

Distributed Traffic Shaping Configuration Example

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Introduction

This document discusses Distributed Traffic Shaping (DTS) and consolidates much of the information that is available today.

Traffic shaping (TS) provides a mechanism to control the traffic flow on a particular interface. "Distributed" TS is a feature specific to the higher-end platforms such as the Cisco 7500 or the 12000 Series Internet Router. These platforms have the ability to offload traffic shaping from the main processor (Route Switch Processor – RSP or Gigabit Route Processor – GRP) to the individual interface processors (Versatile Interface Processor – VIP or line card – LC). In networks where Distributed Cisco Express Forwarding (dCEF) is the preferred mode of switching, DTS on the VIP or line card is the logical choice for traffic shaping.

Prerequisites

Requirements

There are no specific requirements for this document.

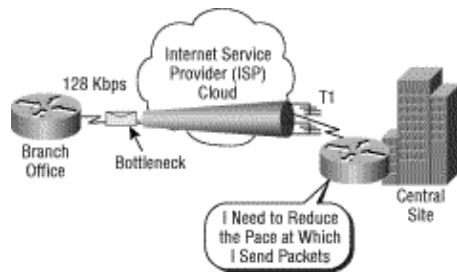
Components Used

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

Why Shape Traffic with DTS?

If you are reading this document, then, most likely, you already have an idea of why you want to shape traffic. The distributed piece of the puzzle should be pretty clear, too – you are distributing the duties of the main

processor to the individual card processors. With respect to shaping, many customers are simply trying to avoid exceeding the guaranteed rate of the circuit based on the agreement with the provider. This prevents drops in the cloud and, as a result, reduces retransmissions (with TCP/IP) when the provider discards packets. A common scenario where you need to shape traffic is depicted below. In this example, there is no need for the Central Site to forward traffic at T1 rate if the Branch Office only has a 128K circuit:



There are many additional reasons for using DTS. Benefits include an assortment of related Quality of Service (QoS) functionalities, and the drive to use bandwidth as efficiently as possible across varied types of traffic. DTS configures traffic shaping at the interface level, subinterface level, or logical interface level for ATM or Frame Relay permanent virtual circuits (PVCs).

Shaping can achieve an array of network goals and can key on the following criteria:

- All traffic on the physical or logical interface
- Traffic classified through simple and extended IP access control lists (ACLs) (IP addresses, TCP/UDP ports, IP Precedence)
- Traffic classified by QoS group (an internal packet label applied upstream by Committed Access Rate – CAR, or QoS policy propagation – QPPB)

DTS supports up to 200 shape queues per VIP, supporting up to OC-3 rates when the average packet size is 250 bytes or greater, and when using a VIP2-50 or better with 8M static RAM (SRAM). Unlike regular traffic shaping (GTS), DTS does not require that weighted fair queueing (WFQ) be enabled. Instead, DTS uses fair queueing or distributed first-in, first-out (FIFO) for the shaped queue.

Platform Specifics

This table describes how to configure TS depending on the platform – mainly illustrating that the feature is significant for high-end platforms:

	12000 Series	7500 Series	7200, 3600, 2600 and Other Non-VIP Platforms
Supported shaping mechanisms	DTS	DTS	GTS or Frame Relay TS
Configuration command	shape command in a policy map	shape command in a policy map	traffic-rate or frame-relay traffic-shaping on a main interface, and with FRTS – map-class configuration

			commands to specify shaping parameters
Requires distributed Cisco Express Forwarding (dCEF)	Default is CEF	Yes (verify with the show cef linecard command)	No

7500 Series DTS Notes

On the Cisco 7500 Series, the ability to configure Frame Relay Traffic Shaping (FRTS) using the **frame-relay traffic-shaping** command is now blocked since FRTS executes on the RSP in a non-distributed mode. With dCEF and FRTS, a CEF "punt" adjacency causes all packets to be fast switched by the RSP, which is sub-optimal for maximum forwarding performance.

As of Cisco IOS® Software Release 12.1(5)T, QoS policies must run in distributed mode on the VIP; Route/Switch Processor (RSP)-based QoS is no longer supported. Therefore, you must use the **shape** command and other commands of the Modular QoS Command Line Interface (MQC) to implement DTS for interfaces on VIPs on the Cisco 7500 Series.

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 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 and can apply the **service-policy** command directly to the subinterface or DLCI. However, Cisco recommends that you configure dLLQ inside a map class.

When applying distributed FRF.12 (fragmentation) to a Frame Relay interface, you must define a map class and apply the service policy under the map class. FRF.12 was introduced in Cisco IOS software version 12.0(4)T and is extended to the Cisco 805, 1600, 1700, 2500, 4500, and 4700 router platforms as from Cisco IOS software version 12.1(2)T. For additional details, refer to FRF.12 Support on Additional Platforms.

12000 Series Internet Router DTS Notes

On the 12000 Series, fast switching and process switching are not options. If a destination prefix cannot be resolved to a forwarding entry in the inbound line card's (LC) tables, the packet is dropped. Only packets matching a glean adjacency are punted to the Gigabit Routing Processor (GRP). In addition, on the 12000, the LC CPU won't punt packets to the GRP for features, and the LC sends an Internet Control Message Protocol (ICMP) unreachable (as long as the no ip unreachable command is not configured). On the 12000, the only traffic punted to the GRP are packets destined to an interface on the router or packets sourced from the router. For more information, refer to What Quality of Service (QoS) features are available for the 12000 Series Internet Router?

Configure

Use the first two steps to configure DTS on VIP-based Frame Relay interfaces (7500 Series):

1. Use this command in order to enable dCEF:

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

2. Ensure that the frame relay interface is enabled for distributed switching:

```

router(config-if)#interface serial 2/0/0
router(config-if)#ip route-cache distributed
router#show ip interface serial 2/0/0
Serial8/0/0 is up, line protocol is up
  Internet address is 64.0.0.2/24
  Broadcast address is 255.255.255.255
  ICMP redirects are always sent
  ICMP unreachable 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 traffic class. (Required)
4. Configure a DTS traffic policy. (Required)
5. Attach the traffic policy and enable DTS. (Required)
6. Monitor and maintain DTS. (Optional)

Note: Use the Command Lookup Tool (registered customers only) for more information on the commands used in this document.

Create a Traffic Class

The first step to enabling any feature using the Modular QoS CLI is to create a traffic class.

Router(config)#**class-map** [**match-any** | **match-all**] *class-name* Specifies the name and whether any or all of the criteria will constitute a match.

For information on the Modular QoS CLI and the procedure for creating a traffic class, refer to Modular Quality of Service Command-Line Interface Overview.

Configure a DTS Traffic Policy

You must configure a traffic policy in order to enable DTS. You can configure traffic policies for as many classes as are defined on the router up to the maximum of 256.

To configure a traffic policy, use the **policy-map** command beginning in global configuration mode to specify the traffic policy name, then use the **class** and **shape** configuration commands in order to configure the traffic class name and traffic shaping.

1. Router(config)#**policy-map** *policy-name* Specifies the name of the traffic policy to be created.
2. Router(config-pmap)#**class** *class-name* Specifies the name of a predefined traffic class included in the traffic policy. The class was defined in the previous step of this process.
3. Router(config-pmap-c)#**shape** {**average** | **peak**} *cir* [*bc*] [*be*] Specifies the average or peak rate traffic shaping.

Traffic is directed to the traffic policy default class if it does not satisfy the match criteria of any other classes whose policies are defined in the traffic policy.

Attach the Traffic Policy and Enable DTS

Use this command in interface (or map-class) configuration mode in order to attach a traffic policy to the interface, subinterface, or map-class and in order to enable DTS on the interface:

- Router(config-if)#**service-policy output** *policy-name* Enables DTS and attaches the specified traffic policy to the interface or map-class.

Note: Applications of dLLQ and FRF.12 are strongly recommended to have the service policy applied to the frame-relay map class.

Refer to Frame Relay Traffic Shaping with Distributed QoS on the Cisco 7500 Series for more information about fragmentation.

Monitor and Maintain DTS

Use these commands in EXEC mode in order to monitor and maintain the DTS feature:

- Router# **show interface** [*interface-name*] **shape** Displays detail status of the traffic shaping.
- Router# **show policy** *policy-name* Displays the configuration of all classes composing the specified traffic policy.
- Router# **show policy** *policy-name* **class** *class-name* Displays the configuration of the specified class of the specified traffic policy.

For more information about QoS monitoring commands, refer to Understanding Packet Counters in show policy-map interface Output.

Sample Configurations

DTS on Main Interface

In this example, traffic that goes out on interface *pos1/0/0* is shaped at the rate of 10Mbps/sec.

```
router(config)#class-map class-interface-all

router(config-cmap)#match any

router(config-cmap)#exit

router(config)#policy-map DTS-interface-all-action
router(config-pmap)#class class-interface-all

router(config-pmap-c)#shape average 10000000
router(config-pmap-c)#exit

router(config)#interface pos1/0/0

router(config-if)#service-policy output DTS-interface-all-action
```

Class-based DTS on Main Interface

In this example, two classes are created, and the match criteria is defined based on the access list number. Traffic that goes out on interface *fd4/0/0* and matches the criteria in access list 10 is shaped to 16Mbps. Traffic that matches the criteria in access list 20 is shaped to 8 Mbps.

```
router(config)#access-list 10 permit 171.69.0.0
```

```
router(config)#access-list 20 permit 192.168.0.0

router(config)#class-map class1

router(config-cmap)#match access-group 10

router(config-cmap)#exit

router(config)#class-map class2

router(config-cmap)#match access-group 20

router(config-cmap)#exit

router(config)#policy-map DTS-interface-class-action
router(config-pmap)#class class1

router(config-pmap-c)#shape average 16000000

router(config-pmap-c)#exit

router(config-pmap)#class class2

router(config-pmap-c)#shape average 8000000

router(config-pmap-c)#exit

router(config-pmap)#interface fd4/0/0

router(config-if)#service-policy output DTS-interface-class-action
```

Note: The IP addresses in this configuration are examples only.

For additional configuration examples, refer to [Configuring Distributed Traffic Shaping](#).

Verify

There is currently no verification procedure available for this configuration.

Troubleshoot

A VIP interface configured with Frame Relay encapsulation might crash with a bus error if it applies a service-policy while the interface passes traffic. This problem is resolved in various versions of Cisco IOS software (Cisco bug ID CSCdt88568). For more information on this ddts and additional bugs, refer to [Cisco Support Tools & Resources](#) or the [Bug Toolkit](#) (registered customers only) .

Related Information

- [Cisco 12000 Series Internet Router: Frequently Asked Questions](#)
- [When is CEF Required for Quality of Service?](#)
- [Understanding Packet Counters in show policy-map interface Output](#)
- [Configuring Class Based Weighted Fair Queueing with FRTS](#)
- [FRF.12 Support on Additional Platforms](#)
- [Technical Support & Documentation – Cisco Systems](#)

