simple shared shaper reacts to changing rates, expressed as a percentage. The default value of 200 changes the algorithm to use 200 percent of the changing rate.

This section describes the algorithm tasks in detail.

Step 1: Calculate the New Measured Rate

The simple shared shaper uses the following formula to calculate the new measured rate:

$$\text{newMeasuredRate} = \text{bytes enqueued} \times 8 \text{ bits per byte} / \text{rate-period} \times 1000 \text{ ms/sec}$$

Step 2: Calculate the VOQL

The simple shared shaper maintains a VOQL, which cannot become less than zero, using the following formulas:

$$\text{VOQL} = \text{VOQL} + (\text{oldDynamicRate} - \text{oldMeasuredRate} - \text{sharedShapingRate})$$

$$\text{If } (\text{VOQL} > \text{maximumVOQL}), \text{ then } (\text{VOQL} = \text{maximumVOQL})$$

Step 3: Calculate the New Dynamic Rate

Each rate period, the simple shared shaper calculates the new dynamic rate (the shaping rate of the best-effort node or queue) using the following formula. The system prevents the new dynamic rate from becoming less than zero.

$$\text{newDynamicRate} = (\text{convergenceFactor} \times \text{oldDynamicRate}) + (1 - \text{convergenceFactor}) \times (\text{sharedShapingRate} - \text{newMeasuredRate}) - \text{reactionFactor} \times (\text{newMeasuredRate} - \text{oldMeasuredRate}) - \text{VOQL}$$

Step 4: Determine the Larger Value of the New Dynamic Rate and the Minimum Dynamic Rate

The simple shared shaper determines the larger of the new dynamic rate and a minimum dynamic rate, where the minimumDynamicRate is a fraction of the shared-shaping rate, using the following formula:

$$\text{Max}\,(\text{newDynamicRate}),(\text{minimumDynamicRatePercent} \times \text{sharedShapingRate})$$

Related Topics

- Simple Shared Shaping Algorithm Overview on page 91
- Sample Process for Controlling the Simple Shared Shaper Algorithm on page 97

Guidelines for Controlling the Simple Shared Shaper Algorithm

You can configure the simple shared shaper variables individually, but it is useful to use configuration guidelines to determine how the variables work together to achieve a desired behavior.

Table 8 displays guidelines for configuring the most liberal shared shaper to the most conservative shared shaper.

- Most liberal—Appropriate when over-queuing is not a concern
- Liberal—Appropriate when over-queuing is not a concern and a smoother rate adjustments are desirable
- Moderate—Default settings
- Conservative—Appropriate when over-queuing is a major concern
- Most conservative—Rarely appropriate.

Table 8: Guidelines for Configuring Simple Shared Shaper Algorithm Variables

Control	Most Liberal	Liberal	Moderate	Conservative	Most Conservative
convergence-factor	0	25	50	75	99
maximum-voql	0	25	400	600	1000
reaction-factor	0	50	200	300	1000

Related Topics

- Simple Shared Shaping Algorithm Overview on page 91
- Configuring Simple Shared Shaper Algorithm Variables on page 96

Configuring Simple Shared Shaper Algorithm Variables

To configure the variables for all simple shared shapers on the router:

1. Enter QoS Shared Shaper Control Configuration mode.

   host1(config)#**qos-shared-shaper-control**
   host1(config-qos-shared-shaper-control)#

2. (Optional) Configure the convergence factor for all simple shared shapers on the router.

   host1(config-qos-shared-shaper-control)#**convergence-factor 25**

   The convergence factor determines how quickly the dynamic shaping rate converges with the calculated dynamic shaping rate, and is expressed as a percentage of the available bandwidth.

   The range for the convergence factor is 0–99 percent, with 0 being the most liberal and 99 the most conservative. The default value is 50.

3. (Optional) Configure the specify the reaction factor for all simple shared shapers on the router.

   host1(config-qos-shared-shaper-control)#**reaction-factor 50**

   The reaction factor determines how the shared shaper reacts to changes in the measured rate.

   The range for the reaction factor is 0–1000; 0 is the most liberal and 1000 is the most conservative. The default value is 200.

4. (Optional) Specify the minimum value of the dynamic shaping rate as a percentage of the shared shaping rate for all simple shared shapers on the router.

   host1(config-qos-shared-shaper-control)#**minimum-dynamic-rate-percent 50**

   The range for the minimum dynamic rate value is 0–100 percent. The default value is 0.

5. (Optional) Configure a maximum value for the virtual output queue length (VOQL) for all simple shared shapers on the router.

   host1(config-qos-shared-shaper-control)#**maximum-voql 25**

   The VOQL tracks the amount of data over queued between simple shared-shaper rate periods.

   The range for the maximum VOQL value is 0–10000 milliseconds (ms). The default value is 4000.

Related Topics

- Simple Shared Shaping Algorithm Overview on page 91
- Variables of the Simple Shared Shaper Algorithm on page 93
- Guidelines for Controlling the Simple Shared Shaper Algorithm on page 95
- Sample Process for Controlling the Simple Shared Shaper Algorithm on page 97
- Configuring Simple Shared Shaping on page 81
- **convergence-factor** command
- **maximum-voql** command
- **minimum-dynamic-rate-percent** command
- **qos-shared-shaper-control** command
- **reaction-factor** command

Sample Process for Controlling the Simple Shared Shaper Algorithm

The simple shared shaper in this example contains two constituents, best-effort and video. The shared-shaping rate is 15 Mbps, and the video rate is 4 Mbps.

The example contains two parts: when the video flow is turned on, and then turned off.

NOTE: The rates in this example are approximate and for illustrative purposes only. Your configuration might yield different results based on network variables.

Starting Video Flow

Table 9 lists the dynamic rate when the video flow is turned on for the five classes of simple shared shaper variables. Results vary because the amount of video measured in the first rising period is random, in the range 0–4 Mbps non-inclusive.

Table 9: Rising Edge Sample When Video Flow Starts

	Period of Dynamic Rate, in Kbps									
Control	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Most liberal	15000	13080	11000	11000	11000	11000	11000	11000	11000	11000
Liberal	15000	9542	8880	10470	10867	10972	10979	10994	10998	10994
Moderate	15000	6510	5606	8303	9651	10329	10628	10814	10967	10953
Conservative	15000	6022	1604	3953	5714	7038	7978	8733	9300	9735
Most conservative	–	–	–	–	–	–	–	–	–	–

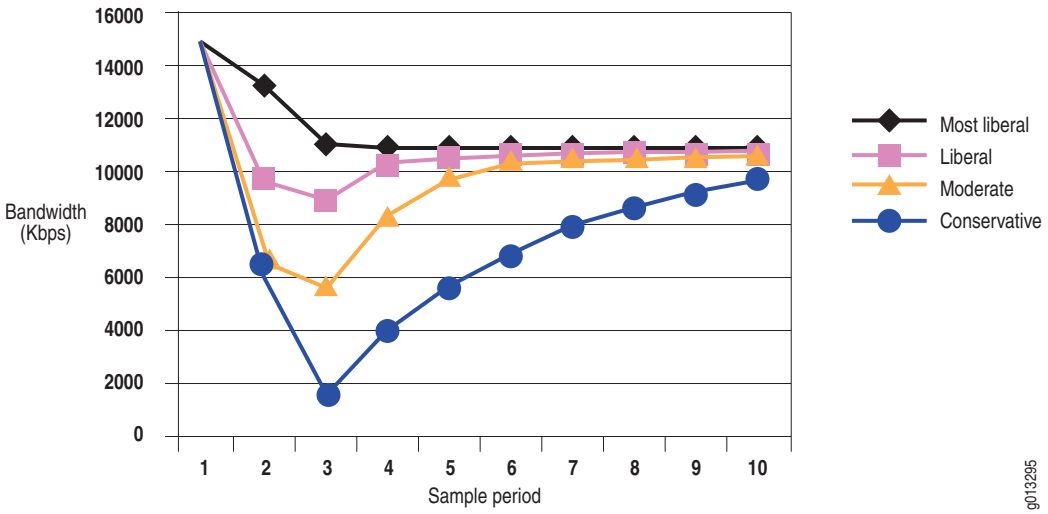
In this example, a liberal maximum VOQL value is ineffective because the 15 Mbps shared-shaping rate is much higher than the 4 Mbps video rate. The video rate divided by the shared shaping rate is 26.6 percent, so any value higher than this has no effect.

NOTE: The rates in this example represent approximate egress-queue enqueue rates on an Ethernet line module; therefore, there is no ATM SAR or downstream devices are not used. More liberal configurations can be inappropriate when there might be queuing between the scheduler and the destination. VLAN queuing is used, and saturation rates are offered.

The most liberal case heavily reduces VOQL and changes of rate, leading to a shared shaper that quickly converges. The conservative configuration overreacts to VOQL and the change of rate, and converges very slowly.

Figure 25 shows a graph of the dynamic rate when the video flow starts.

Figure 25: Dynamic Rate When Video Flow Starts



Stopping Video Flow

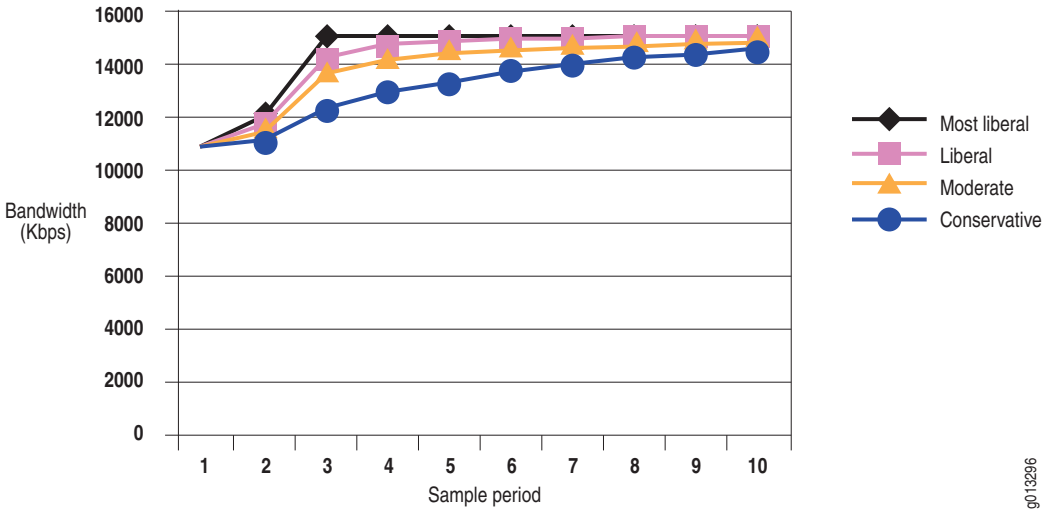
Table 10 lists the dynamic rate as the video flow stops for the five classes of simple shared shaper controls. Results might vary because the amount of video measured in the first falling period is random, in the range 0–4 Mbps non-inclusive.

Table 10: Data When Video Flow Stops

	Period of Dynamic Rate, in Kbps									
Control	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Most liberal	11000	12132	15000	15000	15000	15000	15000	15000	15000	15000
Liberal	11000	11584	14146	14786	14946	14986	14996	14999	14999	15000
Moderate	11000	11728	13364	14182	14591	14795	14897	14948	14974	14987
Conservative	10955	11278	12208	12906	13429	13822	14116	14337	14503	14701
Most conservative	–	–	–	–	–	–	–	–	–	–

Figure 26 shows a graph of the dynamic rate when the video flow stops.

Figure 26: Dynamic Rate When Video Flow Stops



Related Topics

- Simple Shared Shaping Algorithm Overview on page 91
- Variables of the Simple Shared Shaper Algorithm on page 93
- Configuring Simple Shared Shaper Algorithm Variables on page 96