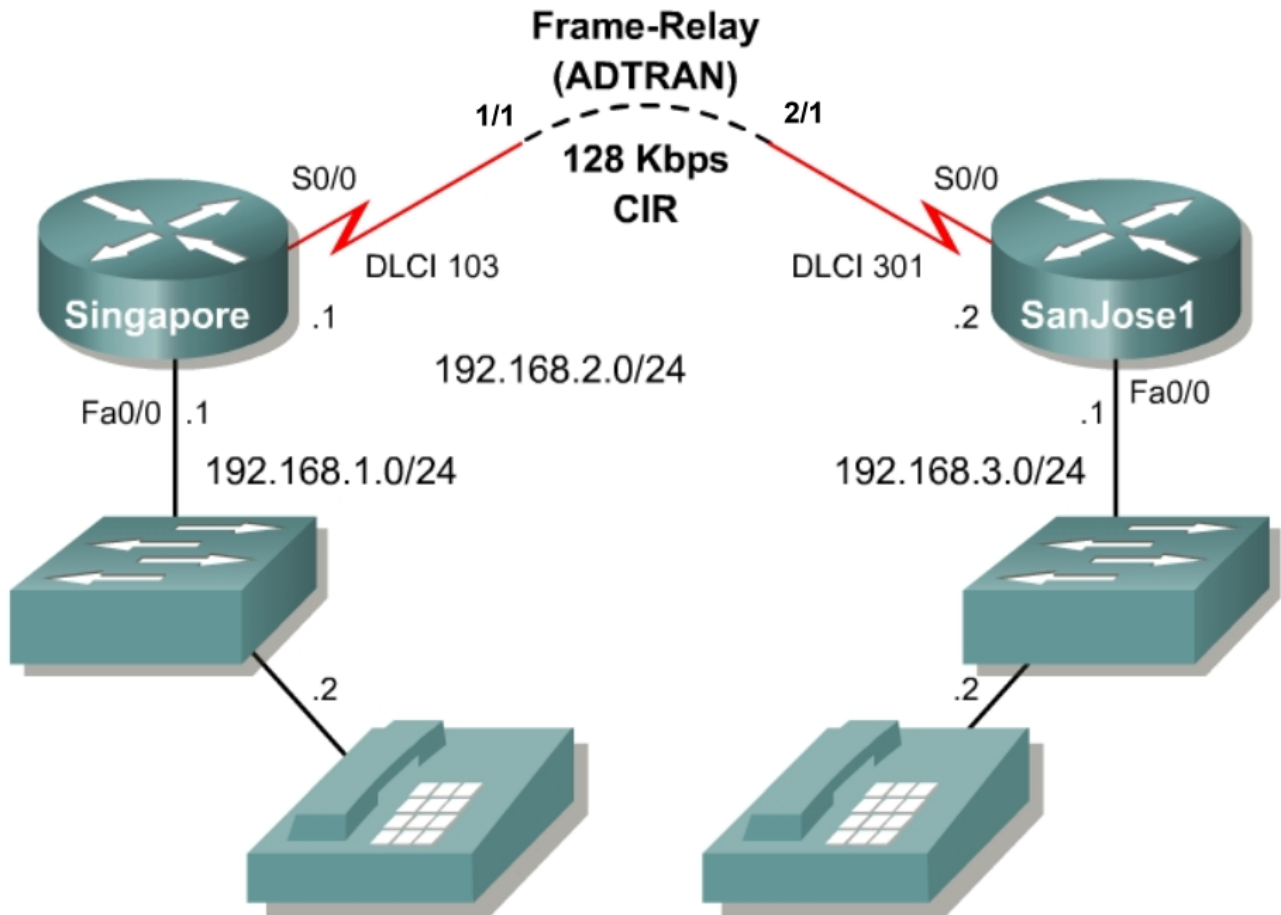


## Lab 8.1.10.9 QoS Manually Configured Frame Relay Traffic Shaping



### Objective

Failing to perform traffic shaping before injecting traffic into a Frame Relay permanent virtual circuit (PVC) is likely to lead to drop frames, since the traffic rate will exceed the guarantees provided by the service provider. In this lab, Frame Relay traffic shaping (FRTS) is used to shape traffic exiting a Frame Relay interface. This is done so that the traffic matches the committed information rate (CIR), committed burst (Bc), and excess burst (Be) provided by the ISP.

### Scenario

A Frame Relay link was recently added between the Singapore and SanJose1 offices. The Frame Relay service provider will guarantee a CIR of 128 kbps and a Bc of 256 kbps. Configure the routers so that these rates are not exceeded.

### Step 1

Build and configure the network according to the diagram. Before beginning a lab, the configurations on all the routers should be cleared and then reloaded or power cycled to reset their default

configurations. Delete the **vlan.dat** and startup configuration files on the switches before reloading them.

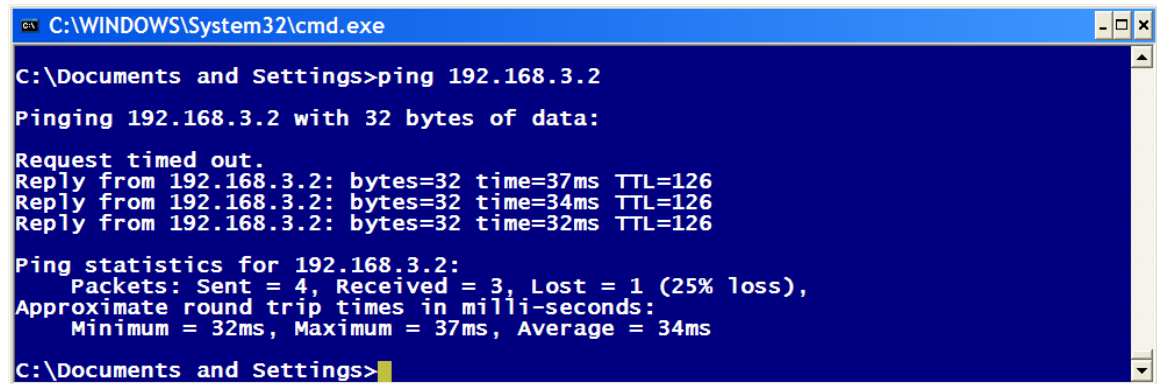
Configure the hostnames and the FastEthernet interfaces on the routers. Configure Enhanced Interior Gateway Routing Protocol (EIGRP) with an autonomous system (AS) of 100 as the routing protocol. The configuration of FRTS will occur on the routers so the Access Layer switches can be left in the factory-default configuration.

The Frame-Relay should be configured using sub-interfaces as follows:

```
Singapore(config)#interface serial 0/0
Singapore(config-if)#encapsulation frame-relay
Singapore(config-if)#interface serial 0/0.103 point-to-point
Singapore(config-subif)#frame-relay interface-dlci 103
Singapore(config-fr-dlci)#ip address 192.168.2.1 255.255.255.0

SanJose1(config)#interface serial 0/0
SanJose1(config-if)#encapsulation frame-relay
SanJose1(config-if)#interface serial 0/0.301 point-to-point
SanJose1(config-subif)#frame-relay interface-dlci 301
SanJose1(config-fr-dlci)#ip address 192.168.2.2 255.255.255.0
```

Verify the configuration by pinging between the hosts and troubleshoot as necessary.



```
C:\WINDOWS\System32\cmd.exe

C:\Documents and Settings>ping 192.168.3.2

Pinging 192.168.3.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.3.2: bytes=32 time=37ms TTL=126
Reply from 192.168.3.2: bytes=32 time=34ms TTL=126
Reply from 192.168.3.2: bytes=32 time=32ms TTL=126

Ping statistics for 192.168.3.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 32ms, Maximum = 37ms, Average = 34ms

C:\Documents and Settings>
```

```
Router(config)#hostname Singapore
Singapore(config)#interface fastethernet 0/0
Singapore(config-if)#ip address 192.168.1.1 255.255.255.0
Singapore(config-if)#no shutdown
Singapore(config-if)#interface serial 0/0
Singapore(config-if)#no shutdown
Singapore(config-if)#encapsulation frame-relay
Singapore(config-if)#interface serial 0/0.103 point-to-point
Singapore(config-subif)#frame-relay interface-dlci 103
Singapore(config-fr-dlci)#ip address 192.168.2.1 255.255.255.0
```

```
Singapore(config-if)#router eigrp 100
Singapore(config-router)#network 192.168.1.0
Singapore(config-router)#network 192.168.2.0
```

```
Router(config)#hostname SanJose1
SanJose1(config)#interface fastethernet 0/0
SanJose1(config-if)#ip address 192.168.3.1 255.255.255.0
SanJose1(config-if)#no shutdown
SanJose1(config-if)#interface serial 0/0
SanJose1(config-if)#no shutdown
```

```

SanJose1(config-if)#encapsulation frame-relay
SanJose1(config-if)#interface serial 0/0.301 point-to-point
SanJose1(config-subif)#frame-relay interface-dlci 301
SanJose1(config-fr-dlci)#ip address 192.168.2.2 255.255.255.0
SanJose1(config-if)#
SanJose1(config-if)#router eigrp 100
SanJose1(config-router)#network 192.168.3.0
SanJose1(config-router)#network 192.168.2.0

```

## Step 2

On each router, configure a map-class to define the shape of the traffic. The CIR should be 128 kbps and any Bc can be used, as long as it is not greater than the Bc specified by the service provider. A smaller Bc will produce a smoother traffic flow, since jitter will be reduced. For voice traffic it is recommended that the Bc be kept to 1% of the CIR. In this example, some jitter is acceptable in return for the higher performance that a larger Bc allows. The Bc will be set at 12800 bps. The application requires that traffic loss must be minimized so Be over the CIR will not be allowed. This should prevent the ISP marking any frames as discard eligible (DE) and prevent the frames from potentially being dropped.

Use the command **map-class frame-relay map-name** to create a map-class called **MY-CLASS**. Then use the question mark to examine the available options:

```

Singapore(config)#map-class frame-relay MY-CLASS

SanJose1(config)#map-class frame-relay MY-CLASS
SanJose1(config-map-class)#?
Static maps class configuration commands:
  default      Set a command to its defaults
  exit-class    Exit from static map class configuration mode
  frame-relay   Configure Map parameters
  help         Description of the interactive help system
  no           Negate a command or set its defaults
  service-policy class-based service policy

SanJose1(config-map-class)#

```

Configure the Frame-Relay parameters as follows:

```

Singapore(config-map-class)#frame-relay cir 128000
Singapore(config-map-class)#frame-relay bc 12800
Singapore(config-map-class)#frame-relay be 0
Singapore(config-map-class)#frame-relay fair-queue

SanJose1(config-map-class)#frame-relay cir 128000
SanJose1(config-map-class)#frame-relay bc 12800
SanJose1(config-map-class)#frame-relay be 0
SanJose1(config-map-class)#frame-relay fair-queue

```

## Step 3

In order to activate FRTS, apply the **frame-relay traffic-shaping** commands to the main Frame Relay (S0/0) interface:

```

Singapore(config)#interface serial 0/0
Singapore(config-if)#frame-relay traffic-shaping

SanJose1(config)#interface serial 0/0
SanJose1(config-if)#frame-relay traffic-shaping

```

Once FRTS is activated on the interface, the traffic shape or map-class must be specified for each PVC using the frame relay class statement on the sub-interface:

```
Singapore(config-if)#interface serial 0/0.103
Singapore(config-subif)#frame-relay class MY-CLASS

SanJose1(config-if)#interface serial 0/0.301 point-to-point
SanJose1(config-subif)#frame-relay class MY-CLASS
```

Verify the FRTS configuration on subinterface 103 with the **show traffic-shape** command.

```
Singapore#show traffic-shape

Interface  Se0/0
Access Target  Byte  Sustain  Excess  Interval  Increment Adapt
List  Rate  Limit bits/int bits/int (ms)      (bytes)  Active
102      56000  875   7000    0       125      875      -
104      56000  875   7000    0       125      875      -

Interface  Se0/0.103
Access Target  Byte  Sustain  Excess  Interval  Increment Adapt
List  Rate  Limit bits/int bits/int (ms)      (bytes)  Active
103      128000  1600  12800   0       100      1600     -
Singapore#
```

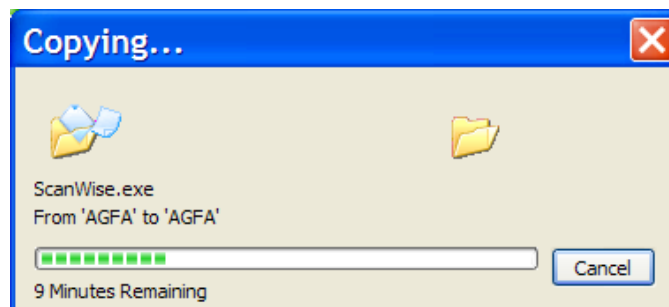
```
SanJose1#show traffic-shape

Interface  Se0/0
Access Target  Byte  Sustain  Excess  Interval  Increment Adapt
List  Rate  Limit bits/int bits/int (ms)      (bytes)  Active
302      56000  875   7000    0       125      875      -
304      56000  875   7000    0       125      875      -

Interface  Se0/0.301
Access Target  Byte  Sustain  Excess  Interval  Increment Adapt
List  Rate  Limit bits/int bits/int (ms)      (bytes)  Active
301      128000  1600  12800   0       100      1600     -
```

#### Step 4

In order to test the traffic shaping, set up file sharing on the Singapore host and copy a large file to the SanJose1 host.



#### Sample Output

Note the traffic shaping statistics with the **show traffic-shape statistics** command.

```
Singapore#show traffic-shape statistics

I/F      Access Queue  Packets  Bytes  Packets  Bytes  Shaping
List     Depth             Delayed  Delayed  Active
Se0/0      0             0         0         0         no
Se0/0      0             0         0         0         no
```

Se0/0.103	0	65	5300	0	0	no
-----------	---	----	------	---	---	----

SanJose1#show traffic-shape statistics

I/F	Access List	Queue Depth	Packets	Bytes	Packets Delayed	Bytes Delayed	Shaping Active
Se0/0		0	0	0	0	0	no
Se0/0		0	0	0	0	0	no
Se0/0.301		0	66	5349	0	0	no

Periodically re-issue to see if any of the statistics have changed. Pay attention to the **Shaping Active** field. Eventually Frame Relay Traffic Shaping should be invoked.

Singapore#show traffic-shape statistics

I/F	Access List	Queue Depth	Packets	Bytes	Packets Delayed	Bytes Delayed	Shaping Active
Se0/0		0	0	0	0	0	no
Se0/0		0	0	0	0	0	no
Se0/0.103		1	1118	1296236	880	1205183	yes

---

**Note** The other router, which in this case is SanJose1, will not show traffic shaping as it is only carrying the TCP ACK traffic, which is insufficient to force the shaping to take effect. In order to see traffic shaping on SanJose1 it will be necessary to reverse the file copy.

---

After a few minutes the **show interfaces serial 0/0** command can be used to determine the average traffic rate:

```
Singapore#show interfaces serial 0/0
Serial0/0 is up, line protocol is up
  Hardware is PowerQUICC Serial
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
    reliability 255/255, txload 15/255, rxload 1/255
  Encapsulation FRAME-RELAY, loopback not set
  Keepalive set (10 sec)
  LMI enq sent 612, LMI stat recvd 612, LMI upd recvd 0, DTE LMI up
  LMI enq recvd 0, LMI stat sent 0, LMI upd sent 0
  LMI DLCI 0 LMI type is ANSI Annex D frame relay DTE
  Broadcast queue 0/64, broadcasts sent/dropped 1438/0, interface
  broadcasts 1336
  Last input 00:00:04, output 00:00:00, output hang never
  Last clearing of "show interface" counters 01:41:58
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue :0/40 (size/max)
  5 minute input rate 2000 bits/sec, 6 packets/sec
  5 minute output rate 91000 bits/sec, 12 packets/sec
    5185 packets input, 308426 bytes, 0 no buffer
    Received 0 broadcasts, 0 runs, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    6353 packets output, 5078253 bytes, 0 underruns
    0 output errors, 0 collisions, 0 interface resets
    0 output buffer failures, 0 output buffers swapped out
    0 carrier transitions
  DCD=up DSR=up DTR=up RTS=up CTS=up
```

## Step 5

Try making the CIR much smaller, 10 kbps, and confirm that FRTS is in fact shaping the traffic.

---

**Note** Make sure to clear the counters and leave enough time for the traffic shaping to occur.

---

Singapore#configure terminal

```

Enter configuration commands, one per line. End with CNTL/Z.
Singapore(config)#map-class frame-relay MY-CLASS
Singapore(config-map-class)#no frame-relay cir 128000
Singapore(config-map-class)#no frame-relay bc 12800
Singapore(config-map-class)#frame-relay cir 10000
Singapore(config-map-class)#frame-relay bc 1000
Singapore(config-map-class)^Z
Singapore#clear counters
Clear "show interface" counters on all interfaces [confirm]
Singapore#
02:01:40: %CLEAR-5-COUNTERS: Clear counter on all interfaces by console

```

```

SanJose1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
SanJose1(config)#map-class frame-relay MY-CLASS
SanJose1(config-map-class)#no frame-relay cir 128000
SanJose1(config-map-class)#no frame-relay bc 12800
SanJose1(config-map-class)#frame-relay cir 10000
SanJose1(config-map-class)#frame-relay bc 1000
SanJose1(config-map-class)^Z
SanJose1#clear counters
Clear "show interface" counters on all interfaces [confirm]
SanJose1#
02:01:40: %CLEAR-5-COUNTERS: Clear counter on all interfaces by console

```

It takes time for the average output rate to reflect the traffic shaping. Periodically verify the traffic shaping statistics and the average output rate to confirm that FRTS is in fact shaping the traffic.

```

Singapore#show traffic-shape statistics

```

I/F	Access List	Queue Depth	Packets	Bytes	Packets Delayed	Bytes Delayed	Shaping Active
Se0/0		0	0	0	0	0	no
Se0/0		0	0	0	0	0	no
Se0/0.301		23	185	111810	145	106417	yes

```

Singapore#
Singapore#show interfaces serial 0/0
Serial0/0 is up, line protocol is up
  Hardware is PowerQUICC Serial
  MTU 1500 bytes, BW 128 Kbit, DLY 20000 usec,
    reliability 255/255, txload 19/255, rxload 1/255
  Encapsulation FRAME-RELAY, loopback not set
  Keepalive set (10 sec)
  LMI enq sent 19, LMI stat recvd 19, LMI upd recvd 0, DTE LMI up
  LMI enq recvd 0, LMI stat sent 0, LMI upd sent 0
  LMI DLCI 0 LMI type is ANSI Annex D frame relay DTE
  FR SVC disabled, LAPF state down
  Broadcast queue 0/64, broadcasts sent/dropped 45/0, interface broadcasts
41
  Last input 00:00:00, output 00:00:00, output hang never
  Last clearing of "show interface" counters 00:03:06
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue :0/40 (size/max)
  5 minute input rate 0 bits/sec, 1 packets/sec
  5 minute output rate 10000 bits/sec, 1 packets/sec
    194 packets input, 17770 bytes, 0 no buffer
    Received 0 broadcasts, 0 runs, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    189 packets output, 96776 bytes, 0 underruns
    0 output errors, 0 collisions, 0 interface resets
    0 output buffer failures, 0 output buffers swapped out
    0 carrier transitions
  DCD=up DSR=up DTR=up RTS=up CTS=up

```