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

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Contents

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:

	7500 Series	**7200, 3600, 2600 and Other Non-VIP Platforms**
Supported shaping mechanisms	DTS	Frame Relay TS
Configuration command	**shape** command in a policy map	**frame-relay traffic-shaping** on a main interface; **map-class** configuration commands to specify shaping parameters
Requires dCEF[1]	Yes (Verify with the **show cef linecard** command.)	No

[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.

```
router(config-if)# interface serial 8/0/0
router(config-if)# ip route-cache distributed

router# show ip interface serial 8/0/0
Serial8/0/0 is up, line protocol is up
  Internet address is 24.0.0.2/24
  Broadcast address is 255.255.255.255

!--- Output suppressed.

  ICMP redirects are always sent
  ICMP unreachables are always sent
  ICMP mask replies are never sent
  IP fast switching is enabled
  IP fast switching on the same interface is disabled
  IP Flow switching is disabled
  IP CEF switching is enabled
  IP Distributed switching is enabled
  IP Fast switching turbo vector
  IP CEF switching with tag imposition turbo vector
  IP multicast fast switching is enabled
  IP multicast distributed fast switching is disabled
  IP route-cache flags are Fast, Distributed, CEF
  Router Discovery is disabled
  IP output packet accounting is disabled
```

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

     Refer to Traffic Policy as a QoS Policy (Hierarchical Traffic Policies) Example for more information.

   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

```
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

```
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: 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
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 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: 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
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  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
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 page.

Related Information

- **QoS Technology Support**
- **Technical Support & Documentation - Cisco Systems**

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