CHAPTER 6

Configuring Virtual Connections

This chapter describes how to configure virtual connections (VCs) in a typical ATM network after autoconfiguration has established the default network connections. The network configuration modifications described in this chapter are used to optimize your ATM network operation.

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 virtual connection types and applications, 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.

The tasks to configure virtual connections are described in the following sections:

Characteristics and Types of Virtual Connections

This section lists the various virtual connections (VC) types in Table 6-1.

Table 6-1 Supported VC Types

Connection	Point-to-Point	Point-to-Multipoint	Transit	Terminate
Permanent virtual channel link (PVCL)	x	x	—	—
Permanent virtual path link (PVPL)	x	x	—	—
Permanent virtual channel (PVC)	x	x	x	x
Permanent virtual path (PVP)	x	x	x	—
Soft permanent virtual channel (Soft PVC)	x	—	x	—
Soft permanent virtual path (Soft PVP)	x	—	x	—
Switched virtual channel (SVC)	x	x	x	x
Switched virtual path (SVP)	x	x	x	—

Configuring Virtual Channel Connections

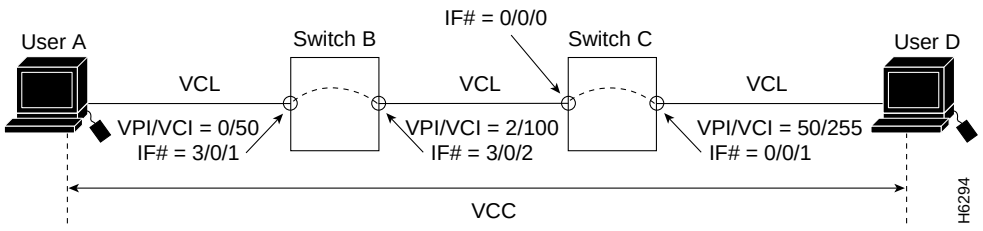
This section describes configuring virtual channel connections (VCCs) on the ATM switch router. A VCC is established as a bidirectional facility to transfer ATM traffic between two ATM layer users. Figure 6-1 shows an example VCC between ATM user A and user D.

An end-to-end VCC, as shown in Figure 6-1 between user A and user D, has two parts:

- Virtual channel links, labelled VCL. These are the interconnections between switches, either directly or through VP tunnels.
- Internal connections, shown by the dotted line in the switch. These connections are also sometimes called cross-connections or cross-connects.

The common endpoint between an internal connection and a link occurs at the switch interface. The endpoint of the internal connection is also referred to as a *connection leg* or *half-leg*. A cross-connect connects two legs together.

Figure 6-1 VCC Example



Note The value of the VPIs and VCIs can change as the traffic is relayed through the ATM network.

To configure a point-to-point VCC, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm pvc** *vpi-A* [*vci-A* | **any-vci**[1]] [**rx-cttr** *index*] [**tx-cttr** *index*] **interface atm** *card*/*subcard*/*port*[**.***vpt#*] *vpi-B* [*vci*-B | **any-vci**[1]]	Configures the PVC.

1. The **any-vci** parameter is only available for interface atm0.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Note When configuring PVC connections, begin with lower VCI numbers. Using low VCI numbers allows more efficient use of the switch fabric resources.

Examples

The following example shows how to configure the internal cross-connect PVC on Switch B between interface ATM 3/0/1 (VPI = 0, VCI = 50) and interface ATM 3/0/2 (VPI = 2, VCI = 100) (see Figure 6-1):

```
Switch-B(config)# interface atm 3/0/1
Switch-B(config-if)# atm pvc 0 50 interface atm 3/0/2 2 100
```

The following example shows how to configure the internal cross-connect PVC on Switch C between interface ATM 0/0/0, VPI = 2, VCI = 100, and interface ATM 0/0/1, VPI 50, VCI = 255:

```
Switch-C(config)# interface atm 0/0/0
Switch-C(config-if)# atm pvc 2 100 interface atm 0/0/1 50 255
```

Each subsequent VC cross-connection and link must be configured until the VC is terminated to create the entire VCC.

Note The above examples show how to configure cross-connections using one command. This is the preferred method, but it is also possible to configure each leg separately, then connect them with the **atm pvc** *vpi vci* **interface atm** *card*/*subcard*/*port vpi vci* command. This alternative method requires more steps, but might be convenient if each leg has many additional configuration parameters or if you have configured individual legs with SNMP commands and you want to connect them with one CLI command.

Displaying VCCs

To show the VCC configuration, use the following EXEC commands:

Command	Purpose
show atm interface [**atm** *card*/*subcard*/*port*]	Shows the ATM interface configuration.
show atm vc [**interface atm** *card*/*subcard*/*port vpi vci*]	Shows the PVC interface configuration.

Note The following examples differ depending on the feature card installed on the processor.

Examples

The following example shows the Switch B PVC configuration on ATM interface 3/0/1:

```
Switch-B# show atm interface

Interface:      ATM3/0/1        Port-type:    oc3suni
IF Status:      UP              Admin Status:   up
Auto-config:    enabled         AutoCfgState:   completed
IF-Side:        Network         IF-type:        NNI
Uni-type:       not applicable  Uni-version:    not applicable
Max-VPI-bits:   8               Max-VCI-bits:   14
Max-VP:         255             Max-VC:         16383
ConfMaxSvpcVpi: 255             CurrMaxSvpcVpi: 255
ConfMaxSvccVpi: 255             CurrMaxSvccVpi: 255
ConfMinSvccVci: 35              CurrMinSvccVci: 35
Svc Upc Intent: pass            Signalling:     Enabled
ATM Address for Soft VC: 47.0091.8100.0000.00e0.4fac.b401.4000.0c80.8000.00
Configured virtual links:
  PVCLs SoftVCLs   SVCLs   TVCLs   PVPLs SoftVPLs   SVPLs Total-Cfgd Inst-Conns
      4        0       0       0       0        0       0          4          2
Logical ports(VP-tunnels):     0
Input cells:    264330          Output cells:   273471
5 minute input rate:             0 bits/sec,       0 cells/sec
5 minute output rate:            0 bits/sec,       0 cells/sec
Input AAL5 pkts: 172613, Output AAL5 pkts: 177185, AAL5 crc errors: 0
```

The following example shows the Switch B PVC configuration on ATM interface 3/0/1:

```
Switch-B# show atm vc interface atm 3/0/1
Interface    VPI   VCI   Type    X-Interface  X-VPI X-VCI  Encap Status
ATM3/0/1     0     5      PVC     ATM0         0     57    QSAAL  UP
ATM3/0/1     0     16     PVC     ATM0         0     37    ILMI   UP
ATM3/0/1     0     18     PVC     ATM0         0     73    PNNI   UP
ATM3/0/1     0     50     PVC     ATM3/0/2     2     100         UP
ATM3/0/1     1     50     PVC     ATM0         0     80    SNAP   UP
```

The following example shows the Switch B PVC configuration on ATM interface 3/0/1, VPI = 0, VCI = 50, with the switch processor feature card installed:

```
Switch-B# show atm vc interface atm 3/0/1 0 50

Interface: ATM3/0/1, Type: oc3suni
VPI = 0  VCI = 50
Status: UP
Time-since-last-status-change: 4d02h
Connection-type: PVC
Cast-type: point-to-point
Packet-discard-option: disabled
Usage-Parameter-Control (UPC): pass
Wrr weight: 32
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM3/0/2, Type: oc3suni
Cross-connect-VPI = 2
Cross-connect-VCI = 100
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
Threshold Group: 5, 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 Clp0 q full drops:0, Rx Clp1 qthresh drops:0
Rx connection-traffic-table-index: 1
Rx service-category: UBR (Unspecified Bit Rate)
Rx pcr-clp01: 7113539
Rx scr-clp01: none
Rx mcr-clp01: none
Rx      cdvt: 1024 (from default for interface)
Rx       mbs: none
Tx connection-traffic-table-index: 1
Tx service-category: UBR (Unspecified Bit Rate)
Tx pcr-clp01: 7113539
Tx scr-clp01: none
Tx mcr-clp01: none
Tx      cdvt: none
Tx       mbs: none
```

Deleting VCCs from an Interface

This section describes how to delete a VCC configured on an interface. To delete a VCC, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **no atm pvc** *vpi vci*	Deletes the PVC.

Example

The following example shows how to delete the VCC on ATM interface 3/0/0, VPI = 20, VCI = 200:

```
Switch(config-if)# interface atm 3/0/0
Switch(config-if)# no atm pvc 20 200
```

Confirming VCC Deletion

To confirm the deletion of a VCC from an interface, use the following EXEC command before and after deleting the VCC:

Command	Purpose
show atm vc interface atm *card/subcard/port* [*vpi vci*]	Shows the PVCs configured on the interface.

Example

The following example shows how to confirm that the VCC is deleted from the interface:

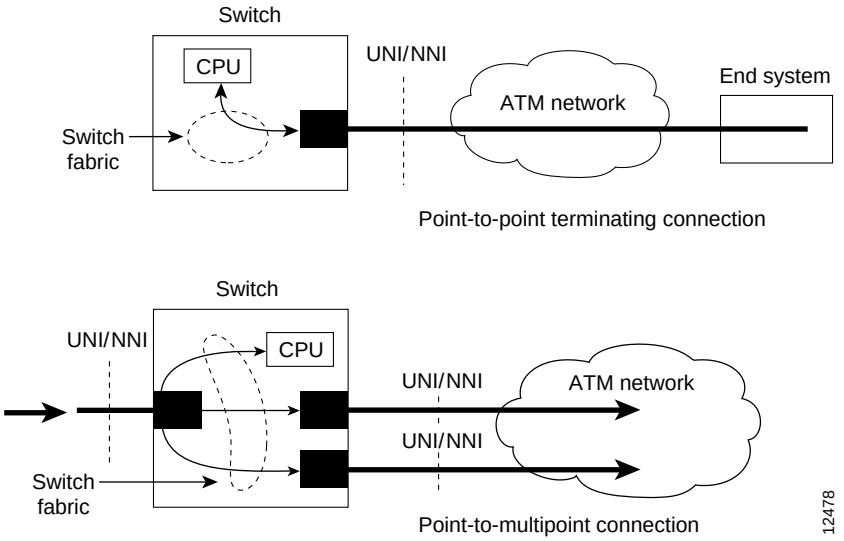
```
Switch# show atm vc interface atm 3/0/0
Interface         VPI  VCI   Type   X-Interface      X-VPI X-VCI Encap  Status
ATM3/0/0          0    5     PVC    ATM2/0/0          0    77    QSAAL  UP
ATM3/0/0          0    16    PVC    ATM2/0/0          0    55    ILMI   UP
ATM3/0/0          0    18    PVC    ATM2/0/0          0    152   PNNI   UP
→ ATM3/0/0        0    34    PVC    ATM2/0/0          0    151   NCDP   UP
→ ATM3/0/0        20   200   PVC    ATM1/1/1          10   100         DOWN
Switch# configure terminal
Switch(config)# interface atm 3/0/0
Switch(config-if)# no atm pvc 20 200
Switch(config-if)# end
Switch# show atm vc interface atm 3/0/0
Interface         VPI  VCI   Type   X-Interface      X-VPI X-VCI Encap  Status
ATM3/0/0          0    5     PVC    ATM2/0/0          0    77    QSAAL  UP
ATM3/0/0          0    16    PVC    ATM2/0/0          0    55    ILMI   UP
ATM3/0/0          0    18    PVC    ATM2/0/0          0    152   PNNI   UP
→ ATM3/0/0        0    34    PVC    ATM2/0/0          0    151   NCDP   UP
```

Configuring Terminating PVC Connections

This section describes configuring point-to-point and point-to-multipoint terminating permanent virtual channel (PVC) connections. Terminating connections provide the connection to the ATM switch router's route processor for LAN emulation (LANE), IP over ATM, and control channels for Integrated Local Management Interface (ILMI), signalling, and Private Network-Network Interface (PNNI) plus network management.

Figure 6-2 shows an example of transit and terminating connections.

Figure 6-2 Terminating PVC Types



Point-to-point and point-to-multipoint are two types of terminating connections. Both terminating connections are configured using the same commands as transit connections (discussed in the previous sections). However, all switch terminating connections use interface atm0 to connect to the route processor.

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

To configure both point-to-point and point-to-multipoint terminating PVC connections, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card-A/subcard-A/port-A*[**.***vpt#*] Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm pvc** *vpi-A* [*vci-A* | **any-vci**[1]] [**cast-type** *type*] [**rx-cttr** *index*] [**tx-cttr** *index*] **interface atm** *card-B/subcard-B/port-B*[**.***vpt#*] *vpi-B* [*vci-B* | **any-vci**[1]] [**encap** *type*] [**cast-type** *type*]	Configures the PVC between ATM switch router connections.

1. The any-vci feature is only available for interface atm 0.

When configuring point-to-multipoint PVC connections using the **atm pvc** command, the root point is port A and the leaf points are port B.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Examples

The following example shows how to configure the internal cross-connect PVC between interface ATM 3/0/1, VPI = 1, VCI = 50, and the terminating connection at the route processor interface ATM 0, VPI = 0, and VCI unspecified:

```
Switch-B(config)# interface atm 3/0/1
Switch-B(config-if)# atm pvc 1 50 interface atm0 0 any-vci encap aal5snap
```

The following example shows how to configure the route processor leg of any terminating PVC:

```
Switch(config)# interface atm0
Switch(config-if)# atm pvc 0 any-vci
```

When configuring the route processor leg of a PVC that is not a tunnel, the VPI should be configured as 0. The preferred method of VCI configuration is to select the **any-vci** parameter, unless a specific VCI is needed as a parameter in another command, such as **map-list**.

Note If configuring a specific VCI value for the route processor leg, select a VCI value higher than 300 to prevent a conflict with an automatically assigned VCI for well-known channels if the ATM switch router reboots.

Displaying the Terminating PVC Connections

To display the terminating PVC configuration VCs on the interface, use the following EXEC command:

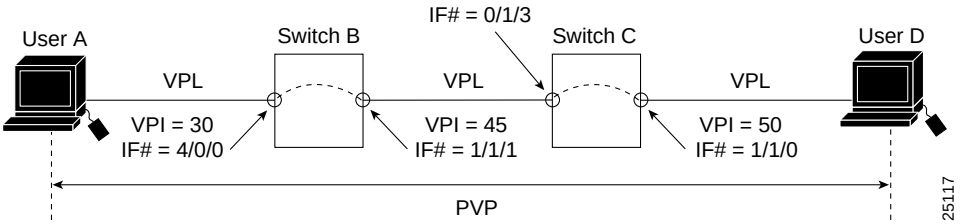
Command	Purpose
show atm vc interface atm *card/subcard/port vpi vci*	Shows the PVC configured on the interface.

See the "Displaying VCCs" section on page 6-4 for examples of the **show atm vc** commands.

Configuring PVP Connections

This section describes configuring a permanent virtual path (PVP) connection. Figure 6-3 shows an example of PVPs configured through the ATM switch routers.

Figure 6-3 Virtual Path Connection Example



To configure a PVP connection, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the physical interface to be configured.
Step 2	Switch(config-if)# **atm pvp** *vpi-A* [**rx-cttr** *index*] [**tx-cttr** *index*] **interface atm** *card/subcard/port vpi-B*	Configures the interface PVP.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Note When configuring PVP connections, begin with lower virtual path identifier (VPI) numbers. Using low VPI numbers allows more efficient use of the switch fabric resources.

Examples

The following example shows how to configure the internal cross-connect PVP within Switch B between interfaces 4/0/0, VPI = 30, and interface ATM 1/1/1, VPI = 45:

```
Switch-B(config)# interface atm 4/0/0
Switch-B(config-if)# atm pvp 30 interface atm 1/1/1 45
```

The following example shows how to configure the internal cross-connect PVP within Switch C between interfaces 0/1/3, VPI = 45, and interface ATM 1/1/0, VPI = 50:

```
Switch-C(config)# interface atm 0/1/3
LS1010(config-if)# atm pvp 45 interface atm 1/1/0 50
```

Each subsequent PVP cross connection and link must be configured until the VP is terminated to create the entire PVP.

Displaying PVP Configuration

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

Command	Purpose
show atm vp [**interface atm** *card*/*subcard*/*port vpi*]	Shows the ATM VP configuration.

Example

The following example shows the PVP configuration of Switch B:

```
Switch-B# show atm vp
Interface     VPI    Type  X-Interface     X-VPI     Status
ATM1/1/1      45      PVP     ATM4/0/0      30        UP
ATM4/0/0      30      PVP     ATM1/1/1      45        UP
```

The following example shows the PVP configuration of Switch B with the switch processor feature card installed:

```
Switch-B# show atm vp interface atm 4/0/0 30

Interface: ATM4/0/0, Type: ds3suni
VPI = 30
Status: UP
Time-since-last-status-change: 00:09:02
Connection-type: PVP
Cast-type: point-to-point
Usage-Parameter-Control (UPC): pass
Wrr weight: 2
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM1/1/1, Type: oc3suni
Cross-connect-VPI = 45
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
Threshold Group: 5, 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 Clp0 q full drops:0, Rx Clp1 qthresh drops:0
Rx connection-traffic-table-index: 1
Rx service-category: UBR (Unspecified Bit Rate)
Rx pcr-clp01: 7113539
Rx scr-clp01: none
Rx mcr-clp01: none
Rx      cdvt: 1024 (from default for interface)
Rx       mbs: none
Tx connection-traffic-table-index: 1
Tx service-category: UBR (Unspecified Bit Rate)
Tx pcr-clp01: 7113539
Tx scr-clp01: none
Tx mcr-clp01: none
Tx      cdvt: none
Tx       mbs: none
```

Deleting PVPs from an Interface

This section describes how to delete a PVP configured on an interface. To delete a PVP, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **no atm pvp** *vpi*	Deletes the PVP.

Example

The following example shows how to delete the PVP on ATM interface 1/1/0, VPI = 200:

```
Switch(config-if)# interface atm 1/1/0
Switch(config-if)# no atm pvp 200
```

Confirming PVP Deletion

To confirm the deletion of a PVP from an interface, use the following EXEC command before and after deleting the PVP:

Command	Purpose
show atm vp interface atm [*card/subcard/port vpi*]	Shows the PVCs configured on the interface.

Example

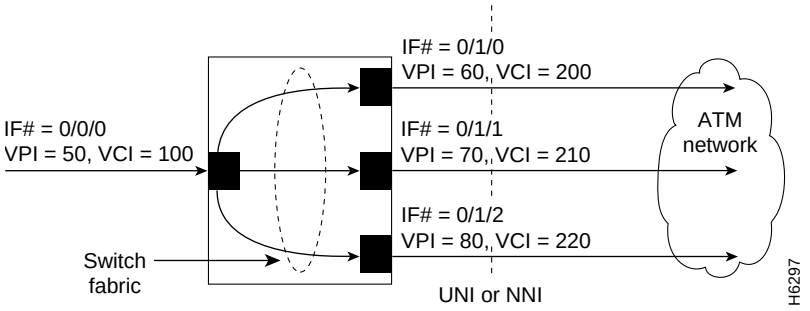
The following example shows how to confirm that the PVP is deleted from the interface:

```
Switch# show atm vp
Interface         VPI  Type  X-InterfaceX-VPI     Status
ATM1/1/0          113  PVP    TUNNEL
→ ATM1/1/0          200  PVP    ATM1/1/1100 DOWN
ATM1/1/1          1    PVP    SHAPED TUNNEL
→ ATM1/1/1          100  PVP    ATM1/1/0200 DOWN
Switch# configure terminal
Switch(config)# interface atm 1/1/0
Switch(config-if)# no atm pvp 200
Switch(config-if)# end
Switch# show atm vp
Interface         VPI  Type  X-InterfaceX-VPI     Status
ATM1/1/0          113  PVP    TUNNEL
ATM1/1/1          1    PVP    SHAPED TUNNEL
Switch#
```

Configuring Point-to-Multipoint PVC Connections

This section describes configuring point-to-multipoint PVC connections. In Figure 6-4, cells entering the ATM switch router at the root point (on the left side at interface ATM 0/0/0, VPI = 50, VCI = 100) are duplicated and switched to the leaf points (output interfaces) on the right side of the figure.

Figure 6-4 Point-to-Multipoint PVC Example



Note If desired, one of the leaf points can terminate in the ATM switch router at the route processor interface ATM 0.

To configure the point-to-multipoint PVC connections shown in Figure 6-4, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port*[**.***vpt#*] Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm pvc** *vpi-A vci-A* [**cast-type** *type-A*] [**rx-cttr** *index*] [**tx-cttr** *index*] **interface atm** *card*/*subcard*/*port*[**.***vpt#*] *vpi-B vci-B* [**cast-type** *type-B*]	Configures the PVC between ATM switch router connections.

To configure the point-to-multipoint PVC connections using the **atm pvc** command, the root point is port A and the leaf points are port B.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Examples

The following example shows how to configure the root-point PVC on ATM switch router interface ATM 0/0/0, VPI = 50, VCI = 100, to the leaf-point interfaces (see Figure 6-4):

```
Switch(config)# interface atm 0/0/0
Switch(config-if)# atm pvc 50 100 cast-type p2mp-root interface atm 0/1/0 60 200 cast-type p2mp-leaf
Switch(config-if)# atm pvc 50 100 cast-type p2mp-root interface atm 0/1/1 70 210 cast-type p2mp-leaf
Switch(config-if)# atm pvc 50 100 cast-type p2mp-root interface atm 0/1/2 80 220 cast-type p2mp-leaf
```

Displaying Point-to-Multipoint PVC Configuration

To display the point-to-multipoint PVC configuration, use the following EXEC mode command:

Command	Purpose
show atm vc interface atm *card/subcard/port*	Shows the PVCs configured on the interface.
show atm vc interface atm *card/subcard/port vpi vci*	Shows the PVCs configured on the interface.

Examples

The following example shows the PVC configuration of the point-to-multipoint connections on ATM interface 0/0/0:

```
Switch# show atm vc interface atm 0/0/0
Interface         VPI  VCI   Type   X-Interface      X-VPI X-VCI Encap  Status
ATM0/0/0          0    5     PVC    ATM2/0/0          0    70    QSAAL  UP
ATM0/0/0          0    16    PVC    ATM2/0/0          0    46    ILMI   UP
ATM0/0/0          0    18    PVC    ATM2/0/0          0    120   PNNI   UP
ATM0/0/0          0    34    PVC    ATM2/0/0          0    192   NCDP   UP
ATM0/0/0          50   100   PVC    ATM0/1/0          60   200         UP
                                    ATM0/1/1          70   210         UP
                                    ATM0/1/2          80   220         UP
```

The following example shows the VC configuration on interface ATM 0/0/0, VPI = 50, VCI = 100, with the switch processor feature card installed:

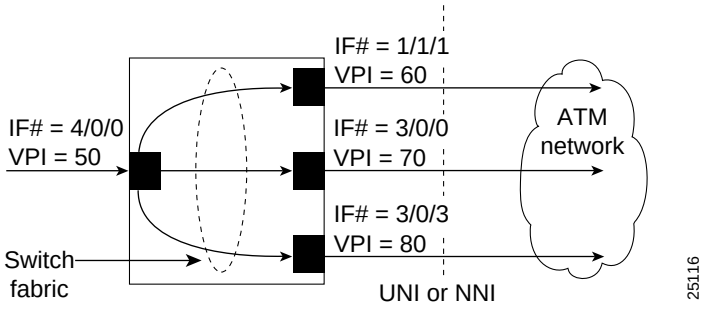
```
Switch# show atm vc interface atm 0/0/0 50 100

Interface: ATM0/0/0, Type: oc3suni
VPI = 50  VCI = 100
Status: UP
Time-since-last-status-change: 00:07:06
Connection-type: PVC
Cast-type: point-to-multipoint-root
Packet-discard-option: disabled
Usage-Parameter-Control (UPC): pass
Wrr weight: 32
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM0/1/0, Type: oc3suni
Cross-connect-VPI = 60
Cross-connect-VCI = 200
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
Cross-connect-interface: ATM0/1/1
Cross-connect-VPI = 70
Cross-connect-VCI = 210
Cross-connect-interface: ATM0/1/2
Cross-connect-VPI = 80
Cross-connect-VCI = 220
Threshold Group: 5, 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 Clp0 q full drops:0, Rx Clp1 qthresh drops:0
Rx connection-traffic-table-index: 1
Rx service-category: UBR (Unspecified Bit Rate)
Rx pcr-clp01: 7113539
Rx scr-clp01: none
Rx mcr-clp01: none
Rx      cdvt: 1024 (from default for interface)
Rx       mbs: none
Tx connection-traffic-table-index: 1
Tx service-category: UBR (Unspecified Bit Rate)
Tx pcr-clp01: 7113539
Tx scr-clp01: none
Tx mcr-clp01: none
Tx      cdvt: none
Tx       mbs: none
```

Configuring Point-to-Multipoint PVP Connections

This section describes configuring point-to-multipoint PVP connections. Figure 6-5 provides an example of point-to-multipoint PVP connections.

Figure 6-5 Point-to-Multipoint PVP Example



In Figure 6-5, cells entering the ATM switch router at the root point (the left side at interface ATM 4/0/0), VPI = 50, are duplicated and switched to the leaf points (output interfaces), on the right side of the figure.

To configure point-to-multipoint PVP connections, perform the following steps, beginning in global configuration mode:

Command	Purpose
interface atm *card-A/subcard-A/port-A*	Selects the interface to be configured.

To configure the point-to-multipoint PVP connections using the **atm pvp** command, the root point is port A and the leaf points are port B.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Examples

The following example shows how to configure the root-point PVP on ATM switch router interface ATM 4/0/0 (VPI = 50), to the leaf point interfaces ATM 1/1/1 (VPI = 60), ATM 3/0/0 (VPI = 70), and ATM 3/0/3 (VPI = 80) (see Figure 6-5):

```
Switch(config)# interface atm 4/0/0
Switch(config-if)# atm pvp 50 cast-type p2mp-root interface atm 1/1/1 60 cast-type p2mp-leaf
Switch(config-if)# atm pvp 50 cast-type p2mp-root interface atm 3/0/0 70 cast-type p2mp-leaf
Switch(config-if)# atm pvp 50 cast-type p2mp-root interface atm 3/0/3 80 cast-type p2mp-leaf
```

Displaying Point-to-Multipoint PVP Configuration

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

Command	Purpose
show atm vp [**interface atm** *card*/*subcard*/*port vpi*]	Shows the ATM VP configuration.

Examples

The following example shows the PVP configuration of the point-to-multipoint PVP connections on ATM interface 4/0/0:

```
Switch# show atm vp interface atm 4/0/0
Interface    VPI    Type  X-Interface     X-VPI     Status
ATM4/0/0     50      PVP     ATM1/1/1     60        UP
                             ATM3/0/0     70        UP
                             ATM3/0/3     80        UP
```

The following example shows the PVP configuration of the point-to-multipoint PVP connections on ATM interface 4/0/0, VPI = 50, with the switch processor feature card installed:

```
Switch# show atm vp interface atm 4/0/0 50

Interface: ATM4/0/0, Type: ds3suni
VPI = 50
Status: UP
Time-since-last-status-change: 00:01:51
Connection-type: PVP
Cast-type: point-to-multipoint-root
Usage-Parameter-Control (UPC): pass
Wrr weight: 2
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM1/1/1, Type: oc3suni
Cross-connect-VPI = 60
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
Cross-connect-interface: ATM3/0/0
Cross-connect-VPI = 70
Cross-connect-interface: ATM3/0/3
Cross-connect-VPI = 80
Threshold Group: 5, 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 Clp0 q full drops:0, Rx Clp1 qthresh drops:0
Rx connection-traffic-table-index: 1
Rx service-category: UBR (Unspecified Bit Rate)
Rx pcr-clp01: 7113539
Rx scr-clp01: none
Rx mcr-clp01: none
Rx      cdvt: 1024 (from default for interface)
Rx       mbs: none
```

```
Tx connection-traffic-table-index: 1
Tx service-category: UBR (Unspecified Bit Rate)
Tx pcr-clp01: 7113539
Tx scr-clp01: none
Tx mcr-clp01: none
Tx      cdvt: none
Tx       mbs: none
```

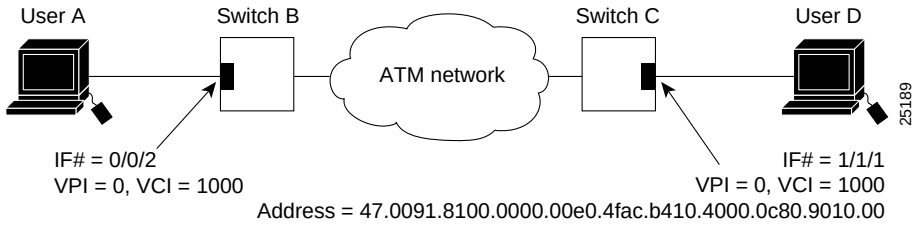
Configuring Soft PVC Connections

This section describes configuring soft permanent virtual channel (PVC) connections, which provide the following features:

- Connection to another host or ATM switch router that supports signalling
- Configuration of PVCs without the manual configuration steps described in the "Configuring Virtual Channel Connections" section on page 6-2
- Configuration of PVCs with the reroute or retry capabilities when a failure occurs in the network

Figure 6-6 illustrates the soft PVC connections used in the following examples.

Figure 6-6 Soft PCV Connection Example



Guidelines for Creating Soft PVCs

Perform the following steps when you configure soft PVCs:

Step 1 Determine which two ports you want to define as participants in the soft PVC.

Step 2 Decide which of these two ports you want to designate as the destination (or passive) side of the soft PVC.

This decision is arbitrary—it makes no difference which port you define as the destination end of the circuit.

Step 3 Retrieve the ATM address of the destination end of the soft PVC using the **show atm address** command.

Step 4 Retrieve the VPI/VCI values for the circuit using the **show atm vc** command.

Step 5 Configure the source (active) end of the soft PVC. At the same time, complete the soft PVC setup using the information derived from Step 3 and Step 4. Be sure to select an unused VPI/VCI value (one that does not appear in the **show atm vc** display).

Configuring Soft PVCs

To configure a soft PVC connection, perform the following steps, beginning in privileged EXEC mode:

	Command	Purpose
Step 1	Switch# **show atm addresses**	Determines the destination ATM address.
Step 2	Switch# **configure terminal** Switch(config)#	At the privileged EXEC prompt, enters configuration mode from the terminal.
Step 3	Switch(config)# **interface atm** *card*/*subcard*/*port*[**.***vpt#*] Switch(config-if)#	Selects the interface to be configured.
Step 4	Switch(config-if)# **atm soft-vc** *source-vpi source-vci* **dest-address** *atm-address dest-vpi dest-vci* [**enable** | **disable**] [**upc** *upc*] [**pd** *pd*] [**rx-cttr** *index*] [**tx-cttr** *index*] [**retry-interval** [**first** *interval*] [**maximum** *interval*]] [**redo-explicit** [**explicit-path** *precedence* {**name** *path-name* | **identifier** *path-id*} [**upto** *partial-entry-index*]] [**only-explicit**]]	Configures the soft PVC connection.

Note The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Examples

The following example shows the destination ATM address of the interface connected to User D:

```
Switch-C# show atm addresses

Switch Address(es):
  47.00918100000000400B0A2A81.00400B0A2A81.00 active
  47.00918100000000E04FACB401.00E04FACB401.00

Soft VC Address(es):

<Information deleted>

  47.0091.8100.0000.00e0.4fac.b401.4000.0c80.9000.00 ATM1/1/0
  47.0091.8100.0000.00e0.4fac.b401.4000.0c80.9010.00 ATM1/1/1
  47.0091.8100.0000.00e0.4fac.b401.4000.0c80.9020.00 ATM1/1/2

<Information deleted>
```

The following example shows how to configure a soft PVC on Switch B between interface ATM 0/0/2, source VPI = 0, VCI = 1000; and Switch C, destination VPI = 0, VCI = 1000 with a specified ATM address (see Figure 6-6):

```
Switch-B(config)# interface atm 0/0/2
Switch-B(config-if)# atm soft-vc 0 1000 dest-address 47.0091.8100.0000.00e0.4fac.b401.4000.0c80.9010.00 0
1000
```

Displaying Soft PVC Configuration

To display the soft PVC configuration at either end of a ATM switch router, use the following EXEC commands:

Command	Purpose
show atm vc interface atm *card/subcard/port*	Shows the VCs configured on the ATM interface.
show atm vc interface atm *card/subcard/port vpi vci*	Shows the soft PVC interface configuration.

Examples

The following example shows the soft PVC configuration of Switch B, on interface ATM 0/0/2 out to the ATM network:

```
Switch-B# show atm vc interface atm 0/0/2
Interface         VPI  VCI   Type   X-Interface      X-VPI X-VCI Encap  Status
ATM0/0/2          0    5     PVC    ATM0              0    45    QSAAL  UP
ATM0/0/2          0    16    PVC    ATM0              0    37    ILMI   UP
ATM0/0/2          0    18    PVC    ATM0              0    52    PNNI   UP
ATM0/0/2          0    34    PVC    ATM0              0    51    NCDP   UP
ATM0/0/2          0    35    SVC    ATM0/0/2          0    1000        UP
→ ATM0/0/2        0    1000  SoftVC ATM0/0/2          0    35          UP
```

The following example shows the soft PVC configuration of Switch C, on interface ATM 1/1/1 out to the ATM network:

```
Switch-C# show atm vc interface atm 1/1/1
Interface         VPI  VCI   Type   X-Interface      X-VPI X-VCI Encap  Status
ATM1/1/1          0    5     PVC    ATM2/0/0          0    74    QSAAL  UP
ATM1/1/1          0    16    PVC    ATM2/0/0          0    44    ILMI   UP
ATM1/1/1          0    18    PVC    ATM2/0/0          0    109   PNNI   UP
ATM1/1/1          0    34    PVC    ATM2/0/0          0    120   NCDP   UP
ATM1/1/1          0    123   SVC    ATM1/1/1          0    1000        UP
→ ATM1/1/1        0    1000  SoftVC ATM1/1/1          0    123         UP
ATM1/1/1          2    100   PVC    ATM2/0/0          0    103   SNAP   UP
```

The following example shows the soft PVC configuration of Switch B, on interface ATM 0/0/2 (VPI = 0, VCI = 1000) out to the ATM network with the switch processor feature card installed:

```
Switch-B# show atm vc interface atm 0/0/2 0 1000

Interface: ATM0/0/2, Type: oc3suni
→ VPI = 0  VCI = 1000
Status: UP
Time-since-last-status-change: 21:56:48
Connection-type: SoftVC
Cast-type: point-to-point
 Soft vc location: Source
→ Remote ATM address: 47.0091.8100.0000.0040.0b0a.2a81.4000.0c80.9010.00
 Remote VPI: 0
 Remote VCI: 1000
 Soft vc call state: Active
 Number of soft vc re-try attempts: 0
 First-retry-interval: 5000 milliseconds
 Maximum-retry-interval: 60000 milliseconds
 Aggregate admin weight: 10080
 TIME STAMPS:
 Current Slot:2
  Outgoing Setup     May 25 10:38:50.718
  Incoming Connect   May 25 10:38:50.762

Packet-discard-option: disabled
Usage-Parameter-Control (UPC): pass
Wrr weight: 2
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM0/0/2, Type: oc3suni
Cross-connect-VPI = 0
Cross-connect-VCI = 35
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
Threshold Group: 5, 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 Clp0 q full drops:0, Rx Clp1 qthresh drops:0
Rx connection-traffic-table-index: 1
Rx service-category: UBR (Unspecified Bit Rate)
Rx pcr-clp01: 7113539
Rx scr-clp01: none
Rx mcr-clp01: none
Rx      cdvt: 1024 (from default for interface)
Rx       mbs: none
Tx connection-traffic-table-index: 1
Tx service-category: UBR (Unspecified Bit Rate)
Tx pcr-clp01: 7113539
Tx scr-clp01: none
Tx mcr-clp01: none
Tx      cdvt: none
Tx       mbs: none
```

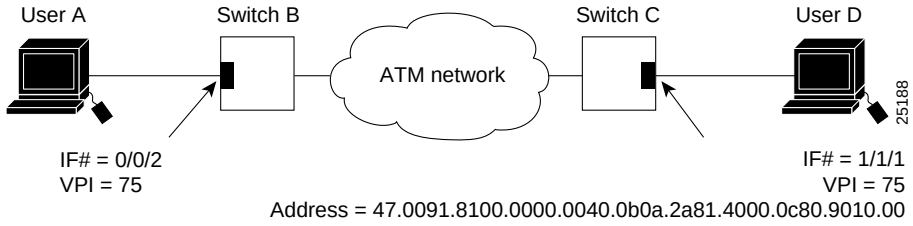
Configuring Soft PVP Connections

This section describes configuring soft permanent virtual path (PVP) connections, which provide the following features:

- Connection to another host or ATM switch router that does supports signalling
- Configuration of PVPs without the manual configuration steps described in the "Configuring Virtual Channel Connections" section on page 6-2.
- Configuration of PVPs with the reroute or retry capabilities when a failure occurs within the network

Figure 6-7 is an illustration of the soft PVP connections used in the examples in this section.

Figure 6-7 Soft PVP Connection Example



To configure a soft PVP connection, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm soft-vp** *source-vpi* **dest-address** *atm-address dest-vpi* [**enable** | **disable**] [**upc** *upc*] [**rx-cttr** *index*] [**tx-cttr** *index*] [**retry-interval** [**first** *interval*] [**maximum** *interval*]] [**redo-explicit** [**explicit-path** *precedence* {**name** *path-name* | **identifier** *path-id*} [**upto** *partial-entry-index*]] [**only-explicit**]]	Configures the soft PVP connection.

The row index for **rx-cttr** and **tx-cttr** must be configured before using this optional parameter. See the "Configuring the Connection Traffic Table" section on page 8-10.

Example

The following example shows how to configure a soft PVP on Switch B between interface ATM 0/0/2, source VPI = 75; and Switch C, destination VPI = 75, with a specified ATM address (see Figure 6-7):

```
Switch-B(config)# interface atm 0/0/2
Switch-B(config-if)# atm soft-vp 75 dest-address 47.0091.8100.0000.0040.0b0a.2a81.4000.0c80.9010.00 75
```

Displaying Soft PVP Connections

To display the ATM soft PVP configuration, use the following EXEC command:

Command	Purpose
show atm vp [**interface atm** *card/subcard/port vpi*]	Shows the soft PVP configuration.

Examples

The following example shows the soft PVP configuration at Switch B, on interface ATM 0/0/2 out to the ATM network:

```
Switch-B# show atm vp
Interface         VPI  Type  X-Interface         X-VPI     Status
ATM0/0/2          1    SVP    ATM0/0/2          75  UP
ATM0/0/2          75   SoftVP ATM0/0/2          1   UP
```

The following example shows the soft PVP configuration on interface ATM 1/1/1 at Switch C out to the ATM network:

```
Switch-C# show atm vp
Interface         VPI  Type  X-Interface         X-VPI     Status
ATM1/1/1          1    SVP    ATM1/1/1          75  UP
ATM1/1/1          75   SoftVP ATM1/1/1          1   UP
```

The following example shows the soft PVP configuration at Switch B on interface ATM 0/0/2 (VPI = 75) out to the ATM network with the switch processor feature card installed:

```
Switch-B# show atm vp interface atm 0/0/2 75

Interface: ATM0/0/2, Type: oc3suni
→ VPI = 75
Status: UP
Time-since-last-status-change: 00:09:46
Connection-type: SoftVP
Cast-type: point-to-point
 Soft vp location: Source
→ Remote ATM address: 47.0091.8100.0000.0040.0b0a.2a81.4000.0c80.9010.00
 Remote VPI: 75
 Soft vp call state: Active
 Number of soft vp re-try attempts: 0
 First-retry-interval: 5000 milliseconds
 Maximum-retry-interval: 60000 milliseconds
 Aggregate admin weight: 10080
 TIME STAMPS:
 Current Slot:2
  Outgoing Setup     May 26 09:45:30.292
  Incoming Connect   May 26 09:45:30.320
<information deleted>
```

Configuring the Soft PVP or Soft PVC Route Optimization Feature

This section describes the soft PVP or soft PVC route optimization feature. Most soft PVPs or soft PVCs have a much longer lifetime than SVCs. The route chosen during the soft connection setup remains the same even though the network topology might change.

Soft connections, with the route optimization percentage threshold set, provide the following features:

- When a better route is available, soft PVPs or PVCs are dynamically rerouted
- Route optimization can be triggered manually

Note Soft PVC route optimization should not be configured with constant bit rate (CBR) connections.

Route optimization is directly related to administrative weight, which is similar to hop count. For a description of administrative weight, see the "Configuring the Global Administrative Weight Mode" section on page 10-41.

Configuring soft PVP or soft PVC route optimization is described in the following sections:

- Enabling Soft PVP or Soft PVC Route Optimization on page 6-24
- Configuring a Soft PVP/PVC Interface with Route Optimization on page 6-24

For overview information about the route optimization feature refer to the *Guide to ATM Technology.*

Enabling Soft PVP or Soft PVC Route Optimization

Soft PVP or soft PVC route optimization must be enabled and a threshold level configured to determine the point when a better route is identified and the old route is reconfigured.

To enable and configure route optimization, use the following global configuration command:

Command	Purpose
atm route-optimization percentage-threshold *percent*	Configures route optimization.

Example

The following example enables route optimization and sets the threshold percentage to 85 percent:

```
Switch(config)# atm route-optimization percentage-threshold 85
```

Configuring a Soft PVP/PVC Interface with Route Optimization

Soft PVP or soft PVC route optimization must be enabled and configured to determine the point at which a better route is found and the old route is reconfigured.

To enable and configure a soft PVC/PVP interface with route optimization, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface** [**atm** *card*/*subcard*/*port* | **serial** *card*/*subcard*/*port*:*cgn*] Switch(config-if)#	Selects the interface to configure. Enter the interface number of the source end of the soft PVC/PVP. Route optimization works for the source end of a soft PVC/PVP only and is ignored if configured on the destination interface.
Step 2	Switch(config-if)# **atm route-optimization soft-connection** [**interval** *minutes*] [**time-of-day** {**anytime** | *start-time end-time*}]	Configures the interface for route optimization.

Example

The following example shows how to configure an interface with a route optimization interval configured as every 30 minutes between the hours of 6:00 P.M. and 5:00 A.M.:

```
Switch(config)# interface atm 0/0/0
Switch(config-if)# atm route-optimization soft-connection interval 30 time-of-day 18:00 5:00
```

Displaying an Interface Route Optimization Configuration

To display the interface route optimization configuration, use the following EXEC command:

Command	Purpose
show atm interface [**atm** *card*/*subcard*/*port* | **serial** *card*/*subcard*/*port*:*cgn*]	Shows the interface configuration route optimization configuration.

Example

The following example shows the route optimization configuration of ATM interface 0/0/0:

```
Switch# show atm interface atm 0/0/0
IF Status:      UP              Admin Status:   up
Auto-config:    enabled         AutoCfgState:   completed
IF-Side:        Network         IF-type:        NNI
Uni-type:       not applicable  Uni-version:    not applicable
Max-VPI-bits:   8               Max-VCI-bits:   14
Max-VP:         255             Max-VC:         16383
ConfMaxSvpcVpi: 255             CurrMaxSvpcVpi: 255
ConfMaxSvccVpi: 255             CurrMaxSvccVpi: 255
ConfMinSvccVci: 35              CurrMinSvccVci: 35
Svc Upc Intent: pass            Signalling:     Enabled
→ Soft vc route optimization is enabled
→ Soft vc route optimization interval = 30 minutes
→ Soft vc route optimization time-of-day range = (18:0 - 5:0)
ATM Address for Soft VC: 47.0091.8100.0000.00e0.4fac.b401.4000.0c80.8000.00
<information deleted>
```

Configuring Soft PVCs with Explicit Paths

Normally, soft PVCs and soft PVPs are automatically routed by PNNI over paths that meet the traffic parameter objectives. However, for cases where manually configured paths are needed, PNNI explicit paths can optionally be specified for routing the soft PVC or soft PVP. For detailed information on configuring PNNI explicit paths, refer to the “Configuring Explicit Paths” section on page 10-38.

The explicit paths are assigned using precedence numbers 1 through 3. The precedence 1 path is tried first and if it fails the soft connection is routed using the precedence 2 path and so forth. If all of the explicit paths fail, standard on-demand PNNI routing is tried unless the **only-explicit** keyword is specified.

If the soft connection destination address is reachable at one of the included entries in an explicit path, any following entries in that path are automatically disregarded. This allows longer paths to be reused for closer destinations. Alternatively, the **upto** keyword can be specified for an explicit path in order to disregard later path entries.

Example

The following example shows how to configure a soft PVC between ATM switch router dallas_1 and an address on ATM switch router new_york_3 using either of the two explicit paths new_york.path1 and new_york.path2. If both explicit paths fail, the ATM switch router uses PNNI on-demand routing to calculate the route.

```
dallas_1(config)# interface atm 0/0/0
dallas_1(config)# atm soft-vc 0 201 dest-address 47.0091.8100.0000.1061.3e7b.2f99.4000.0c80.0030.00 0 101
explicit-path 1 name new_york.path1 explicit-path 2 name new_york.path2
```

Changing Explicit Paths for an Existing Soft PVC

Explicit paths can be added, modified or removed without tearing down existing soft PVCs by using the **redo-explicit** keyword. Only the source VPI and VCI options need to be specified. All applicable explicit path options are replaced by the respecified explicit path options.

The soft PVC is not immediately rerouted using the new explicit path. However, reroutes using the new explicit path can happen for the following four reasons:

1. A failure occurs along the current path.
2. The EXEC command **atm route-optimization soft-connection** is entered for the soft PVC.
3. **route-optimization** is enabled and the retry time interval has expired.
4. The soft PVC is disabled and then reenabled using the **disable** and **enable** keywords.

Example

The following example shows how to change the explicit path configuration for an existing soft PVC on the ATM switch router dallas_1 without tearing down the connection. The new configuration specifies the two explicit paths, new_york.path3 and new_york.path4, and uses the only-explicit option.

```
dallas_1(config)# interface atm 0/0/0
dallas_1(config)# atm soft-vc 0 201 redo-explicit explicit-path 1 name new_york.path3
explicit-path 2 name new_york.path4 only-explicit
```

Note The configuration displayed for soft connections with explicit paths is always shown as two separate lines using the **redo-explicit** keyword on the second line, even if it is originally configured using a single command line.

Displaying Explicit Path for Soft PVC Connections

To display a soft PVC connection successfully routed over an explicit path, use the following EXEC command:

Command	Purpose
show atm vc interface atm *card/subcard/port vpi vci*	Displays the soft PVC connection status including the PNNI explicit path routing status for the last setup attempt.

Example

The following example shows the last explicit path status for a soft PVC using the **show atm vc interface** EXEC command. Note that the first listed explicit path new_york.path2 shows an unreachable result, but the second explicit path new_york.path1 succeeded.

```
Switch# show atm vc interface atm 0/1/3 0 40
VPI = 0  VCI = 40
Status:UP
Time-since-last-status-change:00:00:03
Connection-type:SoftVC
Cast-type:point-to-point
 Soft vc location:Source
 Remote ATM address:47.0091.8100.0000.0060.705b.d900.4000.0c81.9000.00
 Remote VPI:0
 Remote VCI:40
 Soft vc call state:Active
 Number of soft vc re-try attempts:0
 First-retry-interval:5000 milliseconds
 Maximum-retry-interval:60000 milliseconds
 Aggregate admin weight:15120
 TIME STAMPS:
 Current Slot:4
  Outgoing Release   February 26 17:02:45.940
  Incoming Rel comp  February 26 17:02:45.944
  Outgoing Setup     February 26 17:02:45.948
  Incoming Connect   February 26 17:02:46.000
  Outgoing Setup     February 23 11:54:17.587
  Incoming Release   February 23 11:54:17.591
  Outgoing Setup     February 23 11:54:37.591
  Incoming Release   February 23 11:54:37.611
  Outgoing Setup     February 23 11:55:17.611
  Incoming Connect   February 23 11:55:17.655

→  Explicit-path 1:result=6  PNNI_DEST_UNREACHABLE  (new_york.path2)
→  Explicit-path 2:result=1  PNNI_SUCCESS  (new_york.path1)
   Only-explicit
Packet-discard-option:disabled
Usage-Parameter-Control (UPC):pass
Number of OAM-configured connections:0
OAM-configuration:disabled
```

```
OAM-states: Not-applicable
Cross-connect-interface:ATM0/0/3.4, Type:oc3suni
Cross-connect-VPI = 4
Cross-connect-VCI = 35
Cross-connect-UPC:pass
Cross-connect OAM-configuration:disabled
Cross-connect OAM-state: Not-applicable
Rx cells:0, Tx cells:0
Rx connection-traffic-table-index:1
Rx service-category:UBR (Unspecified Bit Rate)
Rx pcr-clp01:7113539
Rx scr-clp01:none
Rx mcr-clp01:none
Rx      cdvt:1024 (from default for interface)
Rx       mbs:none
Tx connection-traffic-table-index:1
Tx service-category:UBR (Unspecified Bit Rate)
Tx pcr-clp01:7113539
Tx scr-clp01:none
Tx mcr-clp01:none
Tx      cdvt:none
Tx       mbs:none
```

Configuring Nondefault Well-Known PVCs

Normally the default well-known VCs are automatically created with default virtual channel identifiers (VCIs). However, for the unusual instances where the ATM switch router interfaces with nonstandard equipment, you can configure nondefault well-known VCI values on a per-interface basis.

For overview information about the well-known PVCs, refer to the *Guide to ATM Technology*.

Table 6-2 lists the default well-known VCs and their default configuration.

Table 6-2 Well-Known Virtual Channels

Channel Type	Virtual Path Identifier	Virtual Channel Identifier
Signalling	0	5
ILMI	0	16
PNNI	0	18
Tag switching	0	32

Caution Do not change the well-known channels to use a VC where the remote end is sending AAL5 messages not intended for the well-known VC. For example, do not swap VC values between two types of well-known VCs.

Overview of Nondefault PVC Configuration

Following is an overview of the steps needed to configure nondefault well-known VCs:

Step 1 Enable manual well-known VC configuration.

Step 2 Delete any existing automatically created well-known VCs.

Step 3 Configure the individual encapsulation type as follows:

- Signalling (QSAAL)
- ILMI
- PNNI
- Tag switching

Step 4 Copy the running-configuration file to the startup-configuration file.

Configuring Nondefault PVCs

To configure the nondefault PVCs for signalling, ILMI, and PNNI, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm manual-well-known-vc** {**keep** | **delete**}	Enters manual-well-known-vc mode.
Step 3	Switch(config-if)# **atm pvc** *vpi vci* [**rx-cttr** *index*] [**tx-cttr** *index*] **interface atm** *card/subcard/port* **any-vci** [**encap** {**ilmi | pnni | qsaal**}] or Switch(config-if)# **tag-switching atm control-vc** *vpi vci*	Configures the nondefault PVC for encapsulation type.
Step 4	Switch(config-if)# **end** Switch#	Returns to privileged EXEC mode.
Step 5	Switch# **copy system:running-config nvram:startup-config**	Copies the running configuration file to the startup configuration file.

Note An error condition occurs if either the signalling or ILMI well-known VCs remain unconfigured when an interface is enabled.

Example

The following example shows the nondefault VC configuration steps:

Step 1 Use the **show atm vc interface atm** command to display the configuration of the existing default well-known VCs for ATM interface 0/0/0.

Step 2 Change to interface configuration mode for ATM interface 0/0/0.

Step 3 Enter manual well-known-vc mode and delete the existing default well-known VCs using the **atm manual-well-known-vc delete** command.

Step 4 Confirm deletion by entering **y.**

Step 5 Configure the nondefault VC for signalling from 5 (the default) to 35 using the **atm pvc** command.

Step 6 Configure the ILMI VC, then configure the PNNI VC if needed using the same procedure.

Step 7 Save the new running configuration to the startup configuration.

An example of this procedure follows:

```
Switch# show atm vc interface atm 0/0/0
Interface    VPI   VCI   Type    X-Interface  X-VPI X-VCI  Encap Status
ATM0/0/0     0     5      PVC     ATM0         0     49    QSAAL  UP
ATM0/0/0     0     16     PVC     ATM0         0     33    ILMI   UP
ATM0/0/0     0     18     PVC     ATM0         0     65    PNNI   UP
Switch#
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface atm 0/0/0
Switch(config-if)# atm manual-well-known-vc delete

Okay to delete well-known VCs for this interface? [no]: y
Switch(config-if)# atm pvc 1 35 interface atm0 any-vci encap qsaal
Switch(config-if)# end
Switch#
%SYS-5-CONFIG_I: Configured from console by console
Switch# show atm vc interface atm 0/0/0
Interface    VPI   VCI   Type    X-Interface  X-VPI X-VCI  Encap Status
ATM0/0/0     1    35     PVC     ATM0         0     150   QSAAL  UP
Switch# copy system:running-config nvram:startup-config
Building configuration...
[OK]
```

Configuring a VPI/VCI Range for SVPs and SVCs

You can configure a virtual path identifier/virtual channel identifier (VPI/VCI) range for switched virtual channels and switched virtual paths (SVCs and SVPs). ILMI uses the specified range to negotiate the VPI/VCI range parameters with peers. This feature allows you to:

- Specify ranges for SVPs/SVCs.
- Avoid VPI/VCI conflicts when attempting to set up soft PVPs or soft PVCs.

You can still configure PVPs and PVCs in any supported range, including any VPI/VCI range you configured for SVPs/SVCs.

Note This feature is supported in ILMI 4.0.

The default maximum switched virtual path connection (SVPC) VPI is equal to 255. You can change the maximum SVPC VPI by entering the **atm svpc vpi max** *value* command. See Table 6-3 for the allowable ranges.

Table 6-3 Maximum SVPC VPI Range

VPI Bit Type	Maximum Value Range
8-bit VPI	0 to 255
12-bit VPI[1]	0 to 4095

1. Only available on ATM NNI interfaces.

Note The maximum value specified applies to all interfaces except logical interfaces, which have a fixed value of 0.

For further information and examples of using VPI/VCI ranges for SVPs/SVCs, refer to the *Guide to ATM Technology.*

Every interface negotiates the local values for the maximum SVPC VPI, maximum SVCC VPI, and minimum SVCC VCI with the peer's local value during ILMI initialization. The negotiated values determine the ranges for SVPs and SVCs. If the peer interface does not support these objects or autoconfiguration is turned off on the local interface, the local values determine the range.

To configure a VPI/VCI range for SVCs/SVPs, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the physical interface to be configured.
Step 2	Switch(config-if)# **atm svpc vpi max** *value*	Configures the maximum VPI value for a SVPC.
Step 3	Switch(config-if)# **atm svcc vpi max** *value*	Configures the maximum VPI value for a SVCC.
Step 4	Switch(config-if)# **atm svcc vci min** *value*	Configures the minimum VCI value for a SVCC.

The following example shows configuring ATM interface 0/0/0 with the SVPC and SVCC VPI maximum set to 100, and SVCC VCI minimum set to 60.

```
Switch(config)# interface atm 0/0/0
Switch(config-if)# atm svpc vpi max 100
Switch(config-if)# atm svcc vpi max 100
Switch(config-if)# atm svcc vci min 60
```

Displaying the VPI/VCI Range Configuration

To confirm the VPI or VCI range configuration, use one of the following commands:

Command	Purpose
show atm interface atm *card/subcard/port*	Shows the ATM interface configuration.
show atm ilmi-status atm *card/subcard/port*	Shows the ILMI status on the ATM interface.

Examples

The following example shows how to confirm the VPI and VCI range configuration on an ATM interface. The values displayed for ConfMaxSvpcVpi, ConfMaxSvccVpi, and ConfMinSvccVci are local values. The values displayed for CurrMaxSvpcVpi, CurrMaxSvccVpi, and CurrMinSvccVci are negotiated values.

```
Switch# show atm interface atm 0/0/0
Interface:      ATM0/0/0        Port-type:      oc3suni
IF Status:      DOWN            Admin Status:   down
Auto-config:    enabled         AutoCfgState:   waiting for response from peer
IF-Side:        Network         IF-type:        UNI
Uni-type:       Private         Uni-version:    V3.0
Max-VPI-bits:   8               Max-VCI-bits:   14
Max-VP:         255             Max-VC:         16383
→ ConfMaxSvpcVpi: 100           CurrMaxSvpcVpi: 100
→ ConfMaxSvccVpi: 100           CurrMaxSvccVpi: 100
→ ConfMinSvccVci: 60            CurrMinSvccVci: 60
Svc Upc Intent: pass            Signalling:     Enabled
ATM Address for Soft VC: 47.0091.8100.0000.0040.0b0a.2a81.4000.0c80.0000.00
Configured virtual links:
  PVCLs SoftVCLs   SVCLs   TVCLs   PVPLs SoftVPLs   SVPLs Total-Cfgd Inst-Conns
      3        0       0       0       0        0       0          3          0
Logical ports(VP-tunnels):     0
Input cells:    0               Output cells:   0
5 minute input rate:             0 bits/sec,       0 cells/sec
5 minute output rate:            0 bits/sec,       0 cells/sec
Input AAL5 pkts: 0, Output AAL5 pkts: 0, AAL5 crc errors: 0
```

The following example shows how to confirm the peer's local values for VPI and VCI range configuration by displaying the ILMI status on an ATM interface:

```
Switch# show atm ilmi-status atm 0/0/0

Interface : ATM0/0/0 Interface Type : Private NNI
ILMI VCC : (0, 16) ILMI Keepalive : Disabled
Addr Reg State:   UpAndNormal
Peer IP Addr:     172.20.40.232   Peer IF Name:     ATM0/0/0
Peer MaxVPIbits:  8               Peer MaxVCIbits:  14
→ Peer MaxVPCs:     255             Peer MaxVCCs:     16383
→ Peer MaxSvccVpi:  255             Peer MinSvccVci:  255
→ Peer MaxSvpcVpi:  48
Configured Prefix(s) :
47.0091.8100.0000.0010.11ba.9901
```

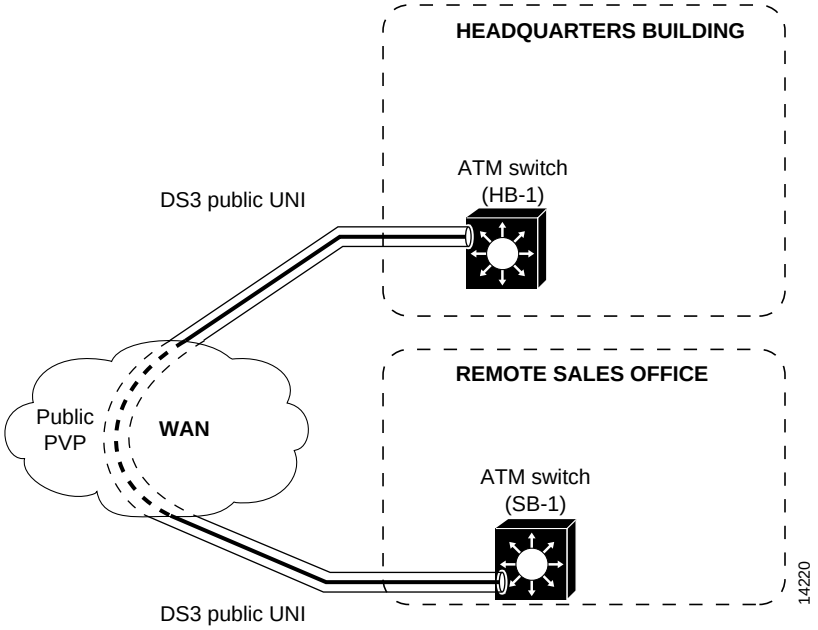
Note Note that the **show atm ilmi-status** command displays the information above only if the peer supports it.

Configuring VP Tunnels

This section describes configuring virtual path (VP) tunnels, which provide the ability to interconnect ATM switch routers across public networks using PVPs. You can configure a VP tunnel to carry a single service category, or you can configure a VP tunnel to carry multiple service categories, including merged VCs.

Figure 6-8 shows a public UNI interface over a DS3 connection between the ATM switch router (HB-1) in the Headquarters building and the ATM switch router (SB-1) in the Remote Sales building. To support signalling across this connection, a VP tunnel must be configured.

Figure 6-8 Public VP Tunnel Network Example



Configuring a VP Tunnel for a Single Service Category

The type of VP tunnel described in this section is configured as a VP of a single service category. Only virtual circuits (VCs) of that service category can transit the tunnel.

To configure a VP tunnel connection for a single service category, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **atm connection-traffic-table-row** [**index** *row-index*] [{**vbr-rt** | **vbr-nrt**} **pcr** *pcr_value* {**scr0** | **scr10**} *scr_value* [**mbs** *mbs_value*] [**cdvt** *cdvt_value*] | [**cbr pcr** *pcr_value* [**cdvt** *cdvt_value*] | [**abr pcr** *pcr_value* [**mcr** *mcr_value*] [**cdvt** *cdvt_value*] | [**ubr pcr** *pcr_value* [**mcr** *mcr_value*] [**cdvt** *cdvt_value*]]	Configures the connection-traffic-table-row index for any nondefault traffic values (Optional).
Step 2	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the physical interface to be configured.
Step 3	Switch(config-if)# **atm pvp** *vpi* [**rx-cttr** *index*] [**tx-cttr** *index*]	Configures an interface permanent virtual path (PVP) leg.
Step 4	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode.
Step 5	Switch(config)# **interface atm** *card/subcard/port.vpt#* Switch(config-subif)#	Creates a VP tunnel using a VP tunnel number that matches the PVP leg virtual path identifier (VPI).

Note The row index for nondefault **rx-cttr** and **tx-cttr** must be configured before these optional parameters are used.

Examples

The following example shows how to configure the ATM VP tunnel on the ATM switch router (HB-1) at interface ATM 1/0/0, VPI 99:

```
Switch(HB-1)(config)# interface atm 1/0/0
Switch(HB-1)(config-if)# atm pvp 99
Switch(HB-1)(config-if)# exit
Switch(HB-1)(config)# interface atm 1/0/0.99
Switch(HB-1)(config-subif)# end
Switch(HB-1)#
```

The following example shows how to configure the ATM VP tunnel on the ATM switch router (SB-1) interface ATM 0/0/0, VPI 99:

```
Switch(SB-1)(config)# interface atm 0/0/0
Switch(SB-1)(config-if)# atm pvp 99
Switch(SB-1)(config-if)# exit
Switch(SB-1)(config)# interface atm 0/0/0.99
Switch(SB-1)(config-subif)# end
Switch(SB-1)#
```

Displaying the VP Tunnel Configuration

To show the ATM virtual interface configuration, use the following EXEC command:

Command	Purpose
show atm interface atm *card/subcard/port.vpt#*	Shows the ATM interface configuration.

The following example shows the ATM virtual interface configuration for interface ATM 1/0/0.99:

```
Switch# show atm interface atm 1/0/0.99
→ Interface:      ATM1/0/0.99     Port-type:      vp tunnel
IF Status:      UP              Admin Status:   up
Auto-config:    enabled         AutoCfgState:   waiting for response from peer
IF-Side:        Network         IF-type:        UNI
Uni-type:       Private         Uni-version:    V3.0
<information deleted>
```

Configuring a Shaped VP Tunnel

This section describes configuring a shaped VP tunnel for a single service category with rate-limited tunnel output on a switch.

A shaped VP tunnel is configured as a VP of the CBR service category. By default, this tunnel can carry VCs only of the CBR service category. However, you can configure this VP tunnel to carry VCs of other service categories. The overall output of this VP tunnel is rate-limited by hardware to the peak cell rate (PCR) of the tunnel.

Note Shaped VP tunnels are supported only on systems with the FC-PFQ feature card. (Catalyst 8510 MSR and LightStream 1010)

A shaped VP tunnel is defined as a CBR VP with a PCR. The following limitations apply:

- A maximum of 64 shaped VP tunnels can be defined on each of the following interface groups: (0/0/*x*, 1/0/*x*), (0/1/*x*, 1/1/*x*), (2/0/*x*, 3/0/*x*), (2/1/*x*, 3/1/*x*), (9/0/*x*, 10/0/*x*), (9/1/*x*, 10/1/*x*), (11/0/*x*, 12/0/*x*), and (11/1/*x*, 12/1/*x*). (Catalyst 8540 MSR)
- A maximum of 64 shaped VP tunnels can be defined on interfaces *x*/0/*y*; similarly, a maximum of 64 shaped VP tunnels can be defined on interfaces *x*/1/*y*. (Catalyst 8510 MSR and LightStream 1010)
- The bandwidth of the shaped VP tunnel is shared by the active VCs inside the tunnel in strict round-robin (RR) fashion.

- Even though the shaped VP tunnel is defined as CBR, it can carry VCs of another service category by substituting the new service category after the tunnel interface has been initially configured. For configuration information, see the "Configuring Interface Service Category Support" section on page 8-35.
- Shaped VP tunnels do not support merged VCs for tag switching.
- UBR+ and ABR VCs with non-zero MCR are not allowed on a shaped VP tunnel interface.
- A maximum of 128 VCs can transit a shaped VP tunnel interface.
- Shaped VP tunnels support interface overbooking. For configuration information, see the "Configuring Interface Overbooking" section on page 8-37.
- Shaped VP tunnels cannot be configured with ATM router modules because CBR scheduling is not supported on those interfaces.

Configuring a Shaped VP Tunnel on an Interface

To configure a shaped VP tunnel, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **atm connection-traffic-table-row** [**index** *row-index*] **cbr pcr** *rate*	Configures the connection-traffic-table row for the desired PVP CBR cell rate.
Step 2	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the physical interface to configure.
Step 3	Switch(config-if)# **atm pvp** *vpi* **shaped rx-cttr** *index* **tx-cttr** *index*	Configures an interface PVP leg.
Step 4	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode.
Step 5	Switch(config)# **interface atm** *card/subcard/port.vpt#* Switch(config-subif)#	Creates a shaped VP tunnel using a VP tunnel number that matches the PVP leg VPI.

Note The **rx-cttr** and **tx-cttr** row indexes must be configured before they are used.

Example

The following example shows how to configure a shaped VP tunnel with a VPI of 99 as ATM interface 0/0/0.99

```
Switch(config)# interface atm 0/0/0
Switch(config-if)# atm pvp 99 shaped rx-cttr 100 tx-cttr 100
Switch(config-if)# exit
Switch(config-if)# interface atm 0/0/0.99
Switch(config-subif)#
```

Displaying the Shaped VP Tunnel Configuration

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

Command	Purpose
show atm interface atm *card/subcard/port.vpt#*	Shows the ATM VP interface configuration.

For an example display from the **show atm interface** command, see the "Displaying the Hierarchical VP Tunnel Configuration" section on page 6-39.

Configuring a Hierarchical VP Tunnel for Multiple Service Categories

This section describes configuring a hierarchical VP tunnel for multiple service categories with rate-limited tunnel output.

A hierarchical VP tunnel allows VCs of multiple service categories to pass through the tunnel. In addition, the overall output of the VP tunnel is rate-limited to the PCR of the tunnel. There is no general limit on the number of connections allowed on a such a tunnel. Hierarchical VP tunnels can also support merged VCs for tag switching. See the "Configuring VC Merge" section on page 15-13.

Service categories supported include the following:

- Constant bit rate (CBR)
- Variable bit rate (VBR)
- Available bit rate (ABR) with a nonzero minimum cell rate (MCR)
- Unspecified bit rate (UBR+) with a nonzero MCR

Note Hierarchical VP tunnels are supported only on systems with the FC-PFQ feature card. (Catalyst 8510 MSR and LightStream 1010)

While capable of carrying any traffic category, a hierarchical VP tunnel is itself defined as CBR with a PCR. The following limitations apply on the Catalyst 8540 MSR:

- Hierarchical VP tunnels can be defined only on interfaces in slots 0, 2, 9, and 11.
- For carrier module port adapters, interfaces 0/*x*/*y*, 2/*x*/*y*, 9/*x*/*y*, and 11/*x*/*y* can each support 30 hierarchical VP tunnels, for a combined total of 120. For OC-12 full-width modules, ports 0/0/[0-1], 0/0/[2-3], 2/0/[0-1], 2/0/[2-3], 9/0/[0-1], 9/0/[2-3], 11/0/[0-1], and 11/0/[2-3] can each support 30 hierarchical VP tunnels, for a combined total of 240.

The following limitations apply on the Catalyst 8510 MSR and LightStream 1010:

- A maximum of 30 hierarchical VP tunnels can be defined on interfaces 0/0/x and 3/0/x.
  A maximum of 30 hierarchical VP tunnels can be defined on interfaces 0/1/x and 3/1/x.
- Hierarchical VP tunnels can be defined only on interfaces in slots 0 and 3.

The following limitations apply on the Catalyst 8540 MSR, Catalyst 8510 MSR and LightStream 1010:

- Only hierarchical VPs are allowed on the interface (not other VCs or VPs).
- Bandwidth allocated on output to a hierarchical VP cannot be used by another hierarchical VP.

- At system boot, when global hierarchical scheduling is enabled, the switch router initializes the slot pairs according to the following restrictions:
  - Hierarchical scheduling is disabled for any slot pair that contains an ATM router module or Ethernet interface module. On the Catalyst 8540 MSR, the slot pairs are slots 0 and 1, slots 2 and 3, slots 9 and 10, and slots 11 and 12. On the Catalyst 8510 MSR and LightStream 1010, the slot pairs are slots 0 and 1 and slots 3 and 4.
  - Hierarchical scheduling is enabled for any slot pair that has an ATM port adapter or interface module in one slot and the other slot empty, or ATM port adapters or interface modules in both slots.
  - If a slot pair is empty, the hierarchical scheduling mode is determined by the first port adapter or interface module that is installed in the slot pair. If you insert an ATM port adapter or interface module first, hierarchical scheduling is enabled; if you insert an ATM router module or Ethernet interface module first, hierarchical scheduling is disabled.
- If hierarchical scheduling is enabled for a slot pair, ATM router modules or Ethernet interface modules inserted into the slot pair do not function.
- If hierarchical scheduling is disabled for a slot pair, ATM port adapters or interface modules inserted into the slot pair do not support hierarchical VP tunnels, and any hierarchical VP tunnels configured for the slot pair do not function.
- Hierarchical VP tunnels support interface overbooking. For configuration information, see the "Configuring Interface Overbooking" section on page 8-37.

Enabling Hierarchical Mode

Before configuring a hierarchical VP tunnel, you must first enable hierarchical mode, then reload the ATM switch router. Perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **atm hierarchical-tunnel**	Enables hierarchical mode.
Step 2	Switch(config)# **exit** Switch#	Exits global configuration mode.
Step 3	Switch# **copy system:running-config nvram:startup-config**	Saves the running configuration to the startup configuration.
Step 4	Switch# **reload**	Reloads the operating system.

Note Enabling hierarchical mode causes the minimum rate allocated for guaranteed bandwidth to a connection to be increased.

Example

The following example shows how to enable hierarchical mode, then save and reload the configuration.

```
Switch(config)# atm hierarchical-tunnel
Switch(config)# exit
Switch# copy system:running-config nvram:startup-config
Switch# reload
```

Configuring a Hierarchical VP Tunnel on an Interface

To configure a hierarchical VP tunnel, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **atm connection-traffic-table-row** [**index** *row-index*] **cbr pcr** *rate*	Configures the connection-traffic-table row for the desired PVP CBR cell rate.
Step 2	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the physical interface to be configured.
Step 3	Switch(config-if)# **atm pvp** *vpi* **hierarchical rx-cttr** *index* **tx-cttr** *index*	Configures an interface PVP leg.
Step 4	Switch(config-if)# **exit** Switch(config)#	Exits interface configuration mode.
Step 5	Switch(config)# **interface atm** *card/subcard/port.vpt#* Switch(config-subif)#	Creates a hierarchical VP tunnel using a VP tunnel number that matches the PVP leg VPI.

Note The **rx-cttr** and **tx-cttr** row indexes must be configured before they are used.

Example

The following example shows how to configure a hierarchical VP tunnel with a PVP of 99 as ATM interface 0/0/0.99

```
Switch(config)# interface atm 0/0/0
Switch(config-if)# atm pvp 99 hierarchical rx-cttr 100 tx-cttr 100
Switch(config-if)# exit
Switch(config-if)# interface atm 0/0/0.99
Switch(config-subif)#
```

Displaying the Hierarchical VP Tunnel Configuration

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

Command	Purpose
show atm interface atm *card/subcard/port.vpt#*	Shows the ATM VP interface configuration.

Example

The following example shows the VP tunnel configuration on interface ATM 1/0/0 with PVP 99:

```
Switch# show atm interface atm 1/0/0.99
Interface:      ATM1/0/0.99     Port-type:      vp tunnel
IF Status:      UP              Admin Status:   up
Auto-config:    enabled         AutoCfgState:   waiting for response from peer
IF-Side:        Network         IF-type:        UNI
Uni-type:       Private         Uni-version:    V3.0
Max-VPI-bits:   0               Max-VCI-bits:   14
Max-VP:         0               Max-VC:         16383
ConfMaxSvpcVpi: 0               CurrMaxSvpcVpi: 0
ConfMaxSvccVpi: 0               CurrMaxSvccVpi: 0
ConfMinSvccVci: 35              CurrMinSvccVci: 35
Signalling:     Enabled
ATM Address for Soft VC: 47.0091.8100.0000.0060.3e64.fe01.4000.0c81.9000.63
Configured virtual links:
  PVCLs SoftVCLs   SVCLs   TVCLs Total-Cfgd Inst-Conns
      4        0       0       0          4          4
```

Configuring an End-Point PVC to a PVP Tunnel

To configure an end point of a permanent virtual channel (PVC) to a previously created PVP tunnel, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the physical interface to be configured.
Step 2	Switch(config-if)# **atm pvc** *vpi-a vci-a* [**upc** *upc*] [**pd** *pd*] [**rx-cttr** *index*] [**tx-cttr** *index*] **interface atm** *card/subcard/port***.***vpt# vpi-b vci-b* [**upc** *upc*]	Configures the PVC with the VPI of the tunnel leg matching the tunnel VP tunnel number.

The following restrictions apply to an end point of a PVC-to-PVP tunnel subinterface:

- The VPI number of the tunnel leg of any PVC connection must match the VP tunnel number of the tunnel.
- For single service-category VP tunnels, the service class specified by the connection-traffic-table row (CTTR) of any PVC connections must match the service category for the row(s) selected for the tunnel PVP (for simple VP tunnels), or the configured service category (for shaped VP tunnels). This restriction does not apply to VP tunnels configured for multiple service categories (hierarchical VP tunnels).
- For service classes other than UBR, the PCRs of all PVCs must be within the peak cell rate of the tunnel PVP. This setup requires new CTTR rows to be defined for CBR or VBR PVCs, with peak cell rates that are less than the intended tunnel PVP.

Example

The following example shows how to configure the example tunnel ATM 1/0/0.99 with a PVC from ATM interface 0/0/1 to the tunnel at ATM interface 1/0/0.99:

```
Switch(HB-1)(config)# interface atm 0/0/1
Switch(HB-1)(config-if)# atm pvc 0 50 interface atm 1/0/0.99 99 40
```

Displaying PVCs

To confirm PVC interface configuration, use the following EXEC command:

Command	Purpose
show atm vc interface atm *card/subcard/port*	Shows the ATM VC interface configuration.

Example

The following example shows the configuration of ATM subinterface 1/0/0.99 on the ATM switch router Switch(HB-1):

```
Switch(HB-1)# show atm vc interface atm 0/0/1
Interface    VPI   VCI   Type    X-Interface  X-VPI X-VCI  Encap Status
ATM0/0/1     0     5      PVC     ATM2/0/0     0     41    QSAAL  UP
ATM0/0/1     0     16     PVC     ATM2/0/0     0     33    ILMI   UP
ATM0/0/1     0     50     PVC     ATM1/0/0.99  99    40          UP
```

Configuring Signalling VPCI for VP Tunnels

You can specify the value of the virtual path connection identifier (VPCI) that is to be carried in the signalling messages within a VP tunnel. The connection identifier information element (IE) is used in signalling messages to identify the corresponding user information flow. The connection identifier IE contains the VPCI and VCI.

Note By default, the VPCI is the same as the VPI on the ATM switch router.

This feature can also be used to support connections over a virtual UNI.

To configure a VP tunnel connection signalling VPCI, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port.vpt#* Switch(config-if)#	Selects the subinterface.
Step 2	Switch(config-if)# **atm signalling vpci** *vpci-number*	Configures the ATM signalling VPCI number 0 to 255.

Example

The following example configures a VP tunnel on ATM interface 0/0/0, PVP 99, and then configures the connection ID VCPI as 0.

```
Switch(config)# interface atm 1/0/0
Switch(config-if)# atm pvp 99
Switch(config-if)# exit
Switch(config)# interface atm 1/0/0.99
→ Switch(config-subif)# atm signalling vpci 0
Switch(config-subif)# end
```

Displaying the VP Tunnel VPCI Configuration

To confirm the VP tunnel VPCI configuration, use the following privileged EXEC command:

Command	Purpose
more system:running-config	Shows the VP tunnel subinterface configuration.

Deleting VP Tunnels

To delete a VP tunnel connection, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **no interface atm** *card*/*subcard*/*port*.*vpt#*	Deletes the subinterface.
Step 2	Switch(config)# **interface atm** *card*/*subcard*/*port* Switch(config-if)#	Selects the physical interface to be modified.
Step 3	Switch(config-if)# **no atm pvp** *vpi*	Deletes the interface PVP half-leg.

Example

The following example shows deleting subinterface 99 at ATM interface 1/0/0 and then PVP half-leg 99:

```
Switch(HB-1)(config)# no interface atm 1/0/0.99
Switch(HB-1)(config)# interface atm 1/0/0
Switch(HB-1)(config-if)# no atm pvp 99
```

Confirming VP Tunnel Deletion

To confirm the ATM virtual interface deletion, use the following EXEC command:

Command	Purpose
show atm interface [**atm** *card*/*subcard*/*port*[.*vpt#*]]	Shows the ATM interface configuration.

Example

The following example shows that ATM subinterface 1/0/0.99 on the ATM switch router (HB-1) has been deleted:

```
Switch(HB-1)# show interfaces atm 1/0/0

IF Status:      UP              Admin Status:   up
Auto-config:    disabled        AutoCfgState:   not applicable
IF-Side:        Network         IF-type:        NNI
Uni-type:       not applicable  Uni-version:    not applicable
Max-VPI-bits:   8               Max-VCI-bits:   14
Max-VP:         255             Max-VC:         16383
ConfMaxSvpcVpi: 255             CurrMaxSvpcVpi: 255
ConfMaxSvccVpi: 255             CurrMaxSvccVpi: 255
ConfMinSvccVci: 35              CurrMinSvccVci: 35
Svc Upc Intent: pass            Signalling:     Enabled
ATM Address for Soft VC: 47.0091.8100.0000.00e0.4fac.b401.4000.0c80.8000.00
Configured virtual links:
  PVCLs SoftVCLs   SVCLs   TVCLs   PVPLs SoftVPLs   SVPLs Total-Cfgd Inst-Conns
      4        0       0       0       0        0       0          4          3
Logical ports(VP-tunnels):     0
Input cells:    263843          Output cells:   273010
5 minute input rate:             0 bits/sec,       0 cells/sec
5 minute output rate:            0 bits/sec,       0 cells/sec
Input AAL5 pkts: 172265, Output AAL5 pkts: 176838, AAL5 crc errors: 0
```

Configuring Interface and Connection Snooping

Snooping allows the cells from all connections, in either receive or transmit direction, on a selected physical port to be transparently mirrored to a snoop test port where an external ATM analyzer can be attached. Unlike shared medium LANs, an ATM system requires a separate port to allow nonintrusive traffic monitoring on a line.

Note Only cells that belong to existing connections are sent to the snoop test port. Any received cells that do not belong to existing connections are not copied. In addition, the STS-3c (or other) overhead bytes transmitted at the test port are not copies of the overhead bytes at the monitored port.

Snooping Test Ports (Catalyst 8510 MSR and LightStream 1010)

With the FC-PCQ installed, only the highest port on the last module in the ATM switch router can be configured as a snoop test port. Table 6-4 lists the interface number of the allowed snoop test port for the various port adapter types. If you specify an incorrect snoop test port for the currently installed port adapter type, an error appears on the console. The feature card per-class queuing (FC-PCQ) also does not support per-connection snooping.

The port number of the test port depends on the card type. Table 6-4 lists the allowed snoop test port number for the supported interfaces.

Table 6-4 Allowed ATM Snoop Ports with FC-PCQ

Interface	Port Number
25-Mbps	4/1/11[1]
OC-3	4/1/3
OC-12	4/1/0
DS3/E3	Not supported
CES	Not supported

1. Both transmit and receive interfaces must be on 25-Mbps port adapters.

Effect of Snooping on Monitored Port

There is no effect on cell transmission, interface or VC status and statistics, front panel indicators, or any other parameters associated with a port being monitored during snooping. Any port, other than the highest port, that contains a port adapter type with a bandwidth less than or equal to the port adapter bandwidth for the test port can be monitored by snooping.

Shutting Down Test Port for Snoop Mode Configuration

The port being configured as a test port must be shut down before configuration. While the test port is shut down and after snoop mode has been configured, no cells are transmitted from the test port until it is reenabled using the **no shutdown** command. A test port can be put into snoop mode even if there are existing connections to it; however, those connections remain "Down" even after the test port is reenabled using the **no shutdown** command. This includes any terminating connections for ILMI, PNNI, or signalling channels on the test port.

If you use a **show atm interface** command while the test port is enabled in snoop mode, the screen shows the following:

- Interface state appears as "Snooping" instead of "up" or "down."
- Other ATM layer information for the test port is still displayed.
- Any previously configured connections on the test port remain installed, but are listed as Connection Status = down.
- Data for transmitted cells and output rates indicates the snooping cells are being transmitted.
- Counts for receive cells should remain unchanged and the input rate should be 0.

Other Configuration Options for Snoop Test Port

Most inapplicable configurations on the test port interface are disregarded while in snoop mode. However, the following configuration options are not valid when specified for the snoop test port and may affect the proper operation of the snoop mode on the test port:

- Diagnostic and PIF loopbacks of the snoop test port. These types of loopbacks do not function in snooping mode since the PIF receive side signals are disabled.
- Other physical layer loopbacks (line, cell, or payload) function normally when in snooping mode since they loop toward the line and are unaffected by the lack of PIF receive input.

- Interface pacing (with the rate for the snoop test port lower than the rate for the monitored port).
- Network-derived clock source using the snoop test port.
- Clock-source = loop-timed for the snoop test port.

Caution You should ensure that all options are valid and configured correctly while in the snoop mode.

Configuring Interface Snooping

The **atm snoop interface atm** command enables a snoop test port. Cells transmitted from the snoop test port are copies of cells from a single direction of a monitored port.

When in snoop mode, any prior permanent virtual connections to the snoop test port remain in the down state.

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

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card*/*subcard*/*port* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm snoop interface atm** *card*/*subcard*/*port* **direction** [**receive** | **transmit**]	Specifies the interface and direction to be snooped.

Example

The following example shows how to configure ATM interface 12/1/3 as the port in snoop mode to monitor ATM interface 3/0/0, tested in the receive direction:

```
Switch(config)# interface atm 12/1/3
Switch(config-if)# atm snoop interface atm 3/0/0 direction receive
```

Displaying Interface Snooping

To display the test port information, use the following EXEC command:

Command	Purpose
show atm snoop	Displays the snoop configuration.

Example

The following example shows the snoop configuration on the OC-3c port and the actual register values for the highest interface:

```
Switch# show atm snoop
Snoop Test Port Name:  ATM12/1/3 (interface status=SNOOPING)
Snoop option:          (configured=enabled) (actual=enabled)
Monitored Port Name:   (configured=ATM3/0/0) (actual=ATM3/0/0)
Snoop direction:       (configured=receive) (actual=receive)
```

Configuring Per-Connection Snooping

With per-connection snooping you must specify both the snooped connection endpoint and the snooping connection endpoint. The Cisco IOS software adds the snooping connection endpoint as a leaf to the snooped connection. The root of the temporary multicast connection depends on the direction being snooped. Snooping in the direction of leaf to root is not allowed for multicast connections. Per-connection snooping features are as follows:

- Per-VC snooping
- Per-VP snooping

The snooping connection can be configured on any port when there is no VPI/VCI collision for the snoop connection with the existing connections on the port. Also the port should have enough resources to satisfy the snoop connection resource requirements. In case of failure, due to VPI/VCI collision or resource exhaustion, a warning message is displayed, and you can reconfigure the connection on a different port.

To snoop both transmit and receive directions of a connection, you need to configure two different snoop connections.

Note Per-connection snooping is available only with the switch processor feature card.

Nondisruptive per-connection snooping is achieved by dynamically adding a leaf to an existing connection (either unicast or multicast). This can lead to cell discard if the added leaf cannot process the snooped cells fast enough. For a multicast connection, the queue buildup is dictated by the slowest leaf in the connection. The leaf added for snooping inherits the same traffic characteristics as the other connection leg. This ensures that the added leaf does not become the bottleneck and affect the existing connection.

To configure connection snooping, perform the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# **interface atm** *card/subcard/port* Switch(config-if)#	Selects the interface to be configured.
Step 2	Switch(config-if)# **atm snoop-vc** [*a-vpi a-vci*] **interface atm** *card/subcard/port x-vpi x-vci* [**direction** {**receive** | **transmit**}]	Configures the virtual channel to be snooped. *a* denotes the snooping connection. *x* denotes the snooped connection.
Step 3	Switch(config-if)# **atm snoop-vp** [*a-vpi*] **interface atm** *card/subcard/port x-vpi* [**direction** {**receive** | **transmit**}]	Configures the virtual path to be snooped.

Examples

The following example shows how to configure VC 100 200 on ATM interface 3/1/0 to snoop VC 200 150 on ATM interface 1/0/0:

```
Switch(config)# interface atm 3/1/0
Switch(config-if)# atm snoop-vc 100 200 interface atm 1/0/0 200 150 direction receive
```

The following example shows how to configure VP 100 on ATM interface 3/1/0 to snoop VP 200 on ATM interface 1/0/0:

```
Switch(config)# interface atm 3/1/0
Switch(config-if)# atm snoop-vp 100 interface atm 1/0/0 200 direction receive
```

Displaying Per-connection Snooping

To display the test per-connection information, use the following EXEC commands:

Command	Purpose
show atm snoop-vc [**interface atm** *card/subcard/port* [*vpi vci*]]	Displays the snoop VC information.
show atm snoop-vp [**interface atm** *card/subcard/port* [*vpi*]]	Displays the snoop VP information.

Examples

The following example shows all VC snoop connections on the ATM switch router:

```
Switch> show atm snoop-vc
      Snooping                              Snooped
Interface    VPI   VCI   Type    X-Interface  X-VPI X-VCI Dir    Status
ATM0/0/2     0     5     PVC     ATM0/1/1     0     5     Rx     DOWN
ATM0/0/2     0     16    PVC     ATM0/1/1     0     16    Rx     DOWN
ATM0/1/2     0     5     PVC     ATM0/0/1     0     5     Tx     DOWN
ATM0/1/2     0     16    PVC     ATM0/0/1     0     16    Tx     DOWN
ATM0/1/2     0     18    PVC     ATM0/0/1     0     18    Tx     UP
ATM0/1/2     0     100   PVC     ATM0/0/1     0     100   Tx     DOWN
ATM0/1/2     0     201   PVC     ATM0/0/1     0     201   Tx     DOWN
ATM0/1/2     0     202   PVC     ATM0/0/1     0     202   Tx     DOWN
ATM0/1/2     0     300   PVC     ATM0/0/1     0     300   Tx     DOWN
ATM0/1/2     0     301   PVC     ATM0/0/1     0     301   Tx     DOWN
```

The following example shows the VC snoop connections on ATM interface 0/1/2:

```
Switch> show atm snoop-vc interface atm 0/1/2
      Snooping                              Snooped
Interface    VPI   VCI   Type    X-Interface  X-VPI X-VCI Dir    Status
ATM0/1/2     0     5     PVC     ATM0/0/1     0     5     Tx     DOWN
ATM0/1/2     0     16    PVC     ATM0/0/1     0     16    Tx     DOWN
ATM0/1/2     0     18    PVC     ATM0/0/1     0     18    Tx     UP
ATM0/1/2     0     100   PVC     ATM0/0/1     0     100   Tx     DOWN
ATM0/1/2     0     201   PVC     ATM0/0/1     0     201   Tx     DOWN
ATM0/1/2     0     202   PVC     ATM0/0/1     0     202   Tx     DOWN
ATM0/1/2     0     300   PVC     ATM0/0/1     0     300   Tx     DOWN
ATM0/1/2     0     301   PVC     ATM0/0/1     0     301   Tx     DOWN
```

The following example shows the VC snoop connection 0, 55 on ATM interface 0/0/2 in extended mode with the switch processor feature card installed:

```
Switch> show atm snoop-vc interface atm 0/0/2 0 55
Interface: ATM0/0/2, Type: oc3suni
VPI = 0  VCI = 55
Status: DOWN
Time-since-last-status-change: 00:01:59
Connection-type: PVC
Cast-type: snooping-leaf
Packet-discard-option: disabled
Usage-Parameter-Control (UPC): pass
Wrr weight: 32
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM0/1/1, Type: oc3suni
Cross-connect-VPI = 0
Cross-connect-VCI = 5
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
Threshold Group: 6, 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 Clp0 q full drops:0, Rx Clp1 qthresh drops:0
Rx connection-traffic-table-index: 3
Rx service-category: VBR-RT (Realtime Variable Bit Rate)
Rx pcr-clp01: 424
Rx scr-clp01: 424
Rx mcr-clp01: none
Rx      cdvt: 1024 (from default for interface)
Rx       mbs: none
Tx connection-traffic-table-index: 3
Tx service-category: VBR-RT (Realtime Variable Bit Rate)
Tx pcr-clp01: 424
Tx scr-clp01: 424
Tx mcr-clp01: none
Tx      cdvt: none
Tx       mbs: none
```

The following example shows all VP snoop connections on the ATM switch router:

```
Switch> show atm snoop-vp
      Snooping                    Snooped
Interface    VPI   Type    X-Interface  X-VPI Dir    Status
ATM0/1/2     57    PVP     ATM0/0/1     57    Tx     DOWN
```

The following example shows all VP snoop connections on ATM interface 0/1/2, VPI = 57, in extended mode with the switch processor feature card installed:

```
Switch> show atm snoop-vp interface atm 0/1/2 57
Interface: ATM0/1/2, Type: oc3suni
VPI = 57
Status: DOWN
Time-since-last-status-change: 00:14:46
Connection-type: PVP
Cast-type: snooping-leaf
Usage-Parameter-Control (UPC): pass
Wrr weight: 32
Number of OAM-configured connections: 0
OAM-configuration: disabled
OAM-states:  Not-applicable
Cross-connect-interface: ATM0/0/2, Type: oc3suni
Cross-connect-VPI = 57
Cross-connect-UPC: pass
Cross-connect OAM-configuration: disabled
Cross-connect OAM-state:  Not-applicable
Threshold Group: 5, 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 Clp0 q full drops:0, Rx Clp1 qthresh drops:0
Rx connection-traffic-table-index: 1
Rx service-category: UBR (Unspecified Bit Rate)
Rx pcr-clp01: 7113539
Rx scr-clp01: none
Rx mcr-clp01: none
Rx      cdvt: 1024 (from default for interface)
Rx       mbs: none
Tx connection-traffic-table-index: 1
Tx service-category: UBR (Unspecified Bit Rate)
Tx pcr-clp01: 7113539
Tx scr-clp01: none
Tx mcr-clp01: none
Tx      cdvt: none
Tx       mbs: none
```