Configuring ATM 10

This chapter introduces basic Asynchronous Transfer Mode (ATM) concepts, describes features of the ATM interfaces, and provides information for configuring ATM on your ERX system.

Overview

ATM is a high-speed networking technology that handles data in fixed-size units called cells. It enables high-speed communication between edge routers and core routers in an ATM network.

ATM Interfaces

An ATM port can have a major interface and one or more subinterfaces. An ATM subinterface is a mechanism that allows a single physical ATM interface to support multiple logical interfaces. Several logical interfaces can be associated with a single physical interface.

ATM subinterfaces meet the specifications in RFC 2684 – Multiprotocol Encapsulation over ATM Adaptation Layer 5 (September 1999), which replaces RFC 1483. All references to ATM subinterfaces in this chapter are still to ATM 1483 subinterfaces.

You can configure a single IP interface on each of the subinterfaces via the **interface atm** *slot/port* command. ATM subinterfaces are identified by user-defined numbers. To select a subinterface, you append a subinterface number to the port-level **interface atm** command. Table 10-1 shows examples of how the **interface atm** command is used.

Table 10-1 ATM interface commands

CLI Command	Description
interface atm 3/0	Select major interface on slot 3, port 0
interface atm 2/1.40	Select subinterface 40 on slot 2, port 1

When you create an ATM 1483 subinterface, you must configure a permanent virtual circuit (PVC). Protocols such as ATM require one or more virtual circuits over which data traffic is transmitted to higher layers in the protocol stack.

Figure 10-1 shows a typical point-to-point ATM interface column.

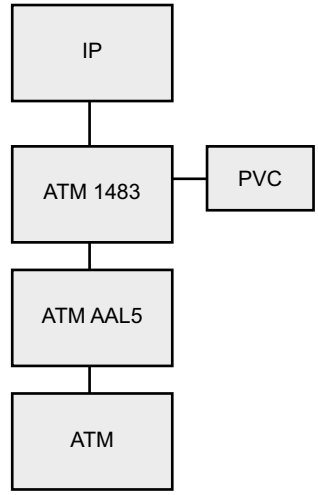

Figure 10-1 ATM interface column

ATM Physical Connections

ATM interfaces and subinterfaces support two types of connections—*point-to-point* and *multipoint*. The system defaults to point-to-point.

- Point-to-point – indicates a standard connection; for example, connecting two ATM end stations
- Multipoint – indicates a single-source end system connected to multiple destination end systems. Multipoint indicates a nonbroadcast multiaccess (NBMA) interface. See *ATM NBMA* later in this chapter.

Depending on the type of connection you choose, you can specify one or more PVCs on each interface. For a standard point-to-point ATM interface, you configure only one PVC. For NBMA ATM connections, you configure multiple circuits.

ATM Virtual Connections

A *virtual connection* (VC) defines a logical networking path between two endpoints in an ATM network. ATM *cells* travel from one point to the other over a virtual connection. An ATM cell is a package of information that is always 53 bytes in length, unlike a frame or packet, which has a variable length. An ATM cell has a cell header and a *payload*. The payload contains the user data.

The cell header includes an 8-bit VPI and a 16-bit VCI.

An ATM network can have two types of VCs, depending on the addressing used to switch the traffic:

- Virtual channel connection (VCC)
- Virtual path connection (VPC)

Virtual Channel Connection

A VCC uses all the addressing bits of the cell header to move traffic from one link to another. The VCC is formed by joining a series of virtual channels, which are logical circuits uniquely identified for each link of the network. On a VCC, switching is done based on the combined VPI and VCI values.

Virtual Path Connection

A VPC uses the higher-order addressing bits of the cell header to move traffic from one link to another. A VPC carries many VCCs within it. A VPC can be set up permanently between two points, and then switched.

VCCs can be assigned within the VPC easily and quickly. The VPC is formed by joining a series of virtual paths, which are the logical groups of circuits uniquely defined for each link of the network. On a VPC, switching is done based on the VPI value only.

ATM SVCs

In addition to PVCs, ATM supports switched virtual circuits (SVCs). PVCs provide a static connection that is usually set up manually. SVCs are established on demand via signalling. Table 10-2 shows the differences between PVCs and SVCs.

Table 10-2 Differences between PVCs and SVCs

PVCs	SVCs
Connected on a permanent basis. Users are charged a flat rate.	Dynamically connect as needed. Users are charged only for time and resources used.
Manually configured, permanent connections. Each PVC must be configured at both end systems and on all ATM switches in the network.	Dynamically signaled. SVCs are configured only on the end systems; they do not require configuration on all ATM switches in the network.
Provisioned when the connection is set up. Bandwidth and services allocated to the PVC are not available to other applications even when not in use.	Can request bandwidth and ATM service quality information needed for a particular connection. Once the connection is released, network resources are made available to other users or applications.
Cannot take alternate routes in the event of a failure in the network.	Can take alternate routes in the event of a failure in the network.

Addressing on SVCs

Each ATM endpoint must have a unique address. The ATM Forum defines different types of ATM addresses for use with private ATM networks. These addresses are 20 octets long and are called ATM end system addresses (AESAs). Public networks typically use E.164 native addresses.

For private networks, ERX system SVCs support the three types of AESA addresses shown in Figure 10-2. For public networks, the ERX system supports E.164 native addresses.

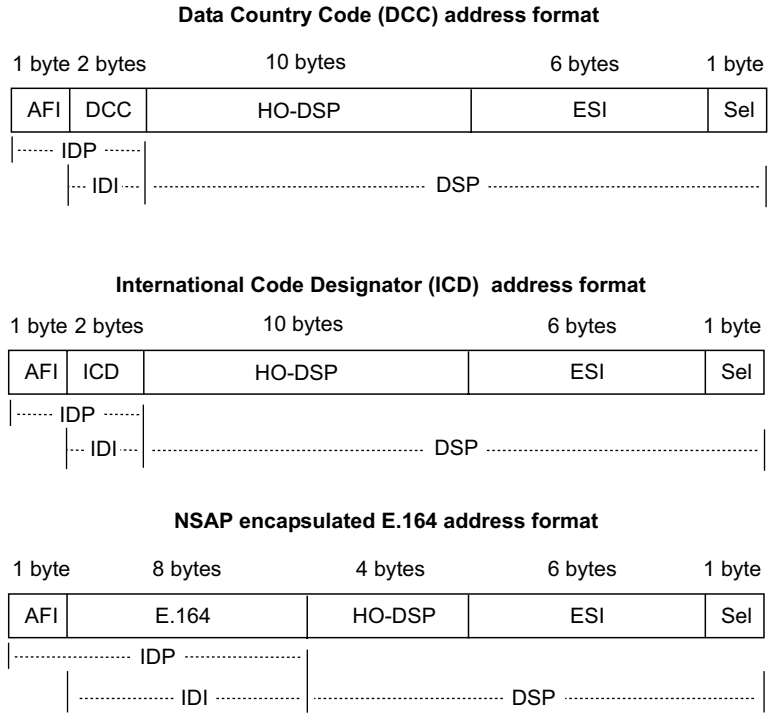

Figure 10-2 AESA address formats

Table 10-3 describes the fields in these addresses.

Table 10-3 Field descriptions for AESA addresses

Field	Description
AFI (authority and format identifier)	Identifies the type of address (DCC, ICD, or NSAP encapsulated E.164 address) and the format of the address. The AFI for DCC is 39, the AFI for ICD is 47, and AFI for an NSAP encapsulated E.164 address is 45.
DCC	Identifies the country. ISO assigns this code, and each country has a unique DCC.
DSP (domain-specific part)	Contains the actual routing information in three elements: HO-DSP; ESI, which is the MAC address; and the Sel field.
ESI (end system identifier)	Identifies the ATM device attached to the switch. Each device attached to the switch must have a unique ESI value (6 bytes).
E.164	Specifies the E.164 address (8 bytes)
HO-DSP (high-order domain-specific part)	Combines the routing domain (RD) and area identifier (Area) portion of the address.

Table 10-3 Field descriptions for AESA addresses (continued)

Field	Description
ICD	Identifies an international organization and indicates to which code set or organization the particular ICD is assigned.
IDI (initial domain identifier)	Identifies the address allocation and administrative authority.
IDP (initial domain part)	Identifies the type and format of the IDI.
Sel (selector)	Identifies the process within the device that the connection targets (1 byte).

SVC Call Setup and Teardown

SVCs use Q.2931 UNI signalling to establish and release switched connections. Before you create SVCs, you configure a PVC signalling channel that the system uses to pass signalling messages during call setup and teardown.

To set up an ATM SVC connection:

1 An end user initiates a call setup request message and forwards the request to the network to establish a connection.

   The call setup request message includes information, such as traffic category and service quality information, needed to define and support the connection.

2 The network routes the call setup request through the network to the destination. While routing the connection, the network makes sure that the path has the resources to support the connection information specified in the call setup request.

3 The destination receives the setup request message and either accepts or rejects the call by sending a connect message back to the initiator. The network can also verify the address prefix of the initiator so that the destination can accept or reject the call on that basis, as well.

Once established, the connection is available for use until either the source or destination issues a call release message and the end user who receives the message acknowledges the message.

ATM Adaptation Layer

The AAL defines the conversion of user information into cells by segmenting upper-layer information into cells at the transmitter and reassembling them at the receiver. AAL1 and AAL2 handle intermittent traffic, such as voice and video, and are not relevant to the system.

AAL3/4 and AAL5 support data communications by segmenting and reassembling packets.

Your system supports the following AAL5 encapsulation types as specified in RFC 2684 – Multiprotocol Encapsulation over ATM Adaptation Layer 5 (September 1999), which replaces RFC 1483:

- aal5snap – LLC/SNAP
- aal5mux ip – VC-based multiplexing
- aal5autoconfig – LLC/SNAP or VC based multiplexing (see *Chapter 21, Configuring Dynamic Interfaces*)

Traffic Management

The OC3/STM1 ATM and OC12/STM4 ATM line modules support the following traffic management rates:

- UBR with or without a peak cell rate (PCR)
- VBR-RT
- VBR-NRT
- CBR

The level of support for traffic management is dependent on the specific I/O module. See *Module Capabilities* later in this chapter.

Connection Admission Control (CAC)

ATM networks use CAC to determine whether to accept a connection request, based on whether allocating the connection's requested bandwidth would cause the network to violate the traffic contracts of existing connections. CAC is a set of actions that the network takes during connection setup or renegotiation.

The system supports CAC on PVCs on major ATM interfaces. This implementation of CAC determines available bandwidth based on port subscription bandwidth. The system maintains available bandwidth for each major ATM port. Bandwidth for VP tunnels is included in CAC computations.

Table 10-4 shows the traffic parameter that the system uses for each service category to compute the bandwidth that the connection will require. For example, the peak cell rate is used to calculate how much bandwidth is required for CBR connections.

Table 10-4 Traffic parameters used to compute bandwidth

Service Category	Traffic Parameter Used to Calculate Required Bandwidth
CBR	PCR
VBR-RT	SCR
VBR-NRT	SCR
UBR	UBR bandwidth configured on the ATM major interface
UBR with PCR	UBR bandwidth configured on the ATM major interface

How CAC Works With no connections, the available bandwidth is equal to the subscription port bandwidth. As connections are requested, the required bandwidth, which is based on the service category and traffic parameters of the connection, is compared against the available port bandwidth. If sufficient bandwidth is available, the system accepts the connection and updates the available port bandwidth accordingly.

Similarly, when a connection is deleted, the available port bandwidth is updated accordingly.

Configuring CAC You enable and configure CAC on an ATM major interface using the **atm cac** command. When you enable CAC on an ATM interface, you can optionally specify a subscription bandwidth and a UBR weight:

- The subscription bandwidth can be greater than the effective port bandwidth to allow oversubscription. The default value of the subscription bandwidth is the effective bandwidth of the AMT port.
- The UBR weight allows you to limit the number of UBR connections by allowing a bandwidth or weight to be assigned to each UBR or VBR with a PCR connection.

ILMI

ATM interfaces support the ATM Forum ILMI, versions 3.0, 3.1, and 4.0. An important feature of ILMI is the ability to “poll” or send keepalive messages across the User-Network Interface (UNI). ATM interfaces always respond to such messages, which are sent by an ATM peer device. Optionally, you can configure ATM major interfaces to generate keepalive messages, a process that enables a continuous ATM-layer connectivity verification; if the ATM peer stops responding to keepalive messages, the

system will disable the ATM interface. The ATM interface will not be reenabled until the keepalive message's responses are received (or until the keepalive feature is disabled on the ATM port). To enable ILMI and control the generation of keepalive messages, use the **atm ilmi-enable** and **atm ilmi-keepalive** commands.

VPI/VCI Address Ranges

The VPI/VCI address ranges allowed on ATM interfaces are module dependent. Certain modules have a fixed allocation scheme, whereas others have a configurable allocation scheme. In the configurable allocation scheme, a bit range is shared across the VPI and VCI fields. For example, if an ATM interface has a bit range of 18, and 4 bits are allocated to the VPI space, then 14 bits are left for the VCI space. The resulting numeric range is 0 to 2^n-1, where *n* is the number of bits for each space. Completing the example, if 4 bits were allocated for the VPI space and 14 for the VCI space, the configurable range would be 0 to 15 for VPI and 0 to 16383 for the VCI space. To configure the bit range, use the **atm vc-per-vp** command.

- For command details, see the *ERX Command Reference Guide*.
- For details on module support for configurable VPI/VCI address ranges, see *Module Capabilities* later in this chapter.

VP Tunneling

VP tunneling allows traffic shaping to be applied to the aggregation of all VCs within a single VP. Thus, VP tunnels can be used to ensure that the total traffic transmitted on a VP does not exceed the specified PCR. VP tunneling uses a round-robin algorithm to guarantee fairness among all of the VCs within the tunnel.

It is possible to change the PCR associated with a tunnel even when VCs have already been configured on the tunnel. The individual VCs within a tunnel must be specified as UBR VCs. In other words, they may not have their own traffic-shaping parameters.

The level of support for VP tunneling is dependent on the specific I/O module. See *Module Capabilities* later in this chapter for details.

References

The ATM interface meets the following specifications:

- ATM Forum – ATM User-Network Interface Specification, Version 3.0 (September 1993)
- ATM Forum – ATM User-Network Interface Specification, Version 3.1 (September 1994)
- ATM Forum – Integrated Local Management Interface (ILMI) Specifications, Versions 3.0, 3.1, and 4.0 (September 1996)
- ATM Forum – Traffic Management Specification, Version 4.0 (April 1996)
- CCITT Draft Recommendation I.363 (AAL5 support) (January 1993)
- RFC 2684 – Multiprotocol Encapsulation over ATM Adaptation Layer 5 (September 1999) (RFC 2684 obsoletes RFC 1483)
- RFC 2390 – Inverse Address Resolution Protocol (September 1998)
- CCITT ITU-T Recommendation I.160 – B-ISDN Operation and Maintenance Principles and Functions (February 1999)
- *ERX Release Notes*, *Appendix A, System Maximums* - refer to the Release Notes corresponding to your software release for information on maximum values.

Module Capabilities

The level of support for certain ATM capabilities varies depending on the module. Table 10-5 shows the specific differences in the capabilities of the modules.

Table 10-5 ATM capabilities on line modules and I/O modules

Line Module	I/O Module	Number of VP Tunnels[a]	VPI/VCI Address Range	Configurable Bit Range	Number of VCs on Each Port	Traffic Management Types
OC3 (dual port)	OC3	512[b]	Fixed (0–127 VPI) (0–32K VCI)	N/A	4,095 for 64-MB modules 2,047 for 32-MB modules	UBR
OCx/STMx ATM	OCx/STMx with OC3-4 I/O module	1024	Configurable	20	8,000 active 16,000 configured	CBR, UBR, UBR with PCR, VBR-NRT, VBR-RT

Table 10-5 ATM capabilities on line modules and I/O modules (continued)

Line Module	I/O Module	Number of VP Tunnels[a]	VPI/VCI Address Range	Configurable Bit Range	Number of VCs on Each Port	Traffic Management Types
OCx/STMx ATM	OCx/STMx with OC12 STM4 I/O module	256	Configurable	20	8,000 active 16,000 configured	CBR, UBR, UBR with PCR, VBR-NRT, VBR-RT
T3 ATM E3 ATM OCx/STMx ATM	CT3/T3 E3/ATM[c] 4xDS3 ATM	768	Configurable	18	4,000 for 64-MB modules 3,071 for 32-MB modules	UBR, UBR with PCR, VBR-NRT

a. Varies with the number of ports in the associated line module. The limit is 256 VP tunnels per port.
b. The OC3-2 module does not support rate shaping of egress traffic for VP tunnels. It does support rate limiting, where traffic exceeding the rate is dropped. When traffic is dropped, the link bandwidth corresponding to the discarded packets is not reallocated to other tunnels or individual VCs, resulting in unused bandwidth.
c. Traffic rates (for tunnels or circuits) on T3/E3 ATM modules must be a minimum of 64 Kbps.

Line Modules

Note that the following features are supported only on OC3-4 and OC12 line modules:

- The NBMA feature.
- The Operations, Administration, Management (OAM) alarm cell filter feature.

Virtual Channel Support

The system supports up to 16,000 virtual channels on each port (for a total of 64,000 VCs), depending on the type of module and how much memory it has, as shown in Table 10-6.

Table 10-6 Configuring virtual channels for specific modules

	No. of Virtual Channels		
Module Type	**Port**	**Module**	**System**
32-MB OC3	2,047	2,047	64,000
64-MB OC3	4,000	4,000	
OC3-4/STM1	16,000	16,000	
OC12/STM4	16,000	16,000	
32-MB E3/T3 ATM	3,071	3,071	
64-MB E3/T3 ATM	4,000	4,000	

F4 OAM Support

F4 OAM flows are supported only on the following ERX I/O modules:

- OC3-4, OC12
- T3/E3 ATM

ATM NBMA

The software supports NBMA networks, which interconnect more than two routers and have no broadcast capabilities.

An ATM NBMA network can be thought of as an interface stack with a single IP interface at the top, eventually fanning out to multiple independent PVCs. See Figure 10-3.

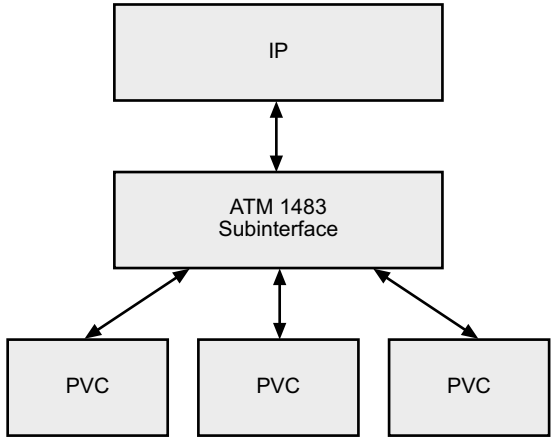

Figure 10-3 NBMA interface stack

Unlike standard point-to-point ATM interfaces and broadcast-oriented Ethernet interfaces, NBMA interfaces form a point-to-multipoint connection. For example, you can use NBMA to connect a system to multiple stations.

An NBMA interface consists of a single ATM 1483 subinterface that has two or more VCs. You can add circuits to an existing ATM 1483 subinterface at any time. New circuits become usable once they have valid ARP table entries. NBMA circuits support only IP directly over ATM 1483.

The system software restricts NBMA interfaces so that all circuits reside on the same physical interface. An NBMA interface can use as many PVCs as are available on a physical port.

ARP Table

To maintain the ARP table, you can use either static mapping via the CLI or Inverse ARP (InARP). InARP provides a way of determining the IP address of the device at the far end of a circuit. For NBMA interfaces, InARP allows for automatic creation of ARP table entries for each circuit on the interface.

You must enable InARP when you create a PVC using the **atm pvc** command. Once configured, a protocol mapping between an ATM PVC and a network address is learned dynamically as a result of the exchange of InARP packets.

Static Map vs. Inverse ARP

If the device at the other end of a circuit does not support InARP, static mapping is required for that circuit. One of these two methods must be used to generate an ARP table entry for each circuit of the NBMA interface.

InARP and static mapping are complementary within an NBMA subinterface, but are not compatible with regard to individual circuits. If InARP is configured on a circuit, the corresponding VCD cannot be present in a static map applied to that interface.

Aging

ARP table entries, with the exception of those declared static, are aged out based on an aging interval defined on a subinterface basis. For the purposes of aging, entries produced via a static map are treated as static ARP table entries. InARP-generated entries are also treated as static; however, the InARP state machine automatically removes entries that cannot be successfully refreshed after three successive failed InARP requests.

Removing Circuits

If a circuit is removed, it is also removed from the ARP table, but not from the static map. If the circuit is reconfigured, a new ARP table entry is generated from the existing map entry. If the circuit uses InARP, the ARP table entry is immediately removed on removal of the circuit.

If a subinterface is removed, all associated circuits and their associated ARP table entries are removed.

Operations, Administration, and Management (OAM) of ATM Interfaces

ATM interfaces support the OAM standards of the ITU, per recommendation I.610. OAM provides VC/VP integrity and fault and performance management.

The system supports F4 and F5 ATM OAM fault management, loopback, and continuity check (CC) cells. These cells perform fault detection and notification, loopback testing, and link integrity. ATM uses F4 and F5 cell flows as follows:

- F4—used in VPs
- F5—used in VCs

Note that ATM interfaces always generate and validate CRC-10 checksums on OAM cells.

End-to-End and Segment Endpoints

An ATM connection consists of a group of points. This OAM implementation provides management for the following points:

- Connection endpoint—the end of a VC/VP connection where the ATM cells are terminated
- Segment endpoint—the end of a connection segment

Fault Management

ATM uses fault management cells to convey defect information to the endpoints of a VP/VC. There are two types of fault management cells:

- Alarm indication signal (AIS) cells, which are used to indicate a fault to the downstream endpoint. AIS cells contain defect type and defect location fields, which may optionally convey information about the type of defect detected and the location of the defect.
- Remote defect indication (RDI) cells, which are received from the remote endpoint of the VP/VC and indicate an interruption in the cell transfer capability of the VP/VC.

Connecting points in the VP/VC that detect a fault send AIS cells in the downstream direction to the endpoint of the VP/VC. Upon receipt of AIS cells, the downstream endpoint generates RDI cells in the upstream direction to alert all connecting points and the remote endpoint of an interruption in the cell transfer capability of the VP/VC.

If fault management detects a failure condition (because of arrival of AIS or RDI cells), the system disables the corresponding VC until the fault condition is no longer detected.

How the ATM Interface Handles AIS Cells

Nodes that detect a failure send AIS cells to the downstream endpoint. Since the ATM interface is an endpoint and there is no downstream neighbor to an ATM endpoint, the ATM interface never generates AIS cells. The ATM interface responds to the receipt of AIS cells as follows:

1. When an ATM interface receives an F4 or F5 end-to-end AIS cell, it enters the AIS state.
2. While in the AIS state, the ATM interface sends F4 or F5 end-to-end RDI cells to the remote endpoint. It sends the RDI cells at the rate of one cell per second for as long as the AIS condition exists.

   Note that for all RDI cells sent, the defect type and defect location fields contain the values from the received AIS cells.
3. RDI cell generation stops when one of the following conditions occurs:
   - The interface receives an F4 or F5 end-to-end loopback cell or an F4 or F5 CC cell.
   - The interface does not receive an AIS cell for three seconds.
   - The OAM VC status field of the **show atm vc atm** command shows whether the circuit is in AIS state.

How the ATM Interface Handles RDI Cells

RDI cells received from the remote endpoint of the VP/VC indicate an interruption in the cell transfer capability of the VP/VC. For example, the remote endpoint of a VC receives an F5 AIS cell, enters the AIS state, and transmits F5 end-to-end RDI cells for the duration of the AIS condition. On receipt of an F4 or F5 end-to-end RDI cell, the ATM interface declares an RDI state but does not generate OAM fault management cells in response to the condition. The ATM interface leaves the RDI condition when no RDI cells have been received for three seconds.

The OAM VC status field of the **show atm vc atm** command shows whether the circuit is in RDI state.

Continuity Check

CC cells provide continual monitoring of a connection on a segment or end-to-end basis. To check the integrity of the link, you can set up a VP or VC to regularly send or receive CC cells at either the segment level or at the end-to-end level.

The CC cell source generates the CC cells, and the sink receives and processes the cells. You can set up a VP or VC as the source, the sink, or both the source and the sink. If you enable a VP or VC as a CC cell source, it generates CC cells. The VP or VC counts CC cells whether or not CC cell flow is enabled. You can enable CC cells only on data circuits, not on control circuits, such as ILMI or signalling circuits.

Activation and Deactivation Cells

To enable and disable CC cell flows, ATM OAM uses activation and deactivation cells:

- To enable a CC cell flow, the system sends activation OAM cells to the peer. The peer replies with a confirmation or denial. If the CC sink point is not activated, all received CC cells are dropped. (See the next section for more details.)
- To disable a CC cell flow, the system sends deactivation OAM cells to the peer. The peer replies with a confirmation or denial.

Activating CC Cell Flow

When the system sends a CC activation cell to the peer, one of the following occurs:

- If the system receives a positive response (Activation Confirmed), the VC or VP goes to CC active state, and CC is enabled on the VC or VP.
- If the system receives a negative response (Activation Req. Denied), the VC or VP goes to CC failed state, and CC is not enabled on the VC or VP.
- If the system does not receive a response within 5 seconds, it sends another activation cell. This process is repeated three times. If the system does not receive a response, it stops the activation process.

If the VC or VP is the source point, CC cell generation starts as soon as the system sends the activation request to the peer. CC cell generation stops if the CC fails, when the maximum number of retries is reached, or when the deactivation process is complete.

Deactivating CC Cell Flow

In the case of a deactivation request, the process is the same except that deactivation cells are sent instead of activation cells.

Also, the **atm oam flush** command causes the system to send a deactivation request to the peer and suspend all CC operations. Therefore, it is recommended that you disable CC cell generation on all VCs before entering **atm oam flush**.

Once CC Cell Flow is Enabled

If the VC or VP is set up as the source point, the ATM interface sends one CC cell per second. CC cell generation stops if one of the following conditions occur:

- The ATM interface goes down.
- OAM CC is disabled on the interface with the **atm pvc** command.
- The peer deactivates the OAM CC cell flow.
- OAM cell reception is disabled on the interface with the **atm oam flush** command.

If the VP is set up as a CC sink point and no CC cell is received for 4 seconds, the VP goes to AIS state and sends one RDI cell per second.

To view the current state of the activation or deactivation process including statistics, use the **show atm oam** command for VPs and use the **show atm vc atm interface** command for VCs.

Loopback

You can use loopback cells to verify connectivity between VP/VC endpoints, as well as segment endpoints within the VP/VC. You can use these tests to perform fault isolation over the VP/VC.

The ATM interface supports VC integrity, which generates F5 end-to-end loopback cells. It also supports ATM ping, which generates F4 and F5 segment and end-to-end loopback cells to test the reachability of an endpoint or a segment endpoint.

VC Integrity

VC integrity is used to monitor the operational status of an individual VC, which provides continuous ATM VC-layer connectivity verification. It involves periodically sending F5 end-to-end loopback cells on individual PVCs to verify end-to-end connectivity. If enabled, the peer ATM host must respond to the system’s loopback cells, or the circuit will be

disabled. The ATM interface will not reenable the circuit until it receives loopback responses or until local VC integrity is disabled.

To set up the ATM interface to transmit F5 end-to-end loopback cells over a VC, use the **oam** keyword with the **atm pvc** command. To send F5 segment loopback cells, use the ATM ping mechanism described later in this chapter.

F5 loopback receive and transmit statistics are available with the **show atm vc atm** command.

F4 OAM Cells

You can generate F4 loopback cells using the **atm oam** command or the ATM ping mechanism. F4 loopback receive and transmit statistics are available with the **show atm oam** command and include statistics on incoming and outgoing F4 end-to-end and segment loopback cells.

ATM Ping

ATM ping lets you check whether a connection endpoint or segment point can be reached on a VC or VP. ATM ping uses F4 and F5 loopback cells and as such is supported only for data circuits and not control circuits (ILMI, signalling circuits). To generate:

- F5 segment or end-to-end loopback cells, issue the **ping atm** command on a VC.
- F4 segment or end-to-end loopback cells, issue the **ping atm** command on a VP.

You can specify the number of loopback cells that are sent, the location ID, and the timer value. Once the interface sends the loopback cells, the timer is started and the interface waits for a response. On receiving the loopback response (or when the timer expires) the ATM interface sends the next cell. This operation is repeated for the number of cells specified.

Because F4 and F5 are OAM cells, disabling receipt of OAM cells (using the **atm oam flush** command) stops all outstanding ping operations. You need to manually restart the ping operation once receipt of OAM cells for the interface is enabled.

How the ATM Interface Handles Loopback Cells Received

The ATM interface responds to received F4 and F5 loopback cells as shown in Table 10-7.

Table 10-7 Handling of F4 and F5 loopback cells received

Loopback Cell Received	ATM Interface Response
F4 and F5 end-to-end and segment loopback cells with the loopback location field set to all 1s (ones) and the loopback indication set.	Clears the loopback indication (sets it to all zeros) and loops back the received cell.
F4 and F5 segment loopback cells with loopback location field set to all 0s (zeros) and the loopback indication set.	Resets the loopback indication and the location ID to all 1s (ones) and loops back the received cells.
F4 and F5 end-to-end and segment loopback cells with the loopback location field set to the loopback location ID of the ATM interface and the loopback indication set.	Clears the loopback indication and loops back the received cell without resetting the location ID.
F5 end-to-end loopback cells with loopback location field set to a value other than all 1s and the loopback location ID of the ATM interface.	Discards the cell.
F5 segment loopback cells with loopback location field set to other than all 1s (ones), all 0s (zeros), or the loopback location ID of the ATM interface.	Discards the cell.

Before You Configure ATM

Before you configure an ATM interface, verify that you have installed the physical module (such as an OC3 module) correctly. For more information on preconfiguration procedures, see the *ERX Installation and User Guide*.

You should also have the following information available:

- Slot and port numbers of the modules over which you want to create ATM interfaces
- Subinterface numbers for each logical interface you want to create
- Virtual path and channel numbers for each virtual circuit you want to create
- IP addresses and subnet mask assignments for IP interfaces

Note: *You can configure four types of dynamic interfaces for ATM 1483 interfaces: IP over ATM, IP over PPP over ATM, IP over PPPoE over ATM, and IP over bridged Ethernet over ATM. For information, see Chapter 21, Configuring Dynamic Interfaces.*

Configuration Tasks

This section covers the following topics:

- Creating a Basic Configuration
- Setting Optional Parameters
- Configuring SVCs
- Configuring OAM
- Configuring an NBMA Interface
- Creating an NBMA Static Map

Creating a Basic Configuration

To configure ATM, perform the following tasks. (Figure 10-4 shows the relationship of steps 1 through 3.)

1. Configure an ATM physical interface.

```
host1(config)#interface atm 0/1
```

2. Configure an ATM 1483 subinterface.

```
host1(config-if)#interface atm 0/1.20
```

3. Configure a PVC by specifying the VCD, the VPI, the VCI, and the encapsulation type.

```
host1(config-subif)#atm pvc 10 100 22 aal5snap
```

4. Assign an IP address and subnet mask to the PVC.

```
host1(config-subif)#ip address 192.32.10.20 255.255.255.0
```

5. (Optional) Verify your configuration using the appropriate **show** commands.

```
host1#show atm interface atm 0/1
host1#show atm vc atm 0/1 10
host1#show atm subinterface atm 0/1.20
```

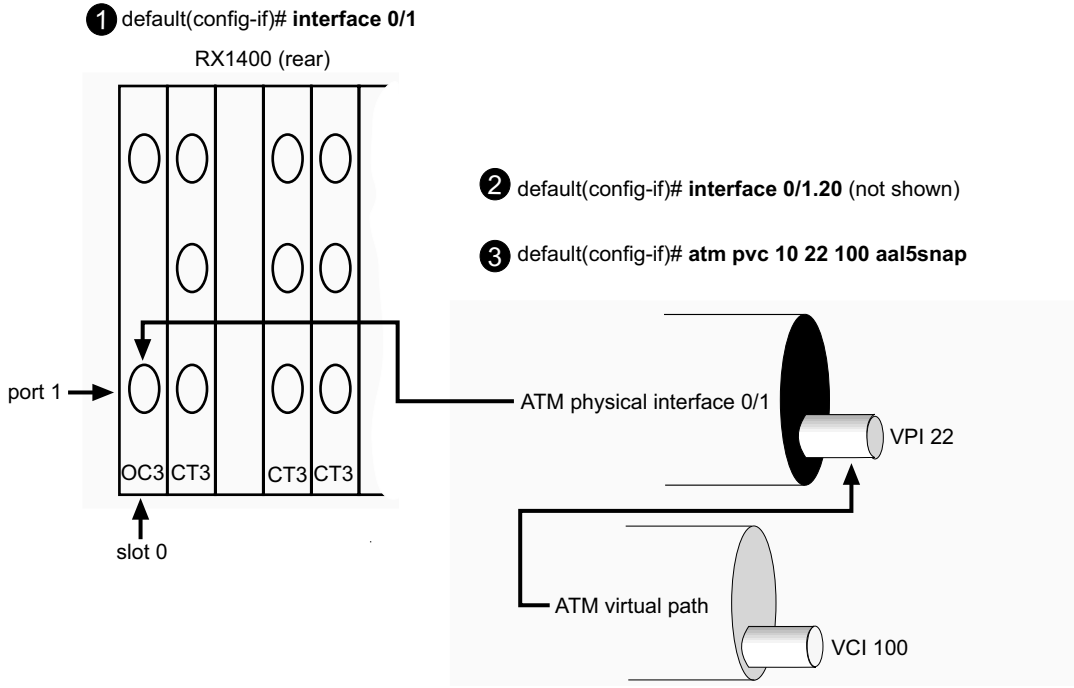

Figure 10-4 Configuring an ATM interface, subinterface, and PVC

atm pvc

- Use to configure a PVC on an ATM interface.
- Specify one of the following encapsulation types:
  - **aal5snap** – specifies an LLC encapsulated circuit; LLC/SNAP precedes the protocol datagram.
  - **aal5mux ip** – specifies a VC-based multiplexed circuit. This option is used for IP only.
  - **aal5autoconfig** – enables autodetection of the 1483 encapsulation (LLC/SNAP or VC multiplexed) for dynamic interfaces. See *Chapter 21, Configuring Dynamic Interfaces* for more explanation.
  - **ilmi** – defines the PVC for ILMI keepalive messages. You can set this option only on major interfaces. Once the PVC is set up for ILMI, use the **atm ilmi-keepalive** command to cause the system to generate ILMI keepalive messages on the interface.
- You can optionally set the *peak*, *average*, and *burst* sizes. To use VBR-RT or VBR-NRT as the service type, you must specify each of these options.
- The default service type is UBR. To set a different service type, specify one of the following keywords:
  - **rt** – selects VBR-RT as the service type. You can select **rt** only if you set the *peak*, *average*, and *burst* parameters.
  - **cbr** – selects CBR as the service type. You must set the CBR rate in Kbps.

- To enable VC integrity, use the following keyword:
  - **oam** – enables generation of OAM F5 loopback cells on this circuit
- Example

```
host1(config-if)#atm pvc 6 0 11 aal5snap cbr 10000
```

- Use the **no** version to remove the specified PVC.

interface atm

- Use to configure an ATM interface or subinterface type in the *slot/port.subinterface* format:
  - *slot* – system chassis slot
  - *port* – I/O module port
  - *subinterface* – number of the subinterface in the range 1–4294967293
- Specify the type of interface or subinterface: **point-to-point** or **multipoint**. Point-to-point is the default.
- Use the **no** version to remove the subinterface or the logical interface.

Setting Optional Parameters

You can also set the following parameters:

- Set the administrative state of an ATM AAL5 interface to disabled.

```
host1(config-if)#atm aal5 shutdown
```

- Enable CAC on the interface.

```
host1(config-if)#atm cac 3000000 ubr 3000
```

- Configure the clock source.

```
host1(config-if)#atm clock internal
```

- Configure framing on a T3/E3 physical interface.

```
host1(config-if)#atm framing g751adm
```

- Set the ILMI keepalive timer.

```
host1(config-if)#atm ilmi-keepalive 5
```

- Specify the cable length (line build-out) for the ATM interface.

```
host1(config-if)#atm lbo long
```

- Set the administrative state of the ATM interface to disabled.

```
host1(config-if)#atm shutdown
```

- Configure SNMP link status traps on the interface.

```
host1(config-if)#atm snmp trap link-status
host1(config-if)#atm aal5 snmp trap link-status
```

- Set the operational mode of the physical interface to SDH STM1.

```
host1(config-if)#atm sonet stm-1
```

- Configure the UNI version of ILMI using one of the following methods:
  - > Enable auto configuration of ILMI.

```
host1(config-if)#atm auto-configuration
```

  - > Set UNI version that the router should use when ILMI link autodetermination is unsuccessful or ILMI is disabled.

```
host1(config-if)#atm uni-version 4.0
```

- Configure the number of virtual circuits for each virtual path.

```
host1(config-if)#atm vc-per-vp 128
```

- Configure a virtual path tunnel and its traffic parameters.

```
host1(config-if)#atm vp-tunnel 2 128
```

- Enable scrambling of the ATM cell payload on a T3 or an E3 interface.

```
host1(config-if)#ds3-scramble
```

- Set the time interval at which the system records bit and packet rates.

```
host1(config-if)#load-interval 90
```

- Place the interface into loopback mode for router-to-router testing.

```
host1(config-if)#loopback diagnostic
```

- Disable an interface.

```
host1(config-if)#shutdown
```

Optional Tasks on ATM 1483 Subinterfaces

The following are optional tasks that you can perform on ATM 1483 subinterfaces:

- Set the MTU.

```
host1(config-subif)#atm atm1483 mtu 7800
```

- Configure SNMP link status traps.

```
host1(config-subif)#atm atm1483 snmp trap link-status
```

- Set the administrative state of an ATM 1483 subinterface to disabled.

```
host1(config-subif)#atm atm1483 shutdown
```

atm aal5 shutdown

- Use to set an ATM AAL5 interface administrative state to disabled.
- Example

```
host1(config-if)#atm aal5 shutdown
```

- Use the **no** version to enable a disabled interface.

atm aal5 snmp trap link-status

- Use to enable SNMP link status traps on the AAL5 layer interface.
- Example

```
host1(config-if)#atm aal5 snmp trap link-status
```

- Use the **no** version to disable the traps.

atm atm1483 mtu

- Use to set the MTU size for an ATM 1483 subinterface.
- The range is 256–9180.
- Use the **no** version to restore the default size of 9180.

atm atm1483 snmp trap link-status

- Use to enable SNMP link status traps on an ATM 1483 layer subinterface.
- Use the **no** version to disable the traps.

atm atm1483 shutdown

- Use to set an ATM 1483 subinterface administrative state to disabled.
- Use the **no** version to enable a disabled subinterface.

atm auto-configuration

- Use to enable auto configuration of ILMI. Entering the **atm auto-configuration** command overrides any previous configuration of the **atm uni-version** command.
- Auto configuration is enabled by default.
- Example

```
host1(config-if)#atm auto-configuration
```

- Use the **no** version to disable auto configuration and set the ILMI parameters to the UNI version configured using the **atm uni-version** command, which has a default value of UNI 4.0.

atm cac

- Use to enable CAC on the interface. You can set a subscription limit, which lets you oversubscribe the port, and the UBR weight, which lets you limit the number of UBR connections.
- Example

```
host1(config-if)#atm cac 3000000 ubr 3000
```

- Use the **no** version to disable CAC on the interface.

atm clock internal

- Use to cause the ATM interface to generate the transmit clock internally.
- You must specify one of the following:
  - **module** – internal clock is from the line module (the default)
  - **chassis** – internal clock is from the configured system clock
- Example

```
host1(config-if)#atm clock internal
```

- Use the **no** version to cause ATM interfaces to recover the clock from the received signal.

atm framing

- Use to configure T3 or E3 framing on an ATM interface.
- Specify one of the following framing types for a T3 (DS3) interface:
  - **cbitadm** – c-bit with ATM direct mapping
  - **cbitplcp** – c-bit with PLCP framing (default)
  - **m23adm** – M23 ATM direct mapping
  - **m23plcp** – M23 with PLCP framing
- Specify one of the following framing types for an E3 interface:
  - **g832adm** – G.832 ATM direct mapping
  - **g751adm** – G.751 ATM direct mapping
  - **g751plcp** – G.751 PLCP mapping (default)
- Example

```
host1(config-if)#atm framing g751adm
```

- Use the **no** version to return framing to the default:
  - For a T3 interface, the default is **cbitplcp**
  - For an E3 interface, the default is **g751plcp**

atm ilmi-keepalive

- Use to generate ILMI keepalive messages. This value sets the allowable time between poll PDU transmissions if there are no pending sequence data PDUs.
- Example

```
host1(config-if)#atm ilmi-keepalive 5
```

- Use the **no** version to disable the generation of keepalive messages.

atm lbo

- Use to specify the cable length (line build-out) for the ATM T3 or E3 interface. The length of cable determines power requirements.
- Specify one of the following keywords:
  - **long** – a cable length in the range 0–225 (the default)
  - **short** – a cable length in the range 226–450
- Example

```
host1(config-if)#atm lbo long
```

- Use the **no** version to return to the default value: short.

atm shutdown

- Use to set an ATM interface administrative state to disabled.
- Example

```
host1(config-if)#atm shutdown
```

- Use the **no** version to enable a disabled interface.

atm snmp trap link-status

- Use to enable SNMP link status traps on the ATM layer interface.
- Example

```
host1(config-if)#atm snmp trap link-status
```

- Use the **no** version to disable the traps.

atm sonet stm-1

- Use to set the mode of operation on the physical interface to Synchronous Digital Hierarchy (SDH) Synchronous Transport Mode (STM).

```
host1(config-if)#atm sonet stm-1
```

- Use the **no** version to restore the default, SONET STS-3c operation.

atm uni-version

- Use to specify the UNI version the interface should use.
- Valid values are 3.0, 3.1, or 4.0.
- Example

```
host1(config-if)#atm uni-version 4.0
```

- There is no **no** version.

atm vc-per-vp

- Use to configure the number of VCs for each VP. The system will not execute this command if any VCs are open on the interface.
- The specified value must be a power of 2, or an error message is returned.

- The minimum number of VCs per VP is 4096 for OCx/STMx ATM line modules and 1024 for T3 ATM line modules. If you enter a value that is below the minimum, the system uses the minimum value.
- Example

```
host1(config-if)#atm vc-per-vp 128
```

- Use the **no** version to restore the default value.

atm vp-tunnel

- Use to define a VP tunnel and configure the rate of traffic flow within the tunnel.
- You specify a tunnel rate in Kbps. All circuits in the VP are restricted to the rate that you set.
- If any virtual circuits are open within the VPI before the tunnel is created, the system will not execute this command.
- Example

```
host1(config-if)#atm vp-tunnel 2 128
```

- Use the **no** version to remove the VP tunnel. If circuits are open within the tunnel, the system will not remove the tunnel.

ds3-scramble
e3-scramble

- Use to scramble the ATM cell payload on a T3 or an E3 interface. DS3 (T3) and E3 scrambling assists clock recovery on the receiving end of the interface.
- Example

```
host1(config-if)#ds3-scramble
```

- Use the **no** version to disable scrambling.

load-interval

- Use to set the time interval at which the system calculates bit and packet rate counters for the ATM interface.
- You can choose a multiple of 30 seconds, in the range 30–300 seconds.
- Example

```
host1(config-if)#load-interval 90
```

- Use the **no** version to return to the default setting, 300 seconds.

loopback

- Use to place the interface into loopback mode.
- Specify either:
  - **diagnostic** – places the interface into internal loopback.
  - **line** – places the interface into external loopback.

- Example

```
host1(config-if)#loopback diagnostic
```

- Use the **no** version to remove any loopback.

Configuring SVCs

To configure SVCs:

1 Enable ILMI on the ATM interface.

```
host1(config)#interface atm 4/0
host1(config-if)#atm ilmi-enable
```

2 Create a PVC with a QSAAL signalling channel on the ATM interface. This PVC performs call setup for the SVC.

```
host1(config-if)#atm pvc 5 0 5 qsaal
```

3 Go to the subinterface configuration and specify an ATM ESI address.

```
host1(config-if)#interface atm 4/0.1
host1(config-subif)#atm esi-address 004ff8234002.00
```

4 Create the SVC and define the SVC parameters, including the destination ATM address, encapsulation method, and traffic parameters.

```
host1(config-subif)#atm svc nsap
  70.000458ff000b923011f22100.234f89bb0000.00 aal5snap cbr
  23961
```

Once you define an SVC, the system attempts to set up an SVC to this destination with the requested traffic parameters and encapsulation method.

atm esi-address

- Use to specify an ESI address. The ESI address identifies the ATM device attached to the switch. The subinterface uses this address when it responds to ATM SVC signalling setup requests.
- Example

```
host1(config-subif)#atm esi-address 004ff8234002.00
```

- Use the **no** version to remove the ESI address

atm ilmi-enable

- Use to enable ILMI on the interface.
- Example

```
host1(config-if)#atm ilmi-enable
```

- Use the **no** version to disable ILMI on the interface.

atm pvc

- Use with the **qsaal** keyword to create a QSAAL signalling channel for the SVC.
- Recommended values are VPI=0 and VCI=5.
- Example

```
host1(config-if)#atm pvc 5 0 5 qsaal
```

- Use the **no** version to remove the signalling channel.

atm svc

- Use to configure an SVC on an ATM subinterface.
- You must include the **nsap** keyword to define the destination ATM NSAP address.
- Specify one of the following encapsulation types:
  - **aal5snap** – specifies an LLC encapsulated circuit; LLC/SNAP precedes the protocol datagram.
  - **aal5mux ip** – specifies a VC-based multiplexed circuit. This option is used for IP only.
- You can optionally set the *peak*, *average*, and *burst* sizes. To use the VBR-RT service type, you must specify each of these options.
- Use the **cbr** keyword to specify the CBR service type.
- Example

```
host1(config-subif)#atm svc nsap
  70.000458ff000b923011f22100.234f89bb0000.00
```

- Use the **no** version to remove the SVC definition.

Configuring OAM

This section covers:

- Configuring F4 OAM
- Configuring F5 OAM
- Setting a Loopback Location ID
- Setting Up the System to Ignore Received OAM Cells
- Running ATM Ping

Configuring F4 OAM

The ATM interface does not support sending F4 segment loopback cells, but it does respond to F4 segment loopback cells that it receives.

F4 OAM flows need their own channel, and they are identified by the VCI on which they are sent or received. The following VCIs are reserved for F4 OAM flows for each virtual path, and you cannot open PVCs on them:

- VCI 3 – for segment F4 flows
- VCI 4 – for end-to-end F4 flows

Note: *You cannot enable both loopback cells and CC cells at the same time.*

To set up F4 OAM:

1 Enable F4 OAM on an interface or VP. The system enables F4 OAM at the interface level unless you specify a VPI. This example opens both segment and end-to-end F4 OAM circuits on VPI 10.

```
host1(config-if)#atm oam 10
```

2 (Optional) Enable only segment or end-to-end loopback.

```
host1(config-if)#atm oam 10 seg-loopback
host1(config-if)#atm oam 10 end-loopback
```

3 (Optional) To cause the interface to generate end-to-end loopback cells in addition to receiving and responding to them, set the loopback timer.

```
host1(config-if)#atm oam 10 end-loopback loopback-timer 20
```

4 (Optional) Enable CC cell flows.

```
host1(config-if)#atm oam 10 seg-loopback cc source
```

atm oam

- Use to configure F4 OAM on an interface or circuit. F4 OAM is configured at the interface level unless you specify a VPI.
- To open F4 OAM on either a segment or end-to-end basis, use the following keywords:
  - **seg-loopback** – enables F4 segment OAM
  - **end-loopback** – enables F4 end-to-end OAM

Note: *If you do not specify either segment or end-to-end loopback, the command applies to both end-to-end and segment F4 OAM circuits.*

- To configure CC cell flow on the PVC, use the following keywords:
  - **both** – enables the PVC as both the source and the sink endpoints
  - **sink** – enables the PVC as the sink endpoint
  - **source** – enables the PVC as the source endpoint

  - **loopback-timer** – when F4 OAM is enabled, the interface or circuit accepts and responds to F4 OAM cells. However, to generate F4 loopback cells, you must configure the loopback timer. This timer represents the frequency with which F4 loopback cells are transmitted. You can set the loopback timer only for end-to-end loopback.
- Use the **no** version to remove the specified PVC.
- Example 1 – opens both F4 end-to-end and segment OAM circuits for VPI 8

```
host1(config-if)#atm oam 8
```

- Example 2 – opens the F4 end-to-end OAM circuit for VPI 10 and enables sending F4 end-to-end loopback cells on the circuit at a frequency of 20 seconds

```
host1(config-if)#atm oam 10 end-loopback loopback-timer 20
```

- Example 3 – opens both F4 end-to-end and segment OAM circuits on all VPs on this interface

```
host1(config-if)#atm oam
```

- Example 4 – opens F4 segment OAM circuits on all VPs on this interface

```
host1(config-if)#atm oam seg-loopback
```

- Example 5 – opens F4 end-to-end loopback on VPI 12

```
host1(config-if)#atm oam 12 end-loopback
```

- Example 6 – opens F4 segment OAM circuit for VPI 8 and enables CC cell generation on the segment

```
host1(config-if)#atm oam 8 seg-loopback cc source
```

- Use the **no** version to delete F4 OAM circuits. Using the options, you can delete all F4 OAM circuits on the interface, segment or end-to-end F4 OAM circuits, or F4 OAM circuits on a specific VPI.
  - Example 1 – deletes all F4 OAM circuits on the interface

```
host1(config-if)#no atm oam
```

  - Example 2 – deletes all F4 segment OAM circuits on the interface

```
host1(config-if)#no atm oam segment
```

  - Example 3 – deletes the F4 end-to-end OAM circuit on VPI 8

```
host1(config-if)#no atm oam 8 end-loopback
```

Configuring F5 OAM

F5 OAM flows run over existing PVCs. The ATM interface does not support sending F5 segment loopback cells, but it does respond to F5 segment loopback cells that it receives.

Note: *You cannot enable both loopback cells and CC cells at the same time.*

To set up F5 OAM:

1 To enable VC integrity, which causes the ATM interface to periodically send F5 end-to-end loopback cells over a VC, use the **oam** keyword with the **atm pvc** command. You can include the frequency (in seconds) with which the system sends F5 end-to-end loopback cells.

```
host1(config-if)#atm pvc 98 38 22 aal5snap oam 300
```

2 (Optional) To enable CC cell flows on a circuit, use the **cc** keyword with the **atm pvc** command. You can enable cell flows on a segment or end-to-end basis, and you can enable the PVC as a sink, source, or both a sink and a source.

```
host1(config-if)#atm pvc 50 0 50 aal5snap oam cc end-to-end
  sink
```

atm pvc

- Use the **atm pvc** command with the **oam** keyword to set up the PVC to periodically transmit F5 end-to-end loopback cells over a VC.
- Use the following keywords to enable and configure CC cell flows:
  - **end-to-end** – opens an end-to-end CC cell flow
  - **segment** – opens a segment CC cell flow
  - **sink** – enables this VC as a sink point (cell receiver)
  - **source** – enables this VC as the source point (cell generator)
  - **both** – enables this VC as both a sink point and a source point
- Example 1 – enables F5 end-to-end loopback cells

  ```
  host1(config-if)#atm pvc 20 20 20 aal5snap oam
  ```

- Example 2 – enables end-to-end CC cell flow and enables the PVC as the sink

  ```
  host1(config-if)#atm pvc 5 0 5 aal5auto oam cc end-to-end
    sink
  ```

- Use the **no** version of the **atm pvc** command *without* the **oam** keyword to disable F5 OAM on the PVC and *without* the **cc** keyword to disable CC cell flows on the PVC.
- Example – disables CC cell flow shown in example 2 above

  ```
  host1(config-if)#no atm pvc 5 0 5 aal5auto
  ```

Setting a Loopback Location ID

To allow other nodes to specifically send OAM loopback cells to the ATM interface, set the location ID of the ATM interface or circuit.

```
host1(config-if)#atm oam loopback-location 01090708
```

Note: *Because the system is a connection endpoint, the default loopback location ID is all 1s (ones). This command allows you to specify a nondefault value.*

atm oam loopback-location

- Use to set the location ID of the ATM interface. The location ID is a 4-octet field, and the default value is all 1s (ones).
  - › You can set a specific value to identify this ATM interface as the intended recipient of OAM loopback cells.
  - › You can also set the location ID to all 0s (zeros).
  - › For information on how the system handles loopback cells based on location ID, see Table 10-7.
- Example

```
host1(config-if)#atm oam loopback-location 01090708
```

- Use the **no** version to return the loopback location ID to the default value, all 1s (ones).

Setting Up the System to Ignore Received OAM Cells

You can also configure the system to ignore all received OAM cells or to ignore only AIS and RDI cells, which is useful in diagnostic situations when it may be preferable to ignore alarm conditions. The **atm oam flush** command controls this feature.

atm oam flush

- Use to enable the OAM flush feature. When OAM flush is enabled, the system ignores all OAM cells received on the interface.
- To cause the system to ignore only AIS and RDI cells and to accept all other OAM cells, use the **alarm-cells** keyword.
- Example

```
host1(config-if)#atm oam flush
```

- Use the **no** version to disable the feature.

Running ATM Ping

Keep in mind the following when you use ATM ping:

- Before you can run ATM ping, you need to add a PVC for the VPI and VCI over which you run the ping.
- Because ATM ping requires the receipt of OAM cells, make sure that the receipt of OAM cells is not disabled (using the **atm oam flush** command). To reenable the receipt of OAM cells, enter **no atm oam flush**.
- Disabling receipt of OAM cells during a ping operation stops all outstanding ping operations. You need to manually restart the ping operation once receipt of OAM cells for the interface is enabled.

- Since ATM ping is a dynamic (on-demand) operation, none of the configuration related to ATM ping is saved. To avoid acquiring excessive bandwidth for OAM, the number of outstanding ping operations on each interface is limited to 12.

ping atm interface atm

- Use to send loopback cells from an ATM interface or circuit.
- The VPI and VCI fields determine the type of loopback cells used for the ping operation. By default F5 end-to-end loopback OAM cells are used.
  - To send F4 segment loopback cells, set the VCI to 3.
  - To send F4 end-to-end loopback cells, set the VCI to 4.
- Use the **end-loopback** keyword to send the ping to the connection endpoint.
- Use the **seg-loopback** keyword to send the ping to the first segment point (for example, the next neighbor switch).
- Use the *destination* option to specify the value of the location ID included in the loopback cell. The location ID is a 16-octet field, and the destination portion is 4 octets. You can set the location ID to a specific destination or to 0s (zeros) or 1s (ones).
  - If you set the destination to 0, the loopback location ID in the loopback cell is initialized to all 0s, and each segment point in the network responds to the ping.
  - If you set the destination to 1s, the loopback location ID in the loopback cell is initialized to all 1s, and only the connection endpoint responds to the ping.
  - If you use the default value of 0xFFFFFFFF, the loopback location ID in the loopback cell is initialized to all 1s.

  For information on how the system handles loopback cells based on location ID, see Table 10-7.
- The **count** keyword sets the number of OAM loopback cells to send to the destination. The default value is 5. The maximum is 32.
- The **timeout** keyword sets the amount of time to wait for a response to the sent OAM loopback cell. The default value is 5 seconds.
- The following characters can appear in the display after the **ping** command has been issued:
  - ! – each exclamation point indicates that a reply was received
  - . – each period indicates that the ping timed out while waiting for a reply
- Example – this example generates end-to-end loopback cells for VPI=0 and VCI=100 on ATM interface 3/0. The destination is set to 0xaabbccdd.

```
host1#ping atm interface atm 3/0 0 100 end-loopback
  0xaabbccdd
Sending 5, 53-byte OAM End-to-End Loopback Echoes, timeout
  is 5 seconds
Press Ctrl-c to stop
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
  1/2/4 ms
```

- There is no **no** version.

Configuring an NBMA Interface

You configure an ATM NBMA 1483 subinterface in a manner similar to configuring a standard ATM 1483 subinterface. When you specify a subinterface, however, you must select the multipoint option if you plan to add multiple circuits to form an NBMA interface. If you do not select multipoint, the subinterface defaults to point-to-point, and only a single circuit can be affiliated with that subinterface.

You can configure one or more PVCs and associate them with the subinterface you create. Also, you can enable InARP and identify a refresh rate on each specific circuit. For each NMBA interface, either InARP must be enabled, or a static map entry must be provided for each circuit owned by the interface; otherwise, transmitting over that circuit is impossible.

Note: *NBMA interfaces support only the aal5snap encapsulation.*

To configure an NBMA interface:

1 Configure a physical interface.

```
host1(config)#interface atm 2/0
```

2 Configure a 1483 subinterface.

```
host1(config-if)#interface atm 2/0.2 multipoint
```

3 Configure PVCs by specifying the VCD, VPI, VCI, and encapsulation type.

```
host1(config-subif)#atm pvc 1 1 1 aal5snap inarp 10
host1(config-subif)#atm pvc 2 2 2 aal5snap
```

4 (Optional) Specify InARP and a refresh rate (also optional).

```
host1(config-subif)#atm pvc 3 3 3 aal5snap inarp 5
host1(config-subif)#atm pvc 4 4 4 aal5snap inarp
```

5 Assign an IP address and subnet mask to the PVC.

```
host1(config-subif)#ip address 192.32.10.20 255.255.255.0
```

6 (Optional) Use the appropriate **show** commands to verify your configuration.

```
host1#show atm interface atm 2/0
host1#show atm map
host1#show nbma arp atm 2/0
host1#show atm vc atm 2/0 2
host1#show atm subinterface atm 2/0.2
```

Creating an NBMA Static Map

Static mapping creates an association between IP address–ATM PVC pairs for one or more member circuits of an ATM 1483 NBMA interface. Not every circuit necessarily gets the required association from a static map.

In the following procedure, you can repeat step 2 for each circuit you want to map. A map group name that you have not already established can be associated with an interface. When you define the map list, the name will then be associated with that interface. You can perform steps 3 and 4 before steps 1 and 2 without affecting the results.

To set up a static map:

1 Create a map list by naming it.

```
host1(config)#map-list charlie
```

2 Associate a protocol and an address with a specific virtual circuit.

```
host1(config-map-list)#ip 192.168.13.13 atm-vc 1 broadcast
```

3 Specify an ATM port adapter interface.

```
host1(config-if)#interface atm 2/0
```

4 Associate the map list with the interface.

```
host1(config-if)#map-group charlie
```

atm pvc

- Use to configure a PVC on an ATM interface.
- InARP and refresh rate are optional parameters.
- InARP determines if InARP requests are used and is specified on a per-circuit basis. If you disable InARP, you must use a static map table entry. Transmission over the circuit is not possible unless you use either InARP or static map table entries.
- The default refresh rate is 15 minutes.
- Example

  ```
  host1(config-if)#atm pvc 6 0 11 aal5snap inarp 10
  ```

- Use the **no** version to remove the specified PVC.

interface atm

- Use to configure an ATM interface or subinterface type in the *slot/port.subinterface* format:
  - *slot* – number of the system chassis slot
  - *port* – port number on the I/O module
  - *subinterface* – number of the subinterface in the range 1–4294967293

- Specify **multipoint** to identify the subinterface as NBMA.
- Use the **no** version to remove the subinterface or the logical interface.

ip atm-vc

- Use to associate a protocol and address with a specific virtual circuit.
- Use this command repeatedly for each circuit to be mapped.
- This command is available in Map List Configuration mode only.
- Example

```
host1(config-map-list)#ip 192.168.13.13 atm-vc 1 broadcast
```

- Use the **no** version to remove the association.

map-group

- Use to associate the map list with an NBMA interface when configuring static mapping.
- You can issue this command before or after the **map-list** command without changing anything.
- This command is available in Interface Configuration mode only.
- See the **map-list** command.
- Example

```
host1(config-if)#map-group charlie
```

- Use the **no** version to remove the association.

map-list

- Use to create a map list when configuring static mapped NBMA interfaces.
- You can create multiple map lists; however, you can associate only one map list with each physical interface. Each map list can be associated with a single interface.
- If a map list contains an entry for a VCD that was previously configured to run InARP, the **map-group** command fails. If this is the case, either reconfigure the circuit with InARP disabled, or remove the entry for that circuit from the map list.
- Example

```
host1(config)#map-list charlie
```

- Use the **no** version to remove the map list.

Monitoring ATM

This section shows how to assign text descriptions to ATM interfaces, set a statistics baseline, and use the **show** commands to view your ATM configuration and monitor ATM interfaces.

Assigning Descriptions to Interfaces

You can use the **description** commands to assign a text description or alias to an interface, which allows that information to be picked up by other **show** commands.

atm aal5 description

- Use to assign a text description or alias to an aal5 interface.
- Use the **show atm aal5 interface** to display the text description.
- Use the **no** version to remove the text description or alias.

atm atm1483 description

- Use to assign a text description or alias to an ATM 1483 subinterface.
- Use the **show atm subinterface** to display the text description.
- Use the **no** version to remove the text description or alias.

atm description

- Use to assign a text description or alias to the interface.
- Use the **show atm interface** command to display the text description.
- The ATM description is pushed out to RADIUS during authentication and accounting.
- Use the **no** version to remove the text description or alias.

Setting Statistics Baselines

You can set a statistics baseline for ATM interfaces or circuits using the **baseline interface atm** command.

baseline interface atm

- Use to set a statistics baseline for ATM interfaces or a specific virtual circuit.
- The system implements the baseline by reading and storing the statistics at the time the baseline is set and then subtracting this baseline whenever baseline-relative statistics are retrieved.
- To set the baseline for a circuit, specify a VCD in the range 1–2147483647.
- To set the baseline on an interface, omit the VCD.
- To specify that baseline statistics are to be shown, use the **delta** keyword with ATM **show** commands.

- Example

```
host1#baseline atm interface atm 9/1 123
```

- There is no **no** version.

ATM show Commands

Use the following versions of the **show atm** command to view your ATM configuration and monitor ATM interfaces:

- **show atm aal5 interface**
- **show atm interface**
- **show atm map**
- **show atm oam**
- **show atm ping**
- **show atm subinterface**
- **show atm vc**
- **show atm vc atm**
- **show atm vp-tunnel**
- **show nbma arp**

You can use the output filtering feature of the **show** command to include or exclude lines of output based on a text string you specify. See *show Commands* in *ERX System Basics Configuration Guide, Chapter 2, Command Line Interface*.

show atm aal5 interface

- Use to display a configured ATM AAL5 interface.
- Field descriptions
  - AAL5 Interface operational status – operational status of the AAL5 interface: up, down, lowerlayerDown
  - time since last status change – time since last reported change to the AAL5 interface operational status
  - InPackets – number of packets received on this interface
  - InBytes – number of bytes received on this interface
  - OutPackets – number of packets transmitted on this interface
  - OutBytes – number of bytes transmitted on this interface
  - InErrors – number of incoming errors received on this interface
  - OutErrors – number of outgoing errors on this interface
  - InPacketDiscards – number of incoming packets discarded on this interface
  - OutDiscards – number of outgoing packets discarded on this interface

- Example

```
host1#show atm aal5 interface atm 2/0
AAL5 Interface ATM 2/0 operational status:       up
      time since last status change: 01:27:38

InPackets:        0
InBytes:          0
OutPackets:       0
OutBytes:         0
InErrors:         0
OutErrors:        0
InPacketDiscards: 0
OutDiscards:      0
```

show atm interface
show interfaces atm

- Use to display configuration and state information and statistics about a specific ATM interface, or to display a brief description of all ATM interfaces configured in the system. You specify an ATM interface in the format: *slot/port.*
- To display the status and number of configured VCs for all ATM interfaces configured in the system, use the **brief** keyword.
- Field descriptions
  - ATM Interface status – state of the physical interface: up, down
  - line protocol – state of the ILMI protocol: disabled, up, down
  - AAL5 operational status – operational status of the ATM AAL5 interface: up, down, lowerLayerDown
  - time since last status change – time since last reported change to the AAL5 operational status
  - ATM operational status – operational status of the ATM interface: up, down, lowerLayerDown
  - time since last status change – time since last reported change to the ATM operational status
  - UNI version – UNI version (3.0, 3.1, 4.0)
  - Maximum VCs – maximum number of virtual circuits supported on this interface
  - Current VCs – current number of virtual circuits configured
  - ILMI VPI/VCI – VPI and VCI configured for ILMI (displays only if ILMI is configured on the interface)
  - VCD – VCD (displays only if ILMI is configured on the interface)
  - ILMI keepalive – state and status of the ILMI (displays only if ILMI is configured on the interface)
  - Max VCI per VPI – maximum number of virtual circuits on each virtual path
  - CAC admin state – enabled, disabled
  - Subscription bandwidth – maximum allowable bandwidth on the port (displays only if CAC is enabled)

- UBR weight – configured bandwidth for UBR and UBR-PCR connections (displays only if CAC is enabled)
- Available bandwidth – bandwidth currently available on the port (displays only if CAC is enabled)
- signalling VPI/VCI, VCD – VPI, VCI, and VCD of the QSAAL signalling PVC
- QSAAL status – status of the ATM signalling SSCOP protocol: connected, disconnected
- Network prefix – ATM address prefix registered by the ATM switch attached to this interface
- SNMP trap link-status – enabled, disabled
- OAM cell receive status – whether the ATM interface processes or flushes OAM cells: enabled, disabled
- OAM cell filter – whether the interface flushes all OAM cells or flushes only AIS and RDI alarm cells (displays only if OAM cell receive status is enabled)
- atm oam loopback-location – loopback location ID for this interface
- InPackets – number of packets received on this interface
- InBytes – number of bytes received on this interface
- InCells – number of cells received on this interface
- OutPackets – number of packets transmitted on this interface
- OutBytes – number of bytes transmitted on this interface
- OutCells – number of cells transmitted on this interface
- InErrors – number of incoming errors received on this interface
- OutErrors – number of outgoing errors on this interface
- InPacketDiscards – number of incoming packets discarded on this interface
- InByteDiscards – number of incoming bytes discarded on this interface
- InCellErrors – increments when a T3 or an E3 ATM interface receives cells for a VPI or VCI that is not configured on that interface

• This command also displays information specific to the applicable physical interface. In the example below, the output contains the following physical interface fields:
  - SONET path operational status – state of the SONET path interface: up, down, lowerLayerDown
  - time since last status change – time since last reported change to the SONET path operational status
  - SONET operational status – state of SONET interface: up, down, lowerLayerDown
  - time since last status change – time since last reported change to the SONET operational status
  - PHY Type – physical port type on which this interface is running
  - Framing – framing type of the physical interface
  - TX clocking – clocking type for the physical interface
  - Loopback – loopback status for the physical interface: enabled, disabled
  - Receive FIFO Overruns – number of times received FIFO was overrun
  - qos-mode-port – status of SAR backpressure: enabled, disabled

- queue – hardware packet queue associated with the specified traffic class and interface
- Forwarded packets, Bytes – number of packets and bytes forwarded on this queue
- Dropped committed packets, Bytes – number of committed packets and bytes that were dropped
- Dropped conformed packets 0, Bytes 0 – number of conformed packets and bytes that were dropped
- Dropped exceeded packets 0, Bytes 0 – number of exceeded packets and bytes that were dropped
- Interface – slot and port number of the ATM interface
- Status – status of the ATM interface: up, down, lowerLayerDown
- Configured VCs – number of VCs configured on the interface

• Example 1 – displays information about a specific interface

```
host1#show atm interface atm 2/0
ATM Interface 2/0 is down, line protocol is down

AAL5 operational status:       lowerLayerDown
      time since last status change: 22:08:21
ATM operational status:        down
      time since last status change: 22:02:11
SONET path operational status: lowerLayerDown
      time since last status change: 1 day, 0 hours
SONET operational status:      down
      time since last status change: 1 day, 0 hours

UNI version: 3.0, Maximum VCs: 4096
Current VCs: 1
ILMI VPI/VCI: 17/23, VCD 26, ILMI keepalive: disabled
Max VCI per VPI: 32768
CAC admin state: enabled
Subscription bandwidth: 3000000 kbps
UBR weight: 3000 kbps
Available bandwidth: 2992000 kbps
signalling VPI/VCI: 0/5, VCD 5
QSAAL status: disconnected
Network prefix:
SNMP trap link-status: enabled
OAM cell receive status: enabled
OAM cell filter : all cells
   atm oam loopback-location 0XFFFFFFFF

PHY Type: oc3, Framing: sonet, TX clocking: line
Loopback: none, Receive FIFO Overruns: 0
```

```
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec

InPackets:        0
InBytes:          0
InCells:          0
OutPackets:       0
OutBytes:         0
OutCells:         0
InErrors:         0
OutErrors:        0
InPacketDiscards: 0
InByteDiscards:   0
InCellErrors:     0

qos-mode-port disabled

queue 0: traffic class control, bound to ATM2/0
  Forwarded packets 643, Bytes 36008
  Dropped committed packets 0, Bytes 0
  Dropped conformed packets 0, Bytes 0
  Dropped exceeded packets 0, Bytes 0
```

- Example 2 – shows a summary of all ATM interfaces

```
host1#show atm interface brief
                                  Configured
Interface       Status              VCs
---------   --------------   ----------
ATM 2/0     up                        2
ATM 2/1     up                        3
ATM 2/2     lowerLayerDown            4
ATM 2/3     down                      5
ATM 4/0     up                        2
ATM 6/0     lowerLayerDown            2
```

show atm interface signalling-stats

- Use to display signalling statistics for the ATM interface.
- Field descriptions
  - Signalling statistics for interface – type and specifier of the interface
  - SSCOP Connection Events – sum of the following errors:
    - SSCOP connection disconnect counter
    - SSCOP connection initiation failure
    - SSCOP connection re-establ/resynch

- SSCOP Errored PDUs – sum of the following errors:
  - Invalid PDUs
  - PDUs that result in MAA-ERROR codes and are discarded
- Received Call Setup Attempts – number of call setup attempts (both successful and unsuccessful) detected on this interface
- Transmitted Call Setup Attempts – number of call setup attempts (both successful and unsuccessful) transmitted on this interface
- Received Route Unavailability Messages – number of Route Unavailability messages detected on this interface
- Transmitted Route Unavailability Messages – number of Route Unavailability messages transmitted on this interface
- Received Resource Unavailability Messages – number of Resource Unavailability messages detected on this interface
- Transmitted Resource Unavailability Messages – number of Resource Unavailability messages transmitted on this interface
- Received Called Party Responsible Clearing Messages – number of Called Party Responsible For Unsuccessful Call messages detected on this interface
- Transmitted Called Party Responsible Clearing Messages – number of Called Party Responsible For Unsuccessful Call messages transmitted on this interface
- Received Incorrect Messages – number of Incorrect Messages detected on this interface
- Transmitted Incorrect Messages – number of Incorrect Messages transmitted on this interface
- Received Calling Party Responsible Clearing Messages – number of Calling Party Events detected on this interface
- Transmitted Calling Party Responsible Clearing Messages – number of Calling Party Events transmitted on this interface
- Detected Timer Expiries – number of Timer Expiries detected on this interface
- Transmitted Timer Expiries – number of Timer Expiries transmitted on this interface
- Received Restarts – number of Restart Activity errors detected on this interface
- Transmitted Restarts – number of Restart Activity errors transmitted on this interface
- Incoming SVCs established – number of SVCs established at this signalling entity for incoming connections
- Outgoing SVCs established – number of SVCs established at this signalling entity for outgoing connections

- Example

```
host1#show atm interface atm 3/0 signalling-stats

Signalling statistics for interface ATM3/0

SSCOP Connection Events:                                    288
SSCOP Errored PDUs:                                         0
Received Call Setup Attempts:                               0
Transmited Call Setup Attempts:                             0
Received Route Unavailability Messages:                     0
Transmitted Route Unavailability Messages:                  0
Received Resource Unavailability Messages:                  0
Transmitted Resource Unavailability Messages:               0
Received Called Party Responsible Clearing Messages:        0
Transmitted Called Party Responsible Clearing Messages:     0
Received Incorrect Messages:                                0
Transmitted Incorrect Messages:                             0
Received Calling Party Responsible Clearing Messages:       0
Transmitted Calling Party Responsible Clearing Messages:    0
Detected Timer Expiries:                                    0
Transmitted Timer Expiries:                                 0
Received Restarts:                                          0
Transmitted Restarts:                                       0
Incoming SVCs established:                                  0
Outgoing SVCs established:                                  0
```

show atm map

- Use to display the list of all configured ATM static maps to remote hosts on an ATM network.
- Field descriptions
  - Map list – name of map list and method used to enter the map list. PERMANENT indicates that the map entry was configured; it was not entered automatically by a process.
  - protocol address maps to VCx – name of protocol, the protocol address, and the VCD that the address is mapped to (for ATM VCs configured with the **atm pvc** command).
    - VC – number of the virtual circuit
    - broadcast – indicates pseudo-broadcasting
    - connection up – indicates a point-to-point virtual circuit
- Example

```
host1# show atm map
Map list my-map : PERMANENT
 ip 192.168.2.10 maps to VC 10 atm 2/0
 ip 192.168.2.20 maps to VC 11 atm 2/0    broadcast
 ip 192.168.2.30 maps to VC 12   atm 2/0
```

```
Map list other-map : PERMANENT
 ip 192.10.2.10 maps to VC 100 atm 2/1
 ip 192.10.2.20 maps to VC 101 atm 2/1
 ip 192.10.2.30 maps to VC 102   atm 2/1  broadcast

host1#show atm map brief
Map list my-map : PERMANENT
Map list other-map : PERMANENT

host1#show atm map my-map
Map list my-map : PERMANENT
 ip 192.168.2.10 maps to VC 10 atm 2/0
 ip 192.168.2.20 maps to VC 11 atm 2/0    broadcast
 ip 192.168.2.30 maps to VC 12   atm 2/0
```

show atm oam

- Use to display F4 OAM statistics. You specify an ATM interface in the format: *slot/port* and an optional *vpi.*
- You can use the following keywords.
  - **segment** – displays information on segment loopbacks
  - **end-to-end** – displays information on end-to-end loopbacks
- To see F4 OAM circuits that are open, use the **show atm vc** command.
- Field descriptions
  - Sending End To End Loopback Cells – enabled, disabled
  - Frequency – frequency configured on this circuit
  - End To End OAM CC verification – whether end-to-end CC verification is enabled or disabled
  - OAM CC Type – whether the circuit is a sink, source, or both a sink and a source
  - OAM Current CC state
    - Ready – OAM CC is not enabled
    - Active – OAM CC cell flow is running
    - Activation Failed – OAM CC activation failed
    - Wait Activate – waiting for interface to come up before the software sends the activation request
    - Wait Activation Confirmation – waiting for activation confirmation from the peer
    - Wait DeActivate – waiting for interface to come up before the software sends the deactivation request
    - Wait DeActivation Confirmation – waiting for deactivation confirmation from the peer
  - Segment OAM CC verification – whether segment CC verification is enabled or disabled
  - VP State – state of the VP: up, down

- VP End To End Oam State
  - not managed – circuit is in normal OAM state; no OAM fault conditions
  - AIS – circuit is in AIS state
  - RDI – circuit is in RDI state
- VP Segment Oam State
  - not managed – circuit is in normal OAM state; no OAM fault conditions
  - AIS – circuit is in AIS state
  - RDI – circuit is in RDI state
- InOamF4Cells – number of F4 OAM cells received
- InOamF4CellsDropped – number of incoming F4 OAM cells that were dropped
- InOamF4EndLoopbackCells – number of F4 end-to-end loopback cells received
- InOamF4SegLoopbackCells – number of F4 segment loopback cells received
- InOamF4EndAisCells – number of F4 end-to-end AIS cells received
- InOamF4SegAisCells – number of F4 segment AIS cells received
- InOamF4EndRdiCells – number of F4 end-to-end RDI cells received
- InOamF4SegRdiCells – number of F4 segment RDI cells received
- InOamF4EndCCActDeActCells – number of F4 end-to-end activation or deactivation CC cells received
- InOamF4SegCCActDeActCells – number of F4 segment activation or deactivation CC cells received
- InOamF4EndCCCells – number of F4 end-to-end CC cells received
- InOamF4SegCCCells – number of F4 segment CC cells received
- InOamF4SegmentCells – number of F4 segment cells received
- InOamF4SegmentCellsDropped – number of incoming F4 segment cells that were dropped
- InOamF4SegmentLoopbackCells – number of F4 segment loopback cells received
- InOamF4EndCells – number of F4 end-to-end cells received
- InOamF4EndCellsDropped – number of incoming F4 end-to-end cells that were dropped
- OutOamF4Cells – number of F4 OAM cells sent
- OutOamF4EndLoopbackCells – number of F4 end-to-end loopback cells sent
- OutOamF4SegLoopbackCells – number of F4 segment loopback cells sent
- OutOamF4EndRdiCells – number of end-to-end RDI cells sent
- OutOAM F4SegRdiCells – number of segment RDI cells sent
- OutOamF4EndCCActDeActCells – number of F4 end-to-end activation or deactivation CC cells sent
- OutOamF4SegCCActDeActCells – number of F4 segment activation or deactivation CC cells sent

- OutOamF4EndCCCells – number of F4 end-to-end CC cells sent
- OutOamF4SegCCCells – number of F4 segment CC cells sent
- OutOamF4SegmentCells – number of F4 segment cells sent
- OutOamF4SegmentLoopbackCells – number of F4 segment loopback cells sent
- OutOamF4EndCells – number of F4 end-to-end cells sent

- Example 1

```
host1#show atm oam 2/1 0
Sending End To End Loopback Cells is Enabled: Frequency = 20
  secs
End To End OAM CC verification enabled
OAM CC Type : CC Sink End Point
OAM Current CC state : Ready
Segment OAM CC verification enabled
OAM CC Type : CC Sink End Point
OAM Current CC state : Ready
VP State                          :down
VP End To End Oam State           :not managed
VP Segment Oam State              :not managed
InOamF4Cells                      :0
InOamF4CellsDropped               :0
InOamF4EndLoopbackCells           :0
InOamF4SegLoopbackCells           :0
InOamF4EndAisCells                :0
InOamF4SegAisCells                :0
InOamF4EndRdiCells                :0
InOamF4SegRdiCells                :0
InOamF4EndCCActDeActCells         :0
InOamF4SegCCActDeActCells         :0
InOamF4EndCCCells                 :0
InOamF4SegCCCells                 :0
OutOamF4Cells                     :0
OutOamF4EndLoopbackCells          :0
OutOamF4SegLoopbackCells          :0
OutOamF4EndRdiCells               :0
OutOamF4SegRdiCells               :0
OutOamF4EndCCActDeActCells        :0
OutOamF4SegCCActDeActCells        :0
OutOamF4EndCCCells                :0
OutOamF4SegCCCells                :0
Time since last status change     :00:00:33
```

- Example 2

```
host1#show atm oam 2/1 0 segment
Segment OAM CC verification enabled
OAM CC Type : CC Sink End Point
OAM Current CC state: Ready
```

```
VP State                          :down
VP Oam State                      :not managed
InOamF4SegmentCells               :0
InOamF4SegmentCellsDropped        :0
InOamF4SegmentLoopbackCells       :0
InOamF4SegCCActDeActCells         :0
InOamF4SegCCCells                 :0
OutOamF4SegmentCells              :0
OutOamF4SegmentLoopbackCells      :0
OutOamF4SegRdiCells               :0
OutOamF4SegCCActDeActCells        :0
OutOamF4SegCCCells                :0
Time since last status change     :00:00:53
```

- Example 3

```
host1#show atm oam 2/1 0 end-to-end
Sending End To End Loopback Cells Disabled:
End To End OAM CC verification enabled
OAM CC Type : CC Sink End Point
OAM Current CC state: Ready
VP State                          :down
VP Oam State                      :not managed
InOamF4SegmentCells               :0
InOamF4SegmentCellsDropped        :0
InOamF4SegmentLoopbackCells       :0
InOamF4SegCCActDeActCells         :0
InOamF4SegCCCells                 :0
OutOamF4SegmentCells              :0
OutOamF4SegmentLoopbackCells      :0
OutOamF4SegRdiCells               :0
OutOamF4SegCCActDeActCells        :0
OutOamF4SegCCCells                :0
Time since last status change     :00:00:53
```

show atm ping

- Use to show all existing ping entries, both completed and outstanding. Remember that ping statistics are overwritten when a new ping is issued on the circuit.
- You can specify the following options to show ping for entries for a specific interface, VPI, or VCI.
  - *interfaceSpecifier* – shows ping entries for this interface
  - *vpi* – shows details of the last **ping atm** command on this VPI
  - *vci* – shows details of the last **ping atm** command on this VCI

- Field descriptions
  - Interface – interface number
  - VPI – virtual path identifier
  - VCI – virtual channel identifier
  - CellCount – OAM loopback cell count configured on the interface
  - TimeOut – time-out configured on the interface
  - SentCellCount – number of loopback cells sent
  - RespCount – number of loopback response cells received
  - Status – status of the ping
  - Ping Cell Count – cell count configured on the circuit
  - Ping Time Out – time-out, in seconds, configured on the circuit
  - No Of Cells Sent – number of ping cells sent on this circuit
  - No Of Response Received – number of ping responses received on this circuit
  - Success Rate – percentage of successful responses received for pings sent
  - round-trip min/max/avg – minimum, maximum, and average time in milliseconds that it took to receive responses to ping messages sent
  - Ping Status – results of the ping operation; possible values are:
    - Ping Completed – number of ping requests in the cell count were sent
    - Ping in Progress – ping is in operation
    - Ping Not Started – ping operation is not started; you may see this via SNMP
    - Ping Stopped – ping operation was manually stopped
    - Ping Stopped OAM Down – **atm oam flush** command was issued when ping was enabled
    - ATM Interface Down – ping operation is stopped as a result of interface down operational status
  - OAM Flow Type – whether this is a segment or end-to-end flow
- Example 1 – displays all entries in the system

```
host1#show atm ping
Interface VPI VCI CellCount TimeOut  SentCellCount  RespCount    Status
--------- --- --- --------- -------  -------------  ----------   -------
ATM 2/1   0   100         5       5              5           5   Ping Completed
ATM 2/1   0   200         5       5              5           5   Ping Completed
ATM 2/2   0   100         5       5              5           5   Ping Completed
ATM 2/2   0   200         5       5              5           5   Ping Completed
% Found 4  Entries in the system
```

- Example 2 – displays entries on an interface

```
host1#show atm ping 2/1
Interface VPI VCI  CellCount TimeOut  SentCellCount  RespCount    Status
--------- --- ---  --------- -------  -------------  ----------   -------
ATM 2/1   0   100         5       5             5          5   Ping Completed
ATM 2/1   0   200         5       5             5          5   Ping Completed
% Found 2  Entries in this Interface
```

- Example 3 – displays entries on a circuit

```
host1#show atm ping atm 2/1 0 100
Ping Cell Count            :5
Ping Time Out              :5secs
No Of Cells Sent           :5
No Of Response Received    :5
Success Rate               :100%
round-trip min/max/avg     :0/10/2 ms
Ping Status                :Completed
Oam Flow Type              :Segment
```

show atm subinterface

- Use to display the current state of all the ATM subinterfaces you specify.
- Field descriptions
  - Interface – subinterface number
  - ATM-Prot – ATM protocol type
  - VCD – virtual circuit descriptor
  - VPI – virtual path identifier
  - VCI – virtual channel identifier
  - Type – circuit type: PVC, SVC
  - Encap – administered encapsulation method based on what was configured using the **atm pvc** command
  - MTU – MTU size for the interface
  - Status – state of the subinterface: up, down, dormant, lowerLayerDown, absent
  - ATM Address – ATM ESI address configured on the circuit
  - Auto configure status – setting of the auto configuration feature. Dynamic means that the feature is on and the next upper interface will be automatically detected. Static means that the feature is off.
  - Auto configure upper interface(s) – type of dynamic upper interface(s) configured using the **auto-configure** command: IP, PPP, PPPoE, bridged Ethernet
  - Detected 1483 encapsulation – if the encapsulation type is set to **aal5autoconfig**, displays the 1483 encapsulation type detected on the subinterface (displays AAL5-AUTO until a packet is detected)
  - Detected dynamic upper interface – type of dynamic upper interface detected during autoconfiguration

- Assigned profile – for each dynamic interface type, shows whether or not a profile is assigned and, if assigned, shows the profile name
- ATM Address – ATM ESI address configured on the circuit
- Destination NSAP – NSAP address configured on the circuit
- SNMP trap link-status – whether the trap link status is enabled or disabled
- InPackets – number of packets received on this interface
- InBytes – number of bytes received on this interface
- OutPackets – number of packets transmitted on this interface
- OutBytes – number of bytes transmitted on this interface
- InErrors – number of errors received on this interface
- OutErrors – number of outgoing errors on this interface
- InPacketDiscards – number of incoming packets discarded on this interface
- OutDiscards – number of outgoing packets discarded on this interface

- Example 1 – displays the current state of all ATM subinterfaces

```
host1#show atm subinterface
Interface ATM-Prot VCD VPI VCI Type Encap MTU      Status       ATM Address
--------- -------- --- --- --- ---- ----- ---- -------------- ---------------
ATM 3/0.1 NBMA      10   0  10 PVC  SNAP  9180 up             --
ATM 3/0.1 NBMA      11   0  11 PVC  SNAP  9180 up             --
ATM 3/1.1 RFC-1483   3   0   5 PVC  AUTO  9180 lowerLayerDown 123456789012.33
ATM 3/1.2 RFC-1483   4   0   5 PVC  MUX   9180 lowerLayerDown 123456789012.12
ATM 3/1.2 RFC-1483   5   0   8 PVC  SNAP  9180 lowerLayerDown --

5 interface(s) found
```

- Example 2 – displays the current state of a specific ATM subinterface

```
host1#show atm subinterface atm 3/0.1
Interface ATM-Prot VCD VPI VCI Type Encap MTU      Status       ATM Address
--------- -------- --- --- --- ---- ----- ---- -------------- ---------------
ATM 3/0.1 RFC-1483   5   0   8 PVC  SNAP  9180 lowerLayerDown 004ff8234002.00

1 interface(s) found

Auto configure status: dynamic
Auto configure upper interface(s): PPP
Detected 1483 encapsulation      : AAL5-AUTO
Detected dynamic upper interface : none
Assigned profile (IP)   : none assigned
Assigned profile (PPP)  : foo
Assigned profile (PPPOE): none assigned
Assigned profile (any)  : none assigned

ATM Address:      .004ff8234002.00
Destination NSAP: 70.000458ff000b923011f22100.234f89bb0000.00
```

```
SNMP trap link-status: disabled

InPackets:        0
InBytes:          0
OutPackets:       0
OutBytes:         0
InErrors:         0
OutErrors:        0
InPacketDiscards: 0
OutDiscards:      0
```

show atm vc

- Use to display a summary of all configured ATM virtual circuits. You specify an ATM interface in the format: *slot/port*.
- You can specify one or more of the following keywords:
  - vpi – displays VCs on a specific VPI
  - category – displays VCs that have a specific service category
  - status – displays VCs with a certain status
- Field descriptions
  - Interface – interface number
  - VCD – virtual circuit descriptor
  - VPI – virtual path identifier
  - VCI – virtual channel identifier
  - Encap – encapsulation method: AUTO, MUX, QSAAL, SNAP, ILMI, F4-OAM
  - Category – service type configured on the VC: UBR, UBR-PCR, NRT-VBR, RT-VBR, CBR
  - Peak – peak rate in Kbps
  - Avg – average rate in Kbps
  - Burst – maximum number of cells that can be burst at the peak cell rate
  - InARP – whether or not Inverse ARP is enabled: Yes, No
  - Status – state of the virtual circuit: Up, Down
- Example 1 – displays all VCs in the system

```
host#show atm vc
                                      Cate                  In  Sta
Interface VCD VPI VCI Type Encap      gory  Peak Avg Burst ARP tus
--------- --- --- --- ---- ------ ------ ---- --- ----- --- ----
ATM 2/0.1   1   0   1 PVC  SNAP   RT-VBR  500 400    10  No UP
ATM 2/0     2   0   3 PVC  F4-OAM UBR       0   0     0  No UP
ATM 2/0     3   0   4 PVC  F4-OAM UBR       0   0     0  No UP
ATM 2/0.2  11   1   1 PVC  SNAP   UBR       0   0     0  No UP
ATM 2/0.3  33   0  33 PVC  SNAP   UBR       0   0     0  No DOWN
```

```
ATM 4/1.1 100   0 100 PVC  SNAP   UBR       0   0     0  No DOWN
ATM 4/1.1 101   0 101 PVC  SNAP   UBR       0   0     0  No DOWN
7 circuit(s) found
```

- Example 2 – displays VCs with a VPI of zero (0)

```
host 1#show atm vc vpi 0
                                      Cate                  In   Sta
 Interface   VCD VPI VCI  Type  Encap gory Peak Avg  Burst ARP  tus
-----------  --- --- ---  ----- ----- ---- ---- ---- ----- ---  ---
ATM 2/0.1      1   0   1  PVC  AUTO  UBR     0    0     0  No   UP
ATM 2/0.2      2   0   2  PVC  AUTO  UBR     0    0     0  No   UP
ATM 2/1.1      1   0   1  PVC  SNAP  UBR-PCR  512 0     0  No   UP
ATM 2/1.2      2   0   2  PVC  SNAP  UBR-PCR  256 0     0  No   UP
ATM 2/2.1      1   0   1  PVC  SNAP  NRT-VBR  512 256   10 No   DOWN
ATM 2/2.2      2   0   2       SNAP  NRT-VBR  256 128   5  No   DOWN
ATM 2/2.5      5   0   5       SNAP  NRT-VBR  128 64    2  No   DOWN
ATM 2/3.1      1   0   1       SNAP  CBR     1024 0     0  No   DOWN
ATM 2/3.2      2   0   2       SNAP  CBR      512 0     0  No   DOWN
ATM 2/3.5      5   0   5       SNAP  CBR      256 0     0  No   DOWN
ATM 2/3.6      6   0   6       SNAP  CBR      128 0     0  No   DOWN
10 circuit(s) found that match filter criteria
```

- Example 3 – displays VCs that are assigned the service category NRT-VBR

```
host1#show atm vc vpi 0 category nrt-vbr
                              Cate                        In   Sta
Interface  VCD VPI VCI  Encap  gory     Peak  Avg  Burst  ARP  tus
---------  --- --- ---  -----  -------  ----  ---  -----  ---  ----
ATM 2/2.1    1   0   1  SNAP   NRT-VBR   512  256     10   No  DOWN
ATM 2/2.2    2   0   2  SNAP   NRT-VBR   256  128      5   No  DOWN
ATM 2/2.5    5   0   5  SNAP   NRT-VBR   128   64      2   No  DOWN
3 circuit(s) found that match filter criteria
```

- Example 4 – displays VCs that have a status of up

```
host1#show atm vc vpi 0 category ubr status up
                                Cate                      In   Sta
Interface  VCD  VPI  VCI  Encap  gory    Peak  Avg  Burst  ARP  tus
---------  ---  ---  ---  -----  ----    ----  ---  -----  ---  ---
ATM 2/0.1    1    0    1  QSAAL  UBR        0    0      0   No  UP
ATM 2/0.2    2    0    2  QSAAL  UBR        0    0      0   No  UP
ATM 4/0.1    1    0    1  SNAP   UBR        0    0      0   No  UP
ATM 4/0.2    2    0    2  SNAP   UBR        0    0      0   No  UP
ATM 2/1.100 100   0  100  SNAP   UBR        0    0      0   No  UP
5 circuit(s) found that match filter criteria
```

show atm vc atm

- Use to display information about a specific VC. You specify the interface in the format: *slot/port.* To specify the circuit, enter the VCD or use the **vpi-vci** keyword and enter the VPI and VCI.
- Field descriptions
  - VCD – virtual circuit descriptor
  - VPI – virtual path identifier
  - VCI – virtual channel identifier
  - Encap – encapsulation method
  - Service Type – service type configured on the VC: UBR, UBR-PCR, NRT-VBR, RT-VBR, CBR
  - Inverse ARP enable – whether or not Inverse ARP is enabled: yes, no
  - InPackets – number of packets received on this circuit
  - InBytes – number of bytes received on this circuit
  - InCells – number of ATM cells received on this circuit
  - OutPackets – number of packets transmitted on this circuit
  - OutBytes – number of bytes transmitted on this circuit
  - OutCells – number of ATM cells transmitted on this circuit
  - InErrors – number of errors received on this circuit
  - OutErrors – number of outgoing errors on this circuit
  - InPacketDiscards – number of incoming packets discarded on this circuit
  - InByteDiscards – number of incoming bytes discarded on this circuit
  - CrcErrors – number of CRC errors detected on this circuit
  - SAR time-outs – number of segmentation and reassembly (SAR) time-outs reached on this circuit
  - Over-sized SDUs – Number of oversized service data units (SDUs) received on this circuit
  - OAM VC verification – whether OAM verification is enabled or disabled
  - OAM loopback cell status:
    - disabled – VC integrity disabled for VC
    - sent – OAM loopback cell sent; waiting for response
    - received – OAM loopback cell response received
    - failed – OAM loopback reply not received within frequency period, or reply contained a bad correlation tag
  - OAM VC status:
    - AIS – VC is in AIS state
    - RDI – VC is in RDI state
    - Down Retry – OAM loopback failed; using retry frequency to verify that the VC is really down
    - Down – OAM loopback failed after Down Retry verification
    - Up Retry – OAM loopback successful; using retry frequency to verify that the VC is really up

- Up – OAM loopback successful after Up Retry verification
- Not Managed – VC integrity is not enabled

› OAM loopback frequency – frequency with which OAM loopback cells are transmitted (when enabled) in seconds

› OAM up retry count – number of consecutive successfully looped OAM cells required to mark the VC as Up

› OAM down retry count – number of consecutive unsuccessfully looped OAM cells required to mark the VC as Down

› OAM loopback retry frequency – frequency with which OAM cells are transmitted in verification mode, in seconds

› OAM CC verification – whether CC verification is enabled or disabled

› OAM CC Type – whether the VC is a sink, source, or both sink and source end point

› OAM CC Flow Type – end to end or segment

› OAM Current CC state

- Ready – OAM CC is not enabled
- Active – OAM CC cell flow is running
- Activation Failed – OAM CC activation failed
- Wait Activate – waiting for interface to come up before the software sends the activation request
- Wait Activation Confirmation – waiting for activation confirmation from the peer
- Wait DeActivate – waiting for interface to come up before the software sends the deactivation request
- Wait DeActivation Confirmation – waiting for deactivation confirmation from the peer

› InOamF5Cells – number of F5 OAM cells received on this circuit

› InOamCellDiscards – number of received OAM cells that were dropped or flushed; dropped cells include unsupported and invalid F5 cells

› InF5EndLoopCells – number of F5 end-to-end loopback cells received on this circuit

› InF5SegLoopCells – number of F5 segment loopback cells received on this circuit

› InF5EndAisCells – number of F5 end-to-end AIS cells received on this circuit

› InF5SegAisCells – number of F5 segment AIS cells received on this circuit

› InF5EndRdiCells – number of F5 end-to-end RDI cells received on this circuit

› InF5SegRdiCells – number of F5 segment RDI cells received on this circuit

› InF5EndCCActDeActCells – number of F5 end-to-end activation and deactivation CC cells received on this circuit

› InF5SegCCActDeActCells – number of F5 segment activation and deactivation CC cells received on this circuit

› InF5EndCCCells – number of F5 end-to-end CC cells received on this circuit

› InF5SegCCCells – number of F5 segment CC cells received on this circuit

- OutOamF5Cells – number of F5 OAM cells transmitted on this circuit
- OutF5EndLoopCells – number of F5 end-to-end loopback cells transmitted on this circuit
- OutF5SegLoopCells – number of F5 segment loopback cells transmitted on this circuit
- OutF5EndRdiCells – number of F5 end-to-end RDI cells transmitted on this circuit
- OutF5SegRdiCells – number of F5 segment RDI cells transmitted on this circuit
- OutF5EndCCActDeActCells – number of F5 end-to-end activation and deactivation CC cells transmitted on this circuit
- OutF5SegCCActDeActCells – number of F5 segment activation and deactivation CC cells transmitted on this circuit
- OutF5EndCCCells – number of F5 end-to-end CC cells transmitted on this circuit
- OutF5SegCCCells – number of F5 segment CC cells transmitted on this circuit
- Circuit is Up/Down – shows status of the circuit and time since the status of the circuit last changed

```
host1#show atm vc atm 2/0.1 46 47
ATM 2/0.1.1: VCD: 45, VPI: 46, VCI: 47, Encap: AAL5-AUTO
Service Type: Ubr
Inverse ARP enable: No
InPackets:         0
InBytes:           0
InCells:           0
OutPackets:        0
OutBytes:          0
OutCells:          0
InErrors:          0
OutErrors:         0
InPacketDiscards:  0
InByteDiscards:    0
CrcErrors:         0
SAR time-outs:     0
Over-sized SDUs:   0
OAM VC verification: enabled
OAM loopback cell status: sent
OAM VC status: up
OAM loopback frequency: 20 second interval
OAM up retry count: 3, OAM down retry count: 5
OAM loopback retry frequency: 20 second interval
OAM CC verification: enabled
OAM CC Type : CC Both Sink and Source End Point
OAM CC Flow Type: End To End
OAM Current CC state: Wait Activation Confirmation
```

```
InOamF5Cells:      2
InOamCellDiscards: 0
InF5EndLoopCells:  2
InF5SegLoopCells:  0
InF5EndAisCells:        49
InF5SegAisCells:        0
InF5EndRdiCells:        0
InF5SegRdiCells:        0
InF5EndCCActDeActCells: 0
InF5SegCCActDeActCells: 0
InF5EndCCCells:         0
InF5SegCCCells:         0
OutOamF5Cells:     2
OutF5EndLoopCells: 2
OutF5SegLoopCells: 0
OutF5EndRdiCells:       50
OutF5SegRdiCells:       0
OutF5EndCCActDeActCells:1
OutF5SegCCActDeActCells:0
OutF5EndCCCells:        1
OutF5SegCCCells:        0
Circuit is Up, time since last change: 5 days, 23 hours
```

show atm vp-tunnel

- Use to display a summary of all configured ATM virtual path tunnels.
- Field descriptions
  - Intfc – interface number
  - VPI – virtual path identifier
  - Kbps – rate in Kbps
- Example

```
host1#show atm vp-tunnel 9/1
Intfc    VPI  Kbps
ATM 9/1  2    4096
```

show nbma arp

- Use to display ARP table entries for ATM NBMA interfaces.
- Field descriptions
  - IP Address – IP address of the entry
  - VPI/VCI – VPI and VCI of the entry
  - Interface – interface specifier of the entry

- Example

```
host1#show nbma arp
                NBMA ARP Table Entries
IP Address              VPI/VCI         Interface
1.1.1.2                 0/100           4/1
2.2.2.2                 0/101           4/1
```