Frame Relay Traffic Shaping with Distributed QoS on the Cisco 7500 Series

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Introduction

This document clarifies the differences between the application of traffic shaping to Frame Relay interfaces on Cisco 7500 series routers with Versatile Interface Processors (VIPs) and on other platforms. The other platforms include the Cisco 7200, 3600, and 2600 series routers.

Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

This document is not restricted to specific software and hardware versions.

Conventions
For more information on document conventions, refer to the Cisco Technical Tips Conventions.

**Background Information**

As of Cisco IOS® Software Release 12.1(5)T, Quality of Service (QoS) policies must run in distributed mode on the VIP; Route Switch Processor (RSP)-based QoS is no longer supported. Thus, you must use the `shape` command and other commands of the Modular QoS Command-Line Interface (MQC) in order to implement Distributed Traffic Shaping (DTS) for Frame Relay interfaces on VIPs on the Cisco 7500 series. DTS combines Generic Traffic Shaping (GTS) and Frame Relay Traffic Shaping (Frame Relay TS). Refer to Configuring Distributed Traffic Shaping for a sample configuration.

This table clarifies how to configure Frame Relay TS, which depends on the platform:

<table>
<thead>
<tr>
<th>Supported shaping mechanisms</th>
<th>7500 Series</th>
<th>7200, 3600, 2600 and Other Non-VIP Platforms</th>
</tr>
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<tbody>
<tr>
<td>Configuration command</td>
<td>DTS</td>
<td>Frame Relay TS</td>
</tr>
<tr>
<td><code>shape</code> command in a policy map</td>
<td>frame-relay traffic-shaping on a main interface; map-class configuration commands to specify shaping parameters</td>
<td></td>
</tr>
<tr>
<td>Requires dCEF(^1)</td>
<td>Yes (Verify with the <code>show cef linecard</code> command.)</td>
<td>No</td>
</tr>
</tbody>
</table>

\(^1\) dCEF = distributed Cisco Express Forwarding

**Note:** On the Cisco 7500 series, the ability to configure Frame Relay TS via the `frame-relay traffic-shaping` command is now blocked because Frame Relay TS executes only the RSP in a nondistributed mode. With dCEF and Frame Relay TS, a CEF "punt" adjacency causes the RSP to fast switch all packets, which is suboptimal for maximum forwarding performance.

**Configuration Steps**

Use these steps to configure DTS on VIP-based Frame Relay interfaces:

1. Enable dCEF with this command:

   ```
   router(config)# ip cef distributed
   ```

2. Ensure that the Frame Relay interface is enabled for distributed switching.
3. Create a service policy and apply it to the map class.

You can implement one of these policies:

- **Single-level policy**—Applies shaping parameters to the virtual circuit (VC) traffic

- **Hierarchical policy**—Applies a two-level policy with shaping at the "parent" level and queuing at the "child" level


**Note:** While Cisco IOS Software Release 12.1(2)T introduced support for low latency queueing (LLQ) on platforms other than the Cisco 7500 series, distributed LLQ (dLLQ) was introduced in Cisco IOS Software Release 12.1(5)T on the VIP. The distributed version enhances the performance of this feature. You can configure a unique service policy per data-link connection identifier (DLCI). You do not need to use a map class. You can apply the **service-policy** command directly to the subinterface or DLCI. However, configure dLLQ inside a map class.

4. Verify the correct operation of your service policy with these commands:

- **show policy-map interface**

- **show interface shape**

- **show vip full-qos**
**Sample Configuration of DTS with a Hierarchical Policy**

```plaintext
ip cef distributed
!
class-map 1
  match <>

!--- Define match-on criteria.

class-map 2
  match <>

!--- Define match-on criteria.

! policy-map CBWFQ
  class 1
    bandwidth <>

!--- Define the value in kbps or percent.

class 2
  priority <>

!--- Define the value in kbps or percent.

! policy-map SHAPE
  class class-default
    shape average
    service-policy CBWFQ

! int s0/0
  encapsulation frame-relay
ip route-cache distributed

!--- Do not configure frame-relay traffic-shaping.

! int s0/0.1 point-to-point
  ip address a.b.c.d
  frame-relay interface-dlci xxx
  class cisco

! map-class frame-relay cisco
  service-policy output SHAPE
```

**FRF.12 and DTS**

Cisco IOS Software Release 12.1(5)T introduced a distributed version of Frame Relay fragmentation, FRF.12. When you apply distributed FRF.12 to a Frame Relay interface, you must define a map class and apply the service policy under the map class. If you attempt to configure a map class with the service policy applied directly to the interface, your router reports this error message with **logging console** enabled:

Frame Relay fragmentation works with dTS only.  
Please remove traffic-shaping from the interface serial 1/0/0
The configuration in this section and the configuration verification commands were tested on a Cisco 7500 series router that runs Cisco IOS Software Release 12.2(5)T on an RSP 8.

Note: Refer to [VoIP over Frame Relay with Quality of Service (Fragmentation, Traffic Shaping, LLQ / IP RTP Priority)] for more information on the selection of fragmentation values.

### Sample Configuration of DTS and FRF.12

```plaintext
interface Ethernet4/1/3
  ip address 10.122.3.206 255.255.255.0
!
interface Serial5/0/0:0
  no ip address
  encapsulation frame-relay
  load-interval 30
  no fair-queue

!--- Do not configure frame-relay traffic-shaping.

! interface Serial5/0/0:0.1 point-to-point
  ip address 10.1.1.2 255.255.255.0
  frame-relay interface-dlci 16
  class test
  frame-relay ip rtp header-compression
!
  map-class frame-relay test
  no frame-relay adaptive-shaping
  service-policy output llq-shape
  frame-relay fragment 120

!--- Apply the frame-relay fragment command to the
!--- Frame Relay map class.

access-list 101 permit udp any range 16384 32767 any range 16384 32767
```

MS-7507-8A# show ip rtp head
RTP/UDP/IP header compression statistics:
DLCI 16 Link/Destination info: point-to-point dlci
Interface Serial5/0/0:0:
  Distributed fast switched:
  4 seconds since line card sent last stats update
  Rcvd: 105475 total, 105472 compressed, 0 errors
  0 dropped, 0 buffer copies, 0 buffer failures
  Sent: 99451 total, 99447 compressed,
  3776208 bytes saved, 2187963 bytes sent
  2.72 efficiency improvement factor
  Connect: 256 rx slots, 256 tx slots,
  0 long searches, 3 misses 0 collisions, 0 negative cache hits
  99% hit ratio, five minute miss rate 0 misses/sec, 0 max

MS-7507-8A# show policy-map
Policy Map llq-shape
  Class class-default
    shape peak 256000 1024 1024
    service-policy llq
Policy Map llq
  Class voip

priority percent 50

MS-7507-8A# show policy-map interface s 5/0/0:0.1
Serial5/0/0:0.1: DLCI 16 -
Service-policy output: 11q-shape
queue stats for all priority classes:
queue size 0, queue limit 32
packets output 147008, packet drops 0
tail/random drops 0, no buffer drops 0, other drops 0
Class-map: class-default (match-any)
148237 packets, 10393582 bytes
30 second offered rate 24000 bps, drop rate 0 bps
Match: any
queue size 0, queue limit 64
packets output 149563, packet drops 0
tail/random drops 0, no buffer drops 0, other drops 0
Shape: cir 256000, Bc 1024, Be 1024
lower bound cir 0, adapt to fecn 0
output bytes 6972057, shape rate 10000 bps
Service-policy : 11q
Class-map: voip (match-all)
146701 packets, 10325334 bytes
30 second offered rate 24000 bps, drop rate 0 bps
Match: access-group 101
Priority: 50% (128 kbps), burst bytes 3200, b/w
exceed drops: 0
Class-map: class-default (match-any)
1536 packets, 68248 bytes
30 second offered rate 0 bps, drop rate 0 bps
Match: any
queue size 0, queue limit 32
packets output 2555, packet drops 0
tail/random drops 0, no buffer drops 0, other drops 0

MS-7507-8A# show frame pvc 16
PVC Statistics for interface Serial5/0/0:0 (Frame Relay DTE)
DLCI = 16, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial5/0/0:0.1
input pkts 3036327 output pkts 199453
in bytes 198958363
out bytes 17271661 dropped pkts 0 in FECN pkts 0
in BECN pkts 0 out FECN pkts 0 out BECN pkts 0
in DE pkts 0 out DE pkts 0
out bcast pkts 1071 out bcast bytes 371448
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 35000 bits/sec, 50 packets/sec
pvc create time 17:51:42, last time pvc status changed 17:50:53
fragment type end-to-end fragment size 120

MS-7507-8A# show interface shape
Serial5/0/0:0 nobuffer drop 0
Serial5/0/0:0.1(class 0):
cir 256000, Bc 1024, Be 1024
lower bound cir 0, adapt to fecn 0
packets output 152104, bytes output 6985505
queue limit 64, queue size 0, drops 0
last clear = 16:58:59 ago, shape rate = 10000 bps

MS-7507-8A# show ip rtp head
RTP/UDP/IP header compression statistics:
DLCI 16 Link/Destination info: point-to-point dlc
Interface Serial5/0/0:0:
 Distributed fast switched:
 4 seconds since line card sent last stats update
 Rcvd: 105475 total, 105472 compressed, 0 errors
 0 dropped, 0 buffer copies, 0 buffer failures
 Sent: 99451 total, 99447 compressed,
 3776208 bytes saved, 2187963 bytes sent
 2.72 efficiency improvement factor
 Connect: 256 rx slots, 256 tx slots,
 0 long searches, 3 misses 0 collisions, 0 negative cache hits
 99% hit ratio, five minute miss rate 0 misses/sec, 0 max

MS-7507-8A# show policy-map
 Policy Map llq-shape
   Class class-default
     shape peak 256000 1024 1024
   service-policy llq
 Policy Map llq
   Class voip
     priority percent 50

MS-7507-8A# show policy-map interface s 5/0/0:0.1
 Serial5/0/0:0.1: DLCI 16 -
 Service-policy output: llq-shape
   queue stats for all priority classes:
   queue size 0, queue limit 32
   packets output 147008, packet drops 0
   tail/random drops 0, no buffer drops 0, other drops 0
 Class-map: class-default (match-any)
 148237 packets, 10393582 bytes
 30 second offered rate 24000 bps, drop rate 0 bps
 Match: any
   queue size 0, queue limit 64
   packets output 149563, packet drops 0
   tail/random drops 0, no buffer drops 0, other drops 0
 Shape: cir 256000, Bc 1024, Be 1024
 lower bound cir 0, adapt to fecn 0
 output bytes 6972057, shape rate 10000 bps
 Service-policy : llq
   Class-map: voip (match-all)
 146701 packets, 10325334 bytes
 30 second offered rate 24000 bps, drop rate 0 bps
 Match: access-group 101
 Priority: 50% (128 kbps), burst bytes 3200, b/w exceed drops: 0
 Class-map: class-default (match-any)
 1536 packets, 68248 bytes
 30 second offered rate 0 bps, drop rate 0 bps
 Match: any
 queue size 0, queue limit 32
 packets output 2555, packet drops 0
 tail/random drops 0, no buffer drops 0, other drops 0

MS-7507-8A# show frame pvc 16
 PVC Statistics for interface Serial5/0/0:0 (Frame Relay DTE)
 DLCI = 16, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial5/0/0:0.1
 input pkts 3036327 output pkts 199453
 in bytes 198958363 output pkts 199453
 out bytes 17271661 dropped pkts 0 in FECN pkts 0
 in BECN pkts 0 out FECN pkts 0 out BECN pkts 0

in DE pkts 0  out DE pkts 0
out bcast pkts 1071  out bcast bytes 371448
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 35000 bits/sec, 50 packets/sec
pvc create time 17:51:42, last time pvc status changed 17:50:53
fragment type end-to-end fragment size 120

MS-7507-8A# show interface shape
Serial5/0/0:0 nobuffer drop 0
Serial5/0/0:0.1(class 0):
cir 256000, Bc 1024, Be 1024
lower bound cir 0, adapt to fecn 0
packets output 152104, bytes output 6985505
queue limit 64, queue size 0, drops 0
last clear = 16:58:59 ago, shape rate = 10000 bps

**Known Issue**

If you still use Cisco IOS Software Release 12.1E, the VIP interface that is configured with Frame Relay encapsulation can crash with a bus error. This crash occurs if you apply a service policy while the interface passes traffic. The workaround is to stop all background traffic before you update the service policy. Or you can upgrade to Cisco IOS Software Release 12.2 or later.

For more information, refer to the [Cisco Tools & Resources](http://www.cisco.com) page.

**Related Information**

- [QoS Technology Support](http://www.cisco.com)
- [Technical Support & Documentation - Cisco Systems](http://www.cisco.com)

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