



Configuring Tag Switching

This chapter describes tag switching, a high-performance packet-forwarding technology that assigns tags to multiprotocol frames for transport across packet- or cell-based networks.



Note

This chapter provides advanced configuration instructions for the Catalyst 8540 MSR, Catalyst 8510 MSR, and LightStream 1010 ATM switch routers. For an overview of tag switching, refer to the *Guide to ATM Technology*. For complete descriptions of the commands mentioned in this chapter, refer to the *ATM Switch Router Command Reference* publication.

This chapter includes the following sections:

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Tag Switching Overview

In conventional Layer 3 forwarding, as a packet traverses the network, each router extracts forwarding information from the Layer 3 header. Header analysis is repeated at each router (hop) through which the packet passes.

In a tag switching network, the Layer 3 header is analyzed just once. It is then mapped into a short fixed-length tag. At each hop, the forwarding decision is made by looking only at the value of the tag. There is no need to reanalyze the Layer 3 header. Because the tag is a fixed-length, unstructured value, lookup is fast and simple.

For an overview of how tag switching works and its benefits, refer to the *Guide to ATM Technology*.

Hardware and Software Requirements and Restrictions (Catalyst 8540 MSR)

The Catalyst 8540 MSR hardware requirements for tag switching include the following:

- The ATM switch router (used as a tag switch)
- A tag edged router such as a Cisco 7000 Route Switch Processor (RSP) with an Optical Carrier 3 (OC-3) ATM interface processor (AIP) installed

Tag switching has the following software restrictions:

- Open Shortest Path First (OSPF) is the only routing protocol currently supported.
- IP is the only network layer protocol supported.
- Hierarchical VP tunnels cannot co-exist on a physical interface with tag switching.

Hardware and Software Requirements and Restrictions (Catalyst 8510 MSR and LightStream 1010)

The Catalyst 8510 MSR and LightStream 1010 ATM switch router hardware requirements for tag switching include the following:

- The ATM switch router (used as a tag switch).
- A switch processor feature card installed on the route processor, if you want to enable VC merge (multipoint-to-point connection). Note that FC-PFQ requires 64 MB of DRAM.
- A tag edged router such as a Cisco 7000 RSP with an OC-3 AIP installed.

Tag switching has the following software restrictions:

- Open Shortest Path First (OSPF) is the only routing protocol currently supported.
- IP is the only network layer protocol supported.
- Hierarchical VP tunnels cannot co-exist on a physical interface with tag switching.

Configuring Tag Switching

This section describes how to configure tag switching on ATM switch routers, and includes the following procedures:

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- Enabling Tag Switching on the ATM Interface on page 15-4
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- Configuring a VPI Range (Optional) on page 15-7
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Configuring a Loopback Interface

You should configure a loopback interface on every ATM switch router configured for tag switching. The loopback interface, a virtual interface, is always active. The IP address of the loopback interface is used as the Tag Distribution Protocol (TDP) identifier for the ATM switch router. If a loopback interface does not exist, the TDP identifier is the highest IP address configured on the ATM switch router. If that IP address is administratively shut down, all TDP sessions through the ATM switch router restart. Therefore, we recommend that you configure a loopback interface.

To configure the loopback interface, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# interface loopback <i>number</i> Switch(config-if)#	Enters interface configuration mode and assigns a number to the loopback interface.
Step 2	Switch(config-if)# ip address <i>ip-address mask</i>	Assigns an IP address and subnet mask to the loopback interface.
		 <p>Note We recommend a 32-bit subnet mask (255.255.255.255) for the loopback interface. If you do not use a 32-bit subnet mask, two TVCs¹ terminate for the same address—one for a 32-bit subnet mask and the other for the mask you entered. Entering a 32-bit subnet mask reduces the number of TVCs to one.</p>

1. TVCs = tag virtual channels.

Example

In the following example, loopback interface 0 is created with an IP address of 1.0.1.11 and a subnet mask of 255.255.255.255:

```
Switch(config)# interface loopback 0
Switch(config-if)# ip address 1.0.1.11 255.255.255.255
Switch(config-if)# exit
```

Displaying Loopback Interface Configuration

The following example shows the loopback 0 configuration using the **show interfaces** privileged EXEC command:

```
Switch# show interfaces loopback 0
Loopback0 is up, line protocol is up
  Hardware is Loopback
  Internet address is 1.0.1.11/24
  MTU 1500 bytes, BW 8000000 Kbit, DLY 5000 usec, rely 255/255, load 1/255
  Encapsulation LOOPBACK, loopback not set, keepalive set (10 sec)
  Last input 00:00:03, output never, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/0, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    0 packets input, 0 bytes, 0 no buffer
    Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    73 packets output, 0 bytes, 0 underruns
    0 output errors, 0 collisions, 0 interface resets
    0 output buffer failures, 0 output buffers swapped out
```

Enabling Tag Switching on the ATM Interface



Note

Configure all parallel interfaces between ATM switch routers for either IP unnumbered or with a specific IP address. Unnumbering some parallel interfaces and assigning specific IP addresses to others might cause TDP sessions to restart on some parallel interfaces when another parallel interface is shut down. Therefore, we highly recommend that you unnumber all parallel interfaces to loopback.

To enable tag switching on the ATM interface, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# interface atm <i>card/subcard/port</i> Switch(config-if)#	Enters interface configuration mode on the specified ATM interface.
Step 2	Switch(config-if)# ip unnumbered <i>type number</i> or Switch(config-if)# ip address <i>ip-address mask</i>	Enables IP unnumbered on the ATM interface and assigns the unnumbered interface to an interface that has an IP address. We recommend enabling IP unnumbered because it allows you to conserve IP addresses and it reduces the number of TVCs terminating on the switch. or Assigns an IP address and subnet mask to the ATM interface.
Step 3	Switch(config-if)# tag-switching ip	Enables tag switching of IPv4 packets.

Examples

In the following example, ATM interface 1/0/1 is configured for IP unnumbered to loopback interface 0:

```
Switch(config-if)# interface atm 1/0/1
Switch(config-if)# ip unnumbered loopback 0
Switch(config-if)# tag-switching ip
Switch(config-if)# exit
```

In the following example, ATM interface 0/0/3 is configured with a specific IP address and subnet mask (1.3.11.3 255.255.0.0):

```
Switch(config)# interface atm 0/0/3
Switch(config-if)# ip address 1.3.11.3 255.255.0.0
Switch(config-if)# tag-switching ip
Switch(config-if)# exit
```

Displaying the ATM Interface Configuration

To display the ATM interface configuration, use the following EXEC command:

Command	Purpose
show tag-switching interfaces	Displays the tag switching configuration on the ATM interface.

The following example shows that tag switching is configured on ATM interfaces 0/0/3 and 1/0/1:

```
Switch# show tag-switching interfaces
Interface          IP      Tunnel  Operational
ATM0/0/3           Yes    No      Yes        (ATM tagging)
ATM1/0/1           Yes    No      Yes        (ATM tagging)
```

Configuring OSPF

Enable OSPF on the ATM switch router so that it can create routing tables, which identify routes through the network. Then add the addresses and associated routing areas to the OSPF process so that it can propagate the addresses to other ATM switch routers:

	Command	Purpose
Step 1	Switch(config)# router ospf <i>process_number</i> Switch(config-router)#	Enables OSPF and assigns it a process number. The process number can be any positive integer.
Step 2	Switch(config-router)# network <i>address wildcard-mask area area-id</i>	Defines the network prefix, a wildcard subnet mask, and the associated area number on which to run OSPF. An area number is an identification number for an OSPF address range. Repeat this command for each additional area you want to add to the OSPF process. Caution Ethernet0 is used for system management only. Do not add this interface to the routing protocol process.

**Note**

Since the 12.0(1a)W5(5b) release of the system software, addressing the interface on the route processor (CPU) has changed. The ATM interface is now called atm0, and the Ethernet interface is now called ethernet0. Old formats (atm 2/0/0 and ethernet 2/0/0) are still supported.

Example

The following is an example of OSPF enabled and assigned process number 10000. All addresses are in area 0:

**Note**

An IP address of 1.1.1.1 with a subnet mask of 255.255.255.0 is entered as an IP network prefix of 1.1.1.0 with a subnet mask of 0.0.0.255. Likewise, an IP address of 1.2.1.1 with a subnet mask of 255.255.255.0 is entered as an IP network prefix of 1.2.1.0 with a subnet mask of 0.0.0.255.

```
Switch(config)# router ospf 10000
Switch(config-router)# network 1.1.1.0 0.0.0.255 area 0
Switch(config-router)# network 1.2.1.0 0.0.0.255 area 0
Switch(config-router)# network 1.3.0.0 0.0.255.255 area 0
Switch(config-router)# network 200.2.2.0 0.0.0.255 area 0
Switch(config-router)# network 1.0.1.0 0.0.0.255 area 0
Switch(config-router)# network 1.18.0.0 0.0.255.255 area 0
```

Displaying the OSPF Configuration

To display the OSPF configuration, use the following privileged EXEC command:

Command	Purpose
show ip ospf	Displays the OSPF configuration.

The following example shows the OSPF configuration using the **show ip ospf** privileged EXEC command:

```
Switch# show ip ospf
Routing Process "ospf 10000" with ID 1.0.1.11
Supports only single TOS(TOS0) routes
SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
Number of DCbitless external LSA 0
Number of DoNotAge external LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Area BACKBONE(0) (Inactive)
    Number of interfaces in this area is 4
    Area has no authentication
    SPF algorithm executed 2 times
    Area ranges are
    Link State Update Interval is 00:30:00 and due in 00:14:42
    Link State Age Interval is 00:20:00 and due in 00:14:10
    Number of DCbitless LSA 0
    Number of indication LSA 0
    Number of DoNotAge LSA 0
```

Configuring a VPI Range (Optional)

Although not necessary for most configurations, you might need to change the default tag virtual path identifier (VPI) range on the switch if:

- It is an administrative policy to use a VPI value other than 1, the default VPI.
- There are a large number of tag virtual channels (TVCs) on an interface.



Note

You cannot enter a VPI range on a VP tunnel. On VP tunnels, the VPI is the permanent virtual path (PVP) number of the tunnel.

To change the default tag VPI range, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# interface atm <i>card/subcard/port</i> Switch(config-if)#	Enters interface configuration mode on the specified ATM interface.
Step 2	Switch(config-if)# tag-switching atm vpi <i>vpi</i> [- <i>vpi</i>]	Enters the VPI range. <div data-bbox="966 913 1015 953" data-label="Image"> </div> <div data-bbox="958 955 1015 984" data-label="Section-Header"> <h3>Note</h3> </div> <div data-bbox="1044 955 1526 1146" data-label="Text"> <p>If the TDP neighbor is a router, the VPI range can be no larger than two. For example, from 5 to 6 (a range of two), not 5 to 7 (a range of three). If the TDP neighbor is a switch, the maximum VPI range is 0 to 255.</p> </div>

Examples

The following example shows how to select a VPI range from 5 to 6 (a range of two), an acceptable range if the TDP neighbor is a router:

```
Switch(config)# interface atm 3/0/1
Switch(config-if)# tag-switching ip
Switch(config-if)# tag-switching atm vpi 5 - 6
```

The following example shows how to select a VPI range from 5 to 7 (a range of three), an acceptable range if the TDP neighbor is a switch:

```
Switch(config)# interface atm 3/0/1
Switch(config-if)# tag-switching ip
Switch(config-if)# tag-switching atm vpi 5 - 7
```



Note

Although the example shows a VPI range of three, you are not limited to a range of three if the TDP neighbor is a switch. The maximum VPI range is 0 to 255 if the TDP neighbor is a switch.

Displaying the Tag Switching VPI Range

To display the tag switching VPI range, use the following EXEC command:

Command	Purpose
show tag-switching interfaces detail	Displays the tag switching VPI range on an interface.

Example

The following example shows the tag switching VPI range on ATM interface 1/0/1:

```
Switch# show tag-switching interfaces detail
Interface ATM0/0/3:
    IP tagging enabled
    TSP Tunnel tagging not enabled
    Tagging operational
    MTU = 4470
    ATM tagging: Tag VPI = 1, Control VC = 0/32
Interface ATM1/0/1:
    IP tagging enabled
    TSP Tunnel tagging not enabled
    Tagging operational
    MTU = 4470
    ATM tagging: Tag VPI range = 5 - 6, Control VC = 6/32
<information deleted>
```

Configuring TDP Control Channels (Optional)

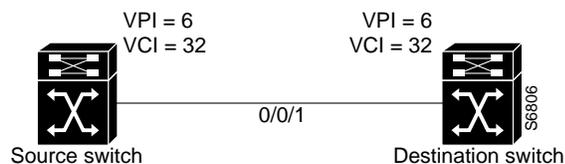
Although not necessary for most configurations, you can change the default Tag Distribution Protocol (TDP) control channel VPI and virtual channel identifier (VCI) if you want to use a nondefault value. The default TDP control channel is on VPI 0 and VCI 32. TDP control channels exchange TDP HELLOs and Protocol Information Elements (PIEs) to establish two-way TDP sessions. TVCs are created by the exchange of PIEs through TDP control channels.

To change the TDP control channel, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# interface atm <i>card/subcard/port</i> Switch(config-if)#	Enters interface configuration mode on the specified ATM interface.
Step 2	Switch(config-if)# ip address <i>ip-address mask</i>	Assigns an IP address and subnet mask to the ATM interface.
Step 3	Switch(config-if)# tag-switching ip	Enables tag switching of IPv4 packets.
Step 4	Switch(config-if)# tag-switching atm control-vc <i>vpi vci</i>	Changes the TDP control channel.

Figure 15-1 shows an example TDP control channel configuration between a source switch and destination switch on ATM interface 0/0/1. Note that the VPI and VCI values match on the source switch and destination switch.

Figure 15-1 Configuring TDP Control Channels



Examples

In the following example, a TDP control channel is configured on the source switch:

```
Switch(config)# interface atm 0/0/1
Switch(config-if)# ip address 1.2.0.11 255.255.255.0
Switch(config-if)# tag-switching ip
Switch(config-if)# tag-switching atm control-vc 6 32
Switch(config-if)# exit
```

In the following example, a TDP control channel is configured on the destination switch:

```
Switch(config)# interface atm 0/0/1
Switch(config-if)# ip address 1.2.0.12 255.255.255.0
Switch(config-if)# tag-switching ip
Switch(config-if)# tag-switching atm control-vc 6 32
Switch(config-if)# exit
```

If you are having trouble establishing a TDP session, verify that the VPI and VCI values match on the TDP control channels of the source switch and destination switch.

Displaying the TDP Control Channels

To display the TDP control channel configuration, use the following EXEC command:

Command	Purpose
show tag-switching interfaces detail	Displays the TDP control channel configuration on an interface.

The following example shows the TDP control channel configuration on interface ATM 0/0/3:

```
Switch# show tag-switching interfaces detail
Interface ATM0/0/3:
    IP tagging enabled
    TSP Tunnel tagging not enabled
    Tagging operational
    MTU = 4470
→   ATM tagging: Tag VPI = 1, Control VC = 0/32
<information deleted>
```

Configuring Tag Switching on VP Tunnels

If you want to configure tag switching on virtual path (VP) tunnels, perform the following steps, beginning in global configuration mode:



Note This procedure is optional.

	Command	Purpose
Step 1	Switch(config)# interface atm <i>card/subcard/port</i> Switch(config-if)#	Enters interface configuration mode on the specified ATM interface.
Step 2	Switch(config-if)# atm pvp <i>vpi</i>	Creates a PVP. When configuring PVP connections, configure the lowest VPI numbers first.
Step 3	Switch(config-if)# exit Switch(config)#	Returns to global configuration mode.
Step 4	Switch(config)# interface atm <i>card/subcard/port.subinterface#</i> Switch(config-subif)#	Enters subinterface configuration mode.
Step 5	Switch(config-subif)# ip unnumbered <i>type number</i> or Switch(config-subif)# ip address <i>ip-address mask</i>	Enables IP unnumbered on the ATM interface and assigns the unnumbered interface to an interface that has an IP address. We recommend enabling IP unnumbered because it allows you to conserve IP addresses and reduces the number of TVCs terminating on the switch. or Assigns an IP address and subnet mask to the ATM interface.
Step 6	Switch(config-subif)# tag-switching ip	Enables tag switching of IPv4 packets.

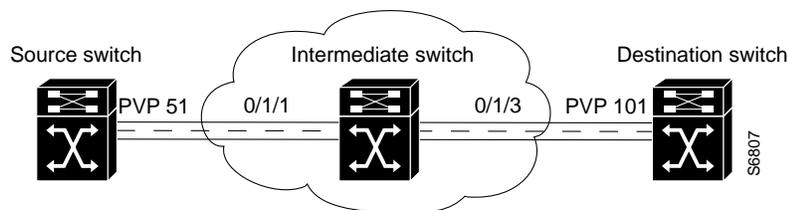
Because a VP tunnel runs between switches, you must also configure a VP tunnel on the connecting ATM interface on the destination switch. The examples that follow show how to configure VP tunnels between switches.



Note The intermediate switch configuration follows in the next section, “Connecting the VP Tunnels.”

Figure 15-2 shows an example VP tunnel between a source switch and destination switch.

Figure 15-2 Configuring VP Tunnels



Examples

In the following example, ATM interface 0/1/1 on the source switch has no IP address and PVP 51 is configured for IP unnumbered to loopback interface 0:

```
Switch(config-if)# interface atm 0/1/1
Switch(config-if)# atm pvp 51
Switch(config-if)# exit
Switch(config-if)# interface atm 0/1/1.51
Switch(config-subif)# ip unnumbered loopback 0
Switch(config-subif)# tag-switching ip
Switch(config-subif)# exit
```

In the following example, ATM interface 0/1/3 on the destination switch has no IP address and PVP 101 is configured for IP unnumbered to loopback interface 0:

```
Switch(config)# interface atm 0/1/3
Switch(config-if)# atm pvp 101
Switch(config-if)# exit
Switch(config)# interface atm 0/1/3.101
Switch(config-subif)# ip unnumbered loopback 0
Switch(config-subif)# tag-switching ip
Switch(config-subif)# exit
```

To connect the source and destination switch VP tunnels, proceed to the next section, “Connecting the VP Tunnels.”

Displaying the VP Tunnel Configuration

To display the VP tunnel configuration, use the following EXEC command:

Command	Purpose
show atm vp	Displays the VP tunnel configuration on an interface.

The following example shows PVP 51 configured on ATM interface 0/1/1:

```
Switch# show atm vp
Interface  VPI   Type  X-Interface  X-VPI  Status
ATM0/1/1  51    PVP   TUNNEL
```

Connecting the VP Tunnels

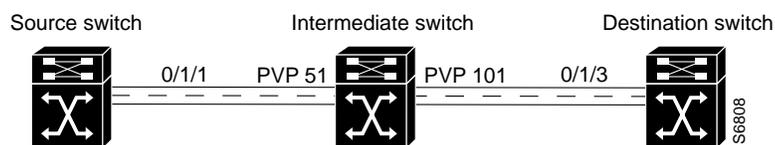
To complete the VP tunnel, you must configure the ATM ports on the intermediate switch to designate where to send packets coming from the source switch and going to the destination switch.

To connect the permanent virtual path (PVP), perform the following steps, beginning in interface configuration mode:

	Command	Purpose
Step 1	Switch(config)# interface atm card/subcard/port Switch(config-if)#	Enters interface configuration mode on the specified ATM interface.
Step 2	Switch(config-if)# atm pvp vpi interface atm card/subcard/port vpi-B	Connects the PVP from the source switch to the destination switch.

Figure 15-3 shows an example configuration on an intermediate switch.

Figure 15-3 Connecting the VP Tunnels



Example

In the following example, PVP 51 on ATM interface 0/1/1 is connected to PVP 101 on ATM interface 0/1/3:

```
Switch(config)# interface atm 0/1/1
Switch(config-if)# atm pvp 51 interface atm 0/1/3 101
Switch(config-if)# exit
```

Displaying the VP Tunnel Configuration

The following example shows PVP 51 on ATM interface 0/1/1 connected to PVP 101 on ATM interface 0/1/3:

```
Switch# show atm vp
Interface  VPI   Type  X-Interface  X-VPI  Status
ATM0/1/1   51    PVP   ATM0/1/3     101    DOWN
ATM0/1/3   101   PVP   ATM0/1/1     51     DOWN
```

Configuring VC Merge

VC merge allows the switch to aggregate multiple incoming flows with the same destination address into a single outgoing flow. Where VC merge occurs, several incoming tags are mapped to one single outgoing tag. Cells from different VCIs going to the same destination are transmitted to the same outgoing VC using multipoint-to-point connections. This sharing of tags reduces the total number of

virtual circuits required for tag switching. Without VC merge, each source-destination prefix pair consumes one tag VC on each interface along the path. VC merge reduces the tag space shortage by sharing tags for different flows with the same destination.



Note

VC merge support requires FC-PFQ on the route processor. If you do not have FC-PFQ, and you try to enable VC merge, the TVCs remain point-to-point. (Catalyst 8510 MSR and LightStream 1010)

VC merge is enabled by default. To disable VC merge, enter the following command in global configuration mode:

Command	Purpose
no tag-switching atm vc-merge	Enables VC merge.

Displaying the VC Merge Configuration

To display the VC merge configuration, use the following EXEC command:

Command	Purpose
show tag-switching atm-tdp capability	Displays the TDP control channel configuration on an interface.

The following example shows that VC merge configuration is enabled on ATM interface 0/1/0:

```
Switch# show tag-switching atm-tdp capability
```

	Control		VPI	VCI	Alloc	VC Merge		
	VP	VC	Range	Range	Scheme	IN	OUT	
ATM0/1/0	Negotiated	0	32	[7 - 8]	[33 - 1023]	UNIDIR	-	-
	Local	-	-	[7 - 8]	[33 - 16383]	UNIDIR	Yes	Yes
	Peer	-	-	[7 - 8]	[33 - 1023]	UNIDIR	-	-

Configuring Tag Switching CoS

Quality of service (QoS) allows ATM to meet the transmission *quality* and *service* availability of many different types of data. The need for delay-sensitive data, such as voice, can be given a higher priority than data that is not delay-sensitive, such as e-mail. The following service categories were created for ATM Forum VCs to meet the transmission needs of various types of data: VBR-RT, VBR-NRT, ABR, and UBR. Refer to Chapter 8, “Configuring Resource Management,” for more information about the standard ATM Forum implementation of QoS. This section describes tag switching class of service (CoS).

Up to eight QoS classes (0 to 7) can be allocated to each physical interface port. Each port has an independent logical rate scheduler (RS) and a weighted round-robin (WRR) scheduler. The RS guarantees minimum bandwidth and has first priority on supplying an eligible cell for transmission. Second priority is given to the service classes, which have been assigned relative weights that are based on the ratio of the total leftover bandwidth. The service class relative weights are configurable so you can change the priority of the default values. The VCs within a service class also have relative weights. The service classes and VCs within a service class are scheduled by their relative weights.

With tag switching CoS, tag switching can dynamically set up to four tag virtual channels (TVCs) with different service categories between a source and destination. TVCs do not share the same QoS classes reserved for ATM Forum VCs (VBR-RT, VBR-NRT, ABR, and UBR). The following four new service classes were created for TVCs: TBR_1 (WRR_1), TBR_2 (WRR_2), TBR_3 (WRR_3), and TBR_4 (WRR_4). These new service classes are called Tag Bit Rate (TBR) classes. TVCs and ATM Forum VCs can only coexist on the same physical interface, but they operate in ships in the night (SIN) mode and are unaware of each other.

TBR classes support only best-effort VCs (similar to the ATM Forum service category UBR); therefore, there is no bandwidth guarantee from the RS, which is not used for TVCs. All of the TVCs fall into one of the four TBR classes, each carrying a different default relative weight. The default values of the relative weights for the four TBR classes are configurable, so you can change the priority of the default values.

Table 15-1 lists the TBR classes and ATM Forum class mappings into the service classes for physical ports.

Table 15-1 Service Class to Weight Mapping for Physical Ports

TBR Class	Service Class	Relative Weight
TBR_1 (WRR_1)	1	1
TBR_2 (WRR_2)	6	2
TBR_3 (WRR_3)	7	3
TBR_4 (WRR_4)	8	4

ATM Forum Service Category	Service Class	Relative Weight
CBR ¹	2	8
VBR-RT	2	8
VBR-NRT	3	1
ABR	4	1
UBR	5	1

1. Even though the CBR service category is mapped to service class 2, all of the CBR VCs are rate scheduled only, and therefore they are not WRR scheduled.

When tag switching is enabled on a hierarchical VP tunnel, the tunnel can only be used for tag switching. Because hierarchical VP tunnels support only four service classes, both TVCs and ATM Forum VCs map to the same service classes. Therefore, both ATM Forum VCs and TVCs cannot coexist in a hierarchical VP tunnel. The relative weights assigned to the service classes depend on which is active (either tag switching or ATM Forum). The class weights change whenever a hierarchical VP tunnel is toggled between ATM Forum and tag switching. By default, a hierarchical VP tunnel comes up as an ATM Forum port.

Table 15-2 lists the TBR classes and ATM Forum service category mappings for hierarchical VP tunnels.

Table 15-2 Service Class to Weight Mapping for Hierarchical VP Tunnels

TBR Class	Service Class	Relative Weight
TBR_1 (WRR_1)	1	1
TBR_2 (WRR_2)	2	2
TBR_3 (WRR_3)	3	3
TBR_4 (WRR_4)	4	4

ATM Forum Service Category	Service Class	Relative Weight
VBR-RT	1	8
VBR-NRT	2	1
ABR	3	1
UBR	4	1

Configuring the Service Class and Relative Weight

Each service class is assigned a relative weight. These weights are configurable and range from 1 to 15. To configure the service class and relative weight on a specific interface, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# interface atm <i>card/subcard/port[.vpt#]</i> Switch(config-if)#	Specifies an ATM interface and enters interface configuration mode.
Step 2	Switch(config-if)# atm service-class {1 6 7 8} wrr-weight weight or Switch(config-if)# atm service-class {1 2 3 4} wrr-weight weight	Enters the service class and relative weight for a physical interface. or Enters the service class and relative weight for a hierarchical interface.

Example

In the following example, ATM interface 0/0/3 is configured with service class 1 and a WRR weight of 3:

```
Switch(config)# interface atm 0/0/3
Switch(config-if)# atm service-class 1 wrr-weight 3
```

Displaying the TVC Configuration

To display the TVC configuration, perform the following task in EXEC mode:

Command	Purpose
show atm vc interface atm card/subcard/port [vpi vci]	Displays the ATM layer connection information about the virtual connection.

The following example shows the service category of the TVC:

```
Switch# show atm vc interface atm 0/0/3 1 35
Interface: ATM0/0/3, Type: oc3suni
VPI = 1   VCI = 35
Status: UP
Time-since-last-status-change: 1d00h
Connection-type: TVC(I)
Cast-type: multipoint-to-point-input
Packet-discard-option: enabled
Usage-Parameter-Control (UPC): pass
Wrr weight: 2
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states: Not-applicable
Cross-connect-interface: ATM0/1/3.10, Type: oc3suni
Cross-connect-VPI = 10
Cross-connect-VCI = 34
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state: Not-applicable
Threshold Group: 7, Cells queued: 0
Rx cells: 0, Tx cells: 0
Tx Clp0:0, Tx Clp1: 0
Rx Clp0:0, Rx Clp1: 0
Rx Upc Violations:0, Rx cell drops:0
Rx pkts:0, Rx pkt drops:0
Rx connection-traffic-table-index: 63998
→ Rx service-category: WRR_1 (WRR Bit Rate)
Rx pcr-clp01: none
Rx scr-clp01: none
Rx mcr-clp01: none
Rx      cdvt: 1616833580 (from default for interface)
Rx      mbs: none
Tx connection-traffic-table-index: 63998
→ Tx service-category: WRR_1 (WRR Bit Rate)
Tx pcr-clp01: none
Tx scr-clp01: none
Tx mcr-clp01: none
Tx      cdvt: none
Tx      mbs: none
```

Threshold Group for TBR Classes

A threshold group utilizes the memory efficiently among VCs of a particular traffic type. Each threshold group is programmed with a dynamic memory allocation profile that maps into the needs of the connections of a particular service class. There are 16 threshold groups (0 to 15) available on the ATM switch router. Each threshold group has a set of eight regions, and each region has a set of thresholds. When these thresholds are exceeded, cells are dropped to maintain the integrity of the shared memory resource.

Each ATM Forum service category is mapped into a distinct threshold group. All the connections in a particular service category map into one threshold group. Similarly, all the Tag Bit Rate (TBR) classes have best effort traffic and the service differentiation comes mainly by giving different weights. Each of the TBR classes map into four different threshold groups whose parameters are the same as the unspecified bit rate (UBR) threshold group.

Table 15-3 shows the threshold group parameters mapped to the connections in all of the TBR classes for the Catalyst 8540 MSR.

Table 15-3 Threshold Group Parameters for TVCs (Catalyst 8540 MSR)

Group	Maximum Cells	Maximum Queue Limit	Minimum Queue Limit	Mark Threshold	Discard Threshold	Use
7	131,071	511	31	25%	87%	TBR_1
8	131,071	511	31	25%	87%	TBR_2
9	131,071	511	31	25%	87%	TBR_3
10	131,071	511	31	25%	87%	TBR_3

Table 15-4 shows the threshold group parameters mapped to the connections in all of the TBR classes for the Catalyst 8510 MSR and LightStream 1010 ATM switch routers.

Table 15-4 Threshold Group Parameters for TVCs (Catalyst 8510 MSR and LightStream 1010)

Group	Maximum Cells	Maximum Queue Limit	Minimum Queue Limit	Mark Threshold	Discard Threshold	Use
7	65,535	511	31	25%	87%	TBR_1
8	65,535	511	31	25%	87%	TBR_2
9	65,535	511	31	25%	87%	TBR_3
10	65,535	511	31	25%	87%	TBR_3

Each threshold group is divided into eight regions. Each region has a set of thresholds that are calculated from the corresponding threshold group parameters given in Table 15-3. The threshold group might be in any one of the regions depending on the fill level (cell occupancy) of that group. And that region is used to derive the set of thresholds which apply to all the connections in that group.

Table 15-5 gives the eight thresholds for threshold groups 6, 7, 8, and 9.

Table 15-5 Region Thresholds for Threshold Groups

Region	Lower Limit	Upper Limit	Queue Limit	Marking Threshold	Discard Threshold
0	0	8191	511	127	447
1	8128	16,383	255	63	223
2	16,320	24,575	127	31	111
3	24,512	32,767	63	15	63
4	32,704	40,959	31	15	31
5	40,896	49,151	31	15	31
6	49,088	57,343	31	15	31
7	57,280	65,535	31	15	31

For more information about threshold groups and configuration parameters, refer to the “Overview of Threshold Groups” section on page 8-15 and the *Guide to ATM Technology*.

CTT Row

A row in the connection traffic table (CTT) is created for each unique combination of traffic parameters. When a TVC is set up in response to a request by tag switching, a CTT row is obtained from the resource manager by passing the traffic parameters that include the service category (TBR_*x* [WRR_*x*], where *x* is 1, 2, 3, or 4). If a match is found for the same set of traffic parameters, the row index is returned; otherwise a new table is created and the row index of that CTT row is returned. Since all data TVCs use the same traffic parameters, the same CTT row can be used for all TVCs of a particular service category once it is created.



Note

There are no user configurable parameters for the CTT with TVCs.

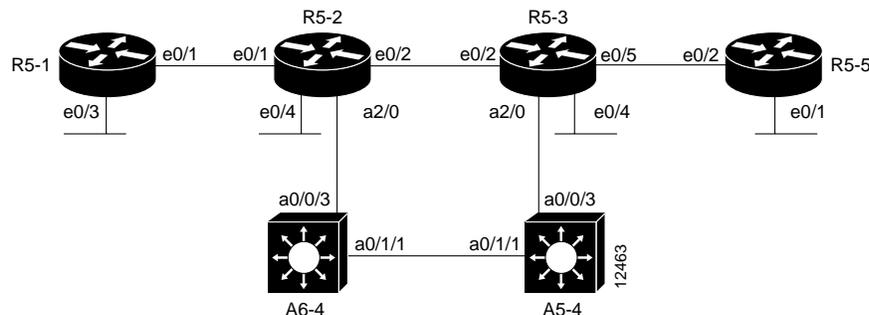
RM CAC Support

Connection admission control (CAC) is not supported for tag virtual channels (TVCs). All TVCs are best effort connections; therefore, no bandwidth is guaranteed by the RS. Only the WRR scheduler is used. So, all of the traffic parameters (PCR, MCR, MBS, CDVT, and SCR) are unspecified. There is no best effort limit like there is with ATM Forum UBR and ABR connections. CAC is bypassed for TVCs.

Tag Switching Configuration Example

Figure 15-4 shows an example tag switching network.

Figure 15-4 Example Network for Tag Switching



Router 5-1 Configuration

The configuration of router R5-1, interface e0/1, follows:

```
router_R5-1# configure terminal
router_R5-2(config)# ip cef switch
router_R5-1(config)# tag-switching advertise-tags
router_R5-1(config)# interface e0/1
router_R5-1(config-if)# tag-switching ip
router_R5-1(config-if)# exit
router_R5-1(config)#
```

Router 5-2 Configuration

The configuration between router R5-1, interface e0/1, and R5-2, interface e0/1, follows:

```
router_R5-2# configure terminal
router_R5-2(config)# ip cef switch
router_R5-2(config)# tag-switching advertise-tags
router_R5-2(config)# interface e0/1
router_R5-2(config-if)# tag-switching ip
router_R5-2(config-if)# exit
router_R5-2(config)#
```

The configuration between router R5-2, interface e0/2, and R5-3, interface e0/2, follows:

```
router_R5-2(config)# interface e0/2
router_R5-2(config-if)# tag-switching ip
router_R5-2(config-if)# exit
```

The configuration of router R5-2, interface a2/0.1, follows:

```
router_R5-2(config-if)# interface a2/0.1
router_R5-2(config-subif)# ip address 189.26.11.15 255.255.0.0
router_R5-2(config-subif)# tag-switching ip
router_R5-2(config-subif)# no shutdown
router_R5-2(config-subif)# exit
router_R5-2(config)# interface a2/0
router_R5-2(config)# no shutdown
```

Router 5-3 Configuration

The configuration of router R5-3, interface e0/2, follows:

```
router_R5-3# configure terminal
router_R5-3(config)# ip cef switch
router_R5-3(config)# tag-switching advertise-tags
router_R5-3(config)# interface e0/2
router_R5-3(config-if)# tag-switching ip
router_R5-3(config-if)# exit
```

The configuration of router R5-3, interface e0/5 follows:

```
router_R5-3(config)# interface e0/5
router_R5-3(config-if)# tag-switching ip
router_R5-3(config-if)# exit
```

The configuration of router R5-3, interface atm 2/0.1, follows:

```
router_R5-3# configure terminal
router_R5-3(config)# interface atm 2/0.1
router_R5-3(config-if)# ip address 189.25.12.13 255.255.0.0
router_R5-3(config-if)# tag-switching ip
router_R5-3(config-if)# no shutdown
router_R5-3(config-if)# exit
router_R5-3(config)# interface a2/0
router_R5-3(config-if)# no shutdown
```

ATM Switch Router A5-4 Configuration

The configuration of ATM switch router A5-4, interfaces atm 0/1/1 and atm 0/0/3, follows:

```
atm_A5-4# configure terminal
atm_A5-4(config)# interface atm 0/1/1
atm_A5-4(config-if)# no shutdown
atm_A5-4(config-if)# ip address 189.24.15.12 255.255.0.0
atm_A5-4(config-if)# tag-switching ip
atm_A5-4(config-if)# exit
atm_A5-4(config)# tag-switching ip
atm_A5-4(config)# interface atm 0/0/3
atm_A5-4(config-if)# no shutdown
atm_A5-4(config-if)# ip address 189.25.15.11 255.255.0.0
atm_A5-4(config-if)# tag-switching ip
atm_A5-4(config-if)# exit
atm_A5-4(config)# tag-switching ip
```

Router 5-5 Configuration

The configuration of router R5-5, interface e0/2, follows:

```
router_R5-5# configure terminal
router_R5-5(config)# ip cef switch
router_R5-5(config)# tag-switching advertise-tags
router_R5-5(config)# interface e0/2
router_R5-5(config-if)# tag-switching ip
router_R5-5(config-if)# exit
```

ATM Switch Router A6-4 Configuration

The configuration of ATM switch router A6-4, interface atm 0/1/1, follows:

```
atm_A6-4# configure terminal
atm_A6-4(config)# interface atm 0/1/1
atm_A6-4(config-if)# no shutdown
atm_A6-4(config-if)# ip address 189.24.14.12 255.255.0.0
atm_A6-4(config-if)# tag-switching ip
atm_A6-4(config-if)# exit
```

The configuration of ATM switch router A6-4, interface atm 0/0/3, follows:

```
atm_A6-4# configure terminal
atm_A6-4(config)# interface atm 0/0/3
atm_A6-4(config-if)# no shutdown
atm_A6-4(config-if)# ip address 189.26.14.11 255.255.0.0
atm_A6-4(config-if)# tag-switching ip
atm_A6-4(config-if)# exit
```

