ATM OAM Traffic Reduction

First Published: 12.0(23)S
Last Updated: February 28, 2006

The ATM OAM Traffic Reduction feature is a mechanism for reducing overhead when using loopback cells for fault detection in bidirectional virtual circuits (VCs) over ATM.

History for the Specifications for ATM OAM Traffic Reduction Feature

Release	Modification
12.0(23)S	This feature was introduced.
12.2(28)SB	This feature was integrated into Cisco IOS Release 12.2(28)SB.

Contents

Prerequisites for ATM OAM Traffic Reduction

The Operations and Maintenance (OAM) loopback cells described in this document are defined in International Telecommunication Union (ITU) specification *I.610 SERIES I: INTEGRATED SERVICES DIGITAL NETWORK, Maintenance principles*, and understanding this specification is requisite to understanding the ATM OAM Traffic Reduction feature.

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Restrictions for ATM OAM Traffic Reduction

- This feature supports only permanent virtual circuits (PVCs) for F5 END_TO_END OAM loopback cells. This feature is not applicable for F4 OAM cells, AIS/RDI cells, or F5 SEGMENT OAM loopback cells.

- This feature will break OAM loopback functionality when there is a unidirectional breakage and when retry frequency is configured to be the same as the F5 OAM loopback frequency.

Information About ATM OAM Traffic Reduction

To configure ATM OAM traffic reduction, you need to understand the following concepts:

- OAM Traffic Flow, page 2

OAM Traffic Flow

The OAM management portion of a PVC sends OAM loopback cells at periodic intervals. When OAM management is enabled at both ends of the PVC, the cells are transmitted and looped back at both ends. This transmission is redundant, because the OAM cells travel through the same physical circuit twice.

In Figure 1, assume PVCs are configured between router R1 and router R2 , and that OAM management is enabled on both ends of the PVC. Router R1, upon receiving OAM command cells from router R2, can stop its own OAM command cell transmission and can manage the link on the basis of incoming OAM command cells. Router R1 can reinitiate OAM command cell transmission upon discovering the absence of command cells from router R2.

Figure 1   **ATM OAM Traffic Flow**
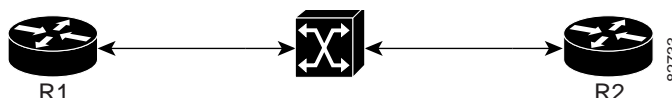
When router R1 detects the first OAM command cell from router R2, time stamp T1 is noted. When the next OAM command cell is detected, time stamp T2 is noted. The interval T1 minus T2 provides the OAM the loopback frequency of router R2. The average value of this interval is taken by measuring it a random number of times. (The interval needs to be taken a random number of times to avoid a race condition that *might* happen when routers R1 and R2 implement this algorithm and the frequency is the same.)

At the end of the random time period, router R1 stops sending OAM command cells and starts the OAM traffic monitoring timer. This timer in router R1 checks for a change in interval frequency in router R2. If there is a change, the traffic monitoring timer is stopped and the VC goes into Retry mode and checks whether the link is still up. In Retry mode, OAM command loopback cells are transmitted at an interval of one per second for 3 seconds. If router R1 does not receive a response to the command cell, the link is changed to the Down state.

> **Note** If ATM OAM traffic reduction is enabled on routers R1 and R2, then because of the random nature of the traffic reduction algorithm, either router can initiate OAM command cells and the other router will have to listen to the incoming OAM command cells.
>
> If this feature is enabled on only one router (R1, for example), then the frequency of that router must be greater than or equal to the interval frequency set in the other router (R2) in order for router R1 to stop sending OAM command cells.
>
> The ATM OAM Traffic Reduction feature is enabled by the **oam-pvc** command. When the **optimum** keyword is enabled, and when a change in the interval frequency of router R2 is detected, the VC initiates an OAM command cell from router R1 and does not go into the Retry mode immediately. If no response is obtained, the VC goes into the Retry mode and follows the OAM Retry procedure.

How to Configure ATM OAM Traffic Reduction

This section contains the following procedures.

Configure ATM OAM Traffic Reduction on an ATM Interface

To configure ATM OAM traffic reduction on an ATM interface, use the following commands.

SUMMARY STEPS

1. **enable**
2. **configure** *terminal*
3. **interface atm** *interface-number*
4. **pvc** *interface-number*
5. **oam-pvc** [**manage**] [*frequency*] [**auto-detect** [**optimum**]]
6. **exit**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router> enable`
		Enables privileged EXEC mode.
		
		• Enter your password if prompted.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

Step 3	`interface atm` *interface-number* **Example:** `Router(config)# interface atm 1/0`	Configures an ATM interface type and enters interface configuration mode.
Step 4	`pvc` *interface-number* **Example:** `Router(config-if)# pvc 0/100`	Assigns a name to an ATM PVC and enters ATM VC configuration mode.
Step 5	`oam-pvc` [`manage`] [*frequency*] [`auto-detect` [`optimum`]] **Example:** `Router(config-if-atm-vc)# oam-pvc manage 10 auto-detect optimum`	Enables end-to-end F5 OAM loopback cell generation and OAM management for an ATM PVC or VC class, including the ATM OAM Traffic Reduction feature. • **auto-detect**—Initiates auto-detection of peer OAM command cells. • **optimum**—Configures an optimum mode so that when the traffic monitoring timer expires, the PVC sends an OAM command cell at the locally configured frequency instead of going into Retry mode immediately. If there is no response, the PVC goes into Retry mode.

Step 6	`exit`
	
	Example:
	`Router(config-if-atm-vc)# exit`
		Exits the configuration mode.
		
		• Enter the **exit** command for each command mode to exit.

Configure ATM OAM Traffic Reduction on a VC Class

To configure ATM OAM traffic reduction on a VC class, use the following commands.

SUMMARY STEPS

1. **enable**

2. **configure terminal**

3. **class-vc** *vc-class-name*

4. **oam-pvc** [**manage**] [*frequency*] [**auto-detect** [**optimum**]]

5. **interface atm** *interface-number*

6. **class-int** *vc-class-name*

7. **pvc** *vpi/vci*

8. **exit**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router> enable`
		Enables privileged EXEC mode.
		
		• Enter your password if prompted.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

Step 3	`class-vc` *`vc-class-name`* **Example:** `Router(config)# class-vc atm`	Assigns a VC class to an ATM VC bundle member.
Step 4	`oam-pvc` [`manage`] [*`frequency`*] [`auto-detect` [`optimum`]] **Example:** `Router(config-vc-class)# oam-pvc manage 10 auto-detect optimum`	Enables end-to-end F5 OAM loopback cell generation and OAM management for an ATM PVC or VC class, including the ATM OAM Traffic Reduction feature. • **auto-detect**—Initiates autodetection of peer OAM command cells. • **optimum**—Configures an optimum mode so that when the traffic monitoring timer expires, the PVC sends an OAM command cell at the locally configured frequency instead of going into Retry mode. If there is no response, the PVC goes into Retry mode.
Step 5	`interface atm` *`interface-number`* **Example:** `Router(config-router)# interface atm 1/0`	Configures an ATM interface and enters interface configuration mode.
Step 6	`class-int` *`vc-class-name`* **Example:** `Router(config-if)# class-int test`	Assigns a VC class to an ATM main interface.

	Command or Action	Purpose
Step 7	`pvc` *vpi/vci* **Example:** `Router(config-if)# pvc 0/100`	Creates an ATM PVC and attaches it to the designated network virtual path identifier (VPI) and virtual channel interface (VCI). In this case, more than one PVC is created.

Step 8	`exit`
	
	Example:
	`Router(config-if)# exit`
	`Router(config-router)# exit`
		Ends the configuration mode.
		
		• Enter the **exit** command for each command mode to exit.

Verify ATM OAM Traffic Reduction

To verify that the ATM OAM Traffic Reduction feature is working, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **show atm oam auto-detect**
3. **show atm pvc**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router> enable`
		Enables privileged EXEC mode.
		
		• Enter your password if prompted.

Step 2	`show atm oam auto-detect` [`atm` *interface-number*] **Example:** `Router# show atm oam auto-detect atm 2/0`	(Optional) Displays the state of the OAM cells when the ATM OAM traffic reduction is enabled. • The **show atm oam auto-detect** command reports the number of VCs in autodetection mode and in OAM loopback mode.

Step 3	`show atm pvc`
	
	Example:
	`Router# show atm pvc`
		(Optional) Displays ATM PVCs and traffic reduction information.
		
		The **show atm pvc** command reports the OAM autodetect state, the OAM peer frequency, and the time the last OAM command cell was received.

Configuration Examples for ATM OAM Traffic Reduction

This section provides the following configuration examples to match the identified configuration tasks in the previous section:

• ATM OAM Traffic Reduction on an ATM Interface: Example, page 7

ATM OAM Traffic Reduction on an ATM Interface: Example

The following example enables ATM OAM traffic reduction on an ATM interface:

```
interface atm 1/0
   pvc 0/100
oam-pvc manage 10 auto-detect optimum
```

ATM OAM Traffic Reduction on a VC Class: Example

The following example enables ATM OAM traffic reduction using a VC class:

```
class-vc atm
    oam-pvc manage 10 auto-detect optimum

interface atm 1/0
class-int test
   pvc 0/100
   pvc 0/200
```

Verify ATM OAM Traffic Reduction: Example

In the following examples, the output is displayed for each command in the task.

Sample Output for the show atm oam auto-detect Command

The following is sample output from the **show atm oam auto-detect** command:

```
Router# show atm oam auto-detect atm 2/0

ATM OAM Auto Detect statistics on ATM2/0

Number of VCs in Auto Detection:
  ATM OAM AUTO DETECT INIT     : 0
  ATM OAM SENDING MONITORING   : 0
  ATM OAM MONITORING           : 0

Number of VCs in OAM Loopback:
   DownRetry    : 0
   UpRetry      : 0
   Verified     : 0
   Not Verified : 0
```

Sample Output for the show atm pvc Command

The following is sample output from the **show atm pvc** command with ATM OAM traffic reduction enabled:

```
Router# show atm pvc 0/100

ATM1/0: VCD: 1, VPI: 0, VCI: 100
UBR, PeakRate: 149760
AAL5-LLC/SNAP, etype:0x0, Flags: 0xC20, VCmode: 0x0
OAM frequency: 10 second(s), OAM retry frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Received
OAM VC state: Verified
OAM Auto Detect state: ATM OAM AUTO DETECT INIT
OAM PEER frequency: 0 second(s)
Last OAM Command Cell was received at 00:02:09
ILMI VC state: Not Managed
```

Additional References

The following sections provide references related to ATM OAM Traffic Reduction:

Related Documents

Related Topic	Document Title
Configuring VC management	"Configuring ATM" chapter in the *Cisco IOS Wide-Area Networking Configuration Guide*, Release 12.4
VC management commands	"ATM Commands" chapter in the *Cisco IOS Wide-Area Networking Command Reference*, Release 12.4T

Standards

Standards	Title
ITU-I Specification	*I.610 SERIES I: INTEGRATED SERVICES DIGITAL NETWORK, Maintenance principles*

MIBs

MIBs	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
None	—

Technical Assistance

Description	Link
The Cisco Technical Support & Documentation website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Command Reference

This section documents modified commands only.

- **oam-pvc**
- **show atm oam auto-detect**
- **show atm pvc**

oam-pvc

To enable end-to-end F5 Operation, Administration, and Maintenance (OAM) loopback cell generation and OAM management for an ATM permanent virtual circuit (PVC), virtual circuit (VC) class, or label-controlled ATM (LC-ATM) VC, use the **oam-pvc** command in the appropriate command mode. To disable generation of OAM loopback cells and OAM management, use the **no** form of this command.

ATM VC or VC Class

> **oam-pvc** [**manage**] [*frequency*]

> **no oam-pvc** [**manage**]

LC-ATM VC

> **oam-pvc manage** [*frequency*]

> **no oam-pvc manage**

Loopback Mode Detection

> **oam-pvc manage** [*frequency*] **loop-detection**

> **no oam-pvc manage loop-detection**

Syntax Description		
manage		(Optional for ATM VCs or VC classes; required for LC-ATM VCs) Enables OAM management. The default is disabled.
frequency		(Optional) Time delay between transmitting OAM loopback cells in seconds. For ATM VCs or VC classes and loopback mode detection, the range is from 0 to 600. The default is 10. For LC-ATM VCs, the range is from 0 to 255. The default is 5.
loop-detection		Enables automatic detection of whether the physically connected ATM switch is in loopback mode. The default is disabled.

Defaults

Disabled.

Command Modes

Interface-ATM-VC configuration (for an ATM PVC or Loopback Mode Detection)
VC-class configuration (for a VC class)
PVC-in-range configuration (for an individual PVC within a PVC range)
Control-VC configuration (for enabling OAM management on an LC-ATM VC)

Command History

Release	Modification
11.3	This command was introduced.
12.1(5)T	This command was implemented in PVC-in-range configuration mode.
12.3(2)T	This command was implemented for LC-ATM VCs.

Release	Modification
12.0(30)S	The **loop-detection** keyword was added.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.

Usage Guidelines

If OAM management is enabled, further control of OAM management is configured using the **oam retry** command.

ATM VCS or VC Classes

If the **oam-pvc** command is not explicitly configured on an ATM PVC, the PVC inherits the following default configuration (listed in order of precedence):

- Configuration of the **oam-pvc** command in a VC class assigned to the PVC itself.
- Configuration of the **oam-pvc** command in a VC class assigned to the PVC's ATM subinterface.
- Configuration of the **oam-pvc** command in a VC class assigned to the PVC's ATM main interface.
- Global default: End-to-end F5 OAM loopback cell generation and OAM management are disabled, but if OAM cells are received, they are looped back. The default value for the *frequency* argument is 10 seconds.

Loopback Mode Detection

When a PVC traverses an ATM cloud and OAM is enabled, the router sends a loopback cell to the other end and waits for a response to determine whether the circuit is up. If an intervening router within the ATM cloud is in loopback mode, however, the router considers the circuit to be up, when in fact the other end is not reachable.

When enabled, the Loopback Mode Detection Through OAM feature detects when an intervening router is in loopback mode, in which case it sets the OAM state to NOT_VERIFIED. This prevents traffic from being routed on the PVC for as long as any intervening router is detected as being in loopback mode.

Examples

The following example shows how to enable end-to-end F5 OAM loopback cell transmission and OAM management on an ATM PVC with a transmission frequency of 3 seconds:

```
Router(cfg-mpls-atm-cvc)# oam-pvc manage 3
```

The following example shows how to enable end-to-end F5 OAM loopback cell transmission and OAM management on an LC-ATM interface with a transmission frequency of 2 seconds:

```
Router(config)# interface Switch1.10 mpls
Router(config-subif)# ip unnumbered Loopback0
Router(config-subif)# mpls atm control-vc 0 32
Router(cfg-mpls-atm-cvc)# oam-pvc manage 2
```

The following example shows how to create a PVC and enable loopback detection:

```
Router(config)# interface ATM1/0
Router(config-if)# pvc 4/100
Router(config-if-atm-vc)# oam-pvc manage loop-detection
```

Related Commands	Command	Description
	ilmi manage	Enables ILMI management on an ATM PVC.
	oam retry	Configures parameters related to OAM management for an ATM PVC, SVC, VC class, or LC-ATM VC.
	show atm pvc	Displays all ATM PVCs and traffic information.

show atm oam auto-detect

To display ATM Operations and Maintenance (OAM) autodetect statistics, use the **show atm oam auto-detect** command in privileged EXEC mode.

show atm oam auto-detect [**atm** *interface-number*]

Syntax Description

atm *interface-number*	(Optional) Specifies a particular ATM interface rather than all ATM interfaces.

Command Default No default behavior or values.

Command Modes Privileged EXEC

Command History

Release	Modification
12.0(23)S	This command was introduced.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.

Usage Guidelines Use this command to check the state of the OAM cells when ATM OAM traffic reduction is enabled.

Examples The following is sample output from the **show atm oam auto-detect** command:

```
Router# show atm oam auto-detect atm 2/0

ATM OAM Auto Detect statistics on ATM2/0

Number of VCs in Auto Detection:
  ATM OAM AUTO DETECT INIT    : 0
  ATM OAM SENDING MONITORING  : 0
  ATM OAM MONITORING          : 0

Number of VCs in OAM Loopback:
   DownRetry    : 0
   UpRetry      : 0
   Verified     : 0
   Not Verified : 0
```

Table 1 describes the significant fields shown in the display.

Table 1   show atm oam auto-detect Field Descriptions

Field	Description
Number of VCs in Auto Detection:	
ATM OAM AUTO DETECT INIT	Indicates the number of VCs in the initial ATM_OAM_AUTO_DETECT_INIT state.

Table 1   show atm oam auto-detect Field Descriptions (continued)

Field	Description
ATM OAM SENDING MONITORING	Indicates the number of VCs in the ATM_OAM_SENDING_MONITORING state. During this state, the peer VC is sending OAM command loopback cells and the Cisco IOS software is monitoring and also sending OAM command loopback cells.
ATM OAM MONITORING	Indicates the number of VCs in the ATM_OAM_MONITORING state. During this state, the peer is sending OAM command loopback cells and the Cisco IOS software is monitoring the cells. This state can also indicate that transmission of OAM command cells has been switched off.
Number of VCs in OAM Loopback:	
DownRetry	ATM OAM loopback cell DownRetry state.
UpRetry	ATM OAM loopback cell UpRetry state.
Verified	ATM OAM loopback cells are verified.
Not Verified	ATM OAM loopback cells are not verified.

Related Commands

Command	Description
show atm pvc	Displays all ATM PVCs and traffic information.

show atm pvc

To display all ATM permanent virtual connections (PVCs) and traffic information, use the **show atm pvc** command in privileged EXEC mode.

> **show atm pvc** [*vpi/vci* | *name* | **interface atm** *interface-number*[**.***subinterface-number* **multipoint**]] [**ppp**]

Syntax Description		
	vpi/vci	(Optional) ATM virtual path identifier (VPI) and virtual channel identifier (VCI) numbers. The absence of the slash character (**/**) and a *vpi* value causes the *vpi* value to default to 0.
	name	(Optional) Name of the PVC.
	interface atm *interface-number*	(Optional) Displays all PVCs on the specified ATM interface.
		To determine the appropriate form of the *interface-number* argument, consult your ATM network module, port adapter, or router documentation.
	.*subinterface-number*	(Optional) Subinterface number in the range from 1 to 4294967293. The dot (**.**) is required as a separator between *interface-number* and *subinterface-number*.
	multipoint	(Optional) Multipoint subinterface.
	ppp	(Optional) Displays each PVC configured for PPP over ATM.

Command Modes Privileged EXEC

Command History

Release	Modification
11.3T	This command was introduced.
12.1(1)T	This command was modified to display PPPoE status.
12.2(4)T	This command was modified to display only PVCs that are attached to a virtual access interface. Before this modification, all PVCs that were configured with PPPoA or PPPoE were displayed.
12.0(23)S	This command was modified to display OAM cell emulation status for Any Transport over MPLS (AToM).
12.2(14)S	This command was integrated into Cisco IOS Release 12.2(14)S.
12.2(15)T	This command was integrated into Cisco IOS Release 12.2(15)T.
12.3(7)T	This command was modified to display information about multilink PPP over ATM link fragmentation and interleaving for ATM PVCs.
12.0(30)S	This command was modified to display information about OAM loopback detection.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.

Usage Guidelines If the *vpi/vci* or *name* argument 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.

If the *vpi*/*vci* or *name* argument is specified, the output of this command is the same as that of the **show atm vc** *vcd* command, with extra information related to PVC management, including connection name, detailed states, and Operation, Administration, and Maintenance (OAM) counters.

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

Examples

The following is sample output from the **show atm pvc** command. The output is the same as that of the **show atm vc** command, but only the configured PVCs are displayed:

```
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* argument specified:

```
Router# show atm pvc 0/41

ATM2/0: VCD: 3, VPI: 0, VCI: 41
UBR, PeakRate: 155000
AAL5-LLC/SNAP, etype:0x0, Flags: 0xC20, VCmode: 0x0
OAM frequency: 0 second(s), OAM retry frequency: 1 second(s), OAM retry frequency: 1
second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Disabled
OAM VC state: Not Managed
OAM Loop detection: Disabled
ILMI VC state: Not Managed
InARP frequency: 15 minutes(s)
InPkts: 31759, OutPkts: 26497, InBytes: 2356434, OutBytes: 1589743
InPRoc: 15785, OutPRoc: 26472, Broadcasts: 0
InFast: 20, OutFast: 20, InAS: 15954, OutAS: 6
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
F4 OutEndloop: 0, F4 OutSegloop: 0, F4 OutRDI: 0
OAM cell drops: 0
Status: UP
PPPOE enabled.
```

The following sample output from the **show atm pvc** command displays OAM cell emulation statistics, which are marked in this example by exclamation points:

```
Router# show atm pvc 5/500

ATM4/1/0.200: VCD: 6, VPI: 5, VCI: 500
UBR, PeakRate: 1
AAL5-LLC/SNAP, etype:0x0, Flags: 0x34000C20, VCmode: 0x0
OAM Cell Emulation: enabled, F5 End2end AIS Xmit frequency: 1 second(s) !!!
OAM frequency: 0 second(s), OAM retry frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Disabled
OAM VC state: Not ManagedVerified
```

```
OAM Loop detection: Disabled
ILMI VC state: Not Managed
InPkts: 564, OutPkts: 560, InBytes: 19792, OutBytes: 19680
InPRoc: 0, OutPRoc: 0
InFast: 4, OutFast: 0, InAS: 560, OutAS: 560
InPktDrops: 0, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0
Out CLP=1 Pkts: 0
OAM cells received: 26
F5 InEndloop: 0, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 26
OAM cells sent: 77
F5 OutEndloop: 0, F5 OutSegloop: 0, F5 OutAIS: 77, F5 OutRDI: 0  !!!
OAM cell drops: 0
Status: UP
```

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 for a PVC that is a member of a multilink PPP bundle:

```
Router# show atm pvc 15/200

ATM4/0.10000:VCD:16, VPI:15, VCI:200
UBR, PeakRate:149760 (353208 cps)
AAL5-LLC/SNAP, etype:0x0, Flags:0xC20, VCmode:0x0, Encapsize:12
OAM frequency:0 second(s), OAM retry frequency:1 second(s)
OAM up retry count:3, OAM down retry count:5
OAM Loopback status:OAM Disabled
OAM VC State:Not Managed
OAM Loop detection: Disabled
ILMI VC status:Not Managed
VC TxRingLimit:40 particles
VC Rx Limit:800 particles
InARP frequency:15 minutes(s)
Transmit priority 6
InPkts:347, OutPkts:399, InBytes:6268, OutBytes:7728
InCells:347, OutCells:399
InPRoc:7, OutPRoc:228
InFast:338, OutFast:169, InAS:0, OutAS:0
InPktDrops:0, OutPktDrops:0/0/0 (holdq/outputq/total)
InCellDrops:0, OutCellDrops:0
InByteDrops:0, OutByteDrops:0
CrcErrors:0, SarTimeOuts:0, OverSizedSDUs:0, LengthViolation:0, CPIErrors:0
Out CLP=1 Pkts:0, Cells: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
F4 OutEndloop:0, F4 OutSegloop:0, F4 OutRDI:0
OAM cell drops:0
Status:UP
PPP:Virtual-Access3 from Virtual-Template1
PPPoA Current State = LOCALLY_TERMINATED
PPPoA Latest  Event = Vaccess Up
PPPoA Latest  Error = None
```

```
PPPoA Session ID    = 7
PPPoA  Handle = 0x4D000006, SSS Handle = 0x00000000
Switch Handle = 0xB5000006, PPP Handle = 0xD700000A
AAA Unique ID = 0x00000007, AIE Handle = 0xE7000006
PVC belongs to Multilink PPP Bundle Virtual-Access4 as a PPPoA member link
Packets in VC Holdq:0 , Particles in VC Tx Ring:0
```

The following is sample output from the **show atm pvc** command with loopback detection mode through OAM enabled:

```
Router# show atm pvc 4/100

ATM1/0: VCD: 4, VPI: 4, VCI: 100
UBR, PeakRate: 149760
AAL5-LLC/SNAP, etype:0x0, Flags: 0xC20, VCmode: 0x0
!
OAM frequency: 10 second(s), OAM retry frequency: 1 second(s)
OAM up retry count: 3, OAM down retry count: 5
OAM Loopback status: OAM Received
OAM VC state: Verified
OAM Loop detection: Enabled ! Indicates that loopback mode detection is enabled.
!
ILMI VC state: Not Managed
VC is managed by OAM.
InARP frequency: 15 minutes(s)
Transmit priority 4
InPkts: 0, OutPkts: 0, InBytes: 0, OutBytes: 0
InPRoc: 0, OutPRoc: 0, Broadcasts: 0
InFast: 0, OutFast: 0, InAS: 0, OutAS: 0
InPktDrops: 0, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0
Out CLP=1 Pkts: 0
OAM cells received: 27
F5 InEndloop: 27, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
OAM cells sent: 27
F5 OutEndloop: 27, F5 OutSegloop: 0, F5 OutAIS: 0, F5 OutRDI: 0
OAM cell drops: 3
Status: UP
```

The following is sample output from the **show atm pvc** command when loopback mode has been detected:

```
Router# show atm pvc 4/100

ATM1/0: VCD: 4, VPI: 4, VCI: 100
UBR, PeakRate: 149760
AAL5-LLC/SNAP, etype:0x0, Flags: 0xC20, VCmode: 0x0
!
OAM frequency: 10 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
OAM Loop detection: Enabled, Detected ! Indicates that loopback mode has been detected on
this interface.
!
ILMI VC state: Not Managed
VC is managed by OAM.
InARP frequency: 15 minutes(s)
Transmit priority 4
InPkts: 0, OutPkts: 0, InBytes: 0, OutBytes: 0
InPRoc: 0, OutPRoc: 0, Broadcasts: 0
InFast: 0, OutFast: 0, InAS: 0, OutAS: 0
InPktDrops: 0, OutPktDrops: 0
CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0
```

```
Out CLP=1 Pkts: 0
OAM cells received: 20
F5 InEndloop: 20, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
OAM cells sent: 20
F5 OutEndloop: 20, F5 OutSegloop: 0, F5 OutAIS: 0, F5 OutRDI: 0
OAM cell drops: 1
Status: DOWN, State: NOT_VERIFIED
```

Table 2 describes the significant fields shown in the display.

Table 2   show atm pvc Field Descriptions

Field	Description
Interface	Interface and subinterface slot and port.
VCD/Name	Virtual connection descriptor (virtual connection 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—PVC created as a result of PVC discovery. • PVC-L—The corresponding peer of this PVC could not be found on the switch. • PVC-M—Some or all of the QoS[1] parameters of this PVC fail to match those of the corresponding peer on the switch.
Encaps	Type of ATM adaptation layer (AAL) and encapsulation.
Peak or PeakRate	Kilobits per second sent at the peak rate.
Avg/Min or Average Rate	Kilobits per second sent at the average rate.
Burst Cells	Maximum number of ATM cells that the VC can send at peak rate.
Sts or Status	Status of the VC connection: • UP—The connection is enabled for data traffic. • DOWN—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 the State field later in this table. • INACTIVE—The interface is down.
Connection Name	Name of the PVC.

Table 2   show atm pvc Field Descriptions (continued)

Field	Description
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 VC 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 VC. This register contains values such as rate queue, peak rate, and AAL mode, which are also displayed in other fields.
OAM Cell emulation	The status of the OAM cell emulation functionality. It is either enabled or disabled.
F5 end2end AIS xmit frequency	Number of seconds between transmission of AIS cells.
OAM frequency	Number of seconds between transmission of OAM loopback cells.

Table 2   show atm pvc Field Descriptions (continued)

Field	Description
OAM retry frequency	Frequency (in seconds) at which end-to-end F5 loopback cells should be sent when a change in state (up or down) is being verified. For example, if a PVC is up and a loopback cell response is not received after the value of the *frequency* argument (in seconds) specified using the **oam-pvc** command, loopback cells are sent at the value of the *retry-frequency* argument to determine whether 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.
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 a bad correlation tag.
OAM VC state	This field will have one of the following states for this VC: • AIS[2]/RDI[3]—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 that 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 that 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.

Table 2   show atm pvc Field Descriptions (continued)

Field	Description
OAM Loop detection	Status of loopback detection mode through OAM: • Disabled—Automatic loopback detection is disabled. • Enabled—Automatic loopback detection is enabled. • Detected—Loopback mode is detected on an ATM interface.
ILMI VC state	This field will have one of the following states for this VC: • Not Managed—VC is not being managed by ILMI[4]. • 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 or ILMI.
InARP frequency	Number of minutes for the Inverse Address Resolution Protocol (ARP) time period.
InPkts	Total number of packets received on this VC. This number includes all fast-switched and process-switched packets.
OutPkts	Total number of packets sent on this VC. This number includes all fast-switched and process-switched packets.
InBytes	Total number of bytes received on this VC. This number includes all fast-switched and process-switched bytes.
OutBytes	Total number of bytes sent on this VC. 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 VC.
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.

Table 2   show atm pvc Field Descriptions (continued)

Field	Description
OAM cells sent	Total number of OAM cells sent on this VC.
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.
Status	When the Status field indicates UP, the VC is established. When the Status field indicates DOWN, refer to the State field for further information about the VC state.
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.
PPP	For PPP over ATM, indicates the virtual access interface number and virtual template number being used.

Table 2   show atm pvc Field Descriptions (continued)

Field	Description
PPPoA Current State	State of the PPPoA session associated with the VC.
PPPoA Latest Event	The latest event that occurred on the PPPoA session associated with the VC.
PPPoA Latest Error	The latest error that occurred on the PPPoA session associated with the VC.
PPPoA Session ID	PPPoA session identifier of the PPPoA session associated with the VC.
PPPoA Handle	PPPoA context handle.
SSS Handle	SSS handle for PPPoA session associated with the VC.
Switch Handle	SSS handle for switch management.
PPP Handle	Handle associated with the PPP context.
AAA Unique ID	Unique identifier associated with the AAA session.
AIE Handle	Access IE handle for the PPPoA session.
Packets in VC Holdq	Number of packets in the hold queue of the VC.
Particles in VC Tx Ring	Number of particles in the Tx ring of the VC.

1. QoS = quality of service

2. AIS = alarm indication signal

3. RDI = remote defect identification

4. ILMI = Interim Local Management Interface