CHAPTER 4

Configuring ATM PVCs and QoS Traffic Shaping

This chapter describes how to configure permanent virtual connection (PVC)-supported VLANs and PVC-supported VLANs with quality of service (QoS) traffic shaping on the ATM modules for the Catalyst 5000 and 6000 family switches.

> **Note** For information on installing Catalyst 5000 family ATM modules, refer to the *Catalyst 5000 Family Module Installation Guide*. For information on installing Catalyst 6000 family ATM modules, refer to the *Catalyst 6000 Family Module Installation Guide*.

> **Note** For syntax and usage information for the commands used in this chapter, see Chapter 7, "Command Reference."

This chapter consists of the following sections:

- Understanding How PVCs Work, page 4-1
- Understanding How QoS Traffic Shaping Works, page 4-2
- Default PVC Configuration, page 4-6
- Configuring PVC-Supported VLANs, page 4-6
- ATM PVC Traffic-Shaping Configuration Examples, page 4-9

Understanding How PVCs Work

PVC-based ATM links allow Catalyst 5000 and 6000 family switches to connect to each other through ATM interfaces over PVCs. You can configure one or more PVCs for each VLAN on every Catalyst 5000 or 6000 family ATM module. Connectivity can be back-to-back or through an ATM switch cloud, using RFC 1483-compliant, bridged Logical Link Control/Subnetwork Access Protocol (LLC/SNAP) packet encapsulation.

> **Note** Traffic cannot be bridged between ports in the same VLAN if these ports are configured for PVCs.

When you create a PVC, you create a virtual channel descriptor (VCD) and attach it to the virtual path identifier (VPI) and virtual channel identifier (VCI). A VCD identifies the VPI-VCI pair for a particular packet. The ATM module requires this feature to manage packet transmission. The number chosen for the VCD is independent of the VPI-VCI pair used.

To use PVCs, you must configure PVCs in both the Catalyst 5000 or 6000 family ATM modules and the ATM switch cloud. PVCs remain active until the circuit is removed from either configuration. You can configure up to 4096 PVCs on the ATM module. In addition, you can divide the PVCs attached to the rate queues among different VLANs.

PVCs are compatible with switched virtual connection (SVC)-based LAN Emulation (LANE), with the following restrictions:

- You can configure a VLAN using either LANE or PVCs. You cannot configure the same VLAN to use both PVCs and LANE simultaneously.

- Only RFC-1483, bridged-Ethernet LLC/SNAP encapsulation is supported.

- If two PVCs are configured on the same VLAN and ATM module, packets received from one PVC are not forwarded to the other PVC.

Understanding How QoS Traffic Shaping Works

You can configure QoS traffic shaping with ATM PVC traffic-shaping software releases 50.1 or 51.1 and with ATM software releases 11.3WA4 and 12.0W5.

QoS consists of the following contracts:

- Class of service (CoS)

- Traffic shaping

- Traffic policing

In the Catalyst 5000 and 6000 family ATM module software, CoS is determined when you specify the traffic-shaping parameters. The following sections describe how CoS and traffic shaping functions in the Catalyst 5000 and 6000 ATM family modules. Traffic policing is not supported on the ATM modules.

Note   Software releases 50.1 and 51.1 are separate images from the Catalyst 5000 family LANE/MPOA software; software releases 50.1 and 51.1 do not support traffic shaping with LANE and support only RFC 1483-bridged Ethernet SNAP-encapsulated PVCs with peak cell-rate shaping.

Caution   The ATM single PHY OC-3, dual PHY OC-3, and dual PHY DS3 modules require compatible releases of the Catalyst 5000 family supervisor engine and ATM PVC traffic-shaping software. Refer to the current release notes applicable to your module for information about software release requirements.

Class of Service

Software releases 50.1 and 51.1 support unspecified bit rate (UBR) and constant bit rate (CBR) CoS. CoS for a PVC is determined by the specified traffic shaping. If you specify the peak cell rate (PCR), the PVC will have a CBR CoS. If no PCR is set, the PVC will have a UBR CoS.

Software releases 11.3 and 12.0 support UBR, CBR, and variable bit rate (VBR). As in software releases 50.1 and 51.1, the CoS is determined by the traffic shaping parameters you specify.

- UBR—CoS assigned to the PVC when you specify no traffic shaping.
- CBR—CoS assigned to the PVC when you specify the PCR.
- VBR—CoS assigned to the PVC when you specify the PCR, sustainable cell rate (SCR), and maximum burst size (MBS).

Note   The MBS should be a value between 2 and 255. If you specify an MBS of 1, the channel is opened with CBR CoS.

Traffic Shaping

Traffic shaping uses queues to constrain data bursts, limit peak data rate, and smooth jitters so that traffic will fit within the promised CoS contract.

Software releases 50.1 and 51.1 support up to ten dynamically created rate queues, and the rate queue assigned to a PVC depends on the PCR you assign to that PVC. When you specify the PCR, the software assigns the PVC to a rate queue that most closely matches that cell rate. If you do not specify the PCR, the software automatically assigns the PVC a service class of UBR and the default rate queue, which is the highest bandwidth rate queue available. See Table 4-1 for rate queue ranges in the different software releases.

Note   Releases 50.1 and 51.1 allow only PCR.

As in releases 50.1 and 51.1, in software releases 11.3WA4 and 12.0W5 rate queues are determined by the traffic shaping you specify. In software releases 11.3 and 12.0, the number of available rate queues is determined by the maximum amount of bandwidth divided by the specified PCR allocated for each PVC. As a result, software release 12.0 provides more rate-queue granularity and makes better use of the available bandwidth. See Table 4-1 for a listing of maximum available bandwidth for specific modules and software versions.

In software versions 11.3WA4 and12.0W5, you can specify PCR, SCR, and MBS traffic-shaping parameters.

The minimum PCR or SCR is 64 Kbps. If you specify a value less than 64 Kbps, the rate specified to the segmentation and reassembly sublayer (SAR) is 64 Kbps.

Table 4-1   Supported Rate Queues

Module	Product Number	Software Release	Number of Rate Queues	PCR Range
ATM LANE PHY OC-3	WS-X5153 WS-X5154 WS-X5155 WS-X5156 WS-X5157 WS-X5158	50.1	8	2081–155,000 Kbps
		51.1	8	2081–155,000 Kbps
			2	1-2080 Kbps
ATM Dual PHY DS-3	WS-X5166	51.1	8	2354–155,000 Kbps
			2	1-2353 Kbps
ATM Dual PHY OC-12	WS-X5161 WS-X5162	11.WA43	n	0-622050 Kbps/n
		12.0W5	n	0-622050 Kbps/n
ATM Dual PHY OC-3	WS-X5167 WS-X5168	11.3WA4	n	0-155,000 Kbps
		12.0W5	n	0-155,000 Kbps
ATM Fabric Integration	WS-X5165	11.3WA4	n	0-622,050 Kbps
		12.0W5	n	0-622,050 Kbps

VTP is disabled by default on the ATM modules, even if you have enabled it to run on the supervisor engine module. If you enable VLAN Trunk Protocol (VTP) in the ATM module, the ATM module creates LAN Emulation Clients (LECs) for each VLAN configured on the supervisor engine. However, because a VLAN cannot simultaneously have LANE and PVCs configured, enabling VTP will cause any previously configured PVCs to be deleted.

Note   If you want to use PVCs to connect VLANs to the ATM cloud, do not enable VTP on the ATM module. VTP will override PVC configurations.

PVC Traffic-Shaping Example

Figure 4-1 shows two Catalyst 5000 family switches with ATM dual PHY DS3 modules in a redundant configuration running ATM PVC traffic-shaping software. The ATM dual PHY DS3 modules contain ten rate queues. Twenty-four PVCs are divided among the ten rate queues; each specifies a particular cell rate for the PVC set attached to it. In this example, PVC 1 through PVC 7 are in VLAN 1, PVC 8 through PVC 20 are in VLAN 2, and PVC 21 through PVC 24 are in VLAN 3.

Figure 4-1   ATM PVC Traffic Shaping with the ATM Dual PHY DS3 Module
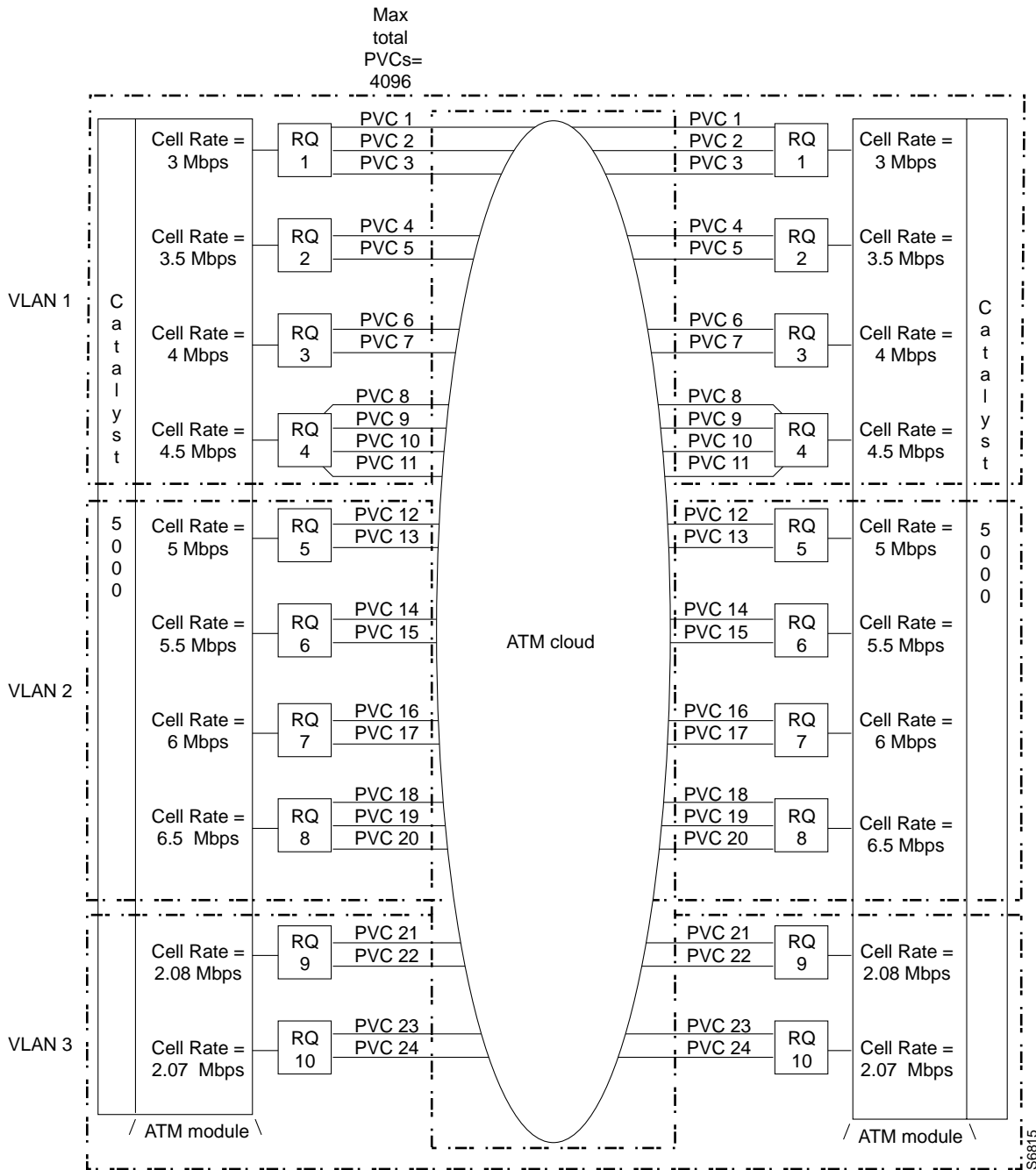
Default PVC Configuration

Table 4-2 shows the default PVC configuration.

Table 4-2   Default ATM PVC Configuration

Feature	Default Configuration
Clock internal	Transmit clock is generated internally
ATM framing	C-Bit with ADM
Line buildout	Short
DS3-scramble	Disabled

Configuring PVC-Supported VLANs

These sections describe how to configure PVC-supported VLANs on the Catalyst 5000 or 6000 family ATM modules:

- Setting Up PVCs in the ATM Cloud, page 4-6
- Configuring a PVC-Supported VLAN, page 4-6
- Configuring a PVC-Supported VLAN with Traffic Shaping, page 4-7
- Unbinding or Removing PVCs from a VLAN, page 4-8

Setting Up PVCs in the ATM Cloud

To configure a PVC within the ATM cloud, refer to the documentation from your ATM switch vendor.

Configuring a PVC-Supported VLAN

To set up a PVC-supported VLAN on the ATM module, perform this task in privileged mode:

	Task	Command
Step 1	On the Catalyst 5000 or 6000 family switch, assign an Ethernet port to the desired VLAN.	**set vlan** *vlan_num mod_num/port_num*
Step 2	Establish a connection to the ATM module.	**session** *mod_num*
Step 3	Activate privileged mode on the ATM module.	**enable**
Step 4	Enter configuration mode.	**configure terminal**
Step 5	Select the ATM interface.	**interface atm0**
Step 6	Set up the PVCs.	**atm pvc** *vcd vpi vci* **aal5snap**
Step 7	Bind the PVCs to the VLAN.	**atm bind pvc vlan** *vcd vlan_num*

	Task	Command
Step 8	(Optional) Set up other PVCs for the same VLAN if needed by repeating Steps 6 and 7.	
Step 9	Exit configuration mode.	**Ctrl-Z**
Step 10	Verify the PVC configuration.	**show atm vlan** **show atm vc**
Step 11	Save the configuration.	**write memory**

Note Traffic cannot be bridged between ports in the same VLAN if these ports are configured for PVCs.

Configuring a PVC-Supported VLAN with Traffic Shaping

Note Traffic shaping requires software release 50.1 or release 51.1.

To configure a PVC-supported VLAN with ATM PVC traffic shaping, perform this task in privileged mode:

	Task	Command
Step 1	Assign an Ethernet port to the desired VLAN.	**set vlan** *vlan_num mod_num/port_num*
Step 2	Establish a connection to the ATM module.	**session** *mod_num*
Step 3	Activate privileged mode on the ATM module.	**enable**
Step 4	Enter configuration mode.	**configure terminal**
Step 5	Select the ATM interface.	**interface atm0**
Step 6	(Optional) Customize the interface configuration if needed.	**atm clock internal** **atm framing** [**m23adm** | **cbitplcp** | **m23plcp**] **atm lbo** {**short** | **long**} **atm ds3-scramble**
Step 7	Set up the PVCs, indicating the desired peak cell rate.	**atm pvc** *vcd vpi vci* [**aal-encap**] **aal5snap**[1] *pcr*[2]scr mbs [**oam** *seconds*]
Step 8	Bind the PVCs to the VLAN.	**atm bind pvc vlan** *vcd vlan_num*[3]
Step 9	Set up other PVCs for the same VLAN if needed by repeating Steps 6 through 8.	
Step 10	Exit configuration mode.	**Ctrl-Z**

	Task	Command
Step 11	Verify the setup.	**show atm vlan** **show atm vc**
Step 12	Write the configuration to NVRAM.	**write memory**

1. To configure traffic shaping, you must use the **aal5snap** options.

2. The *peak* argument must not exceed 45000 for DS3 modules, 155000 for OC-3 modules or 622050 for OC-12 modules.

3. The **atm bind pvc vlan** *vcd vlan_num* command is valid only for the current software release; this command may change in future releases.

> **Note**   The **atm bind pvc vlan** *vcd vlanid* command is valid only for the current software release. The **atm traffic-shape rate** command is not available in software releases 50.1 or 51.1.

Unbinding or Removing PVCs from a VLAN

You can unbind and remove a previously assigned PVC from a VLAN. You can also unbind a previously assigned PVC from a VLAN without removing the PVC. If you do not remove the PVC, you can bind the PVC to a different VLAN.

> **Note**   The procedures in this section apply to ATM software release 4.1 and ATM PVC traffic-shaping software release 50.1.

To remove a previously assigned PVC from a VLAN, perform this task in privileged mode:

	Task	Command
Step 1	Enter privileged mode on the ATM module.	**enable**
Step 2	Enter configuration mode.	**configure terminal**
Step 3	Select the ATM interface.	**interface atm0**
Step 4	Remove the PVC from the VLAN.	**no atm pvc** *vcd*
Step 5	End the session.	**Ctrl-Z**

To unbind a previously assigned PVC from a VLAN without removing the PVC itself, perform this task in privileged mode:

	Task	Command
Step 1	Activate privileged mode on the ATM module.	**enable**
Step 2	Enter configuration mode	**configure terminal**
Step 3	Select the ATM interface.	**interface atm0**

	Task	Command
Step 4	Unbind the PVC from the VLAN.	**no atm bind pvc vlan** *vcd vlan_num*
Step 5	End the session.	**Ctrl-Z**

ATM PVC Traffic-Shaping Configuration Examples

These sections show ATM PVC traffic-shaping configuration examples:

- Nonredundant Configuration Traffic-Shaping Example, page 4-9
- Redundant Configuration Traffic-Shaping Example, page 4-15

Nonredundant Configuration Traffic-Shaping Example

This example configuration describes how to configure a nonredundant PVC-supported VLAN configuration with traffic-shaping. Figure 4-2 shows the network used in this example. Assume that the ATM module in each Catalyst 5000 family switch is in slot 2. This example applies to both the single and dual PHY OC-3 ATM modules and the dual PHY DS3 ATM module.

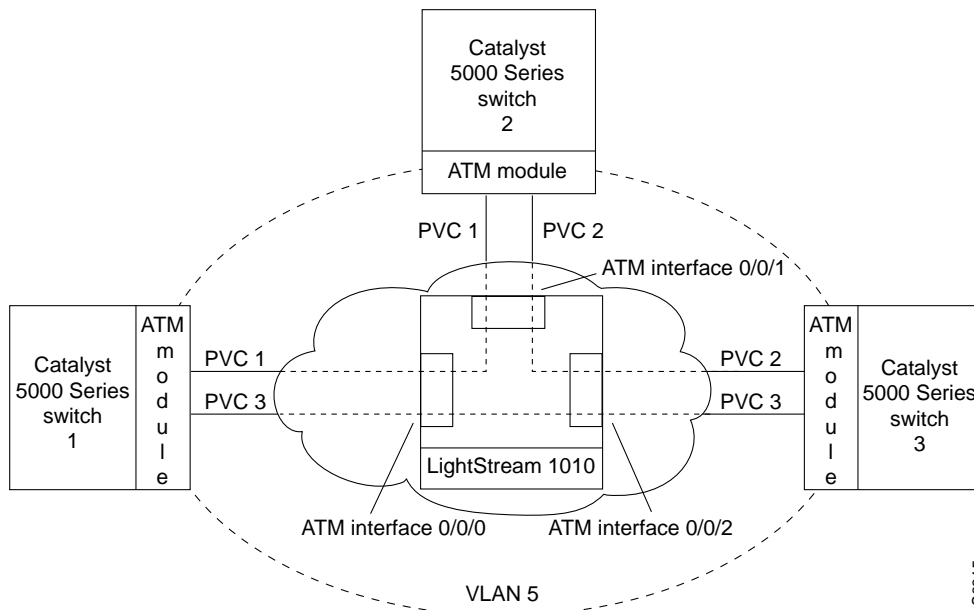*Figure 4-2   Nonredundant Configuration Traffic-Shaping Example Network*

Table 4-3 shows the VLAN and switch connections, VPIs, VCIs, and traffic rates for the network shown in Figure 4-2.

Table 4-3   PVC Connections for Example Network

PVC	VLAN/Switch Connections	VPI	VCI	Rate in kbps
1	Connects Switch 1 to Switch 2 on VLAN 5	0	32	45000
2	Connects Switch 2 to Switch 3 on VLAN 5	0	33	2080
3	Connects Switch 1 to Switch 3 on VLAN 5	0	34	45000

These assumptions apply for this example:

- PVC 3 is required for Switch 1 to communicate with Switch 3, because the ATM module on Switch 2 does not forward packets received from Switch 1 on PVC 1 to Switch 3 on PVC 2.

- Any number of PVCs can be bound to the same VLAN. However, to prevent loops, each PVC must uniquely connect a VLAN group between two Catalyst 5000 family switches. You can also enable the Spanning Tree Protocol to prevent loops.

Before configuring the VLAN over PVCs, you must perform these tasks:

- Verify that you have software release 50.1 or later.

- Obtain the VLAN number to be configured.

- Obtain the VPI and VCI for each PVC to be configured.

- Note the interface number on the LightStream 1010 ATM switch to which the ATM module is connected. You need this interface number to connect the PVCs across the ATM cloud on the LightStream 1010 switch.

Set up the PVCs within the ATM Cloud.

Note These procedures apply only if your ATM switch is a Cisco LightStream 1010 ATM switch. If you have a different ATM switch, consult the documentation provided by the switch vendor.

Step 1 Create PVC 1 within the ATM cloud. Enter these commands on the LightStream 1010 ATM switch:

```
Switch> enable
Switch#
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface atm0/0/0
Switch(config-if)# atm pvc 0 32 interface atm0/0/1 0 32
Switch(config-if)# end
Switch#
```

Step 2 Verify the setup of PVC 1. Enter this command on the LightStream 1010 ATM switch:

```
Switch# show atm vc interface atm0/0/0
Interface   VPI    VCI     Type    X-Interface   X-VPI   X-VCI   Status
ATM0/0/0    0      5       PVC     ATM2/0/0      0       32      UP
ATM0/0/0    0      16      PVC     ATM2/0/0      0       33      UP
ATM0/0/0    0      18      PVC     ATM2/0/0      0       34      UP
ATM0/0/0    0      32      PVC     ATM0/0/1      0       32      UP
Switch#
```

Step 3 Create PVC 2 within the ATM cloud. Enter these commands on the LightStream 1010 ATM switch:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#
Switch(config)# interface atm0/0/1
Switch(config-if)# atm pvc 0 33 interface atm0/0/2 0 33
Switch(config-if)# end
Switch#
```

Step 4 Verify the setup of PVC 2. Enter this command on the LightStream 1010 ATM switch:

```
Switch# show atm vc interface atm0/0/1
Interface   VPI    VCI     Type    X-Interface   X-VPI   X-VCI   Status
ATM0/0/1    0      5       PVC     ATM2/0/0      0       35      UP
ATM0/0/1    0      16      PVC     ATM2/0/0      0       36      UP
ATM0/0/1    0      18      PVC     ATM2/0/0      0       37      UP
ATM0/0/1    0      32      PVC     ATM0/0/0      0       32      UP
ATM0/0/1    0      33      PVC     ATM0/0/2      0       33      UP
Switch#
```

Step 5 Create PVC 3 within the ATM cloud. Enter these commands on the LightStream 1010 ATM switch:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config-if)# interface atm0/0/2
Switch(config-if)# atm pvc 0 34 interface atm0/0/0 0 34
Switch(config-if)# end
Switch#
```

Step 6 Verify the setup of PVC 3. Enter this command on the LightStream 1010 ATM switch:

```
Switch# show atm vc interface atm0/0/2
Interface   VPI    VCI     Type    X-Interface   X-VPI   X-VCI   Status
ATM0/0/2    0      5       PVC     ATM2/0/0      0       38      UP
ATM0/0/2    0      16      PVC     ATM2/0/0      0       39      UP
ATM0/0/2    0      18      PVC     ATM2/0/0      0       40      UP
ATM0/0/2    0      33      PVC     ATM0/0/1      0       33      UP
ATM0/0/2    0      34      PVC     ATM0/0/0      0       34      UP
Switch#
```

Set up PVC 1 and PVC 3 on the Catalyst 5000 family Switch 1.

Step 7   At the console of the Catalyst 5000 family Switch 1, establish a connection to the ATM module in slot 2 by entering these commands:

```
Console> enable
Enter password:
Console> (enable) set vlan 5
Console> (enable) session 2
Trying ATM-2...
Connected to ATM-2.
Escape character is '^]'.
ATM>
```

Step 8   Configure PVC 1 and PVC 3 on Switch 1 by entering these commands:

```
ATM> enable
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm pvc 10 0 32 aal5snap 45000
ATM(config-if)# atm ds3-scramble
ATM(config-if)# atm lbo long
ATM(config-if)# atm framing m23adm
ATM(config-if)# atm clock internal
ATM(config-if)# atm pvc 11 0 34 aal5snap 45000
ATM(config-if)# end
ATM#
```

You can perform all PVC-related configurations for all VLANs on atm0, the major interface, because the subinterface number has no significance for PVC-supported VLANs. VCDs 10 and 11 (used above) can be any unused VCDs. Enter the **show atm vc** command to find unused VCDs.

Step 9   Bind PVC 1 and PVC 3 to VLAN 5 on Switch 1 by entering these commands:

```
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm bind pvc vlan 10 5
ATM(config-if)# atm bind pvc vlan 11 5
ATM(config-if)# end
ATM#
```

Enter the VCD numbers used in Step 8. The last option in the **atm bind pvc** command specifies VLAN 5.

Step 10   Verify the setup on Switch 1 by entering these commands:

```
ATM# show atm vlan
VCD     VLAN-ID
10      5
11      5
ATM#
ATM# show atm vc
                                AAL/           Peak   Avg.  Burst
Interface   VCD   VPI   VCI Type Encapsulation  Kbps   Kbps  Cells  Status
ATM0         10    0    32  PVC  AAL5-SNAP      45000   0      0     ACTIVE
ATM0         11    0    34  PVC  AAL5-SNAP      45000   0      0     ACTIVE
ATM#
```

Step 11   Save the configuration as follows:

```
ATM# write memory
Building configuration...
[OK]
ATM#
```

Set up PVC 1 and PVC 2 on the Catalyst 5000 family Switch 2.

Step 12   At the console of the Catalyst 5000 family Switch 2, establish a connection to the ATM module in slot 2 by entering these commands:

```
Console> enable
Enter password:
Console> (enable) set vlan 5
Console> (enable) session 2
Trying ATM-2...
Connected to ATM-2.
Escape character is '^]'.
ATM#
```

Step 13   Configure PVC 1 and PVC 2 on Switch 2 by entering these commands:

```
ATM> enable
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm pvc 10 0 32 aal5snap 45000
ATM(config-if)# atm ds3-scramble
ATM(config-if)# atm lbo long
ATM(config-if)# atm framing m23adm
ATM(config-if)# atm clock internal
ATM(config-if)# atm pvc 11 0 33 aal5snap 2080
ATM(config-if)# end
ATM#
```

You can perform all PVC-related configurations for all VLANs on atm0, the major interface, because the subinterface number has no significance for PVC-supported VLANs. VCDs 10 and 11 (used above) can be any unused VCDs. Enter the **show atm vc** command to find unused VCDs.

Step 14   Bind PVC 1 and PVC 2 to VLAN 5 on Switch 2 by entering these commands:

```
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm bind pvc vlan 10 5
ATM(config-if)# atm bind pvc vlan 11 5
ATM(config-if)# end
ATM#
```

Enter the VCDs used in Step 13. The last option in the **atm bind pvc** command specifies VLAN 5.

Step 15   Verify the setup on Switch 2 by entering these commands:

```
ATM# show atm vlan
VCD     VLAN-ID
 10     5
 11     5
ATM#
ATM# show atm vc
                                    AAL /        Peak   Avg.  Burst
Interface     VCD   VPI   VCI Type  Encapsulation Kbps   Kbps  Cells Status
ATM0          10    0     32  PVC   AAL5-SNAP     45000  0     0     ACTIVE
ATM0          11    0     33  PVC   AAL5-SNAP     2080   0     0     ACTIVE
ATM#
```

Step 16   Save the configuration as follows:

```
ATM# write memory
Building configuration...
[OK]
ATM#
```

Set up PVC 2 and PVC 3 on the Catalyst 5000 family Switch 3.

Step 17   At the console of the Catalyst 5000 family Switch 3, establish a connection to the ATM module in slot 2 by entering these commands:

```
Console> enable
Enter password:
Console> (enable) set vlan 5
Console> (enable) session 2
Trying ATM-2...
Connected to ATM-2.
Escape character is '^]'.
ATM>
```

Step 18   Configure PVC 2 and PVC 3 on Switch 3 by entering these commands:

```
ATM> enable
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm pvc 10 0 33 aal5snap 2080
ATM(config-if)# atm pvc 11 0 34 aal5snap 45000
ATM(config-if)# end
ATM#
```

You can perform all PVC-related configurations for all VLANs on atm0, the major interface, because the subinterface number has no significance for PVC-supported VLANs. VCDs 10 and 11 (used above) can be any unused VCDs. Enter the **show atm vc** command to find unused VCDs.

Step 19   Bind PVC 2 and PVC 3 to VLAN 5 on Switch 3 by entering these commands:

```
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm bind pvc vlan 10 5
ATM(config-if)# atm bind pvc vlan 11 5
ATM(config-if)# end
ATM#
```

Enter the VCDs used in Step 18. The last option in the **atm bind pvc** command specifies VLAN 5.

Step 20   Verify the setup on Switch 3 by entering these commands:

```
ATM# show atm vlan
VCD     VLAN-ID
 10     5
 11     5
ATM#
ATM# show atm vc
                                    AAL /         Peak  Avg.  Burst
Interface     VCD  VPI  VCI Type  Encapsulation  Kbps  Kbps  Cells Status
ATM0          10    0   33  PVC   AAL5-SNAP      2080    0     0   ACTIVE
ATM0          11    0   34  PVC   AAL5-SNAP      45000   0     0   ACTIVE
ATM#
```

Step 21   Save the configuration as follows:

```
ATM# write memory
Building configuration...
[OK]
ATM#
```

Redundant Configuration Traffic-Shaping Example

Figure 4-3 shows the PVCs needed for complete redundancy if PHY A or PHY B on either Switch 1 or Switch 2 fails. This example (referred to as example 2) applies to the dual PHY DS3 module, but you can use the same configuration for dual PHY OC-3 modules (with appropriate PCRs).

Figure 4-3   Redundant PVC Traffic-Shaping
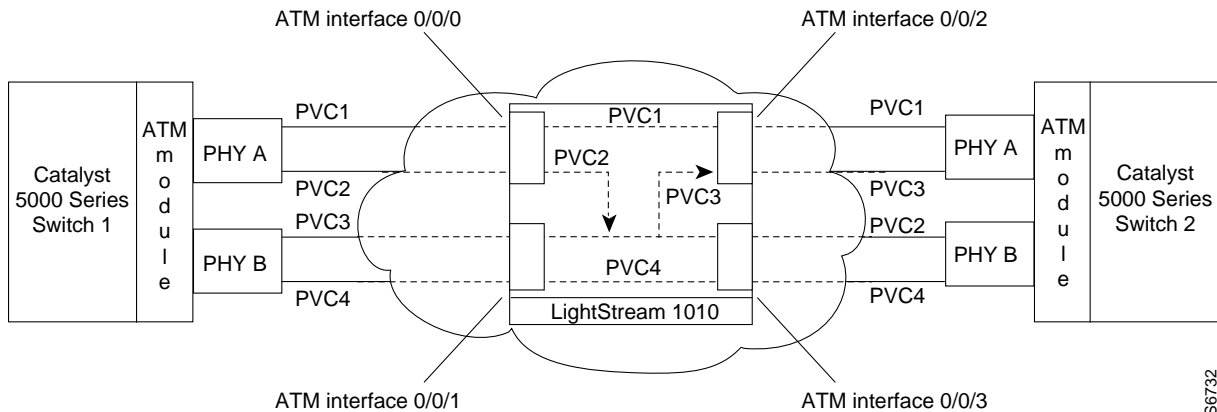
In Figure 4-3, you see Catalyst 5000 family Switch 1 and Catalyst 5000 family Switch 2, each with an ATM dual PHY DS3 module, connected to a LightStream 1010 ATM switch in the ATM cloud.

Assume PHY A on Switch 1 goes down and transmits no data to PHY A on Switch 2 over PVC 1, even though PHY A on Switch 2 remains active. When PHY A on Switch 1 goes down, PHY B on Switch 1 becomes active and transmits data to PHY B on Switch 2 over PVC 2.

Similarly, if PHY A on Switch 2 goes down and transmits no data to Switch 1 over PVC 1, PHY B on Switch 2 becomes active and transmits data to PHY B on Switch 1 over PVC 3.

Table 4-4 shows the PVCs used to transmit data when the specified PHYs for the Catalyst 5000 family switches in Figure 4-3 are active. For example, if PHY A on Switch 1 and PHY A on Switch 2 are both active, data is transmitted on PVC 1.

Table 4-4   Redundancy Coverage for Figure 4-3

Switch 1	Switch 2	PVC Used
PHY A— active	PHY A—active	1
PHY A—active	PHY B—active	2
PHY B—active	PHY A—active	3
PHY B—active	PHY B—active	4

Note To ensure redundancy for data transmission using dual PHYs, you must set up PVCs 1, 2, 3, and 4 on the same VLAN and configure the same data rate for each PVC.

The following assumptions apply for this example configuration:

• Table 4-5 lists the PVC and switch connections, VPI, VCI, and traffic rates shown in Figure 4-3.

Table 4-5   PVC Connections in Figure 4-3

PVC	Switch Connections	VPI	VCI	kbps Rate
1	Connects PHY A on Switch 1 to PHY A on Switch 2	0	32	45000
2	Connects PHY A on Switch 1 to PHY B on Switch 2	0	33	45000
3	Connects PHY B on Switch 1 to PHY A on Switch 2	0	34	45000
4	Connects PHY B on Switch 1 to PHY B on Switch 2	0	35	45000

• The ATM module is installed in slot 2 of the Catalyst 5000 family switches.

• Any number of PVCs can be bound to the same VLAN. However, to prevent loops, each PVC must uniquely connect a VLAN group between two Catalyst 5000 family switches. You can also enable Spanning Tree Protocol to prevent loops.

Before configuring the VLAN over PVCs, you must perform these tasks:

• Verify that you have ATM module software release 51.1(2) or above.

• Obtain the VLAN number to be configured.

• Obtain the VPI and VCI for each PVC to be configured.

• Note the interface number of the LightStream 1010 ATM switch to which the Catalyst 5000 family ATM module is connected. You need this interface number to connect the PVCs across the ATM cloud on the LightStream 1010 ATM switch.

To configure the devices in this example, follow these steps:

Note These procedures apply only if your ATM switch is a Cisco LightStream 1010 ATM switch. If you have a different ATM switch, consult the publication that accompanied the switch.

Set up the PVCs within the ATM cloud.

Step 1 Create PVC 1 within the ATM cloud. Enter these commands on the LightStream 1010 ATM switch:

```
Switch> enable
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface atm0/0/0
Switch(config-if)# atm pvc 0 32 int atm0/0/2 0 32
Switch(config-if)# end
Switch#
```

Step 2 Verify the setup of PVC 1. Enter this command on the LightStream 1010 ATM switch:

```
Switch# show atm vc interface atm0/0/0

Interface   VPI    VCI     Type   X-Interface   X-VPI   X-VCI   Status
ATM0/0/0    0      5       PVC    ATM2/0/0      0       32      UP
ATM0/0/0    0      16      PVC    ATM2/0/0      0       33      UP
ATM0/0/0    0      18      PVC    ATM2/0/0      0       34      UP
ATM0/0/0    0      32      PVC    ATM0/0/2      0       32      UP
Switch#
```

Step 3 Create PVC 2 within the ATM cloud. Enter these commands on the LightStream 1010 ATM switch:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface atm0/0/2
Switch(config-if)# atm pvc 0 33 int atm0/0/1 0 33
Switch(config-if)# end
Switch#
```

Step 4 Verify the setup of PVC 2. Enter this command on the LightStream 1010 ATM switch:

```
Switch# show atm vc interface atm0/0/2

Interface   VPI    VCI     Type   X-Interface   X-VPI   X-VCI   Status
ATM0/0/2    0      5       PVC    ATM2/0/0      0       38      UP
ATM0/0/2    0      16      PVC    ATM2/0/0      0       39      UP
ATM0/0/2    0      18      PVC    ATM2/0/0      0       40      UP
ATM0/0/2    0      32      PVC    ATM0/0/0      0       32      UP
ATM0/0/2    0      33      PVC    ATM0/0/1      0       33      UP
Switch#
```

Step 5 Create PVC 3 within the ATM cloud. Enter these commands on the LightStream 1010 ATM switch:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface atm0/0/3
Switch(config-if)# atm pvc 0 34 int atm0/0/0 0 34
Switch(config-if)# end
Switch#
```

Step 6   Verify the setup of PVC 3. Enter this command on the LightStream 1010 ATM switch:

```
Switch# show atm vc interface atm0/0/3

Interface   VPI    VCI     Type   X-Interface  X-VPI    X-VCI    Status
ATM0/0/3    0      5       PVC    ATM2/0/0     0        41       UP
ATM0/0/3    0      16      PVC    ATM2/0/0     0        42       UP
ATM0/0/3    0      18      PVC    ATM2/0/0     0        43       UP
ATM0/0/3    0      34      PVC    ATM0/0/0     0        34       UP
Switch#
```

Step 7   Create PVC 4 within the ATM cloud. Enter these commands on the LightStream 1010 ATM switch:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface atm0/0/1
Switch(config-if)# atm pvc 0 35 interface atm0/0/3 0 35
Switch(config-if)# end
Switch#
```

Step 8   Verify the setup of PVC 4. Enter this command on the LightStream 1010 ATM switch:

```
Switch# show atm vc interface atm0/0/1

Interface   VPI    VCI     Type   X-Interface  X-VPI    X-VCI    Status
ATM0/0/1    0      5       PVC    ATM2/0/0     0        35       UP
ATM0/0/1    0      16      PVC    ATM2/0/0     0        36       UP
ATM0/0/1    0      18      PVC    ATM2/0/0     0        37       UP
ATM0/0/1    0      33      PVC    ATM0/0/2     0        33       UP
ATM0/0/1    0      35      PVC    ATM0/0/3     0        35       UP
Switch#
```

Set up the PVCs on the Catalyst 5000 family Switch 1.

Step 9   At the console of the Catalyst 5000 family Switch 1, session to the ATM module in slot 2 by entering these commands:

```
Console> enable
Enter password:
Console> (enable) session 2
Trying ATM-2...
Connected to ATM-2.
Escape character is '^]'.
ATM>
```

Step 10   Configure PVCs 1, 2, 3, and 4 on Switch 1 by entering these commands:

```
ATM> enable
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm pvc 1 0 32 aal5snap 45000
ATM(config-if)# atm ds3-scramble
ATM(config-if)# atm lbo long
ATM(config-if)# atm framing m23adm
ATM(config-if)# atm clock internal
ATM(config-if)# atm pvc 2 0 33 aal5snap 45000
ATM(config-if)# atm pvc 3 0 34 aal5snap 45000
ATM(config-if)# atm pvc 4 0 35 aal5snap 45000
ATM(config-if)# end
ATM#
```

You can perform all PVC-related configurations for all VLANs on atm0, the major interface, because the subinterface number has no significance for PVC-supported VLANs. VCDs 10 and 11 (used above) can be any unused VCDs. Enter the **show atm vc** command to find unused VCDs.

Step 11   Bind the PVCs to VLAN 5 on the Switch 1 by entering these commands:

```
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm bind pvc vlan 1 5
ATM(config-if)# atm bind pvc vlan 2 5
ATM(config-if)# atm bind pvc vlan 3 5
ATM(config-if)# atm bind pvc vlan 4 5
ATM(config-if)# end
ATM#
```

Enter the VCD numbers used in Step 8. The last option in the **atm bind pvc** command specifies VLAN 5.

Step 12   Verify the setup on the Switch 1 by entering these commands:

```
ATM# show atm vlan
VCD    VLAN-ID
  1    5
  2    5
  3    5
  4    5
ATM#
ATM# show atm vc
                                  AAL /         Peak   Avg.  Burst
Interface      VCD    VPI    VCI Type Encapsulation Kbps   Kbps  Cells Status
ATM0            1      0     32  PVC  AAL5-SNAP     45000   0      0    ACTIVE
ATM0            2      0     33  PVC  AAL5-SNAP     45000   0      0    ACTIVE
ATM0            3      0     34  PVC  AAL5-SNAP     45000   0      0    ACTIVE
ATM0            4      0     35  PVC  AAL5-SNAP     45000   0      0    ACTIVE
ATM#
```

Step 13   Save the configuration as follows:

```
ATM# write memory
Building configuration...
[OK]
ATM#
```

Set up the PVCs on the Catalyst 5000 family Switch 2.

Step 14   At the console of the Catalyst 5000 family Switch 2, session to the ATM module in slot 2 by entering these commands:

```
Console> enable
Enter password:
Console> (enable) set vlan 5
Console> (enable) session 2
Trying ATM-2...
Connected to ATM-2.
Escape character is '^]'.
ATM>
```

Step 15   Configure PVCs 1, 2, 3, and 4 on Switch 2 by entering these commands:

```
ATM> enable
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm pvc 1 0 32 aal5snap 45000
ATM(config-if)# atm ds3-scramble
ATM(config-if)# atm lbo long
ATM(config-if)# atm framing m23adm
ATM(config-if)# atm clock internal
ATM(config-if)# atm pvc 2 0 33 aal5snap 45000
ATM(config-if)# atm pvc 3 0 34 aal5snap 45000
ATM(config-if)# atm pvc 4 0 35 aal5snap 45000
ATM(config-if)# end
ATM#
```

You can perform all PVC-related configurations for all VLANs on atm0, the major interface, because the subinterface number has no significance for PVC-supported VLANs. VCDs 10 and 11 (used above) can be any unused VCDs. Enter the **show atm vc** command to find unused VCDs.

Step 16   Bind the PVCs to VLAN 5 on the Catalyst 5000 family Switch 2 by entering these commands:

```
ATM# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-if)# atm bind pvc vlan 1 5
ATM(config-if)# atm bind pvc vlan 2 5
ATM(config-if)# atm bind pvc vlan 3 5
ATM(config-if)# atm bind pvc vlan 4 5
ATM(config-if)# end
ATM#
```

Step 17   Verify the setup on the Catalyst 5000 family Switch 2 by entering these commands:

```
ATM# show atm vlan
VCD     VLAN-ID
  1     5
  2     5
  3     5
  4     5
ATM#
ATM# show atm vc
                               AAL /          Peak  Avg.  Burst
Interface    VCD  VPI  VCI Type Encapsulation Kbps  Kbps  Cells Status
ATM0          1    0   32  PVC  AAL5-SNAP     45000   0     0   ACTIVE
ATM0          2    0   33  PVC  AAL5-SNAP     45000   0     0   ACTIVE
ATM0          3    0   34  PVC  AAL5-SNAP     45000   0     0   ACTIVE
ATM0          4    0   35  PVC  AAL5-SNAP     45000   0     0   ACTIVE
ATM#
```

Step 18   Save the configuration as follows:

```
ATM# write memory
Building configuration...
[OK]
ATM#
```