IETF-Compliant PPP over ATM

Feature Summary

Point-to-Point Protocol (PPP) over Asynchronous Transfer Mode (ATM) is now available on an ATM CES port adapter in a Cisco 7200-series router.

In previous releases of PPP over ATM, you configured permanent virtual circuits (PVCs) for PPP over ATM on point-to-point subinterfaces. In this release, each PPP over ATM connection no longer requires two interfaces, a virtual access interface and ATM subinterface. Instead, you can configure multiple PVCs for PPP over ATM on multipoint subinterfaces, thereby providing a significant increase in the number of PPP over ATM sessions per router.

Also in this release, PPP over ATM is enhanced to support virtual circuit (VC) multiplexed encapsulation and complies with the Internet Engineering Task Force (IETF) draft on multiplexed encapsulation titled *PPP over AAL5*. The previous version of PPP over ATM supported only the Frame Forwarding data encapsulation (aal5ciscoppp).

Note The IETF PPP over ATM feature does not currently support LLC encapsulated PPP over ATM Adaptation Layer 5 (AAL5).

Benefits

This release of the PPP over ATM feature provides support for IETF-compliant PPP over ATM and significantly increases the maximum number of PPP over ATM sessions running on a router. The maximum number of PPP over ATM sessions supported on a platform depends on available system resources such as memory and CPU speed.

Restrictions

PPP over ATM is not supported on switched virtual circuits (SVCs) and can only be applied to PVCs. IETF-compliant PPP over ATM VC encapsulations can only be configured using the new ATM syntax. The Frame Forwarding PPP over ATM encapsulation can be configured using either the new command syntax or the old **atm pvc** command.

This release does not support NetFlow switching or optimum switching PPP over ATM traffic; however, PPP over ATM fastswitching will be supported.

Platforms

This feature is supported only on the Cisco 7200 series routers with ATM CES (and NPE-200 processor recommended) for the 11.3 AA release.

Prerequisites

The PPP over ATM feature supports both VC multiplexed and the Frame Forwarding data encapsulations. These configuration tasks are described in the following sections:

- Configure PPP over ATM with IETF-Compliant VC Multiplexed Encapsulation
- Configure PPP over ATM with Frame Forwarding Encapsulation

Supported MIBs and RFCs

None

Configuration Tasks

Decide which encapsulation method you will use, VC multiplexed or Frame Forwarding data encapsulation, then perform one of the tasks in the following sections.

Configure PPP over ATM with IETF-Compliant VC Multiplexed Encapsulation

To configure PPP over ATM to support the VC multiplexed PPP payloads as specified by the *PPP over AAL5* Internet Draft, perform the following tasks beginning in interface configuration mode:

Task	Command
Configure a PPP over ATM PVC on a multipoint ATM interface.	**interface atm** *number* **multipoint**
Configure the PVC.	**pvc** *vpi*/*vci*
Configure VC multiplexed encapsulation.	**encapsulation aal5mux ppp virtual-template** *number*

Configure PPP over ATM with Frame Forwarding Encapsulation

To configure PPP over ATM to support the Frame Forwarding encapsulation type, perform the following tasks beginning in interface configuration mode:

Task	Command
Configure a PPP over ATM PVC on a multipoint ATM interface.	**interface atm** *number* **multipoint**
Configure the PVC.	**pvc** *vpi*/*vci*
Configure 's Frame Forwarding encapsulation.	**encapsulation aal5ciscoppp virtual-template** *number*

Configuration Examples

This section provides the following examples of how to configure IETF PPP over ATM:

- PPP over ATM with Differing Encapsulation Types Example
- ADSL Termination Example
- Two Routers with Back-to-Back PVCs Example
- Multiplexed Encapsulation Using VC Class Example

PPP over ATM with Differing Encapsulation Types Example

Running PVCs with different PPP over ATM encapsulation types under the same subinterface is supported. In the following example, three PVCs are configured for PPP over ATM on subinterface ATM 2/0.1. PVC 0/60 is configured with VC multiplexed PPP payload encapsulation. Its traffic shaping parameter is an unspecified bit rate with peak cell rate at 500 kbps. PVC 0/70 is also configured with VC multiplexed PPP payload encapsulation, but its traffic shaping parameter is non-real-time variable bit rate, with peak cell rate at 1 Mbps, sustainable cell rate at 500 kbps, and burst cell size of 64 cells. PVC 0/80 is configured with the Frame Forwarding encapsulation. Its traffic shaping parameter is an unspecified bit rate with peak cell rate at 700 kbps.

```
int atm 2/0.1 multipoint
 pvc 0/60
  encapsulation aal5mux ppp virtual-template 3
  ubr 500

 pvc 0/70
  encapsulation aal5mux ppp virtual-template 3
  vbr-nrt 1000 500 64

 pvc 0/80
  encapsulation aal5ciscoppp virtual-template 3
  ubr 700
```

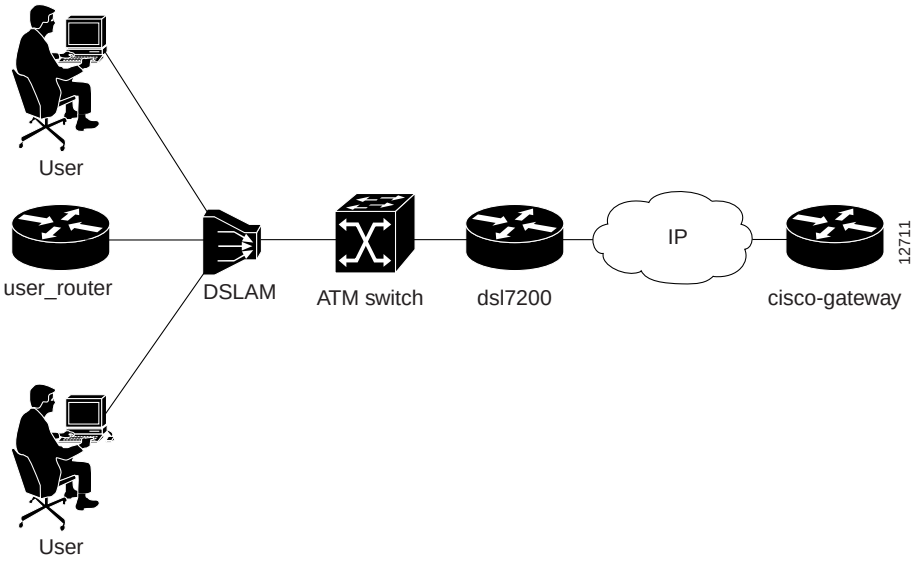
ADSL Termination Example

The IETF PPP over ATM feature was designed to support installations with Asymmetric Digital Subscriber Line (ADSL) circuits. Figure 1 illustrates a topology for ADSL termination. This topology allows you to establish a PPP connection to a Cisco 7200-series router.

The example also illustrates the use of PPP Tunneling using L2F to provide VPDN services, in this case for the domain *cisco.com*. Thus, a user who logs in as *bob@cisco.com* is automatically tunneled to IP address 10.1.2.3. (See the chapter *Configuring Virtual Private Dialup Networks* in the Cisco IOS release 11.3 *Dial Solutions Configuration Guide* for details about setting up VPDN services.)

The commands that you might enter to configure this topology are very similar to those in the previous example, and follow Figure 1.

Figure 1 ADSL Termination



Sample Configuration Commands

```
int atm 4/0.1 multipoint
 pvc 0/60
  encapsulation aal5mux ppp virtual-template 3
  ubr 500

 pvc 0/70
  encapsulation aal5mux ppp virtual-template 3
  vbr-nrt 1000 500 64

 pvc 0/80
  encapsulation aal5mux ppp virtual-template 3
  ubr 700
```

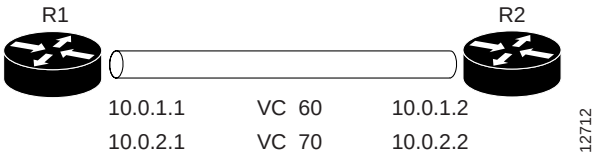
Sample Tunnel Configuration

```
vpdn enable
vpdn outgoing cisco.com dsl7200 ip 10.1.2.3
username dsl7200 password password-1
username cisco-gateway password password-2
```

Two Routers with Back-to-Back PVCs Example

Figure 2 illustrates an ATM interface with two PVC session connections. (See the chapter *Dial-In Terminal Service and Remote Node Configuration* in the Cisco IOS release 11.3 *Dial Solutions Configuration Guide* for details on PPP configuration.) The sample commands following Figure 2 establish the back-to-back router configuration.

Figure 2 Two Routers with Back-to-Back PVCs



Router 1:

```
int atm 2/0
 atm clock internal
 pvc 0/60
  encapsulation aal5mux ppp virtual-template 1
  ubr 90
!
 pvc 0/70
  encapsulation aal5mux ppp virtual-template 2
  vbr-nrt 90 50 1024
!
interface Virtual-Template1
 ip address 10.0.1.1 255.255.255.0
!
interface Virtual-Template2
 ip address 10.0.2.1 255.255.255.0
!
```

Router 2:

```
int atm 2/0.1 multipoint
 pvc 0/60
  encapsulation aal5mux ppp virtual-template 1
  ubr 90
!
 pvc 0/70
  encapsulation aal5mux ppp virtual-template 2
  vbr-nrt 90 50 1024
!
interface Virtual-Template1
 ip address 10.0.1.2 255.255.255.0
!
interface Virtual-Template2
 ip address 10.0.2.2 255.255.255.0
!
```

Multiplexed Encapsulation Using VC Class Example

In the following example, PVC 0/60 is configured on subinterface ATM 2/0.1 with a VC class attached to it. (See the chapter *New VC Configuration* in the Cisco IOS 11.3(2)T release *Enhanced ATM VC Configuration and Management* guide for details on assigning a VC class rather than an encapsulation method.) By rule of inheritance, PVC 0/60 runs with VC multiplexed PPP encapsulation using the configuration from interface virtual-template 1. Its parameter is an unspecified bit rate with peak cell at 90 kbps.

```
int atm 2/0.1
 pvc 0/60
  class pvc-ppp

vc-class atm pvc-ppp
  encapsulation aal5mux ppp virtual-template 1
  ubr 90
```

Command Reference

This section describes enhancements to the following commands:

- **encapsulation**
- **interface atm**
- **show atm pvc**

encapsulation

To configure the ATM adaptation layer (AAL) and encapsulation type for an ATM PVC, SVC, or VC class, use the **encapsulation** command in the appropriate command mode. Use the **no** form of this command to remove an encapsulation from a PVC, SVC, or VC class.

encapsulation *aal-encap* [**virtual-template** *number*]
no encapsulation *aal-encap* [**virtual-template** *number*]

Note To configure ILMI, QSAAL, or SMDS encapsulations for an ATM PVC, use the **pvc** command.

Syntax Description

aal-encap — ATM adaptation layer (AAL) and encapsulation type. When **aal5mux** is specified, a protocol is required. Possible values for *aal-encap* are as follows:

aal5ciscoppp—For Cisco PPP over ATM. Supported on ATM PVCs only. Use the **virtual-template** *number* argument to establish.

aal5mux apollo—For a multiplex (MUX)-type virtual circuit using the Apollo protocol.

aal5mux appletalk—For a MUX-type virtual circuit using the AppleTalk protocol.

aal5mux decnet—For a MUX-type virtual circuit using the DECnet protocol.

aal5mux ip—For a MUX-type virtual circuit using the IP protocol.

aal5mux ipx—For a MUX-type virtual circuit using the IPX protocol.

aal5mux ppp—For a MUX-type virtual circuit running PPP over ATM. Use the **virtual-template** *number* argument to establish.

aal5mux vines—For a MUX-type virtual circuit using the VINES protocol.

aal5mux xns—For a MUX-type virtual circuit using the XNS protocol.

aal5nlpid—Allows ATM interfaces to interoperate with High-Speed Serial Interfaces (HSSIs) that are using an ATM data service unit (ADSU) and running ATM-Data Exchange Interface (DXI). Supported on ATM PVCs only.

aal5snap—The only encapsulation supported for Inverse ARP. Logical Link Control/Subnetwork Access Protocol (LLC/SNAP) precedes the protocol datagram.

virtual-template *number* — (This argument is required for **aal5ciscoppp** and **aal5mux ppp** encapsulations only). Specifies the number used to identify the virtual template.

Default

The global default encapsulation is **aal5snap**. See the "Usage Guidelines" section for other default characteristics.

Command Mode

Interface-ATM-VC configuration (for an ATM PVC or SVC)

VC-class configuration (for a VC class)

Usage Guidelines

This command first appeared in Cisco IOS Release 11.3 T.

Use of one of the **aal5mux** encapsulation options to dedicate the specified PVC to a single protocol; use the **aal5snap** encapsulation option to multiplex two or more protocols over the same PVC. Whether you select **aal5mux** or **aal5snap** encapsulation might depend on practical considerations, such as the type of network and the pricing offered by the network. If the network's pricing depends on the number of PVCs set up, **aal5snap** might be the appropriate choice. If pricing depends on the number of bytes transmitted, **aal5mux** might be the appropriate choice because it has slightly less overhead.

When configuring Cisco PPP over ATM, specify the **aal5ciscoppp** encapsulation for the *aal-encap* argument and specify the virtual template *number.*

It is possible to implicitly create a virtual template when configuring PPP over ATM. In other words, if the parameters of the virtual template are not explicitly defined before configuring the ATM PVC, the PPP interface will be brought up using default values from the virtual template identified. However, some parameters (such as an IP address) take effect only if they are specified before the PPP interface comes up. Therefore, we recommend that you explicitly create and configure the virtual template before configuring the ATM PVC to ensure such parameters take effect.

If you specify virtual template parameters after the ATM PVC is configured, you should issue a **shutdown** command followed by a **no shutdown** command on the ATM subinterface to restart the interface, causing the newly configured parameters (such as an IP address) to take effect.

If the **encapsulation** command is not explicitly configured on an ATM PVC or SVC, the VC inherits the following default configuration (listed in order of next highest precedence):

- Configuration of the **encapsulation** command in a VC class assigned to the PVC or SVC itself.
- Configuration of the **encapsulation** command in a VC class assigned to the PVC's or SVC's ATM subinterface.
- Configuration of the **encapsulation** command in a VC class assigned to the PVC's or SVC's ATM main interface.
- Global default: *aal-encap* = **aal5snap**.

Example

The following example configures an ATM PVC with VPI 0 and VCI 33 for a MUX-type encapsulation using IP:

```
pvc 0/33
encapsulation aal5mux ip
```

interface atm

To configure an ATM interface type and enter interface configuration mode, use the **interface atm** global configuration command.

interface atm *number* (for the NPM on Cisco 4500 and 4700 routers)
interface atm *slot*/**0** (for the AIP on Cisco 7500 series routers; for the ATM port adapter on Cisco 7200 series routers)
interface atm *slot/port-adapter*/**0** (for the ATM port adapter on Cisco 7500 series routers)

To configure a subinterface, use the **interface atm** global configuration command.

interface atm *number.subinterface-number* {**multipoint** | **point-to-point**} (for the NPM on Cisco 4500 and 4700 routers) **interface atm** *slot*/**0.***subinterface-number* {**multipoint** | **point-to-point**} (for the AIP on Cisco 7500 series routers; for the ATM port adapter on Cisco 7200 series routers)
interface atm *slot*/*port-adapter*/**0.***subinterface-number* {**multipoint** | **point-to-point**} (for the ATM port adapter on Cisco 7500 series routers)

Syntax Description

number	On Cisco 4500 and Cisco 4700 routers, specifies the NPM number. The numbers are assigned at the factory at the time of installation or when added to a system, and can be displayed with the **show interfaces** command.
port-adapter	ATM port adapter number for the ATM port adapter on Cisco 7500 series routers. The value can be 0 or 1.
slot	On the Cisco 7000 series routers with RSP7000 and Cisco 7200 series, specifies the backplane slot number. On the 7000, the slot number can be 0, 1, 2, 3, or 4. On the Cisco 7010, the slot number can be 0, 1, or 2. The slots are numbered from left to right. On the Cisco 7505, the slot number can be 0, 1, 2, or 3 from bottom to top. On the Cisco 7507, the slot number can be 0 and 1 (CyBus0) and 4 through 6 (Cybus1), from left to right. On the Cisco 7513, the slot numbers are 0 through 5 (CyBus 0) and 8 through 12 (CyBus 1), from left to right.
.subinterface-number	Subinterface number in the range 1 to 4294967293.
multipoint | **point-to-point**	Specifies a multipoint or point-to-point subinterface. There is no default.

Default

None

Command Mode

Global configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0 for the Cisco 7000 family routers.
This command first appeared in Cisco IOS Release 11.0 for the Cisco 4500 and 4700 routers.

Example

The following example assigns an IP network address and network mask to the ATM interface in slot 1 on port 0 of a Cisco 7500 series router:

```
interface atm 1/0
 ip address 1.1.1.1.255.255.255.0
```

Related Commands

show interfaces atm

show atm pvc

To display all ATM PVCs and traffic information, use the **show atm pvc** privileged EXEC command.

show atm pvc [*vpi*/*vci* | *name* | **interface atm** *interface_number* | **ppp**]

Syntax Description

vpi/*vci*	(Optional) The ATM VPI and VCI numbers. The absence of the slash character **(/)** and a *vpi* value defaults the *vpi* value to 0.
name	(Optional) Name of the PVC.
interface atm *interface_number*	(Optional) Interface number or subinterface number of the PVC. Displays all PVCs on the specified interface or subinterface. The *interface_number* uses one of the following formats, depending on what router platform you are using: *slot*/**0**[**.***subinterface-number* **multipoint**] (for the AIP on Cisco 7500 series routers and ATM port adapter on the Cisco 7200 series routers) *number*[**.***subinterface-number* **multipoint**] (for the NPM on Cisco 4500 and 4700 routers) *slot*/*port-adapter*/**0**[**.***subinterface-number* **multipoint**] (for the ATM port adapter on Cisco 7500 series routers) For a description of these arguments, refer to the **interface atm** command.

Command Mode

Privileged EXEC

Usage Guidelines

This command first appeared in Cisco IOS Release 11.3 T.

If the *vpi*/*vci* or *name* is not specified, the output of this command is the same as that of the **show atm vc** command but only the configured PVCs are displayed. See the first sample output below.

If the *vpi*/*vci* or *name* is specified, the output of this command is the same as the **show atm vc** *vcd* command, plus extra information related to PVC management including connection name, detailed states, and OAM counters. See the second sample output below.

If the **interface atm** *interface-number* option is included in the command, all PVCs under that interface or subinterface are displayed. See the third sample output below.

Sample Displays

The following is sample output from the **show atm pvc** command:

```
Router# show atm pvc

          VCD/                                  Peak  Avg/Min  Burst
Interface Name   VPI   VCI    Type   Encaps     Kbps    Kbps    Cells  Sts
2/0       1        0     5     PVC    SAAL    155000  155000           UP
2/0       2        0    16     PVC    ILMI    155000  155000           UP
2/0.2     101      0    50     PVC    SNAP    155000  155000           UP
2/0.2     102      0    60     PVC    SNAP    155000  155000         DOWN
2/0.2     104      0    80     PVC    SNAP    155000  155000           UP
2/0       hello    0    99     PVC    SNAP      1000                   UP
```

The following is sample output from the **show atm pvc** command with the *vpi*/*vci* specified:

```
Router# show atm pvc 0/99

ATM 2/0.2: VCD 102, VPI: 0, VCI: 60
UBR, PeakRate: 155000
AAL5-LLC/SNAP, etype:0x0, Flags: 0xC20, VCmode: 0x1
OAM frequency: 3 second(s), OAM retry frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Sent
OAM VC state: Not Verified
ILMI VC state: Not Managed
VC is managed by OAM
InARP frequency: 15 minute(s)
InPkts: 1, OutPkts: 1, InBytes: 32, OutBytes: 32
InPRoc: 1, OutPRoc: 0, Broadcasts: 0
InFast: 0, OutFast:0, InAS: 0, OutAS: 0
OAM cells received: 14
F5 InEndloop: 14, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
F4 InEndloop: 0, F4 InSegloop: 0, F4 InAIS: 0, F4 InRDI: 0
OAM cells sent: 25
F5 OutEndloop: 25, F5 OutSegloop: 0, F5 OutRDI: 0
OAM cell drops: 0
PVC Discovery: NOT_VERIFIED
Status: DOWN, State: NOT_VERIFIED
```

The following is sample output from the **show atm pvc** command with the ATM subinterface specified:

```
Router# show atm pvc interface atm 2/0.2

          VCD/                                  Peak  Avg/Min  Burst
Interface Name   VPI   VCI    Type   Encaps     Kbps    Kbps    Cells  Sts
2/0.2     101      0    50     PVC    SNAP    155000  155000           UP
2/0.2     102      0    60     PVC    SNAP    155000  155000         DOWN
2/0.2     104      0    80     PVC    SNAP    155000  155000           UP
```

The following is sample output from the **show atm pvc** command with PPP specified:

```
Router# show atm pvc ppp

          VCD/
ATM Int.       Name          VPI VCI  Type  VCSt  VA   VASt
2/0.1          10              0  60   PVC    UP   1   UP
```

The following is sample output from the **show atm pvc** command that shows the virtual access state:

```
stirling#sh atm pvc 0/100
ATM2/0.100: VCD: 100, VPI: 0, VCI: 100
PeakRate: 155000, Average Rate: 155000
AAL5-CISCOPPP, etype:0x9, Flags: 0xC29, VCmode: 0xE000
OAM frequency: 0 second(s), OAM retry frequency: 0 second(s)
OAM up retry count: 0, OAM down retry count: 0
OAM Loopback status: OAM Disabled
OAM VC state: Not Managed
ILMI VC state: Not Managed
InARP DISABLED
InPkts: 0, OutPkts: 22, InBytes: 0, OutBytes: 308
InPRoc: 0, OutPRoc: 22, Broadcasts: 0
InFast: 0, OutFast: 0, InAS: 0, OutAS: 0
OAM cells received: 0
F5 InEndloop: 0, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
F4 InEndloop: 0, F4 InSegloop: 0, F4 InAIS: 0, F4 InRDI: 0
OAM cells sent: 0
F5 OutEndloop: 0, F5 OutSegloop: 0, F5 OutRDI: 0
OAM cell drops: 0
Status: UP
virtual-access: 1virtual-access state: UP
virtual-template: 3
```

Table 1 describes significant fields shown in the displays.

Table 1 Show ATM PVC Field Descriptions

Field	Description
ATM Int	ATM interface on which the PVC is configured.
Interface	Interface and subinterface slot and port.
VCD/Name	Virtual circuit descriptor (virtual circuit number). The connection name is displayed if a name for the VC was configured using the **pvc** command.
VPI	Virtual path identifier.
VCI	Virtual channel identifier.
Type	Type of PVC detected from PVC discovery, either PVC-D, PVC-L, or PVC-M. • PVC-D indicates a PVC created due to PVC discovery. • PVC-L indicates that the corresponding peer of this PVC could not be found on the switch. • PVC-M indicates that some or all of the QOS parameters of this PVC mismatch that of the corresponding peer on the switch.
Encaps	Type of ATM adaptation layer (AAL) and encapsulation.
Peak or PeakRate	Kilobits per second transmitted at the peak rate.
Avg/Min or Average Rate	Kilobits per second transmitted at the average rate.
Burst Cells	Value that equals the maximum number of ATM cells the virtual circuit can transmit at peak rate.

Table 1 Show ATM PVC Field Descriptions (Continued)

Field	Description
Sts or Status	Status of the VC connection. • UP indicates that the connection is enabled for data traffic. • DOWN indicates that the connection is not ready for data traffic. When the Status field is DOWN, a State field is shown. See a description of the different values for this field listed later in this table. • INACTIVE indicates that the interface is down.
Connection Name	The name of the PVC.
UBR, UBR+, or VBR–NRT	UBR—Unspecified Bit Rate QOS is specified for this PVC. See the **ubr** command for further information. UBR+—Unspecified Bit Rate QOS is specified for this PVC. See the **ubr+** command for further information. VBR–NRT—Variable Bit Rate–Non Real Time QOS rates are specified for this PVC. See the **vbr-nrt** command for further information.
etype	Encapsulation type.
Flags	Bit mask describing virtual circuit information. The flag values are summed to result in the displayed value. 0x40—SVC 0x20—PVC 0x10—ACTIVE 0x0—AAL5-SNAP 0x1—AAL5-NLPID 0x2—AAL5-FRNLPID 0x3—AAL5-MUX 0x4—AAL3/4-SMDS 0x5—QSAAL 0x6—ILMI 0x7—AAL5-LANE 0x9—AAL5-CISCOPPP
virtual-access	Virtual access interface identifier.
virtual-template	Virtual template identifier.
VCmode	AIP-specific or NPM-specific register describing the usage of the virtual circuit. This register contains values such as rate queue, peak rate, and AAL mode, which are also displayed in other fields.
OAM frequency	Number of seconds between sending OAM loopback cells.
OAM retry frequency	The frequency (in seconds) that end-to-end F5 loopback cells should be transmitted when a change in UP/DOWN state is being verified. For example, if a PVC is up and a loopback cell response is not received after the *frequency* (in seconds) specified using the **oam-pvc** command, then loopback cells are sent at the *retry-frequency* to verify whether or not the PVC is down.
OAM up retry count	Number of consecutive end-to-end F5 OAM loopback cell responses that must be received in order to change a PVC state to up. Does not apply to SVCs.
OAM down retry count	Number of consecutive end-to-end F5 OAM loopback cell responses that are not received in order to change a PVC state to down or tear down an SVC.

Table 1 Show ATM PVC Field Descriptions (Continued)

Field	Description
OAM Loopback status	Status of end-to-end F5 OAM loopback cell generation for this VC. This field will have one of the following values: • OAM Disabled—End-to-End F5 OAM loopback cell generation is disabled. • OAM Sent—OAM cell was sent. • OAM Received—OAM cell was received. • OAM Failed—OAM reply was not received within the frequency period or contained bad correlation tag.ssss
OAM VC state	This field will have one of the following states for this VC: • AIS/RDI—The VC received AIS/RDI cells. End-to-end F5 OAM loopback cells are not sent in this state. • Down Retry—An OAM loopback failed. End-to-end F5 OAM loopback cells are sent at retry frequency to verify the VC is really down. After down-count unsuccessful retries, the VC goes to the Not Verified state. • Not Managed—VC is not being managed by OAM. • Not Verified—VC has not been verified by end-to-end F5 OAM loopback cells. AIS and RDI conditions are cleared. • Up Retry—An OAM loopback was successful. End-to-end F5 OAM loopback cells are sent at retry frequency to verify the VC is really up. After up-count successive and successful loopback retries, the VC goes to the Verified state. • Verified—Loopbacks are successful. AIS/RDI cell was not received.
ILMI VC state	|This field will have one of the following states for this VC: • Not Managed—VC is not being managed by ILMI. • Not Verified—VC has not been verified by ILMI. • Verified—VC has been verified by ILMI.
VC is managed by OAM/ILMI	VC is managed by OAM and/or ILMI.
InARP frequency	Number of minutes for the Inverse ARP time period.
InPkts	Total number of packets received on this virtual circuit. This number includes all fast-switched and process-switched packets.
OutPkts	Total number of packets sent on this virtual circuit. This number includes all fast-switched and process-switched packets.
InBytes	Total number of bytes received on this virtual circuit. This number includes all fast-switched and process-switched bytes.
OutBytes	Total number of bytes sent on this virtual circuit. This number includes all fast-switched and process-switched bytes.
InPRoc	Number of process-switched input packets.
OutPRoc	Number of process-switched output packets.
Broadcasts	Number of process-switched broadcast packets.
InFast	Number of fast-switched input packets.
OutFast	Number of fast-switched output packets.
InAS	Number of autonomous-switched or silicon-switched input packets.
OutAS	Number of autonomous-switched or silicon-switched output packets.
OAM cells received	Total number of OAM cells received on this virtual circuit.

Table 1 Show ATM PVC Field Descriptions (Continued)

Field	Description
F5 InEndloop	Number of end-to-end F5 OAM loopback cells received.
F5 InSegloop	Number of segment F5 OAM loopback cells received.
F5 InAIS	Number of F5 OAM AIS cells received.
F5 InRDI	Number of F5 OAM RDI cells received.
F4 InEndloop	Number of end-to-end F4 OAM loopback cells received.
F4 InSegloop	Number of segment F4 OAM loopback cells received.
F4 InAIS	Number of F4 OAM AIS cells received.
F4 InRDI	Number of F4 OAM RDI cells received.
OAM cells sent	Total number of OAM cells sent on this virtual circuit.
F5 OutEndloop	Number of end-to-end F5 OAM loopback cells sent.
F5 OutSegloop	Number of segment F5 OAM loopback cells sent.
F5 OutRDI	Number of F5 OAM RDI cells sent.
OAM cell drops	Number of OAM cells dropped (or flushed).
PVC Discovery	NOT_VERIFIED—This PVC is manually configured on the router and not yet verified with the attached adjacent switch. WELL_KNOWN—This PVC has a VCI value of 0 through 31. DISCOVERED—This PVC is learned from the attached adjacent switch via ILMI. MIXED—Some of the traffic parameters for this PVC were learned from the switch via ILMI. MATCHED—This PVC is manually configured on the router and the local traffic shaping parameters match the parameters learned from the switch. MISMATCHED—This PVC is manually configured on the router and the local traffic shaping parameters do not match the parameters learned from the switch. LOCAL_ONLY—This PVC is configured locally on the router and not on the remote switch.
State	When the Status field is UP, this field does not appear. When the Status field is DOWN or INACTIVE, the State field will appear with one of the following values: NOT_VERIFIED—The VC has been established successfully; Waiting for OAM (if enabled) and ILMI (if enabled) to verify that the VC is up. NOT_EXIST—VC has not been created. HASHING_IN—VC has been hashed into a hash table. ESTABLISHING—Ready to establish VC connection. MODIFYING—VC parameters have been modified. DELETING—VC is being deleted. DELETED—VC has been deleted. NOT_IN_SERVICE—ATM interface is shut down.
VCSt	Virtual circuit state
VA	Virtual Access Interface number
VASt	Virtual Access Interface State