

## Defining the ATM Traffic-Shaping Profile

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When you use an ATM encapsulation on ATM1 and ATM2 IQ interfaces, you can define bandwidth utilization, which consists of either a constant rate or a peak cell rate, with sustained cell rate and burst tolerance.

These values are used in the ATM generic cell-rate algorithm, which is a leaky bucket algorithm that defines the short-term burst rate for ATM cells, the maximum number of cells that can be included in a burst, and the long-term sustained ATM cell traffic rate.

If your routing platform is equipped with an ATM2 IQ PIC, each VC can have independent shaping parameters. For more information, see [Defining Virtual Path Tunnels](#).



**NOTE:** When the DS3 or E3 port parameters are not identical on all ports of a multiport ATM DS3 or E3 PIC, the ATM PIC driver might not always use the minimum port shaping rate (of all the ports on a multiport ATM DS3 or E3 PIC) selected for cell transmission shaping. The PIC's shaping rate is always updated to conform to the last port setting updated by the PIC software driver, rather than use the minimum port (shaping) rate. There is no syslog message to inform the user of the shaping rate decision applied by the software driver.

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By default, the bandwidth utilization is unlimited; that is, unspecified bit rate (UBR) is used. Also, by default, buffer usage by VCs is unregulated.

To define limits to bandwidth utilization, include the **shaping** statement:

```
shaping {  
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate  
    burst length);  
    queue-length number;  
}
```

For a list of hierarchy levels at which you can include this statement, see [shaping](#).

The **rtvbr** statement is supported on ATM2 IQ PICs only. The **queue-length** statement is supported on ATM1 PICs only.

To configure VP tunnels on ATM2 IQ interfaces, include the **shaping** statement at the [edit interfaces *interface-name* atm-options vpi *vpi-identifier*] hierarchy level:

```
[edit interfaces interface-name atm-options vpi vpi-identifier]  
shaping {  
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate  
    burst length);  
}
```

When configuring ATM traffic shaping, you can do the following:

- Configuring ATM CBR on page 2
- Configuring ATM2 IQ Real-Time VBR on page 3
- Configuring ATM VBR on page 3
- Specifying ATM1 Shaping Values on page 4
- Specifying ATM2 IQ Shaping Values on page 7

## Configuring ATM CBR

For traffic that does not require the ability to periodically burst to a higher rate, you can specify a constant bit rate (CBR).

To specify a CBR on ATM1 and ATM2 IQ interfaces, include the **cbr** statement:

```
cbr rate;
```

For a list of hierarchy levels at which you can include this statement, see **cbr**. On J-Series Services Routers, ATM CBR shaping is not supported.

For ATM1 OC3 interfaces, the rate can be from 33 Kbps through 135.6 Mbps; for ATM1 OC12 interfaces, the rate can be from 33 Kbps through 276 Mbps.

For ATM2 IQ OC3 and OC12 interfaces, the rate can be from 33 Kbps through 542,526,792 bps.

For ATM2 IQ OC48 interfaces, the rate can be from 33 Kbps through 2,170,107,168 bps.

For ATM2 IQ DS3 and E3 interfaces, the rate can be from 33 Kbps to the maximum rate. The maximum rate varies depending on the ATM encapsulation and framing you configure, as shown in Table 1.

**Table 1: Shaping Rate Range by Interface Type**

Interface Type	Maximum Rate
DS3 with direct ATM encapsulation	40,038,968 bps
DS3 with PLCP ATM encapsulation	36,864,000 bps
E3 with g.751 framing and direct ATM encapsulation	30,801,509 bps
E3 with g.751 framing PLCP ATM encapsulation	27,648,000 bps
E3 with g.832 framing	30,720,000 bps

## Configuring ATM2 IQ Real-Time VBR

By default, ATM interfaces use UBR; that is, bandwidth utilization is unlimited. For ATM2 IQ interfaces only, you can configure RTVBR, which supports variable bit rate data traffic with average and peak traffic parameters. Compared to non-real-time VBR, RTVBR data is serviced at a higher priority with a relatively small sustainable cell rate (SCR) limit to minimize the delay. Real-time VBR is suitable for carrying packetized video and audio.

To configure RTVBR, include the **rtvbr** statement:

```
rtvbr peak rate sustained rate burst length;
```

For a list of hierarchy levels at which you can include this statement, see **rtvbr**.

When configuring RTVBR, you can define the following shaping properties:

- Peak rate—Top rate at which traffic can burst.
- Sustained rate—Normal traffic rate averaged over time.
- Burst length—Maximum number of cells that a burst of traffic can contain. It can be a value from 1 through 4000 cells.

The peak and sustained rates can be from 33 Kbps through 542,526,792 bps.

## Configuring ATM VBR

By default, ATM interfaces use UBR; that is, bandwidth utilization is unlimited. For ATM1 and ATM2 IQ interfaces, you can configure non-real-time VBR, which supports variable bit rate data traffic with average and peak traffic parameters. Compared to RTVBR, non-real-time VBR is scheduled with a lower priority and with a larger SCR limit, allowing it to recover bandwidth if it falls behind. Non-real-time VBR is suitable for packet data transfers.

To define VBR on ATM1 and ATM2 IQ interfaces, include the **vbr** statement:

```
vbr peak rate sustained rate burst length;
```

For a list of hierarchy levels at which you can include this statement, see **vbr**.

When configuring VBR, you can define the following shaping properties:

- Peak rate—Top rate at which traffic can burst.
- Sustained rate—Normal traffic rate averaged over time.
- Burst length—Maximum number of cells that a burst of traffic can contain. It can be a value from 1 through 4000 cells.

## Specifying ATM1 Shaping Values

For ATM1 interfaces, you can specify the rates in bits per second or cells per second. For OC3c interfaces, the highest rate is 135,631,698 bps (353,207.55 cps), which corresponds to 100 percent of the available line rate. For OC12c interfaces, the highest rate is 271,263,396 bps (706,415.09 cps), which corresponds to 50 percent of the available line rate. Table 2 lists some of the other rates you can specify. If you specify a rate that is not listed, it is rounded to the nearest rate.

The exact number of values differs between OC12c and OC3c interfaces. OC12c interfaces have about four times as many value increments as OC3c interfaces.

For OC12c rates between 1/2 of the line rate and 1/128 of the line rate, there are 128 steps between each 1/*n* value. This means that there is 128 steps between the 1/2 and 1/3 line rate values, and another 128 steps between 1/3 and 1/4 and so on. For rates smaller than 1/127, there are (16,384 minus 127) or 16,257 values. The reason for this is that fractional shaping is ignored at rates below 1/127. This results in a total of about 32,384 distinct rates for OC12c. When *n* is larger than or equal to 127, the steps are 1/*n*.

For OC3c, the starting point is full line rate, the fraction/integer breakpoint is about 1/31, and there is a maximum of 4096 scheduler slots for use after 1/31 of line rate, producing about 8032 total distinct rates. When *n* is larger than or equal to 31, the steps are 1/*n*.

For ATM1 interfaces, the following formula can be used to predict the actual shaping rate:

- OC3 shaping settings between 135,631,698 bps (OC3 ATM cell line rate) and 4,375,216 bps (1/31 of OC3 ATM cell line rate).
- OC12 shaping settings between 271,263,396 bps (half OC12 ATM cell line rate – the highest rate supported) and 4,271,864 bps (1/127 of OC12 ATM cell line rate).

$$\text{actual-rate} = (128 * \text{line-rate}) / (\text{trunc} ((128 * \text{line-rate}) / \text{desired-rate}))$$

*line-rate* is the maximum available rate on the interface (in bits per second) after factoring out the overhead for SONET/SDH and ATM (per-cell) overheads. For OC3c interfaces, the line rate is calculated as follows:

$$\text{line-rate} = 155,520,000 \text{ bps} \times (26/27) \times (48/53) = 135,631,698.1 \text{ bps}$$

For OC12c interfaces, the line rate is calculated as follows:

$$\text{line-rate} = 622,080,000 \text{ bps} \times (26/27) \times (48/53) = 542,526,792.45 \text{ bps}$$

*desired-rate* is the rate you enter in the **vbr** statement, in bits per second.

The **trunc** operator indicates that all digits to the right of the decimal point should be dropped.

For shaping settings smaller than 1/31 of OC3 ATM cell line rate (4,375,216 bps) and 1/127 of OC12 ATM cell line rate (4,271,864 bps), you can predict the actual shaping rate using the following formula:

$$\text{actual-rate} = ( 1 / ( \text{trunc} ( \text{line-rate} / \text{desired-rate} ) + 1 ) ) * \text{line-rate}$$

For example, for OC12 interfaces, the actual rates for shaping below 4,271,864 bps are calculated as follows:

$$1 / 127 * 542,526,792.45 \text{ bps} = 4,271,864 \text{ bps (11124 cells/second)}$$

$$1 / 128 * 542,526,792.45 \text{ bps} = 4,238,490 \text{ bps (11038 cells/second)}$$

$$1 / 129 * 542,526,792.45 \text{ bps} = 4,205,634 \text{ bps (10952 cells/second)}$$

...

Buffers are shared among all VCs, and by default, there is no limit to the buffer size for a VC. If a VC is particularly slow, it might use all the buffer resources.

Table 2 shows ATM1 traffic-shaping rates.

**Table 2: ATM1 Traffic-Shaping Rates**

Interface Type	Line Rate (bps)	Line Rate (cps)	Percentage of Total Line Rate
<b>OC3</b>			
	135,600,000	353,125	100.00
	134,542,320	350,370.66	99.22
	133,511,760	347,686.88	98.46
	132,494,760	345,038.44	97.71
	131,491,320	342,425.31	96.97
	130,501,440	339,847.5	96.24
	129,525,120	337,305	95.52
	128,562,360	334,797.81	94.81
	127,626,720	332,361.25	94.12
	126,691,080	329,924.69	93.43
<b>OC12</b>			
	271,263,396	706,415.09	50.00
	270,207,897	703,666.40	49.81
	269,160,579	700,939.01	49.61
	268,121,349	698,232.68	49.42
	267,090,113	695,547.17	49.23

**Table 2: ATM1 Traffic-Shaping Rates** (continued)

Interface Type	Line Rate (bps)	Line Rate (cps)	Percentage of Total Line Rate
	266,066,779	692,882.24	49.04
	265,051,257	690,237.65	48.85
	264,043,458	687,613.17	48.67
	263,043,293	685,008.58	48.48
	262,050,677	682,423.64	48.30

**Example: Specifying ATM1 Shaping Values**

Determine the actual rate in ATM1 interfaces when the desired rate is 80 percent of the maximum rate:

- OC3c:

$$135,600,000 \text{ bps} * 0.8 = 108,480,000 \text{ bps}$$

Because 108,480,000 bps is greater than 1/31 of OC3 ATM cell line rate:

$$\begin{aligned} \text{actual-rate} &= (128 * 135,600,000.1) / (\text{trunc} ((128 * 135,600,000.1) / \\ &\quad 108,480,000)) \\ \text{actual-rate} &= 17,356,800,013 / (\text{trunc} (17,356,800,013 / 108,480,000)) \\ \text{actual-rate} &= 17,356,800,013 / 160 \\ \text{actual-rate} &= 108,480,000 \text{ bps} \end{aligned}$$

- OC12c:

$$271,263,396 \text{ bps} * 0.8 = 217,010,716.8 \text{ bps}$$

Because 217,010,716.8 bps is greater than 1/127 of OC12 ATM cell line rate:

$$\begin{aligned} \text{actual-rate} &= (128 * 542,526,792.45) / (\text{trunc} ((128 * \\ &\quad 542,526,792.45) / 217,010,716.8)) \\ \text{actual-rate} &= 69,443,429,434 / (\text{trunc} (69,443,429,434 / 217,010,716.8)) \\ \text{actual-rate} &= 69,443,429,434 / 320 \\ \text{actual-rate} &= 217,010,717 \text{ bps} \end{aligned}$$

Determine the actual rate in ATM1 interfaces when the desired rate is 3,000,000 bps:

- OC3c:

Because 3,000,000 bps is smaller than 1/31 of OC3 ATM cell line rate:

$$\begin{aligned} \text{actual-rate} &= (1 / (\text{trunc} (\text{line-rate} / \text{desired-rate}) + 1)) * \text{line-rate} \\ \text{actual-rate} &= (1 / (\text{trunc} (135,631,698 / 3,000,000) + 1)) * 135,631,698 \\ \text{actual-rate} &= (1 / (45 + 1)) * 135,631,698 \\ \text{actual-rate} &= (1 / 46) * 135,631,698 \end{aligned}$$

*actual-rate* = 2,948,515 bps

■ OC12c:

Because 3,000,000 bps is smaller than 1/127 of OC12 ATM cell line rate:

*actual-rate* = ( 1 / ( trunc ( line-rate / desired-rate ) + 1 ) ) \* line-rate  
*actual-rate* = ( 1 / ( trunc ( 542,526,792 / 3,000,000 ) + 1 ) ) \* 542,526,792  
*actual-rate* = ( 1 / ( 180 + 1 ) ) \* 542,526,792  
*actual-rate* = ( 1 / 181 ) \* 542,526,792  
*actual-rate* = 2,997,386 bps

### **Specifying ATM2 IQ Shaping Values**

For ATM2 IQ OC3c interfaces, the maximum available rate is 100 percent of line rate, or 135,600,000 bps. For ATM2 IQ OC12c interfaces, the maximum available rate is 50 percent of line rate, or 271,273,396 bps. You can specify the rates in bits per second or cells per second. Fractional shaping is accurate within 0.5 percent of the desired rate.

