



Configuring ATM

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This chapter describes how to configure ATM on Cisco routers.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

How to Configure ATM

To configure ATM, complete the tasks in the following sections. The first task is required, and then you must configure at least one PVC or SVC. The virtual circuit options you configure must match in three places: on the router, on the ATM switch, and at the remote end of the PVC or SVC connection. The remaining tasks are optional.

- [Enabling the ATM Interface](#) (required)
- [Configuring PVCs](#) (required)
- [Configuring SVCs](#) (required)
- [Configuring VC Classes](#) (optional)
- [Configuring VC Management](#) (optional)
- [Configuring Classical IP and ARP over ATM](#) (optional)
- [Customizing the ATM Interface](#) (optional)
- [Configuring ATM Subinterfaces for SMDs Networks](#) (optional)
- [Configuring Fast-Switched Transparent Bridging for SNAP PVCs](#) (optional)



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- [Configuring Inverse Multiplexing over ATM](#) (optional)
- [Configuring ATM E.164 Auto Conversion](#) (optional)
- [Configuring Circuit Emulation Services](#) (optional)
- [Configuring ATM Access over a Serial Interface](#) (optional)
- [Troubleshooting the ATM Interface](#) (optional)
- [Monitoring and Maintaining the ATM Interface](#) (optional)

**Note**

Beginning Cisco IOS Release 11.3, all commands supported on the Cisco 7500 series routers are also supported on Cisco 7000 series routers equipped with RSP7000.

Enabling the ATM Interface

This section describes how to configure an ATM interface. For the Advanced Inspection and Prevention Security Services (AIP), all ATM port adapters, and the 1-port ATM-25 network module, the port number is always 0. For example, the *slot/port* address of an ATM interface on an AIP installed in slot 1 is 1/0.

Perform the following task to enable the ATM interface:

	Command	Purpose
Step 1	Router# configure terminal	Enters global configuration mode from the terminal.
Step 2	Router(config)# interface atm <i>slot/0</i> or Router(config)# interface atm <i>slot/port-adapter/0</i> or Router(config)# interface atm <i>number</i>	Specifies the ATM interface using the appropriate format of the interface atm command. To determine the correct form of the interface atm command, consult your ATM network module, port adapter, or router documentation.
Step 3	Router(config-if)# ip address <i>ip-address mask</i>	(Optional) If IP routing is enabled on the system, assigns a source IP address and subnet mask to the interface.

To enable the ATM interface, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# no shutdown	Changes the shutdown state to up and enables the ATM interface, thereby beginning the segmentation and reassembly (SAR) operation on the interface.

The **no shutdown** command passes an **enable** command to the ATM interface, which then begins segmentation and reassembly (SAR) operations. It also causes the ATM interface to configure itself based on the previous configuration commands sent.

Configuring PVCs

To use a permanent virtual circuit (PVC), you must configure the PVC into both the router and the ATM switch. PVCs remain active until the circuit is removed from either configuration.



Note

If you use PVC discovery, you do not have to configure the PVC on the router. Refer to the section “[Configuring PVC Discovery](#)” for more information.

When a PVC is configured, all the configuration options are passed on to the ATM interface. These PVCs are writable into the nonvolatile RAM (NVRAM) as part of the Route Processor (RP) configuration and are used when the RP image is reloaded.

Some ATM switches might have point-to-multipoint PVCs that do the equivalent task of broadcasting. If a point-to-multipoint PVC exists, then that PVC can be used as the sole broadcast PVC for all multicast requests.

To configure a PVC, perform the tasks in the following sections. The first two tasks are required; the other tasks are optional.

- [Creating a PVC](#) (required)
- [Mapping a Protocol Address to a PVC](#) (required)
- [Configuring the AAL and Encapsulation Type](#) (optional)
- [Configuring PVC Traffic Parameters](#) (optional)
- [Configuring PVC Discovery](#) (optional)
- [Enabling Inverse ARP](#) (optional)
- [Configuring Generation of End-to-End F5 OAM Loopback Cells to Verify Connectivity](#) (optional)
- [Configuring Broadcast on a PVC](#) (optional)
- [Assigning a VC Class to a PVC](#) (optional)
- [Configuring PVC Trap Support](#) (optional)

Creating a PVC

To create a PVC on the ATM interface and enter interface-ATM-VC configuration mode, use the following command beginning in interface configuration mode:

Command	Purpose
Router(config-if)# pvc [<i>name</i>] <i>vpi/vci</i> [<i>ilmi</i> <i>qsaal</i> <i>smds</i>]	Configures a new ATM PVC by assigning a name (optional) and VPI/VCI numbers. Enters interface-ATM-VC configuration mode. Optionally configures ILMI, QSAAL, or SMDS encapsulation.



Note

After configuring the parameters for an ATM PVC, you must exit interface-ATM-VC configuration mode in order to create the PVC and enable the settings.

Once you specify a name for a PVC, you can reenter the interface-ATM-VC configuration mode by simply entering **pvc** *name*.

**Note**

The **ilmi** keyword in the **pvc** command is used for setting up an ILMI PVC in an SVC environment. Refer to the section “Configuring Communication with the ILMI” later in this chapter for more information.

See examples of PVC configurations in the section “[ATM Configuration Examples](#)” at the end of this chapter.

Mapping a Protocol Address to a PVC

The ATM interface supports a static mapping scheme that identifies the network address of remote hosts or routers. This section describes how to map a PVC to an address, which is a required task for configuring a PVC.

To map a protocol address to a PVC, use the following command in interface-ATM-VC configuration mode:

Command	Purpose
Router(config-if-atm-vc)# protocol <i>protocol</i> <i>protocol-address</i> [no] broadcast	Maps a protocol address to a PVC.

**Note**

If you enable or disable broadcasting directly on a PVC using the **protocol** command, this configuration will take precedence over any direct configuration using the **broadcast** command.

See examples of PVC configurations in the section “[ATM Configuration Examples](#)” at the end of this chapter.

Configuring the AAL and Encapsulation Type

To configure the ATM adaptation layer (AAL) and encapsulation type, use the following command beginning in interface-ATM-VC configuration mode:

Command	Purpose
Router(config-if-atm-vc)# encapsulation aal5 <i>encap</i>	Configures the ATM adaptation layer (AAL) and encapsulation type.

For a list of AAL types and encapsulations supported for the *aal-encap* argument, refer to the **encapsulation aal5** command in the “ATM Commands” chapter of the [Cisco IOS Asynchronous Transfer Mode Command Reference](#). The global default is AAL5 with SNAP encapsulation.

Configuring PVC Traffic Parameters

The supported traffic parameters are part of the following service categories: Available Bit Rate (ABR), Unspecified Bit Rate (UBR), UBR+, Variable Bit Rate Non Real-Time (VBR-NRT), and real-time Variable Bit Rate (VBR). Only one of these categories can be specified per PVC connection, so if a new one is entered, it will replace the existing one.

To configure PVC traffic parameters, use one of the following commands beginning in interface-ATM-VC configuration mode:

Command	Purpose
Router(config-if-atm-vc)# abr <i>output-pcr output-mcr</i>	Configures the Available Bit Rate (ABR). (ATM-CES port adapter and Multiport T1/E1 ATM Network Module only.)
Router(config-if-atm-vc)# ubr <i>output-pcr</i>	Configures the Unspecified Bit Rate (UBR).
Router(config-if-atm-vc)# ubr+ <i>output-pcr output-mcr</i>	Configures the UBR and a minimum guaranteed rate.
Router(config-if-atm-vc)# vbr-nrt <i>output-pcr output-scr output-mbs</i>	Configures the Variable Bit Rate-Non Real Time (VBR-NRT) QOS.
Router(config-if-atm-vc)# vbr-rt <i>peak-rate average-rate burst</i>	Configures the real-time Variable Bit Rate (VBR). (Cisco MC3810 and Multiport T1/E1 ATM Network Module only.)

The *-pcr* and *-mcr* arguments are the peak cell rate and minimum cell rate, respectively. The *-scr* and *-mbs* arguments are the sustainable cell rate and maximum burst size, respectively.

For an example of how to configure an ABR PVC, refer to the section “[Example: Configuring an ABR PVC](#)” at the end of this chapter.

For a description of how to configure traffic parameters in a VC class and apply the VC class to an ATM interface or subinterface, refer to the section “[Configuring VC Classes](#).”



Note

The commands in this section are not supported on the ATM port adapter (PA-A1 series). The ABR service class is only supported on the ATM-CES port adapter for PVCs. The 1-port ATM-25 network module only supports UBR.

For ABR VCs, you can optionally configure the amount that the cell transmission rate increases or decreases in response to flow control information from the network or destination. To configure this option, use the following command in interface-ATM-VC configuration mode:

Command	Purpose
Router(config-if-atm-vc)# atm abr rate-factor <i>[rate-increase-factor] [rate-decrease-factor]</i>	Specifies the ABR rate factors. The default increase and decrease rate factors is 1/16.

For an example of configuring an ABR PVC, see the section “[Example: Configuring an ABR PVC](#)” later in this chapter.

Configuring PVC Discovery

You can configure your router to automatically discover PVCs that are configured on an attached adjacent switch. The discovered PVCs and their traffic parameters are configured on an ATM main interface or subinterface that you specify. Your router receives the PVC parameter information using Interim Local Management Interface (ILMI).

To configure PVC discovery on an ATM interface, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/0 or Router(config)# interface atm slot/port-adapter/0 or Router(config)# interface atm number	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	Router(config-if)# pvc [name] 0/16 ilmi	Configures an ILMI PVC on the main interface.
Step 3	Router(config-if-atm-vc)# exit	Returns to interface configuration mode.
Step 4	Router(config-if)# atm ilmi-pvc-discovery [subinterface]	Configures PVC Discovery on the main interface and optionally specifies that discovered PVCs will be assigned to a subinterface.
Step 5	Router(config-if)# exit	Returns to global configuration mode.
Step 6	Router(config)# interface atm slot/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm slot/port-adapter/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm number[.subinterface-number {multipoint point-to-point}]	Specifies the ATM main interface or subinterface that discovered PVCs will be assigned to.
Step 7	Router(config-subif)# ip address ip-address mask	(Optional) Specifies the protocol address for the subinterface.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

Use the **subinterface** keyword in Step 4 if you want the discovered PVCs to reside on an ATM subinterface that you specify in Step 6. The discovered PVCs are assigned to the subinterface number that matches the VPI number of the discovered PVC. For example, if subinterface 2/0.1 is specified using the **interface atm** command in Step 6, then all discovered PVCs with a VPI value of 1 will be assigned to this subinterface. For an example, see the section “[Example: Configuring PVC Discovery](#)” later in this chapter.

Repeat Steps 6 and 7 if you want discovered PVCs to be assigned to more than one subinterface. If no subinterfaces are configured, discovered PVCs will be assigned to the main interface specified in Step 1.

For an example of configuring PVC discovery, refer to the section “[Example: Configuring PVC Discovery](#)” at the end of this chapter.

Enabling Inverse ARP

Inverse ARP is enabled by default when you create a PVC using the **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 ATM Inverse ARP packets.

Inverse ARP is supported on PVCs running IP or IPX and no static map is configured. If a static map is configured, Inverse ARP will be disabled.

To enable Inverse ARP on an ATM PVC, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	<pre>Router(config)# interface atm slot/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm slot/port-adapter/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm number[.subinterface-number {multipoint point-to-point}]</pre>	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	<pre>Router(config-if)# pvc [name] vpi/vci</pre>	Specifies an ATM PVC by name (optional) and VPI/VCI numbers.
Step 3	<pre>Router(config-if-atm-vc)# encapsulation aal5snap</pre>	Configures AAL5 LLC-SNAP encapsulation if it is not already configured.
Step 4	<pre>Router(config-if-atm-vc)# inarp minutes</pre>	(Optional) Adjusts the Inverse ARP time period.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

When PVC discovery is enabled on an active PVC and the router terminates that PVC, the PVC will generate an ATM Inverse ARP request. This allows the PVC to resolve its own network addresses without configuring a static map.

Address mappings learned through Inverse ARP are aged out. However, mappings are refreshed periodically. This period is configurable using the **inarp** command, which has a default of 15 minutes.

You can also enable Inverse ARP using the **protocol** command. This is necessary only if you disabled Inverse ARP using the **no protocol** command. For more information about this command, refer to the “ATM Commands” chapter in the *Cisco IOS Asynchronous Transfer Mode Command Reference*.

For an example of configuring Inverse ARP, see the section “[Example: Enabling Inverse ARP](#)” at the end of this chapter.

Configuring Generation of End-to-End F5 OAM Loopback Cells to Verify Connectivity

You can optionally configure the PVC to generate end-to-end F5 OAM loopback cells to verify connectivity on the virtual circuit. The remote end must respond by echoing back such cells. If OAM response cells are missed (indicating the lack of connectivity), the PVC state goes down. If all the PVCs on a subinterface go down, the subinterface goes down.

To configure transmission of end-to-end F5 OAM cells on a PVC, use the following commands in interface-ATM-VC configuration mode:

	Command	Purpose
Step 1	Router(config-if-atm-vc)# oam-pvc [manage] <i>frequency</i>	Configures transmission of end-to-end F5 OAM loopback cells on a PVC, specifies how often loopback cells should be sent, and optionally enables OAM management of the connection.
Step 2	Router(config-if-atm-vc)# oam retry <i>up-count</i> <i>down-count</i> <i>retry-frequency</i>	(Optional) Specifies OAM management parameters for verifying connectivity of a PVC connection. This command is only supported if OAM management is enabled.

Use the *up-count* argument to specify the number of consecutive end-to-end F5 OAM loopback cell responses that must be received in order to change a PVC connection state to up. Use the *down-count* argument to specify the number of consecutive end-to-end F5 OAM loopback cell responses that are not received in order to tear down a PVC. Use the *retry-frequency* argument to specify the frequency (in seconds) that end-to-end F5 OAM loopback cells should be transmitted when a change in UP/DOWN state is being verified. For example, if a PVC is up and a loopback cell response is not received after the *frequency* (in seconds) specified using the **oam-pvc** command, then loopback cells are sent at the *retry-frequency* to verify whether or not the PVC is down.

For information about managing PVCs using OAM, see the section “[Configuring OAM Management](#)” later in this chapter.

For an example of OAM loopback cell generation, see the section “[Example: Configuring Generation of End-to-End F5 OAM Loopback Cells](#)” at the end of this chapter.

Configuring Broadcast on a PVC

To send duplicate broadcast packets for all protocols configured on a PVC, use the following command in interface-ATM-VC configuration mode:

Command	Purpose
Router(config-if-atm-vc)# broadcast	Sends duplicate broadcast packets for all protocols configured on a PVC.



Note

If you enable or disable broadcasting directly on a PVC using the **protocol** command, this configuration will take precedence over any direct configuration using the **broadcast** command.

Assigning a VC Class to a PVC

By creating a VC class, you can preconfigure a set of default parameters that you may apply to a PVC. To create a VC class, refer to the section “[Configuring VC Classes](#)” later in this chapter.

Once you have created a VC class, use the following command in interface-ATM-VC configuration mode to apply the VC class to a PVC:

Command	Purpose
Router(config-if-atm-vc) # class-vc <i>vc-class-name</i>	Applies a VC class to a PVC.

The *vc-class-name* argument is the same as the *name* argument you specified when you created a VC class using the **vc-class atm** command. Refer to the section “[Configuring VC Classes](#)” later in this chapter for a description of how to create a VC class.

Configuring PVC Trap Support

You can configure the PVC to provide failure notification by sending a trap when a PVC on an ATM interface fails or leaves the UP operational state.

PVC Failure Notification

Only one trap is generated per hardware interface, within the specified interval defined by the interval “*atmIntPvcNotificationInterval*”. If other PVCs on the same interface go DOWN during this interval, traps are generated and held until the interval has elapsed. Once the interval has elapsed, the traps are sent if the PVCs are still DOWN.

No trap is generated when a PVC returns to the UP state after having been in the DOWN state. If you need to detect the recovery of PVCs, you must use the SNMP management application to regularly poll your router.

PVC Status Tables

When PVC trap support is enabled, the SNMP manager can poll the SNMP agent to get PCV status information. The table “*atmInterfaceExtTable*” provides PVC status on an ATM interface. The table “*atmCurrentlyFailingPvcTable*” provides currently failing and previously failed PVC time-stamp information.



Note

PVC traps are only supported on permanent virtual circuit links (PVCLs), and not on permanent virtual path links (PVPLs).

Prerequisites

Before you enable PVC trap support, you must configure SNMP support and an IP routing protocol on your router. See the “[ATM Configuration Examples](#)” section later in this document. For more information about configuring SNMP support, refer to the chapter “Configuring SNMP Support” in the *Cisco IOS Configuration Fundamentals Configuration Guide*. For information about configuring IP routing protocols, refer to the section “IP Routing Protocols” in the *Cisco IOS IP Configuration Guide*.

To receive PVC failure notification and access to PVC status tables on your router, you must have the Cisco PVC trap MIB called CISCO-IETF-ATM2-PVCTRAP-MIB.mib compiled in your NMS application. You can find this MIB on the Web at Cisco’s MIB website that has the URL <http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>.

Enabling PVC Trap Support

When you configure PVC trap support, you must also enable OAM management on the PVC. To enable PVC trap support and OAM management, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# snmp-server enable traps atm pvc interval <i>seconds</i> fail-interval <i>seconds</i>	Enables PVC trap support.
Step 2	Router(config)# interface atm <i>slot/0[.subinterface-number {multipoint </i> <i>point-to-point}]</i> or Router(config)# interface atm <i>slot/port-adapter/0[.subinterface-number {multipoint</i> <i> point-to-point}]</i> or Router(config)# interface atm <i>number[.subinterface-number {multipoint </i> <i>point-to-point}]</i>	Specifies the ATM interface using the appropriate form of the interface atm command. ¹
Step 3	Router(config-if)# pvc [<i>name</i>] <i>vpi/vci</i>	Enables the PVC.
Step 4	Router(config-if-atm-vc)# oam-pvc manage	Enables end-to-end OAM management for an ATM PVC.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

For more information on OAM management, see the section “[Configuring OAM Management](#)” later in this chapter.

The new objects in this feature are defined in the IETF draft *The Definitions of Supplemental Managed Objects for ATM Management*, which is an extension to the AToM MIB (RFC 1695).

For an example of configuring PVC trap support, see the section “[Example: Configuring PVC Trap Support](#)” at the end of this chapter.

Configuring SVCs

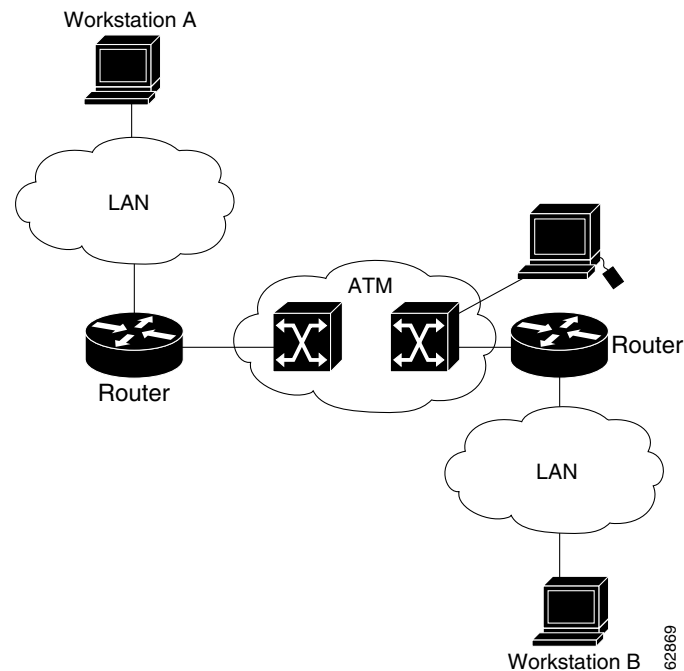
ATM switched virtual circuit (SVC) service operates much like X.25 SVC service, although ATM allows much higher throughput. Virtual circuits are created and released dynamically, providing user bandwidth on demand. This service requires a signaling protocol between the router and the switch.

The ATM signaling software provides a method of dynamically establishing, maintaining, and clearing ATM connections at the User-Network Interface (UNI). The ATM signaling software conforms to ATM Forum UNI 3.0 or ATM Forum UNI 3.1 depending on what version is selected by ILMI or configuration.

In UNI mode, the user is the router and the network is an ATM switch. This is an important distinction. The Cisco router does not perform ATM-level call routing. Instead, the ATM switch does the ATM call routing, and the router routes packets through the resulting circuit. The router is viewed as the user and the LAN interconnection device at the end of the circuit, and the ATM switch is viewed as the network.

Figure 1 illustrates the router position in a basic ATM environment. The router is used primarily to interconnect LANs via an ATM network. The workstation connected directly to the destination ATM switch illustrates that you can connect not only routers to ATM switches, but also any computer with an ATM interface that conforms to the ATM Forum UNI specification.

Figure 1 Basic ATM Environment



To use SVCs, complete the tasks in the following sections:

- [Configuring Communication with the ILMI](#) (required)
- [Configuring the PVC That Performs SVC Call Setup](#) (required)
- [Configuring the NSAP Address](#) (required)
- [Creating an SVC](#) (required)

The tasks in the following sections are optional SVC tasks for customizing your network. These tasks are considered advanced; the default values are almost always adequate. You need perform these tasks unless you need to customize your particular SVC connection.

- [Configuring ATM UNI Version Override](#) (optional)
- [Configuring the Idle Timeout Interval](#) (optional)
- [Configuring Point-to-Multipoint Signaling](#) (optional)
- [Configuring IP Multicast over ATM Point-to-Multipoint Virtual Circuits](#) (optional)
- [Configuring SVC Traffic Parameters](#) (optional)
- [Configuring Strict Traffic Shaping](#) (optional)
- [Configuring Generation of End-to-End F5 OAM Loopback Cells to Verify Connectivity](#) (optional)
- [Configuring Broadcast on an SVC](#) (optional)
- [Assigning a VC Class to an SVC](#) (optional)

- [Configuring SSCOP](#) (optional)
- [Closing an SVC](#) (optional)

**Note**

SVCs are not supported on the 1-port ATM-25 network module.

Configuring Communication with the ILMI

In an SVC environment, you must configure a PVC for communication with the Integrated Local Management Interface (ILMI) so that the router can receive SNMP traps and new network prefixes. The recommended *vpi* and *vci* values for the ILMI PVC are 0 and 16, respectively. To configure ILMI communication, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# pvc [name] 0/16 ilmi	Creates an ILMI PVC on an ATM main interface.

**Note**

This ILMI PVC can be set up only on an ATM main interface, not on ATM subinterfaces.

Once you have configured an ILMI PVC, you can optionally enable the ILMI keepalive function by using the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm ilmi-keepalive [seconds]	Enables ILMI keepalives and sets the interval between keepalives.

No other configuration steps are required.

ILMI address registration for receipt of SNMP traps and new network prefixes is enabled by default. The ILMI keepalive function is disabled by default; when enabled, the default interval between keepalives is 3 seconds.

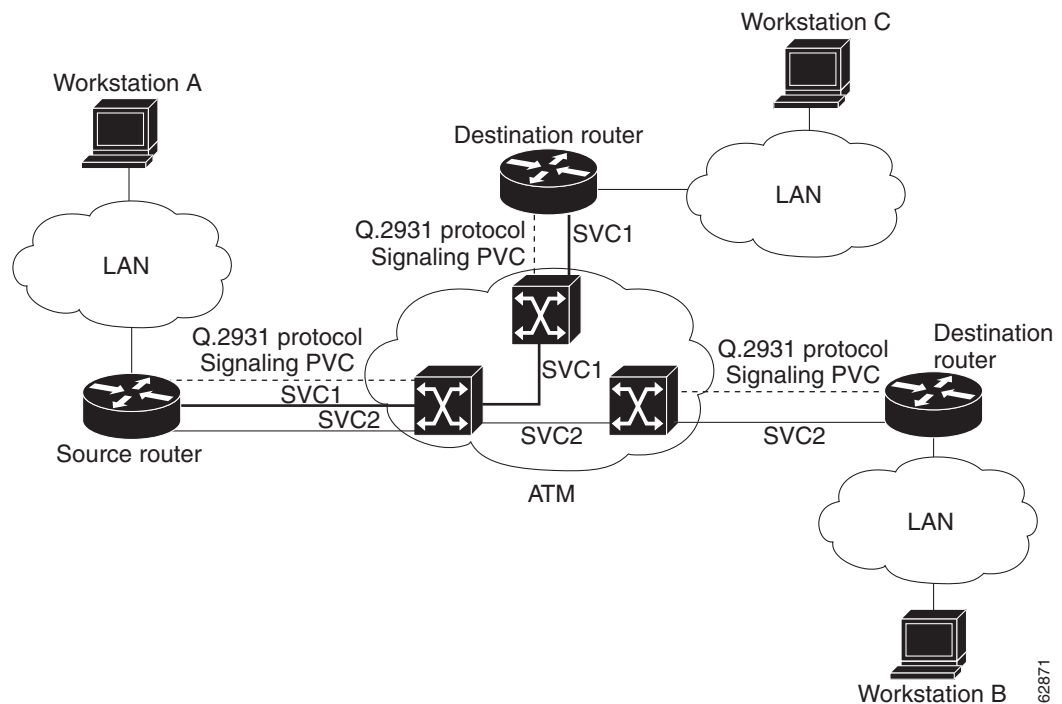
For an example of configuring ILMI, see the section “[Example: Configuring Communication with the ILMI](#)” in the “[ATM Configuration Examples](#)” section at the end of this chapter.

Configuring the PVC That Performs SVC Call Setup

Unlike X.25 service, which uses in-band signaling (connection establishment done on the same circuit as data transfer), ATM uses out-of-band signaling. One dedicated PVC exists between the router and the ATM switch, over which all SVC call establishment and call termination requests flow. After the call is established, data transfer occurs over the SVC, from router to router. The signaling that accomplishes the call setup and teardown is called *Layer 3 signaling* or the *Q.2931 protocol*.

For out-of-band signaling, a signaling PVC must be configured before any SVCs can be set up. [Figure 2](#) illustrates that a signaling PVC from the source router to the ATM switch is used to set up two SVCs. This is a fully meshed network; workstations A, B, and C all can communicate with each other.

Figure 2 **One or More SVCs Require a Signaling PVC**



To configure the signaling PVC for all SVC connections, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# pvc [name] vpi/vci qsaal	Configures the signaling PVC for an ATM main interface that uses SVCs.



Note

This signaling PVC can be set up only on an ATM main interface, not on ATM subinterfaces.

The VPI and VCI values must be configured consistently with the local switch. The standard values for VPI and VCI are 0 and 5, respectively.

See the section “[Example: SVCs in a Fully Meshed Network](#)” at the end of this chapter for a sample ATM signaling configuration.

Configuring the NSAP Address

Every ATM interface involved with signaling must be configured with a network service access point (NSAP) address. The NSAP address is the ATM address of the interface and must be unique across the network.

To configure an NSAP address, complete the tasks described in one of the following sections:

- [Configuring the ESI and Selector Fields](#)
- [Configuring the Complete NSAP Address](#)

Configuring the ESI and Selector Fields

If the switch is capable of delivering the NSAP address prefix to the router by using ILMI, and the router is configured with a PVC for communication with the switch via ILMI, you can configure the endstation ID (ESI) and selector fields using the **atm esi-address** command. The **atm esi-address** command allows you to configure the ATM address by entering the ESI (12 hexadecimal characters) and the selector byte (2 hexadecimal characters). The NSAP prefix (26 hexadecimal characters) is provided by the ATM switch.

To configure the router to get the NSAP prefix from the switch and use locally entered values for the remaining fields of the address, use the following commands beginning in interface configuration mode:

	Command	Purpose
Step 1	Router(config-if)# pvc [name] 0/16 ilmi	Configures an ILMI PVC on an ATM main interface for communicating with the switch by using ILMI.
Step 2	Router(config-if-atm-vc)# exit	Returns to interface configuration mode.
Step 3	Router(config-if)# atm esi-address esi.selector	Enters the ESI and selector fields of the NSAP address.

The recommended *vpi* and *vci* values for the ILMI PVC are 0 and 16, respectively.

You can also specify a keepalive interval for the ILMI PVC. See the “[Configuring Communication with the ILMI](#)” section earlier in this chapter for more information.

To see an example of setting up the ILMI PVC and assigning the ESI and selector fields of an NSAP address, see the section “[Example: SVCs with Multipoint Signaling](#)” at the end of this chapter.

Configuring the Complete NSAP Address

When you configure the ATM NSAP address manually, you must enter the entire address in hexadecimal format because each digit entered represents a hexadecimal digit. To represent the complete NSAP address, you must enter 40 hexadecimal digits in the following format:

```
XX.XXXX.XX.XXXXXX.XXXX.XXXX.XXXX.XXXX.XXXX.XX
```



Note

All ATM NSAP addresses may be entered in the dotted hexadecimal format shown, which conforms to the UNI specification. The dotted method provides some validation that the address is a legal value. If you know your address format is correct, the dots may be omitted.

Because the interface has no default NSAP address, you must configure the NSAP address for SVCs. To set the ATM interface’s source NSAP address, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm nsap-address nsap-address	Configures the ATM NSAP address for an interface.

The **atm nsap-address** and **atm esi-address** commands are mutually exclusive. Configuring the router with the **atm nsap-address** command negates the **atm esi-address** setting, and vice versa. For information about using the **atm esi-address** command, see the preceding section “[Configuring the ESI and Selector Fields](#).”

See an example of assigning an NSAP address to an ATM interface in the section “[Example: ATM NSAP Address](#)” at the end of this chapter.

Creating an SVC

To create an SVC, use the following commands beginning in interface configuration mode.



Note

Cisco IOS software does not support creation of SVCs on a point-to-point subinterface.

	Command	Purpose
Step 1	Router(config-if)# svc [name] nsap address	Creates an SVC and specifies the destination NSAP address.
Step 2	Router(config-if-atm-vc)# encapsulation aal5 encap	(Optional) Configures the ATM adaptation layer (AAL) and encapsulation type.
Step 3	Router(config-if-atm-vc)# protocol protocol protocol-address [[no] broadcast]	Maps a protocol address to an SVC.

Once you specify a name for an SVC, you can reenter interface-ATM-VC configuration mode by simply entering the **svc name** command; you can remove an SVC configuration by entering the **no svc name** command.

For a list of AAL types and encapsulations supported for the *aal-encap* argument, refer to the **encapsulation aal5** command in the [Cisco IOS Asynchronous Transfer Mode Command Reference](#). The default is AAL5 with SNAP encapsulation.

Configuring ATM UNI Version Override

Normally, when ILMI link autodetermination is enabled on the interface and is successful, the router takes the user-network interface (UNI) version returned by ILMI. If the ILMI link autodetermination process is unsuccessful or ILMI is disabled, the UNI version defaults to 3.0. You can override this default by using the **atm uni-version** command. The **no** form of the command sets the UNI version to the one returned by ILMI if ILMI is enabled and the link autodetermination is successful. Otherwise, the UNI version will revert to 3.0. To override the ATM UNI version used by the router, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm uni-version version-number	Overrides UNI version used by router.

No other configuration steps are required.

Configuring the Idle Timeout Interval

You can specify an interval of inactivity after which any idle SVC on an interface is torn down. This timeout interval might help control costs and free router memory and other resources for other uses.

To change the idle timeout interval, use the following command in interface-ATM-VC configuration mode:

Command	Purpose
Router(config-if-atm-vc) # idle-timeout <i>seconds</i> [<i>minimum-rate</i>]	Configures the interval of inactivity, after which an idle SVC will be torn down.

In addition to configuring the interval of inactivity, you can optionally specify the minimum-rate in kilobits per second (kbps). This is the minimum traffic rate required on an ATM SVC to maintain the connection.

Configuring Point-to-Multipoint Signaling

Point-to-multipoint signaling (or multicasting) allows the router to send one packet to the ATM switch and have the switch replicate the packet to the destinations. It replaces pseudobroadcasting on specified virtual circuits for protocols configured for broadcasting.

You can configure multipoint signaling on an ATM interface after you have mapped protocol addresses to NSAPs and configured one or more protocols for broadcasting.

After multipoint signaling is set, the router uses the SVC configurations that have the **broadcast** keyword set to establish multipoint calls. The call is established to the first destination with a Setup message. Additional parties are added to the call with AddParty messages each time a multicast packet is sent. One multipoint call will be established for each logical subnet of each protocol that has the **broadcast** keyword set.

To configure multipoint signaling on an ATM interface, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config) # interface atm <i>slot</i> / <i>0</i> or Router(config) # interface atm <i>slot/port-adapter</i> / <i>0</i> or Router(config) # interface atm <i>number</i>	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	Router(config-if) # pvc [<i>name</i>] 0/5 qsaal	Configures the signaling PVC for an ATM main interface that uses SVCs.
Step 3	Router(config-if-atm-vc) # exit	Returns to interface configuration mode.
Step 4	Router(config-if-atm-vc) # pvc [<i>name</i>] 0/16 ilmi and Router(config-if-atm-vc) # exit	(Optional) Configures an ILMI PVC on an ATM main interface and returns to interface configuration mode. This task is required if you configure the ATM NSAP address in Step 5 by configuring the ESI and selector fields.

	Command	Purpose
Step 5	Router(config-if)# atm nsap-address <i>nsap-address</i>	Configures the complete NSAP address manually.
	or Router(config-if)# atm esi-address <i>esi.selector</i>	Configures the ESI and selector fields. To use this method, you must configure Step 4 first.
Step 6	Router(config-if)# svc [<i>name</i>] nsap <i>address</i>	Create san SVC and specifies the destination NSAP address. Enters interface-ATM-VC mode.
Step 7	Router(config-if-atm-vc)# protocol <i>protocol</i> <i>protocol-address</i> broadcast	Provides a protocol address for the interface and enables broadcasting.
Step 8	Router(config-if-atm-vc)# exit	Returns to interface configuration mode.
Step 9	Router(config-if)# atm multipoint-signalling	Enables multipoint signaling to the ATM switch.
Step 10	Router(config-if)# atm multipoint-interval interval	(Optional) Limits the frequency of sending AddParty messages.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

If multipoint virtual circuits are closed, they are reopened with the next multicast packet. Once the call is established, additional parties are added to the call when additional multicast packets are sent. If a destination never comes up, the router constantly attempts to add it to the call by means of multipoint signaling.

For an example of configuring multipoint signaling on an interface that is configured for SVCs, see the section “[Example: SVCs with Multipoint Signaling](#)” at the end of this chapter.

Configuring IP Multicast over ATM Point-to-Multipoint Virtual Circuits

This task is documented in the “Configuring IP Multicast Routing” chapter of the [Cisco IOS IP Configuration Guide](#).

Configuring SVC Traffic Parameters

The tasks in this section are optional and advanced. The ATM signaling software can specify to the ATM interface on the router and the switch a limit on how much traffic the source router will be sending. It provides this information in the form of traffic parameters. (These parameters have default values.) The ATM switch in turn sends these values as requested by the source to the ATM destination node. If the destination cannot provide such capacity levels, the call may fail. (For Cisco router series behavior, see the per-interface **atm sig-traffic-shaping strict** command in the [Cisco IOS Wide-Area Networking Command Reference](#).) There is a single attempt to match traffic values.

The supported traffic parameters are part of the following service categories: Unspecified bit rate (UBR), UBR+, and variable bit rate nonreal-time (VBR-NRT). Only one of these categories can be specified per SVC connection so if a new one is entered, it will replace the existing one. The commands used to specify the service category and traffic values are identical to those used when you create a PVC.

To configure traffic parameters on an SVC, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	<pre>Router(config)# interface atm slot/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm slot/port-adapter/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm number[.subinterface-number {multipoint point-to-point}]</pre>	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	<pre>Router(config-if)# svc [name] nsap address</pre>	Creates an SVC and specifies the destination NSAP address.
Step 3	<pre>Router(config-if-atm-vc)# protocol protocol protocol-address [[no] broadcast]</pre>	Maps a destination protocol address to an SVC.
Step 4	<pre>Router(config-if-atm-vc)# ubr output-pcr [input-pcr] or Router(config-if-atm-vc)# ubr+ output-pcr output-mcr [input-pcr] [input-mcr] or Router(config-if-atm-vc)# vbr-nrt output-pcr output-scr output-mbs [input-pcr] [input-scr] [input-mbs]</pre>	Configures the UBR. or Configures the UBR and a minimum guaranteed rate. or Configures the VBR-NRT QOS.
Step 5	<pre>Router(config-if-atm-vc)# exit</pre>	Returns to interface configuration mode and enables the traffic parameters on the SVC.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

**Note**

The commands in this section are not supported on the ATM port adapter (PA-A1 series). The 1-port ATM-25 network module only supports UBR.

The *-pcr* and *-mcr* arguments are the peak cell rate and minimum cell rate, respectively. The *-scr* and *-mbs* arguments are the sustainable cell rate and maximum burst size, respectively.

For an example of configuring traffic parameters on an SVC, see the section “[Example: Configuring SVC Traffic Parameters](#)” at the end of this chapter.

For a description of how to configure traffic parameters in a VC class and apply the VC class to an ATM interface or subinterface, refer to the section “[Configuring VC Classes](#).”

Configuring Strict Traffic Shaping

You can configure strict traffic shaping on an ATM interface to specify that an SVC be established using only signaled traffic parameters. If such shaping cannot be provided, the SVC is released.

To specify that an SVC be established on an ATM interface using only signaled traffic parameters, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm sig-traffic-shaping strict	Specifies that an SVC be established on an ATM interface using only signaled traffic parameters.

If you do not configure strict traffic shaping on the router ATM interface, an attempt is made to establish an SVC with traffic shaping for the transmit cell flow per the signaled traffic parameters. If such shaping cannot be provided, the SVC is installed with default shaping parameters; that is, it behaves as though a PVC were created without specifying traffic parameters.

Configuring Generation of End-to-End F5 OAM Loopback Cells to Verify Connectivity

You can optionally configure the SVC to generate end-to-end F5 OAM loopback cells to verify connectivity on the virtual circuit. The remote end must respond by echoing back such cells. If OAM response cells are missed (indicating the lack of connectivity), the SVC is torn down. For more information, refer to the “[Configuring OAM Management](#)” section later in this chapter.

To configure transmission of end-to-end F5 OAM loopback cells on an SVC, use the following commands in interface-ATM-VC configuration mode:

	Command	Purpose
Step 1	Router(config-if-atm-vc)# oam-svc [manage] <i>frequency</i>	Configures transmission of end-to-end F5 OAM loopback cells on an SVC, specifies how often loopback cells should be sent, and optionally enables OAM management of the connection.
Step 2	Router(config-if-atm-vc)# oam retry <i>up-count down-count retry-frequency</i>	(Optional) Specifies OAM management parameters for verifying connectivity of an SVC connection. This command is only supported if OAM management is enabled.

The *up-count* argument does not apply to SVCs, but it must be specified in order to configure the *down-count* and *retry-frequency*. Use the *down-count* argument to specify the number of consecutive end-to-end F5 OAM loopback cell responses that are not received in order to tear down an SVC. Use the *retry-frequency* argument to specify the frequency (in seconds) that end-to-end F5 OAM loopback cells should be transmitted when a change in UP/DOWN state is being verified. For example, if an SVC is up and a loopback cell response is not received after the *frequency* (in seconds) specified using the **oam-svc** command, then loopback cells are sent at the *retry-frequency* to verify whether or not the SVC is down.



Note

Generally, ATM signaling manages ATM SVCs. Configuring the **oam-svc** command on an SVC verifies the inband integrity of the SVC.

Configuring Broadcast on an SVC

To send duplicate broadcast packets or send a single broadcast packet using multipoint signaling for all protocols configured on an SVC, use the following command in interface-ATM-VC configuration mode:

Command	Purpose
Router(config-if-atm-vc) # broadcast	Sends duplicate broadcast packets for all protocols configured on an SVC.



Note

If you enable or disable broadcasting directly on an SVC using the **protocol** command, this configuration will take precedence over any direct configuration using the **broadcast** command.

Assigning a VC Class to an SVC

By creating a VC class, you can preconfigure a set of default parameters that you may apply to an SVC. To create a VC class, refer to the section “[Configuring VC Classes](#)” later in this chapter.

Once you have created a VC class, use the following command in interface-ATM-VC configuration mode to apply the VC class to an SVC:

Command	Purpose
Router(config-if-atm-vc) # class-vc <i>vc-class-name</i>	Applies a VC class to an SVC.

The *vc-class-name* argument is the same as the *name* argument you specified when you created a VC class using the **vc-class atm** command. Refer to the section “[Configuring VC Classes](#)” later in this chapter for a description of how to create a VC class.

Configuring SSCOP

The Service-Specific Connection-Oriented Protocol (SSCOP) resides in the service-specific convergence sublayer (SSCS) of the ATM adaptation layer (AAL). SSCOP is used to transfer variable-length service data units (SDUs) between users of SSCOP. SSCOP provides for the recovery of lost or corrupted SDUs.



Note

The tasks in this section customize the SSCOP feature to a particular network or environment and are optional. The features have default values and are valid in most installations. Before customizing these features, you should have a good understanding of SSCOP and the network involved.

Setting the Poll Timer

The poll timer controls the maximum time between transmission of a POLL PDU when sequential data (SD) or SDP PDUs are queued for transmission or are outstanding pending acknowledgments. To change the poll timer from the default value of 100 seconds, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# sscop poll-timer <i>seconds</i>	Sets the poll timer.

Setting the Keepalive Timer

The keepalive timer controls the maximum time between transmission of a POLL PDU when no SD or SDP PDUs are queued for transmission or are outstanding pending acknowledgments. To change the keepalive timer from the default value of 5 seconds, use the following command in interface configuration mode:

Command	Purpose
Router(config-if-atm-vc)# sscop keepalive-timer <i>seconds</i>	Sets the keepalive timer.

Setting the Connection Control Timer

The connection control timer determines the time between transmission of BGN, END, or RS (resynchronization) PDUs as long as an acknowledgment has not been received. Connection control performs the establishment, release, and resynchronization of an SSCOP connection.

To change the connection control timer from the default value of 1 seconds, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# sscop cc-timer <i>seconds</i>	Sets the connection control timer.

To change the retry count of the connection control timer from the default value of 10, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# sscop max-cc <i>retries</i>	Sets the number of times that SSCOP will retry to transmit BGN, END, or RS PDUs when they have not been acknowledged.

Setting the Transmitter and Receiver Windows

A transmitter window controls how many packets can be transmitted before an acknowledgment is required. To change the transmitter's window from the default value of 7, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# sscop send-window <i>packets</i>	Sets the transmitter's window.

A receiver window controls how many packets can be received before an acknowledgment is required. To change the receiver's window from the default value of 7, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# sscop receive-window <i>packets</i>	Sets the receiver's window.

Closing an SVC

You can disconnect an idle SVC by using the following command in EXEC mode:

Command	Purpose
Router # atmsig close atm slot/0 vcd	(Optional) Closes the signaling PVC for an SVC.

Configuring VC Classes

A VC class is a set of preconfigured VC parameters that you configure and apply to a particular VC or ATM interface. You may apply a VC class to an ATM main interface, subinterface, PVC, or SVC. For example, you can create a VC class that contains VC parameter configurations that you will apply to a particular PVC or SVC. You might create another VC class that contains VC parameter configurations that you will apply to all VCs configured on a particular ATM main interface or subinterface. Refer to the “[ATM Configuration Examples](#)” section later in this chapter for examples of VC class configurations.

To create and use a VC class, complete the tasks in the following sections:

- [Creating a VC Class](#)
- [Configuring VC Parameters](#)
- [Applying a VC Class](#)

Creating a VC Class

To create a VC class, use the following command in global configuration mode:

Command	Purpose
Router(config)# vc-class atm <i>name</i>	Creates a VC class and enters vc-class configuration mode.

For examples of creating VC classes, see the section “[Example: Creating a VC Class](#)” at the end of this chapter.

Configuring VC Parameters

After you create a VC class and enter `vc-class` configuration mode, configure VC parameters using one or more of the following commands:

- **abr**
- **broadcast**
- **encapsulation aal5**
- **idle-timeout**
- **ilmi manage**
- **inarp**
- **oam-pvc**
- **oam retry**
- **oam-svc**
- **protocol**
- **ubr**
- **ubr+**
- **vbr-nrt**

Refer to the sections “[Configuring PVCs](#)” and “[Configuring PVC Trap Support](#)” for descriptions of how to configure these commands for PVCs and SVCs.

If an SVC command (for example, **idle-timeout** or **oam-svc**) is configured in a VC class, but the VC class is applied on a PVC, the SVC command is ignored. This is also true if a PVC command is applied to an SVC.

For examples of creating VC classes, see the section “[Example: Creating a VC Class](#)” at the end of this chapter.

Applying a VC Class

Once you have created and configured a VC class, you can apply it directly on an ATM PVC or SVC, or you can apply it on an ATM interface or subinterface.

To apply a VC class directly on an ATM PVC or SVC, use the following commands beginning in interface configuration mode:

	Command	Purpose
Step 1	Router(config-if)# pvc [name] vpi/vci	Specifies an ATM PVC.
	or	or
	Router(config-if)# svc [name] nsap address	Specifies an ATM SVC.
Step 2	Router(config-if-atm-vc)# class-vc vc-class-name	Applies a VC class directly on the PVC or SVC.

To apply a VC class on an ATM main interface or subinterface, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	<pre>Router(config)# interface atm slot/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm slot/port-adapter/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm number[.subinterface-number {multipoint point-to-point}]</pre>	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	<pre>Router(config-if)# class-int vc-class-name</pre>	Applies a VC class on an the ATM main interface or subinterface.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

For examples of applying a VC class to an ATM interface, see the section “[Example: Applying a VC Class](#)” later in this chapter.

Configuring VC Management

When you configure VC management, you enable the router to detect VC connections and disconnections automatically. This notifies protocols to reroute packets immediately, preventing protocols from waiting for unpredictable and relatively long timeout periods.

You may use Integrated Local Management Interface (ILMI) or operation, administration, and maintenance (OAM) or both for managing your PVCs, and OAM for managing your SVCs. For PVCs, you must decide which method is reliable in your particular network.

When ILMI and OAM management methods are both configured to manage a PVC, both must indicate that a PVC is up in order for that PVC to be determined as up. If either ILMI or OAM is not configured, a PVC will be managed by the method that is configured.

When a PVC goes down, route caches for protocols configured on that PVC are cleared (or flushed) so that new routes may be learned. The route cache flush is applied on the PVC’s interface. When all PVCs on a subinterface go down, VC management shuts down the subinterface, in addition to flushing route caches. ATM hardware must keep the PVC active, however, so that OAM and ILMI cells may flow.

When any PVC on a subinterface comes up, the subinterface is brought up.

VC management using ILMI is referred to as ILMI management. VC management using OAM is referred to as OAM management. To configure either management method or both, perform the tasks in one or both of the following sections:

- [Configuring ILMI Management](#)
- [Configuring OAM Management](#)

Configuring ILMI Management

ILMI management applies to PVCs only. To configure ILMI management, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	<pre>Router(config)# interface atm slot/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm slot/port-adapter/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm number[.subinterface-number {multipoint point-to-point}]</pre>	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	<pre>Router(config-if)# pvc [name] 0/16 ilmi</pre>	Configures a PVC for communication with the ILMI.
Step 3	<pre>Router(config)# interface atm slot/0.subinterface-number multipoint or Router(config)# interface atm slot/port-adapter/0.subinterface-number multipoint or Router(config)# interface atm number.subinterface-number multipoint</pre>	(Optional) Specifies the ATM subinterface of the PVC you want to manage.
Step 4	<pre>Router(config-if)# pvc [name] vpi/vci</pre>	Specifies the PVC to be managed.
Step 5	<pre>Router(config-if-atm-vc)# ilmi manage</pre>	Enables ILMI management on the PVC.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

Repeat Steps 4 and 5 for each PVC you want to manage. Step 3 is necessary only if you want to configure a PVC on a subinterface and not just on the main ATM interface.

The PVC comes up only if ILMI indicates the PVC is up. The PVC comes down when ILMI indicates that the PVC is down. If OAM management is also configured for the same PVC, the PVC comes up only if both ILMI and OAM indicate that the PVC is up.

For an example of configuring ILMI management on a PVC, see the section “[Example: ILMI Management on an ATM PVC](#)” at the end of this chapter.

Configuring OAM Management

OAM management may be enabled for both PVCs and SVCs. To configure OAM management, perform the tasks in one or both of the following sections:

- [Configuring OAM Management for PVCs](#)
- [Configuring OAM Management for SVCs](#)

Configuring OAM Management for PVCs

To configure OAM management for an ATM PVC, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	<pre>Router(config)# interface atm slot/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm slot/port-adapter/0[.subinterface-number {multipoint point-to-point}] or Router(config)# Router(config)# interface atm number[.subinterface-number {multipoint point-to-point}]</pre>	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	Router(config-if)# pvc [name] vpi/vci	Specifies the ATM PVC.
Step 3	Router(config-if-atm-vc)# oam-pvc manage [frequency]	Enables OAM management on the PVC.
Step 4	Router(config-if-atm-vc)# oam retry up-count down-count retry-frequency	(Optional) Specifies OAM management parameters for reestablishing and removing a PVC connection.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

Use the *up-count* argument to specify the number of consecutive end-to-end F5 OAM loopback cell responses that must be received in order to change a PVC connection state to up. Use the *down-count* argument to specify the number of consecutive end-to-end F5 OAM loopback cell responses that are not received in order to tear down a PVC. Use the *retry-frequency* argument to specify the frequency (in seconds) that end-to-end F5 OAM loopback cells should be transmitted when a change in UP/DOWN state is being verified. For example, if a PVC is up and a loopback cell response is not received after the *frequency* (in seconds) specified using the **oam-pvc** command, then loopback cells are sent at the *retry-frequency* to verify whether or not the PVC is down.

By default, end-to-end F5 OAM loopback cell generation is turned off for each PVC. A PVC is determined as down when any of the following is true on that PVC:

- The router does not receive a loopback reply after a configured number of retries of sending end-to-end F5 OAM loopback cells.
- The router receives a Virtual Circuit-Alarm Indication Signals (VC-AIS) cell.
- The router receives a Virtual Circuit-Remote Detect Indicator (VC-RDI) cell.

A PVC is determined as up when all of the following are true on that PVC:

- The router receives a configured number of successive end-to-end F5 OAM loopback cell replies.
- The router does not receive VC-AIS cell for 3 seconds.
- The router does not receive VC-RDI cell for 3 seconds.

For an example of configuring OAM management on a PVC, see the section “[Example: OAM Management on an ATM SVC](#)” at the end of this chapter.

Configuring OAM Management for SVCs

To configure OAM management for an ATM SVC, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	<pre>Router(config)# interface atm slot/0[.subinterface-number {multipoint point-to-point}]</pre> or <pre>Router(config)# interface atm slot/port-adapter/0[.subinterface-number {multipoint point-to-point}]</pre> or <pre>Router(config)# interface atm number[.subinterface-number {multipoint point-to-point}]</pre>	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	<pre>Router(config-if)# svc [name] nsap address</pre>	Specifies the ATM SVC.
Step 3	<pre>Router(config-if-atm-vc)# oam-svc manage [frequency]</pre>	Enables OAM management on the SVC.
Step 4	<pre>Router(config-if-atm-vc)# oam retry up-count down-count retry-frequency</pre>	(Optional) Specifies OAM management parameters for re-establishing and removing an SVC connection.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

If OAM management is enabled on SVCs and detects disconnection on an SVC, that SVC is torn down.

The *up-count* argument does not apply to SVCs, but it must be specified in order to configure the *down-count* and *retry-frequency*. Use the *down-count* argument to specify the number of consecutive end-to-end F5 OAM loopback cell responses that are not received in order to tear down an SVC. Use the *retry-frequency* argument to specify the frequency (in seconds) at which end-to-end F5 OAM loopback cells should be transmitted when a change in UP/DOWN state is being verified. For example, if an SVC is up and a loopback cell response is not received after the *frequency* (in seconds) specified using the **oam-svc** command, then loopback cells are sent at the *retry-frequency* to verify whether or not the SVC is down.

For an example of configuring OAM management on an SVC, see the section “[Example: OAM Management on an ATM SVC](#)” at the end of this chapter.

Configuring Classical IP and ARP over ATM

Cisco implements both the ATM Address Resolution Protocol (ARP) server and ATM ARP client functions described in RFC 1577. RFC 1577 models an ATM network as a logical IP subnetwork on a LAN.

The tasks required to configure classical IP and ARP over ATM depend on whether the environment uses SVCs or PVCs.

Configuring Classical IP and ARP in an SVC Environment

The ATM ARP mechanism is applicable to networks that use SVCs. It requires a network administrator to configure only the device's own ATM address and that of a single ATM ARP server into each client device. When the client makes a connection to the ATM ARP server, the server sends ATM Inverse ARP requests to learn the IP network address and ATM address of the client on the network. It uses the addresses to resolve future ATM ARP requests from clients. Static configuration of the server is not required or needed.

In Cisco's implementation, the ATM ARP client tries to maintain a connection to the ATM ARP server. The ATM ARP server can tear down the connection, but the client attempts once each minute to bring the connection back up. No error messages are generated for a failed connection, but the client will not route packets until the ATM ARP server is connected and translates IP network addresses.

For each packet with an unknown IP address, the client sends an ATM ARP request to the server. Until that address is resolved, any IP packet routed to the ATM interface will cause the client to send another ATM ARP request. When the ARP server responds, the client opens a connection to the new destination so that any additional packets can be routed to it.

Cisco routers may be configured as ATM ARP clients to work with any ATM ARP server conforming to RFC 1577. Alternatively, one of the Cisco routers in a logical IP subnet (LIS) may be configured to act as the ATM ARP server itself. In this case, it automatically acts as a client as well. To configure classical IP and ARP in an SVC environment, perform the tasks in one of the following sections:

- [Configuring the Router as an ATM ARP Client](#)
- [Configuring the Router as an ATM ARP Server](#)

Configuring the Router as an ATM ARP Client

In an SVC environment, configure the ATM ARP mechanism on the interface by using the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm <i>slot/0</i> or Router(config)# interface atm <i>slot/port-adapter/0</i> or Router(config)# interface atm <i>number</i>	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	Router(config-if)# atm esi-address <i>esi.selector</i>	Specifies the ATM address of the interface.
Step 3	Router(config-if)# ip address <i>address mask</i>	Specifies the IP address of the interface.
Step 4	Router(config-if)# atm classic-ip-extensions BFI	(Optional) Enables redundant ATM ARP servers.
Step 5	Router(config-if)# atm arp-server nsap <i>nsap-address</i>	Specifies the ATM address of the ATM ARP server. Enter this command twice to specify two ATM ARP servers.
Step 6	Router(config-if)# no shutdown	Enables the ATM interface.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

You can designate the current router interface as the ATM ARP server in Step 4 by typing **self** in place of **nsap nsap-address**.

To configure the ESI and selector fields in Step 2, the switch must be capable of delivering the NSAP address prefix to the router via ILMI and the router must be configured with a PVC for communication with the switch via ILMI. For a description of how to configure an ILMI PVC, refer to the section “[Configuring Communication with the ILMI](#)” earlier in this chapter.

For an example of configuring the ATM ARP client, see the section “[Example: Configuring ATM ARP Client in an SVC Environment](#)” at the end of this chapter.

Configuring the Router as an ATM ARP Server

Cisco’s implementation of the ATM ARP server supports redundant ATM ARP servers on a single logical IP subnetwork (LIS). In order for redundant ATM ARP server support to work, all of the devices on the LIS must be Cisco devices and must have the **atm classic-ip-extensions BFI** command configured.

To configure the ATM ARP server, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/0	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
	or	
	Router(config)# interface atm slot/port-adapter/0	
	or	
	Router(config)# interface atm number	
Step 2	Router(config-if)# atm esi-address esi.selector	Specifies the ATM address of the interface.
Step 3	Router(config-if)# ip address address mask	Specifies the IP address of the interface.
Step 4	Router(config-if)# atm classic-ip-extensions BFI	(Optional) Enables redundant ATM ARP servers.
Step 5	Router(config-if)# atm arp-server self	Identifies the ATM ARP server for the IP subnetwork network.
Step 6	Router(config-if)# no shutdown	Enables the ATM interface.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

To configure the ESI and selector fields in Step 2, the switch must be capable of delivering the NSAP address prefix to the router via ILMI and the router must be configured with a PVC for communication with the switch via ILMI. For a description of how to configure an ILMI PVC, refer to the section “[Configuring Communication with the ILMI](#)” earlier in this chapter.

For an example of configuring the ATM ARP server, see the section “[Example: Configuring ATM ARP Client in an SVC Environment](#)” at the end of this chapter.

Configuring Classical IP and Inverse ARP in a PVC Environment

The ATM Inverse ARP mechanism is applicable to networks that use PVCs, where connections are established, but the network addresses of the remote ends are not known. A server function is not used in this mode of operation.

In a PVC environment, the ATM Inverse ARP mechanism is enabled by default for IP and IPX when you use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/0 or Router(config)# interface atm slot/port-adapter/0 or Router(config)# interface atm number	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	Router(config-if)# ip address address mask	Specifies the IP address of the interface.
Step 3	Router(config-if)# pvc [name] vpi/vci	Creates a PVC.
Step 4	Router(config-if-atm-vc)# no shutdown	Enables the ATM interface.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

Repeat Step 3 for each PVC you want to create.

By default, Inverse ARP datagrams will be sent on this virtual circuit every 15 minutes. To adjust the Inverse ARP time period, use the **inarp minutes** command in interface-ATM-VC configuration mode.



Note

The ATM ARP mechanism works with IP only. The Inverse ATM ARP mechanism works with IP and IPX only. For all other protocols, the destination address must be specified.

For an example of configuring the ATM Inverse ARP mechanism, see the section “[Example: Configuring ATM Inverse ARP in a PVC Environment](#)” at the end of this chapter.

Customizing the ATM Interface

You can customize the ATM interface. The features you can customize have default values that will most likely suit your environment and probably need not be changed. However, you might need to enter configuration commands, depending upon the requirements for your system configuration and the protocols you plan to route on the interface. To customize the ATM interface, perform the tasks in the following sections:

- [Configuring the Rate Queue](#)
- [Configuring MTU Size](#)
- [Setting the SONET PLIM](#)
- [Setting Loopback Mode](#)
- [Setting the Exception Queue Length](#)
- [Configuring the Maximum Number of Channels](#)

- [Limiting the Number of Virtual Circuits](#)
- [Setting the Raw-Queue Size](#)
- [Configuring Buffer Size](#)
- [Setting the VCI-to-VPI Ratio](#)
- [Setting the Source of the Transmit Clock](#)

Configuring the Rate Queue

A rate queue defines the speed at which individual virtual circuits will transmit data to the remote end. You can configure permanent rate queues, allow the software to set up dynamic rate queues, or perform some combination of the two. The software dynamically creates rate queues when you create a VC with a peak rate that does not match any user-configured rate queue. The software dynamically creates all rate queues if you have not configured any.

**Note**

You can only configure the rate queue for the AIP and NPM.

Using Dynamic Rate Queues

The Cisco IOS software automatically creates rate queues as necessary when you create a VC. If you do not configure traffic shaping on a VC, the peak rate of the VC is set to the UBR at the maximum peak rate that the physical layer interface module (PLIM) will allow. A rate queue is then dynamically created for the peak rate of that VC.

If dynamic rate queues do not satisfy your traffic shaping needs, you can configure permanent rate queues. Refer to the section “[Configuring a Permanent Rate Queue](#)” for more information.

See the section “[Examples: Dynamic Rate Queue](#)” for example configurations of different rate queues.

Configuring Rate Queue Tolerance

To improve rate queue usage, you can configure a peak cell rate tolerance range for dynamically created rate queues. A PVC or SVC requesting a particular rate queue speed will be assigned to a rate queue that is within the range of the peak cell rate tolerance. If no such rate queue exists, a new rate queue is dynamically created on the ATM interface.

To configure a rate queue tolerance range for VCs on an ATM interface, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/0	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
	or	
	Router(config)# interface atm slot/port-adapter/0	
	or	
Step 2	Router(config)# interface atm number	Configures a rate queue tolerance.
	Router(config-if)# atm rate-queue tolerance svc [pvc] tolerance-value [strict]	

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

The value for the *tolerance-value* argument is expressed as a percentage used for assigning rate queues for each VC with a requested peak rate. This value is applied to SVCs, discovered VCs, and PVCs (when the **pvc** keyword is used). This value can be 0 or 5 through 99. For SVCs and discovered VCs, the default value is 10. If the **pvc** keyword is not specified, the rate queue tolerance for PVCs will default to 0.

Configuring a Permanent Rate Queue

The supports up to eight different peak rates. The peak rate is the maximum rate, in kilobits per second, at which a virtual circuit can transmit. Once attached to this rate queue, the virtual circuit is assumed to have its peak rate set to that of the rate queue. The rate queues are broken into a high-priority (0 through 3) and low-priority (4 through 7) bank.

You can configure each permanent rate queue independently to a portion of the overall bandwidth available on the ATM link. The combined bandwidths of all rate queues should not exceed the total bandwidth available. The total bandwidth depends on the PLIM (see the “ATM Interface Types” section in the “Wide-Area Networking Overview” chapter.)

To set a permanent rate queue, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm rate-queue queue-number speed	Configures a permanent rate queue, which defines the maximum speed at which an individual virtual circuit transmits data to a remote ATM host.

Configuring MTU Size

Each interface has a default maximum packet size or maximum transmission unit (MTU) size. For ATM interfaces, this number defaults to 4470 bytes. The maximum is 9188 bytes for the AIP and NPM, 17969 for the ATM port adapter, and 17998 for the ATM-CES port adapter. The MTU can be set on a per-sub-interface basis as long as the interface MTU is as large or larger than the largest subinterface MTU.

To set the maximum MTU size, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# mtu bytes	Sets the maximum MTU size.

For ATM interfaces, the MTU displays the following behavior:

- A new subinterface inherits the MTU from the main interface.
- The MTU is inherited from the main interface when there is a default setting on the subinterface MTU.
- A user configured MTU is nv-generated, even if the MTU is the same as/default MTU or the sub MTU of the main interface.
- If you have not explicitly specified the MTU, after a reload, by default, the subinterface MTU inherits the main interface.
- A change in the main interface MTU does not trigger a change in the subinterface MTUs. However, subsequently created subinterfaces inherit the same main interface MTU.

Setting the SONET PLIM

The default SONET PLIM is STS-3C. To set the SONET PLIM to STM-1 or to set the PLIM framing for E3 or DS3, use one of the following commands in interface configuration mode:

Command	Purpose
Router(config-if) # atm sonet stm-1	Sets the OC-3c SONET PLIM to STM-1.
Router(config-if) # atm framing [cbitadm cbitplcp m23adm m23plcp]	Sets DS3 framing mode.
Router(config-if) # atm framing [g751adm g832 adm g751plcp]	Sets E3 framing mode.

The default for DS3 is C-Bit ADM framing; the default for E3 is G.751 with PLCP framing.

Setting Loopback Mode

To loop all packets back to your ATM interface instead of the network, use the following command in interface configuration mode:

Command	Purpose
Router(config-if) # loopback	Sets loopback mode.

To loop the incoming network packets back to the ATM network, use the following command in interface configuration mode:

Command	Purpose
Router(config-if) # loopback line	Sets line loopback mode.

Setting the Exception Queue Length

The exception queue is used for reporting ATM events, such as CRC errors. By default, it holds 32 entries; the range is 8 to 256. It is unlikely that you will need to configure the exception queue length; if you do, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm exception-queue <i>number</i>	Sets the exception queue length.



Note

This command is supported only on the AIP.

Configuring the Maximum Number of Channels

The **atm max-channels** command, available if you are using the ATM-CES port adapter, can be used to divide the available number (fixed) of transmit descriptors across the configured number of transmit channels. Typically, you think of a one-to-one association between a transmit channel and a VC; however, the ATM-CES port adapter supports types of VCs other than data VCs (for example CES VCs). Also, the ATM-CES port adapter can multiplex one or more VCs over a single virtual path (VP) that is shaped, and the VP only requires a single transmit channel. Therefore, the term transmit channel is used rather than virtual circuit.

The maximum burst of packets that are allowed per VC is limited by the number of transmit descriptors allocated per VC. Because the total number of transmit descriptors available is limited by the available SRAM space, configuration of the number of transmit channels for the interface determines the number of transmit descriptors for each transmit channel. Hence, the burst size for each transmit channel is determined by the **atm max-channels** command. For example, for 64 (default) numbers of transmit channels for the interface, 255 transmit descriptors are associated per transmit channel and for 512 numbers of transmit channels for the interface, 31 transmit descriptors are associated per transmit channel.

To configure the maximum number of transmit channels for the interface, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm max-channels <i>number</i>	Configures the maximum number of transmit channels.



Note

This command is available only on the ATM-CES port adapter.

Limiting the Number of Virtual Circuits

By default, the ATM interface allows the maximum of 2048 virtual circuits. However, you can configure a lower number, thereby limiting the number of virtual circuits on which your ATM interface allows segmentation and reassembly to occur. Limiting the number of virtual circuits does not affect the VPI-VCI pair of each virtual circuit.

To set the maximum number of virtual circuits supported (including PVCs and SVCs), use the following command in interface configuration mode:

Command	Purpose
Router(config-if) # atm maxvc <i>number</i>	Limits the number of virtual circuits.

**Note**

This command is not supported on the ATM-CES port adapter or the NPM.

Setting the Raw-Queue Size

The raw queue is used for raw ATM cells, which include operation, administration, and maintenance (OAM) and Interim Local Management Interface (ILMI) cells. ILMI is a means of passing information to the router, including information about virtual connections and addresses. The raw-queue size is in the range of 8 to 256 cells; the default is 32 cells.

To set the raw-queue size, use the following command in interface configuration mode:

Command	Purpose
Router(config-if) # atm rawq-size <i>number</i>	Sets the raw-queue size.

**Note**

This command is supported only on the AIP.

Configuring Buffer Size

The number of receive buffers determines the maximum number of reassemblies that your ATM interface can perform simultaneously. The number of buffers defaults to 256, although it can be in the range from 0 to 512.

To set the number of receive buffers, use the following command in interface configuration mode:

Command	Purpose
Router(config-if) # atm rxbuff <i>number</i>	Sets the number of receive buffers.

The number of transmit buffers determines the maximum number of fragmentations that your ATM interface can perform simultaneously. The number of buffers defaults to 256, although it can be in the range from 0 to 512.

To set the number of transmit buffers, use the following command in interface configuration mode:

Command	Purpose
Router(config-if) # atm txbuff <i>number</i>	Sets the number of transmit buffers.

**Note**

The commands in this section are not supported on the ATM-CES port adapter or NPM.

Setting the VCI-to-VPI Ratio

By default, the ATM interface supports 1024 VCIs per VPI. Depending on what ATM interface card or port adapter you are using, this value can be any power of 2 in the range of 16 to 8192. (See the **atm vc-per-vp** command in the *Cisco IOS Wide-Area Networking Command Reference* for the exact values that apply to your configuration.) This value controls the memory allocation on your ATM interface that deals with the VCI table. It defines only the maximum number of VCIs to support per VPI.

To set the maximum number of VCIs to support per VPI and limit the highest VCI accordingly, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm vc-per-vp <i>number</i>	Sets the number of VCIs per VPI.

Setting the Source of the Transmit Clock

By default, your ATM interface expects the ATM switch to provide transmit clocking. To specify that the ATM interface generates the transmit clock internally for SONET and E3 PLIM operation, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm clock internal	Specifies that the ATM interface generates the transmit clock internally.

Configuring ATM Subinterfaces for SMDS Networks

An ATM adaptation layer (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 isochronous traffic, such as voice and video, and are not relevant to the router. AAL3/4 and AAL5 support data communications by segmenting and reassembling packets. Beginning in Cisco IOS Release 10.2, we support both AAL3/4 and AAL5.

Our implementation of the AAL3/4 encapsulates each AAL3/4 packet in a Switched Multimegabit Data Service (SMDS) header and trailer. This feature supports both unicast and multicast addressing, and provides subinterfaces for multiple AAL3/4 connections over the same physical interface.

**Note**

Each subinterface configured to support AAL3/4 is allowed only one SMDS E.164 unicast address and one E.164 multicast address. The multicast address is used for all broadcast operations. In addition, only one virtual circuit is allowed on each subinterface that is being used for AAL3/4 processing, and it must be an AAL3/4 virtual circuit.

Support for AAL3/4 on an ATM interface requires static mapping of all protocols except IP. However, dynamic routing of IP can coexist with static mapping of other protocols on the same ATM interface.

To configure an ATM interface for SMDS networks, use the following commands in interface configuration mode:

	Command	Purpose
Step 1	Router(config-if)# atm aal aal3/4	Enables AAL3/4 support on the affected ATM subinterface.
Step 2	Router(config-if)# atm smds-address address	Provides an SMDS E.164 unicast address for the subinterface.
Step 3	Router(config-if)# atm multicast address	Provides an SMDS E.164 multicast address.
Step 4	Router(config-if)# atm vp-filter hexvalue	Configures a virtual path filter for the affected ATM subinterface.
Step 5	Router(config-if)# pvc [name] vpi/vci smds	Creates an AAL3/4 PVC.

**Note**

ATM subinterfaces for SMDS networks are only supported on the AIP and NPM.

The virtual path filter provides a mechanism for specifying which VPIs (or a range of VPIs) will be used for AAL3/4 processing during datagram reassembly. All other VPIs are mapped to AAL5 processing. For more information about the way the **atm vp-filter** command works and the effect of selecting specific values, refer to the [Cisco IOS Wide-Area Networking Command Reference](#).

After configuring the ATM interface for SMDS networks, configure the interface for standard protocol configurations, as needed. For more information about protocol configuration, refer to the relevant chapters of the [Cisco IOS IP Configuration Guide](#), the [Cisco IOS AppleTalk and Novell IPX Configuration Guide](#), and the [Cisco IOS Apollo Domain, Banyan VINES, DECnet, ISO CLNS, and XNS Configuration Guide](#).

For examples of configuring an ATM interface for AAL3/4 support, see the section “[Examples: PVC with AAL3/4 and SMDS Encapsulation](#)” at the end of this chapter.

Limiting the Message Identifiers Allowed on Virtual Circuits

Message identifier (MID) numbers are used by receiving devices to reassemble cells from multiple sources into packets.

To ensure that the message identifiers are unique at the receiving end and, therefore, that messages can be reassembled correctly, you can limit the number of message identifiers allowed on a virtual circuit and assign different ranges of message identifiers to different PVCs.

To limit the number of message identifier numbers allowed on each virtual circuit and to assign different ranges of message identifiers to different PVCs, use the following commands beginning in interface configuration mode:

	Command	Purpose
Step 1	Router(config-if)# atm mid-per-vc maximum	Limits the number of message identifiers allowed per virtual circuit.
Step 2	Router(config-if)# pvc [name] vpi/vci smds	Creates an ATM PVC with SMDS encapsulation.
Step 3	Router(config-if-atm-vc)# mid midlow midhigh	Limits the range of message identifier values used on the PVC.

The maximum number of message identifiers per virtual circuit is set at 16 by default; valid values are 16, 32, 64, 128, 256, 512, or 1024.

The default value for both the *midlow* and the *midhigh* arguments is zero.

Setting the Virtual Path Filter Register

The virtual path filter allows you to specify which VPI or range of VPIs will be used for AAL3/4 processing. The default value of the's virtual path filter register is 0x7B. To set the virtual path filter register, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# atm vp-filter <i>hexvalue</i>	Sets the virtual path filter register.

Configuring Fast-Switched Transparent Bridging for SNAP PVCs

The implementation of transparent bridging over ATM allows the spanning tree for an interface to support virtual circuit descriptors (VCDs) for AAL5-LLC Subnetwork Access Protocol (SNAP) encapsulations.

If the relevant interface or subinterface is explicitly put into a bridge group, as described in the task table below, AAL5-SNAP encapsulated bridge packets on a PVC are fast-switched.

The bridging implementation supports IEEE 802.3 frame formats, IEEE 802.10 frame formats, and Ethernet DIX frames. The router can accept IEEE 802.3 frames with or without frame check sequence (FCS).

When the router receives frames with FCS (RFC 1483 bridge frame formats with 0x0001 in the PID field of the SNAP header), it strips off the FCS and forwards the frame as necessary. All IEEE 802.3 frames that originate at or are forwarded by the router are sent as 802.3 bridge frames without FCS (bridge frame formats with 0x0007 in the PID field of the SNAP header).



Note

Transparent bridging for the ATM works only on AAL5-LLC/SNAP PVCs (fast-switched). AAL3/4-SMDS, AAL5-MUX, and AAL5-NLPID bridging are not yet supported. Transparent bridging for ATM also does not operate in a switched virtual circuit (SVC) environment.

To configure transparent bridging for LLC/SNAP PVCs, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	<pre>Router(config)# interface atm slot/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm slot/port-adapter/0[.subinterface-number {multipoint point-to-point}] or Router(config)# interface atm number[.subinterface-number {multipoint point-to-point}]</pre>	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	<pre>Router(config-if)# pvc [name] vpi/vci</pre>	Creates one or more PVCs using AAL5-SNAP encapsulation. Repeat this command as needed.
Step 3	<pre>Router(config)# exit</pre>	Returns to interface configuration mode.
Step 4	<pre>Router(config-if)# bridge-group group</pre>	Assigns the interface to a bridge group.
Step 5	<pre>Router(config-if)# exit</pre>	Returns to global configuration mode.
Step 6	<pre>Router(config)# bridge group protocol dec</pre>	Defines the type of spanning tree protocol as DEC.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

No other configuration is required. Spanning tree updates are broadcast to all AAL5-SNAP virtual circuits that exist on the ATM interface. Only the AAL5-SNAP virtual circuits on the specific subinterface receive the updates. The router does not send spanning tree updates to AAL5-MUX and AAL5-NLPID virtual circuits.

For an example of transparent bridging for an AAL5-SNAP PVC, see the section “[Example: Transparent Bridging on an AAL5-SNAP PVC](#)” at the end of this chapter.

Configuring Inverse Multiplexing over ATM

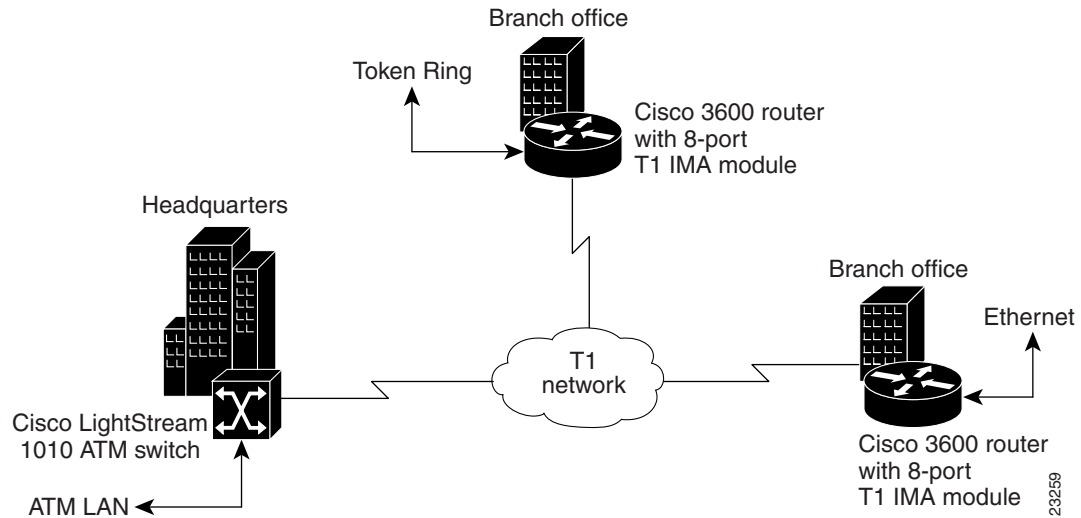
Inverse multiplexing provides the capability to transmit and receive a single high-speed data stream over multiple slower-speed physical links. In inverse multiplexing over ATM (IMA), the originating stream of ATM cells is divided so that complete ATM cells are transmitted in round-robin order across the set of ATM links.

IMA is supported on the Multiport T1/E1 ATM Network Module with Inverse Multiplexing over ATM on Cisco 2600 and Cisco 3600 series routers and the Multiport T1/E1 ATM Port Adapter with Inverse Multiplexing over ATM on Cisco 7100, Cisco 7200, and Cisco 7500 series routers. The Multiport T1/E1 ATM IMA network modules and port adapters provide four or eight T1 or E1 ports and allow wide-area networking (WAN) uplinks at speeds ranging from 1.536 Mbps to 12.288 Mbps for T1, and from 1.92 Mbps to 15.36 Mbps for E1. See the section “[Bandwidth Considerations](#)” later in this chapter for details.

Cisco’s scalable ATM IMA solution means that you can deploy just the bandwidth you need by using multiple E1 or T1 connections instead of a more expensive E3, T3, or OC-3 to create links between LANs and ATM WAN applications. Enterprises and branch offices can aggregate traffic from multiple

low-bandwidth digital physical transmission media, such as T1 pipes, to transmit voice and data at high-bandwidth connection speeds. Figure 3 illustrates a scenario in which an organization must transport a mission-critical application among headquarters and branch offices at 6 Mbps.

Figure 3 LAN-to-WAN Application Connectivity with T1 and IMA



The following sections provide more specific information about IMA and how to configure it:

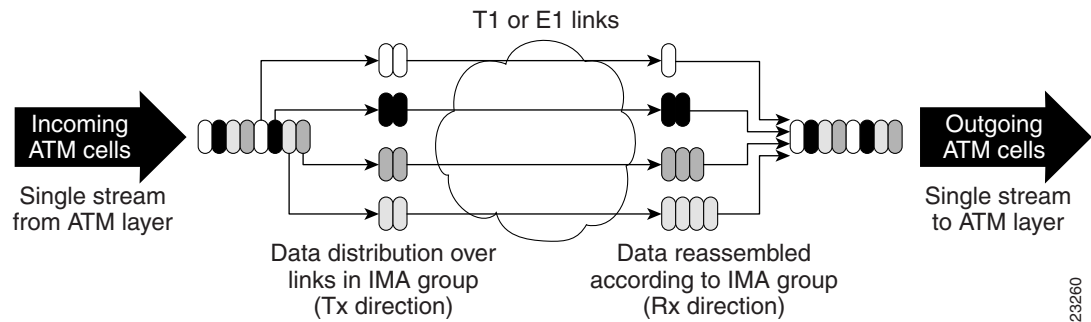
- [IMA Protocol Overview](#)
- [General Description of ATM T1/E1 IMA](#)
- [IMA Configuration Task List](#)
- [Bandwidth Considerations](#)
- [Related Documents](#)

IMA Protocol Overview

In the transmit direction, IMA takes cells from the ATM layer and sends them in sequential distribution over the individual links that make up a logical link group called an IMA group (links can also be used individually instead of being a member of a group). The IMA group performance is approximately the sum of the links, although some overhead is required for ATM control cells. At the receiving end, the cells are recombined to form the original cell stream and are passed up to the ATM layer.

Filler cells are used to ensure a steady stream on the receiving side. IMA control protocol (ICP) cells control the operation of the inverse multiplexing function. With a frame length of 128, one of every 128 cells on each link is an ICP cell. The inverse multiplexing operation is transparent to the ATM layer protocols; therefore, the ATM layer can operate normally as if only a single physical interface were being used.

Figure 4 illustrates inverse multiplexing and demultiplexing with four bundled links, providing 6.144 Mbps of raw bandwidth for T1s and 7.68 Mbps of raw bandwidth for E1 for packet traffic. The transmit side, where cells are distributed across the links, is referred to as *Tx*, and the receive side, where cells are recombined, is called *Rx*.

Figure 4 *Inverse Multiplexing and Demultiplexing*

General Description of ATM T1/E1 IMA

ATM networks were designed to handle the demanding performance needs of voice, video, and data at broadband speeds of 34 Mbps and above. However, the high cost and spotty availability of long-distance broadband links limits broadband ATM WANs, preventing many organizations from taking advantage of the power of ATM. In response to these issues, the ATM Forum defined lower-speed ATM interface options for T1 and E1. However, this was not a complete solution because a single T1 or E1 link often does not provide enough bandwidth to support either traffic among different router and switch locations or heavy end-user demand.

For this reason, many organizations find themselves caught between the bandwidth limitations of a narrowband T1 or E1 line and the much higher costs of moving to broadband links. In response to this dilemma, the ATM Forum, with Cisco as an active member, defined Inverse Multiplexing for ATM (IMA). Using Cisco routers to provide ATM access gives branch offices and enterprises an affordable LAN-to-ATM interface.

For a list of ATM features that are supported on Cisco routers when you use the Multiport T1/E1 ATM Network Module with Inverse Multiplexing over ATM or the Multiport T1/E1 ATM Port Adapter with Inverse Multiplexing over ATM, see the “Cisco ATM Features” section of the “Wide-Area Networking Overview” chapter in this book.

Restrictions

IMA is supported on the following platforms:

- Cisco 2600 series and Cisco 3600 series routers using the Multiport T1/E1 Network Module with Inverse Multiplexing over ATM
- Cisco 7100 series, Cisco 7200 series, and Cisco 7500 series routers using the Multiport T1/E1 ATM Port Adapter with Inverse Multiplexing over ATM

The following restrictions apply to the ATM IMA feature on Cisco 7100 series, Cisco 7200 series, and Cisco 7500 series routers:

- If common transmit clock is configured on an IMA interface using the **ima clock-mode** command with the **common** keyword, then the port adapter internal clock is used as the transmit clock source for all the links of the IMA interface.
- The feature does not support the ATM real-time variable bit rate (rt-VBR) traffic category. The ATM constant bit rate (CBR) traffic category can be approximated by configuring a nonreal-time variable bit rate (nrt-VBR) VC with the same parameters for the sustainable cell rate (SCR) and peak cell rate (PCR).

- The following restrictions apply to SNMP:
 - IMA failure alarm trap is not supported.
 - Set operation for IMA MIB is not supported.
- The IP ATM_COS feature is not supported on Cisco 7500 series routers.

IMA Configuration Task List

The following sections describe the configuration and verification tasks required to set up ATM IMA groups. You can also configure ATM links individually, but these sections include only the steps for configuring IMA groups. To configure and verify IMA groups on an ATM interface, complete the tasks in the following sections. Each task is identified as optional or required.

- [Configuring an ATM Interface for IMA Operation](#) (required)
- [Verifying an ATM Interface Configured for IMA Operation](#) (optional)
- [Configuring IMA Groups](#) (required)
- [Verifying IMA Group Configuration](#) (optional)
- [Troubleshooting Tips](#) (optional)

For examples of IMA configuration, see the section “[Examples: Inverse Multiplexing over ATM](#)” at the end of this chapter.

Configuring an ATM Interface for IMA Operation

To configure the ATM interface for IMA operation, perform the tasks in one of the following two sections:

- [Configuring the ATM Interface on the Multiport T1/E1 ATM Network Module for IMA Operation](#)
- [Configuring the ATM Interface on the Multiport T1/E1 ATM Port Adapter for IMA Operation](#)

Configuring the ATM Interface on the Multiport T1/E1 ATM Network Module for IMA Operation

To configure an ATM interface on a Multiport T1/E1 ATM Network Module with Inverse Multiplexing over ATM for IMA operation, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/port	Enters interface configuration mode and specifies the location of the interface.
Step 2	Router(config-if)# clock source {line internal {loop-timed}}	Sets the clock source for a link.
Step 3	Router(config-if)# cablelength long {gain26 gain36} {-15db -22.5db -7.5db 0db} or Router(config-if)# cablelength short {133 266 399 533 655}	(T1 interfaces only) Sets a cable length longer than 655 feet. (T1 interfaces only) Sets the cable length shorter than 655 feet.

Step 4	Router(config-if)# no ip address	Disables IP address configuration for the physical layer interface. This and other protocol parameters should be configured on the IMA interface instead of the T1/E1 interface.
Step 5	Router(config-if)# no scrambling payload	Randomizes the ATM cell payload frames to avoid continuous nonvariable bit patterns and improves the efficiency of ATM's cell delineation algorithms. By default, payload scrambling is on for E1 links and off for T1 links. Normally, the default setting for this command is sufficient.
Step 6	Router(config-if)# impedance {75-ohm 120-ohm}	(E1 interfaces only) Specifies the impedance (amount of wire resistance and reactivity to current) for the E1 link. The impedance is determined by the dongle-type cable that you plug in to the IMA module.
Step 7	Router(config-if)# loopback [line local payload remote]	(For testing only) Loops all packets from the ATM interface back to the interface and directs the packets to the network.
Step 8	Router(config-if)# fdl {att ansi all none}	(Optional, T1 only) Sets the Facility Data Link (FDL) exchange standard for the CSU controllers. The FDL is a 4-Kpbs channel used with the Extended SuperFrame (ESF) framing format to provide out-of-band messaging for error-checking on a T1 link. Note For T1, ESF framing and binary eight zero substitution (B8ZS) line encoding are set. For E1, CRC4 multiframe framing and HDB3 line encoding are set. These are the parameters specified by the ATM Forum, and they cannot be changed. You should generally leave this setting at the default, ansi, which follows the ANSI T1.403 standard for extended superframe facilities data link exchange support. Changing it allows improved management in some cases, but can cause problems if your setting is not compatible with that of your service provider.
Step 9	Router(config-if)# ima-group group-number	Specifies that the link is included in an IMA group. Enter an IMA group number from 0 to 3. You can specify up to four groups for each IMA network module. IMA groups usually span multiple ports on a module.
Step 10	Router(config-if)# no shutdown	Ensures that the link is active at the IMA level. If shut down, the link is added to the group, but put in an inhibited state.

Configuring the ATM Interface on the Multiport T1/E1 ATM Port Adapter for IMA Operation

To configure an ATM interface on a Multiport T1/E1 ATM Port Adapter with Inverse Multiplexing over ATM for IMA operation, use the following commands beginning in global configuration mode:

Command	Purpose
Step 1 Router(config)# interface atm slot/port (Cisco 7100 series and 7200 series routers) or Router(config)# interface atm slot/port-adapter/port (Cisco 7500 series)	Enters interface configuration mode and specifies the location of the interface. • <i>slot</i> specifies the router slot position of the installed port adapter. Depending upon the router, enter a slot value from 1 to 5. • <i>port</i> specifies the T1 or E1 link that you are configuring. Enter a value from 0 to 7 for the eight ports. • <i>port-adapter</i> specifies on Cisco 7500 series routers the location of the port adapter on a VIP card. The Cisco IOS software creates the interfaces automatically when a port adapter is installed.
Step 2 Router(config-if)# clock source {line internal}	Sets the clock source for a link. • line specifies that the link uses the recovered clock from the link and is the default setting. Generally, this setting is the most reliable. • internal specifies that the DS-1 link uses the internal clock. Note You should ensure that clock settings are properly configured for each link even when you intend to use a common link for clocking all the links in an IMA group.

	Command	Purpose
Step 3	<pre>Router(config-if)# lbo long {gain26 gain36} {-15db -22.5db -7.5db 0db}</pre> or <pre>lbo short {133 266 399 533 655}</pre>	Sets a cable length of greater than 655 feet for a T1 link. • gain26 specifies the decibel pulse gain at 26 decibels. This is the default pulse gain. • gain36 specifies the decibel pulse gain at 36 decibels. • -15db specifies the decibel pulse rate at -15 decibels. • -22.5db specifies the decibel pulse rate at -22.5 decibels. • -7.5db specifies the decibel pulse rate at -7.5 decibels. • 0db specifies the decibel pulse rate at 0 decibels. This is the default pulse rate. Sets a cable length of 655 feet or less for a T1 link. There is no default for lbo short. • 133 specifies a cable length from 0 to 133 feet. • 266 specifies a cable length from 134 to 266 feet. • 399 specifies a cable length from 267 to 399 feet. • 533 specifies a cable length from 400 to 533 feet. • 655 specifies a cable length from 534 to 655 feet. If you do not set the cable length, the system defaults to a setting of lbo long gain26 0db (space between gain26 and 0db).
Step 4	Router(config-if)# no ip address	Disables IP processing. Instead of configuring protocol parameters on the physical interface, you can set these up on the IMA group virtual interface.
Step 5	Router(config-if)# no atm oversubscribe	Disables the ATM bandwidth manager, which keeps track of bandwidth used by virtual circuits on a per-interface basis. When you disable bandwidth manager, a check determines whether the ATM link is already oversubscribed. If it is, the command is rejected. Otherwise, the total bandwidth available on the link is recorded and all future connection setup requests are monitored to ensure that the link does not become oversubscribed.

	Command	Purpose
Step 6	Router(config-if)# no scrambling cell-payload	Randomizes the ATM cell payload frames to avoid continuous nonvariable bit patterns and improve the efficiency of ATM cell delineation algorithms. Normally the default setting for this command is sufficient, with no specific command required. By default, scrambling is off for T1 or E1 links.
Step 7	Router(config-if)# loopback [diagnostic [payload line] remote [iboc esf [payload line]]] for T1 Router(config-if)# loopback [diagnostic local [payload line]] for E1	(For testing only) Loops all packets from the ATM interface back to the interface and directs the packets to the network. The default line setting places the interface into external loopback mode at the line. • remote sets the far end T1 interface into either payload or line loopback. • local loops the incoming receive signal back out of the transmitter. • diagnostic loops the outgoing transmit signal back to the receive signal.
Step 8	Router(config-if)# fdl { ansi att }	(Optional) Sets the Facility Data Link (FDL) exchange standard for the Channel Service Unit (CSU) controllers. The FDL is a 4-Kbps channel used with the Extended Super Frame (ESF) framing format to provide out-of-band messaging for error-checking on a T1 link. Changing the default allows better management in some circumstances, but can cause problems if your setting is not compatible with that of your service provider.
Step 9	Router(config-if)# ima-group <i>group-number</i> ¹	Specifies that the link is included in an IMA group. Enter an IMA group number from 0 to 3. You can specify up to four groups per IMA port adapter. IMA groups usually span multiple ports on a port adapter.
Step 10	Router(config-if)# no shutdown	Ensures that the link is active at the IMA level.

1. It is recommended that if the link is already a port of an IMA group then remove it from the IMA group both at the near end and far end and then move the link to a desired IMA group.

Verifying an ATM Interface Configured for IMA Operation

To verify that the ATM interface is configured correctly for IMA operation, perform the steps in one of the following sections:

- [Verifying an ATM Interface on the Multiport T1/E1 ATM Network Module](#)
- [Verifying an ATM Interface on the Multiport T1/E1 ATM Port Adapter](#)

Verifying an ATM Interface on the Multiport T1/E1 ATM Network Module

Follow the steps below to verify the configuration of an ATM interface on a Multiport T1/E1 ATM Network Module.

- Step 1** To verify the configuration of an ATM interface, enter the **show interface atm** command. Notice that the total count of configured virtual circuits (VCs) is shown.

```
Router# show interface atm 0/1

ATM0/1 is up, line protocol is up
  Hardware is ATM T1
  Internet address is 10.1.1.2/8
  MTU 4470 bytes, sub MTU 4470, BW 1500 Kbit, DLY 20000 usec,
    reliability 0/255, txload 1/255, rxload 1/255
  Encapsulation ATM, loopback not set
  Keepalive not supported
  Encapsulation(s): AAL5
  256 maximum active VCs, 3 current VCCs
  VC idle disconnect time: 300 seconds
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    0 packets input, 0 bytes, 0 no buffer
    Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    0 packets output, 0 bytes, 0 underruns
    0 output errors, 0 collisions, 3 interface resets
    0 output buffer failures, 0 output buffers swapped out
```

- Step 2** To get information about the physical link, enter the **show controller atm** command.

```
Router# show controller atm0/2

Interface ATM0/2 is administratively down
  Hardware is ATM T1
LANE client MAC address is 0050.0f0c.1482
  hwidb=0x617BEE9C, ds=0x617D498C
  slot 0, unit 2, subunit 2
  rs8234 base 0x3C000000, slave base 0x3C000000
  rs8234 ds 0x617D498C
  SBDs - avail 2048, guaranteed 2, unguaranteed 2046, starved 0
  Seg VCC table 3C00B800, Shadow Seg VCC Table 617EF76C, VCD Table 61805798
  Schedule table 3C016800, Shadow Schedule table 618087C4, Size 63D
  RSM VCC Table 3C02ED80, Shadow RSM VCC Table 6180C994
  VPI Index Table 3C02C300, VCI Index Table 3C02E980
  Bucket2 Table 3C01E500, Shadow Bucket2 Table 6180A0E4
  MCR Limit Table 3C01E900, Shadow MCR Table 617D2160
  ABR template 3C01EB00, Shadow template 614DEEAC
  RM Cell RS Queue 3C02C980
Queue      TXQ Addr  Pos  StQ Addr  Pos
0  UBR CHN0   3C028B00  0    03118540  0
1  UBR CHN1   3C028F00  0    03118D40  0
2  UBR CHN2   3C029300  0    03119540  0
3  UBR CHN3   3C029700  0    03119D40  0
4  VBR/ABR CHN0 3C029B00  0    0311A540  0
5  VBR/ABR CHN1 3C029F00  0    0311AD40  0
6  VBR/ABR CHN2 3C02A300  0    0311B540  0
7  VBR/ABR CHN3 3C02A700  0    0311BD40  0
8  VBR-RT CHN0  3C02AB00  0    0311C540  0
9  VBR-RT CHN1  3C02AF00  0    0311CD40  0
10 VBR-RT CHN2 3C02B300  0    0311D540  0
11 VBR-RT CHN3 3C02B700  0    0311DD40  0
12 SIG        3C02BB00  0    0311E540  0
13 VPD        3C02BF00  0    0311ED40  0
```

```

Queue          FBQ Addr  Pos  RSQ Addr  Pos
0  OAM          3C0EED80 255  0311F600  0
1  UBR CHN0     3C0EFD80  0   03120600  0
2  UBR CHN1     3C0F0D80  0   03121600  0
3  UBR CHN2     3C0F1D80  0   03122600  0
4  UBR CHN3     3C0F2D80  0   03123600  0
5  VBR/ABR CHN0 3C0F3D80  0   03124600  0
6  VBR/ABR CHN1 3C0F4D80  0   03125600  0
7  VBR/ABR CHN2 3C0F5D80  0   03126600  0
8  VBR/ABR CHN3 3C0F6D80  0   03127600  0
9  VBR-RT CHN0  3C0F7D80  0   03128600  0
10 VBR-RT CHN1  3C0F8D80  0   03129600  0
11 VBR-RT CHN2  3C0F9D80  0   0312A600  0
12 VBR-RT CHN3  3C0FAD80  0   0312B600  0
13 SIG          3C0FBD80 255  0312C600  0
SAR Scheduling channels: -1 -1 -1 -1 -1 -1 -1
Part of IMA group 3
Link 2 IMA Info:
    group index is 1
    Tx link id is 2, Tx link state is unusableNoGivenReason
    Rx link id is 99, Rx link state is unusableFault
    Rx link failure status is fault,
    0 tx failures, 3 rx failures
Link 2 Frammer Info:
    framing is ESF, line code is B8ZS, fdl is ANSI
    cable-length is long, Rcv gain is 26db and Tx gain is 0db,
    clock src is line, payload-scrambling is disabled, no loopback
    line status is 0x1064; or Tx RAI, Rx LOF, Rx LOS, Rx LCD.
    port is active, link is unavailable
    0 idle rx, 0 correctable hec rx, 0 uncorrectable hec rx
    0 cells rx, 599708004 cells tx, 0 rx fifo overrun.
Link (2):DS1 MIB DATA:
    Data in current interval (518 seconds elapsed):
        0 Line Code Violations, 0 Path Code Violations
        0 Slip Secs, 518 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
        0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 519 Unavail Secs
    Total Data (last 24 hours)
        0 Line Code Violations, 0 Path Code Violations,
        0 Slip Secs, 86400 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins,
        0 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 86400 Unavail Secs
SAR counter totals across all links and groups:
    0 cells output, 0 cells stripped
    0 cells input, 0 cells discarded, 0 AAL5 frames discarded
    0 pci bus err, 0 dma fifo full err, 0 rsm parity err
    0 rsm syn err, 0 rsm/seg q full err, 0 rsm overflow err
    0 hs q full err, 0 no free buff q err, 0 seg underflow err
    0 host seg stat q full err

```

Verifying an ATM Interface on the Multiport T1/E1 ATM Port Adapter

Follow the steps below to verify configuration of an ATM interface on a Multiport T1/E1 ATM Port Adapter.

- Step 1** Use the privileged EXEC **show interface atm slot/port** command to verify configuration of the ATM interface. Note that the total count of configured VCs is shown.

```
Router# show interface atm 5/0
```

```
ATM5/0 is up, line protocol is up
```



```

Hardware is IMA PA
Internet address is 10.0.2.0/16
MTU 4470 bytes, sub MTU 4470, BW 1536 Kbit, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ATM, loopback not set
Keepalive not supported
Encapsulation(s):AAL5
512 maximum active VCs, 3 current VCCs
VC idle disconnect time:300 seconds
1 carrier transitions
Last input 00:43:16, output 00:43:16, output hang never
Last clearing of "show interface" counters never
Input queue:0/75/0 (size/max/drops); Total output drops:0
Queueing strategy:weighted fair
Output queue:0/1000/64/0 (size/max total/threshold/drops)
    Conversations 0/0/256 (active/max active/max total)
    Reserved Conversations 0/0 (allocated/max allocated)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  4803 packets input, 5928671 bytes, 0 no buffer
    Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  4823 packets output, 5911619 bytes, 0 underruns
    0 output errors, 0 collisions, 1 interface resets
    0 output buffer failures, 0 output buffers swapped out

```

Step 2 To get information about the physical link, use the privileged EXEC **show controller [atm [slot/port]]** command.

```

Router# show controller atm 1/ima0

Interface ATM1/ima0 is up
Hardware is IMA PA - DS1 (1Mbps)
Framer is PMC PM7344, SAR is LSI ATMIZER II
Firmware rev:G102, ATMIZER II rev:3
  idb=0x61DE9F10, ds=0x6185C0A0, vc=0x6187D3C0, pa=0x6184AF40
  slot 1, unit 9, subunit 0, fci_type 0x00BA, ticks 701720
  400 rx buffers:size=512, encap=64, trailer=28, magic=4
Curr Stats:
  rx_cell_lost=0, rx_no_buffer=0, rx_crc_10=0
  rx_cell_len=0, rx_no_vcd=0, rx_cell_throttle=0, tx_aci_err=0
Rx Free Ring status:
  base=0x3CFF0040, size=1024, write=320
Rx Compl Ring status:
  base=0x338DCE40, size=2048, read=1275
Tx Ring status:
  base=0x3CFE8040, size=8192, write=700
Tx Compl Ring status:
  base=0x338E0E80, size=2048, read=344
BFD Cache status:
  base=0x61878340, size=5120, read=5107
Rx Cache status:
  base=0x61863D80, size=16, write=11
Tx Shadow status:
  base=0x618641C0, size=8192, read=687, write=700
Control data:
  rx_max_spins=12, max_tx_count=25, tx_count=13
  rx_threshold=267, rx_count=11, tx_threshold=3840
  tx bfd write indx=0x27, rx_pool_info=0x61863E20
Control data base address:
  rx_buf_base = 0x038A15A0      rx_p_base = 0x6185CB40
  rx_pak      = 0x61863AF0      cmd      = 0x6185C320
  device_base = 0x3C800000      ima_pa_stats = 0x038E2FA0
  sdram_base  = 0x3CE00000      pa_cmd_buf = 0x3CFFFC00

```

```

vcd_base[0] = 0x3CE3C100      vcd_base[1] = 0x3CE1C000
chip_dump = 0x038E3D7C      dpram_base = 0x3CD80000
sar_buf_base[0] = 0x3CE4C000  sar_buf_base[1] = 0x3CF22000
bfd_base[0] = 0x3CFD4000      bfd_base[1] = 0x3CFC0000
acd_base[0] = 0x3CE88360      acd_base[1] = 0x3CE5C200
pci_atm_stats = 0x038E2EC0
ATM1/ima0 is up
    hwgrp number = 1
grp tx up reg= 0x5, grp rx up reg= 0x3, rx dcb reg= 0xD4 0x4, tx links grp reg=
0x3, scci reg= 0x3C, ima id reg= 0x0, group status reg= 0xA2, tx timing reg= 0x
20, tx test reg= 0x21, tx test pattern reg= 0x41, rx test pattern reg= 0x42, icp
cell link info reg= 0xFC, icp cell link info reg= 0xFC, icp cell link info r
eg= 0x0, icp cell link info reg= 0x0, icp cell link info reg= 0x0, icp cell li
nk info reg= 0x0, icp cell link info reg= 0x0, icp cell link info reg= 0x0

```

Configuring IMA Groups

As shown in the previous section, the **ima-group** command configures links on an ATM interface as IMA group members. When IMA groups have been set up in this way, you can configure settings for each group. To configure IMA groups and settings for each group, perform the tasks in one of the following two sections:

- [Configuring IMA Groups on the Multiport T1/E1 ATM Network Module](#)
- [Configuring IMA Groups on the Multiport T1/E1 ATM Port Adapter](#)

Configuring IMA Groups on the Multiport T1/E1 ATM Network Module

To configure IMA groups and settings for each group on the Multiport T1/E1 ATM Network Module with Inverse Multiplexing over ATM, use following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/ima group-number	Enters interface configuration mode and specifies the slot location of the interface and IMA group number. • <i>slot</i> indicates the router slot where the port adapter is located. • <i>group-number</i> is the IMA group label. There should be no space between “ima” and the group number.
Step 2	Router(config-if)# ip address ip-address	Sets protocol parameters for the whole group.
Step 3	Router(config-if)# no atm oversubscribe	Disables the ATM bandwidth manager, which keeps track of bandwidth used by virtual circuits on a per-interface basis. When you disable bandwidth manager, a check determines whether the ATM link is already oversubscribed. If it is, the command is rejected. Otherwise, the total bandwidth available on the link is recorded and all future connection setup requests are monitored to ensure that the link does not become oversubscribed.

Step 4	Router(config-if)# pvc [name] vpi/vci ilmi	Creates an ATM PVC for ILMI management purposes and enters Interface-ATM-VC configuration mode.
Step 5	Router(config-if-atm-vc)# exit	Exits Interface-ATM-VC configuration mode.
Step 6	Router(config-if)# pvc [name] vpi/vci	Enables a PVC.
Step 7	Router(config-if-atm-vc)# protocol ip address broadcast	Specifies a protocol address for the PVC. Note The default AAL5 layer and SNAP encapsulation is used in this example, so the encapsulation aal5encap command is unnecessary.
Step 8	Router(config-if-atm-vc)# vbr-rt peak-rate average-rate burst	Configures a type of ATM service on the PVC. This example uses Variable Bit Rate, real-time, for AAL5 communications, allowing you to set different cell rate parameters for connections where there is a fixed timing relationship among samples. (VBR is generally used with AAL5 and IP over ATM.) The command configures traffic shaping so that the carrier does not discard calls. Configures the burst value if the PVC will carry bursty traffic.
Step 9	Router(config-if-atm-vc)# exit	Exits Interface-ATM-VC configuration mode and returns to interface configuration mode.
Step 10	Router(config-if)# ima clock-mode {common [port] {independent}}	Sets the transmit clock mode for the group.
Step 11	Router(config-if)# ima active-links-minimum number	Specifies how many transmit links must be active in order for the IMA group to be operational.
Step 12	Router(config-if)# ima differential-delay-maximum msec	Specifies the maximum allowed differential timing delay that can exist among the active links in an IMA group.
Step 13	Router(config-if)# ima test [link port] [pattern pattern-id]	Starts the IMA link test procedure with the specified link and pattern.

For examples of configuring IMA groups on Multiport T1/E1 ATM Network Modules, see the sections [“Example: E1 IMA on Multiport T1/E1 ATM Network Module”](#) and [“Example: T1 IMA on Multiport T1/E1 ATM Network Module”](#) at the end of this chapter.

Configuring IMA Groups on the Multiport T1/E1 ATM Port Adapter

To configure IMA groups and settings for each group on the Multiport T1/E1 ATM Port Adapter with Inverse Multiplexing over ATM, use following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/ima group number (Cisco 7100 series and 7200 series routers) or Router(config)# interface atm slot/port-adapter/ima group number (Cisco 7500 series routers)	Enters interface configuration mode and specifies the slot location of the interface and IMA group number. • <i>slot</i> indicates the router slot where the port adapter is located. Depending upon the router, enter a slot value from 1 to 5. • <i>group-number</i> is the IMA group label. Enter a value from 0 to 3. There should be no space between “ima” and the group number. • <i>port-adapter</i> indicates the physical port adapter slot on the VIP2. • <i>port</i> identifies the interface port on the IMA port adapter.
Step 2	Router(config-if)# ip address ip-address	Sets protocol parameters for the whole group.
Step 3	Router(config-if)# pvc vpi/vci ilmi	Creates an ATM PVC for ILMI management purposes and enters VC configuration mode. To set up communication with the ILMI, use a value of ilmi for ATM adaptation layer encapsulation; the associated <i>vpi</i> and <i>vci</i> values are ordinarily 0 and 16, respectively.
Step 4	Router(config-if-atm-vc)# pvc vpi/vci qsaal	Enables the signaling for setup and teardown of SVCs by specifying the Q.SAAL¹ encapsulations; the associated <i>vpi</i> and <i>vci</i> values are ordinarily 0 and 5, respectively. Note You can also set up PVCs for sending information.
Step 5	Router(config-if-atm-vc)# exit	To complete configuration of a PVC, exit VC configuration mode.
Step 6	Router(config-if)# svc name nsap nsap-address	Sets up SVCs for sending ATM information. Once you specify a name for an SVC, you can reenter the interface-ATM-VC configuration mode by simply entering svc name. <i>nsap-address</i> is a 40-digit hexadecimal number.
Step 7	Router(config-if-atm-vc)# protocol ip address broadcast	Specifies a protocol address for the SVC. Note The default AAL5 layer and SNAP² encapsulation are used in this example, so the encapsulation aalencap command is unnecessary.
Step 8	Router(config-if-atm-vc)# exit	Exits VC configuration mode and returns to interface configuration mode.

	Command	Purpose
Step 9	Router(config-if)# ima clock-mode { common [<i>port</i>] independent } ³	Sets the transmit clock mode for the group. If all the links in the group should share a clock source, use the common keyword. If each link uses a different clock source, use the independent clock source keyword. Using the <i>port</i> keyword, you can specify a link for common clocking. The default uses the common clock as the transmit clock source.
Step 10	Router(config-if)# ima active-links-minimum <i>number</i>	When used with a number value from 1 to 8, specifies how many transmit links must be active in order for the IMA group to be operational. The setting you choose depends on your performance requirements as well as on the total number of links in the group. If fewer than the preset minimum are active, the group is automatically rendered inactive until the minimum number of links is up again. The default value is 1.
Step 11	Router(config-if)# ima differential-delay-maximum <i>msec</i>	Specifies the differential timing delay among the links in an IMA group by entering a milliseconds value from 25 to 250 for T1 and 25 to 190 for E1. If a link delay exceeds the specified maximum, the link is dropped; otherwise, the IMA feature adjusts for differences in delays so that all links in a group are aligned. A shorter value provides less resiliency in adjusting for variations than a higher value. However, a higher value might affect overall group performance because increased differential delay adds more latency to the traffic that is transmitted across the group.
Step 12	Router(config-if)# ima test [<i>link port</i>] [<i>pattern pattern-id</i>]	(For testing only) Troubleshoots or diagnoses physical link connectivity. The IMA feature performs ongoing tests on all links in a group, to verify link connectivity. Use this command to specify both a link to use for testing and as a test pattern. The pattern is sent from the specified link and looped back from the receiving end in the multiplexing-demultiplexing process. A byte in the ICP cell identifies the pattern.

1. Q Signaling ATM adaptation Layer.
2. Subnetwork Access Protocol.
3. To form an IMA group with independent clock mode, use the **no shut** command in the IMA interface only. To change the mode to independent from an already existing IMA group, use the **no ima** command on the IMA group links. Next, change the mode, add all the links, and then issue the **no shut** command in the IMA interface.

For an example of configuring IMA groups on multiport T1/E1 ATM port adapters, see the section [“Example: T1 IMA on Multiport T1/E1 ATM Port Adapter”](#) at the end of this chapter.

Verifying IMA Group Configuration

To verify IMA group configuration, perform the steps in one of the following two sections:

- [Verifying IMA Group Configuration on the Multiport T1/E1 ATM Network Module](#)
- [Verifying IMA Group Configuration on the Multiport T1/E1 ATM Port Adapter](#)

Verifying IMA Group Configuration on the Multiport T1/E1 ATM Network Module

Perform the following steps to verify IMA group configuration on the Multiport T1/E1 ATM Network Module.

- Step 1** To display information about IMA group interfaces, enter the **show ima interface atm** command. The first example shows the command output without the **detail** keyword; the second example shows the detailed information.

```
Router# show ima interface atm2/ima2
```

```
Interface ATM2/IMA2 is up
  Group index is 2
  Ne state is operational, failure status is noFailure
  active links bitmap 0x30
  IMA Group Current Configuration:
    Tx/Rx configured links bitmap 0x30/0x30
    Tx/Rx minimum required links 1/1
    Maximum allowed diff delay is 25ms, Tx frame length 128
    Ne Tx clock mode CTC, configured timing reference link ATM2/4
    Test pattern procedure is disabled
  IMA Group Current Counters (time elapsed 12 seconds):
    3 Ne Failures, 3 Fe Failures, 4 Unavail Secs
  IMA Group Total Counters (last 0 15 minute intervals):
    0 Ne Failures, 0 Fe Failures, 0 Unavail Secs
  IMA link Information:
    Link      Physical Status      NearEnd Rx Status      Test Status
    ----      -
    ATM2/4    up                          active                  disabled
    ATM2/5    up                          active                  disabled
```

```
router# show ima interface atm2/ima2 detail
```

```
Interface ATM2/IMA2 is up
  Group index is 2
  Ne state is operational, failure status is noFailure
  active links bitmap 0x30
  IMA Group Current Configuration:
    Tx/Rx configured links bitmap 0x30/0x30
    Tx/Rx minimum required links 1/1
    Maximum allowed diff delay is 25ms, Tx frame length 128
    Ne Tx clock mode CTC, configured timing reference link ATM2/4
    Test pattern procedure is disabled
  Detailed group Information:
    Tx/Rx Ima_id 0x22/0x40, symmetry symmetricOperation
    Number of Tx/Rx configured links 2/2
    Number of Tx/Rx active links 2/2
    Fe Tx clock mode ctc, Rx frame length 128
    Tx/Rx timing reference link 4/4
    Maximum observed diff delay 0ms, least delayed link 5
    Running seconds 32
    GTSM last changed 10:14:41 UTC Wed Jun 16 1999
  IMA Group Current Counters (time elapsed 33 seconds):
    3 Ne Failures, 3 Fe Failures, 4 Unavail Secs
  IMA Group Total Counters (last 0 15 minute intervals):
```

```

    0 Ne Failures, 0 Fe Failures, 0 Unavail Secs
Detailed IMA link Information:

```

```

Interface ATM2/4 is up
  ifIndex 13, Group Index 2, Row Status is active
  Tx/Rx Lid 4/4, relative delay 0ms
  Ne Tx/Rx state active/active
  Fe Tx/Rx state active/active
  Ne Rx failure status is noFailure
  Fe Rx failure status is noFailure
  Rx test pattern 0x41, test procedure disabled
IMA Link Current Counters (time elapsed 35 seconds):
  1 Ima Violations, 0 Oif Anomalies
  1 Ne Severely Err Secs, 2 Fe Severely Err Secs
  0 Ne Unavail Secs, 0 Fe Unavail Secs
  2 Ne Tx Unusable Secs, 2 Ne Rx Unusable Secs
  0 Fe Tx Unusable Secs, 2 Fe Rx Unusable Secs
  0 Ne Tx Failures, 0 Ne Rx Failures
  0 Fe Tx Failures, 0 Fe Rx Failures
IMA Link Total Counters (last 0 15 minute intervals):
  0 Ima Violations, 0 Oif Anomalies
  0 Ne Severely Err Secs, 0 Fe Severely Err Secs
  0 Ne Unavail Secs, 0 Fe Unavail Secs
  0 Ne Tx Unusable Secs, 0 Ne Rx Unusable Secs
  0 Fe Tx Unusable Secs, 0 Fe Rx Unusable Secs
  0 Ne Tx Failures, 0 Ne Rx Failures
  0 Fe Tx Failures, 0 Fe Rx Failures

Interface ATM2/5 is up
  ifIndex 14, Group Index 2, Row Status is active
  Tx/Rx Lid 5/5, relative delay 0ms
  Ne Tx/Rx state active/active
  Fe Tx/Rx state active/active
  Ne Rx failure status is noFailure
  Fe Rx failure status is noFailure
  Rx test pattern 0x41, test procedure disabled
IMA Link Current Counters (time elapsed 46 seconds):
  1 Ima Violations, 0 Oif Anomalies
  1 Ne Severely Err Secs, 2 Fe Severely Err Secs
  0 Ne Unavail Secs, 0 Fe Unavail Secs
  2 Ne Tx Unusable Secs, 2 Ne Rx Unusable Secs
  0 Fe Tx Unusable Secs, 2 Fe Rx Unusable Secs
  0 Ne Tx Failures, 0 Ne Rx Failures
  0 Fe Tx Failures, 0 Fe Rx Failures
IMA Link Total Counters (last 0 15 minute intervals):
  0 Ima Violations, 0 Oif Anomalies
  0 Ne Severely Err Secs, 0 Fe Severely Err Secs
  0 Ne Unavail Secs, 0 Fe Unavail Secs
  0 Ne Tx Unusable Secs, 0 Ne Rx Unusable Secs
  0 Fe Tx Unusable Secs, 0 Fe Rx Unusable Secs
  0 Ne Tx Failures, 0 Ne Rx Failures
  0 Fe Tx Failures, 0 Fe Rx Failures

```

Step 2 To review physical level information about the IMA group, enter the **show controllers atm** command in privileged EXEC mode, as shown in the following example:

```

router# show controllers atm0/ima3

Interface ATM0/IMA3 is up
  Hardware is ATM IMA
  LANE client MAC address is 0050.0f0c.148b
  hwidb=0x61C2E990, ds=0x617D498C
  slot 0, unit 3, subunit 3
  rs8234 base 0x3C000000, slave base 0x3C000000

```

```

rs8234 ds 0x617D498C
SBDs - avail 2048, guaranteed 3, unguaranteed 2045, starved 0
Seg VCC table 3C00B800, Shadow Seg VCC Table 617EF76C, VCD Table 61805798
Schedule table 3C016800, Shadow Schedule table 618087C4, Size 63D
RSM VCC Table 3C02ED80, Shadow RSM VCC Table 6180C994
VPI Index Table 3C02C300, VCI Index Table 3C02E980
Bucket2 Table 3C01E500, Shadow Bucket2 Table 6180A0E4
MCR Limit Table 3C01E900, Shadow MCR Table 617D2160
ABR template 3C01EB00, Shadow template 614DEEAC
RM Cell RS Queue 3C02C980
Queue          TXQ Addr  Pos  StQ Addr  Pos
0  UBR CHN0     3C028B00  0    03118540  0
1  UBR CHN1     3C028F00  0    03118D40  0
2  UBR CHN2     3C029300  0    03119540  0
3  UBR CHN3     3C029700  0    03119D40  0
4  VBR/ABR CHN0 3C029B00  0    0311A540  0
5  VBR/ABR CHN1 3C029F00  0    0311AD40  0
6  VBR/ABR CHN2 3C02A300  0    0311B540  0
7  VBR/ABR CHN3 3C02A700  0    0311BD40  0
8  VBR-RT CHN0  3C02AB00  0    0311C540  0
9  VBR-RT CHN1  3C02AF00  0    0311CD40  0
10 VBR-RT CHN2  3C02B300  0    0311D540  0
11 VBR-RT CHN3  3C02B700  0    0311DD40  0
12 SIG          3C02BB00  0    0311E540  0
13 VPD          3C02BF00  0    0311ED40  0

Queue          FBQ Addr  Pos  RSQ Addr  Pos
0  OAM          3C0EED80  255  0311F600  0
1  UBR CHN0     3C0EFD80  0    03120600  0
2  UBR CHN1     3C0F0D80  0    03121600  0
3  UBR CHN2     3C0F1D80  0    03122600  0
4  UBR CHN3     3C0F2D80  0    03123600  0
5  VBR/ABR CHN0 3C0F3D80  0    03124600  0
6  VBR/ABR CHN1 3C0F4D80  0    03125600  0
7  VBR/ABR CHN2 3C0F5D80  0    03126600  0
8  VBR/ABR CHN3 3C0F6D80  0    03127600  0
9  VBR-RT CHN0  3C0F7D80  0    03128600  0
10 VBR-RT CHN1  3C0F8D80  255  03129600  0
11 VBR-RT CHN2  3C0F9D80  0    0312A600  0
12 VBR-RT CHN3  3C0FAD80  0    0312B600  0
13 SIG          3C0FBD80  255  0312C600  0
SAR Scheduling channels: -1 -1 -1 -1 -1 -1 -1 -1
ATM channel number is 1
link members are 0x7, active links are 0x0
Group status is blockedNe, 3 links configured,
Group Info: Configured links bitmap 0x7, Active links bitmap 0x0,
Tx/Rx IMA_id 0x3/0x63,
NE Group status is startUp,
frame length 0x80, Max Diff Delay 0,
1 min links, clock mode ctc, symmetry symmetricOperation, trl 0,
Group Failure status is startUpNe.
Test pattern procedure is disabled
SAR counter totals across all links and groups:
0 cells output, 0 cells stripped
0 cells input, 0 cells discarded, 0 AAL5 frames discarded
0 pci bus err, 0 dma fifo full err, 0 rsm parity err
0 rsm syn err, 0 rsm/seg q full err, 0 rsm overflow err
0 hs q full err, 0 no free buff q err, 0 seg underflow err
0 host seg stat q full err

```

Step 3 To see how SVCs and PVCs are set up, enter the privileged EXEC **show atm vc** command.

VCD /

Peak Avg/Min Burst

Interface	Name	VPI	VCI	Type	Encaps	SC	Kbps	Kbps	Cells	Sts
0/1	1	0	50	PVC	SNAP	UBR	1000			INAC
0/IMA3	2	0	5	PVC	SAAL	UBR	4000			UP
0/IMA3	3	0	16	PVC	ILMI	UBR	4000			UP
0/IMA3	first	1	13	PVC	MUX	VBR	640	320	80	UP
0/IMA3	4	0	34	SVC	SNAP	VBR-RT	768	768		UP

Verifying IMA Group Configuration on the Multiport T1/E1 ATM Port Adapter

Perform the following steps to verify IMA group configuration on the Multiport T1/E1 ATM Port Adapter.

- Step 1** To display information about IMA group interfaces, use the **show ima interface atm** command in privileged EXEC mode. First, the group information appears. Then, information about each link in the group (there are two in this example) is displayed under “IMA Detailed Link Information.”



Note If you do not enter the **detail** keyword, you do not see the IMA MIB information or the “Detailed Link Information” output displayed in the example below.

```
Router# show ima interface atm 1/ima0 detail

ATM1/ima0 is up
  ImaGroupState:NearEnd = operational, FarEnd = operational
  ImaGroupFailureStatus = noFailure
IMA Group Current Configuration:
  ImaGroupMinNumTxLinks = 2      ImaGroupMinNumRxLinks = 2
  ImaGroupDiffDelayMax  = 25     ImaGroupNeTxClkMode  = common(ctc)
  ImaGroupFrameLength   = 128    ImaTestProcStatus    = disabled
  ImaGroupTestLink      = 0      ImaGroupTestPattern  = 0xFF
IMA MIB Information:
  ImaGroupSymmetry      = symmetricOperation
  ImaGroupFeTxClkMode   = common(ctc)
  ImaGroupRxFrameLength = 128
  ImaGroupTxTimingRefLink = 0      ImaGroupRxTimingRefLink = 0
  ImaGroupTxImaId       = 0      ImaGroupRxImaId       = 0
  ImaGroupNumTxCfgLinks = 2      ImaGroupNumRxCfgLinks = 2
  ImaGroupNumTxActLinks = 2      ImaGroupNumRxActLinks = 2
  ImaGroupLeastDelayLink = 1      ImaGroupDiffDelayMaxObs = 0
IMA group counters:
  ImaGroupNeNumFailures = 78      ImaGroupFeNumFailures = 68
  ImaGroupUnAvailSecs   = 441453  ImaGroupRunningSecs   =
445036
IMA Detailed Link Information:

ATM1/0 is up
  ImaLinkRowStatus = LinkRowStatusUnknown
  ImaLinkIfIndex   = 0              ImaLinkGroupIndex = 0
  ImaLinkState:
    NeTx = active
    NeRx = active
    FeTx = active
    FeRx = active
  ImaLinkFailureStatus:
    NeRx = noFailure
    FeRx = noFailure
  ImaLinkTxLid     = 0              ImaLinkRxLid     = 0
  ImaLinkRxTestPattern = 65        ImaLinkTestProcStatus = disabled
  ImaLinkRelDelay   = 0
```

```

IMA Link counters :
    ImaLinkImaViolations      = 1
    ImaLinkNeSevErroredSec    = 41      ImaLinkFeSevErroredSec = 34
    ImaLinkNeUnavailSec       = 441505  ImaLinkFeUnAvailSec      = 28
    ImaLinkNeTxUnusableSec    = 2        ImaLinkNeRxUnUsableSec   = 441542
    ImaLinkFeTxUnusableSec    = 74       ImaLinkFeRxUnusableSec   = 57
    ImaLinkNeTxNumFailures    = 0        ImaLinkNeRxNumFailures   = 15
    ImaLinkFeTxNumFailures    = 4        ImaLinkFeRxNumFailures   = 3

ATM1/1 is up
    ImaLinkRowStatus = LinkRowStatusUnknown
    ImaLinkIfIndex    = 1          ImaLinkGroupIndex = 0
    ImaLinkState:
        NeTx = active
        NeRx = active
        FeTx = active
        FeRx = active
    ImaLinkFailureStatus:
        NeRx = noFailure
        FeRx = noFailure
    ImaLinkTxLid       = 1          ImaLinkRxLid          = 1
    ImaLinkRxTestPattern = 65      ImaLinkTestProcStatus = disabled
    ImaLinkRelDelay     = 0

IMA Link counters :
    ImaLinkImaViolations      = 1
    ImaLinkNeSevErroredSec    = 40      ImaLinkFeSevErroredSec = 42
    ImaLinkNeUnavailSec       = 441389  ImaLinkFeUnAvailSec      = 38
    ImaLinkNeTxUnusableSec    = 2        ImaLinkNeRxUnUsableSec   = 441427
    ImaLinkFeTxUnusableSec    = 99       ImaLinkFeRxUnusableSec   = 99
    ImaLinkNeTxNumFailures    = 0        ImaLinkNeRxNumFailures   = 16
    ImaLinkFeTxNumFailures    = 4        ImaLinkFeRxNumFailures   = 4

```

Step 2 To see how SVCs and PVCs are set up, use the **show atm vc** command in privileged EXEC mode.

```
Router# show atm vc
```

VCD /						Peak	Avg/Min	Burst			
Interface	Name	VPI	VCI	Type	Encaps	SC	Kbps	Kbps	Cells	Sts	
1/1	1	0	50	PVC	SNAP	UBR	1000			INAC	
1/IMA3	2	0	5	PVC	SAAL	UBR	4000			UP	
1/IMA3	3	0	16	PVC	ILMI	UBR	4000			UP	
1/IMA3	first	1	13	PVC	MUX	VBR	640	320	80	UP	
1/IMA3	4	0	34	SVC	SNAP	VBR-RT	768	768		UP	

Troubleshooting Tips

To troubleshoot the ATM and IMA group configuration, enter the **ping** command, which checks host reachability and network connectivity. This command can confirm basic network connectivity on the AppleTalk, ISO CLNS, IP, Novell, Apollo, VINES, DECnet, or XNS networks.

For IP, the **ping** command sends Internet Control Message Protocol (ICMP) Echo messages. If a station receives an ICMP Echo message, it sends an ICMP Echo Reply message back to the source.

The extended command mode of the **ping** command permits you to specify the supported IP header options so that the router can perform a more extensive range of test options. To enter **ping** extended command mode, enter **yes** at the “extended commands” prompt of the **ping** command.

For detailed information on using the **ping** and extended **ping** commands, see the *Cisco IOS Configuration Fundamentals Command Reference*.

If a **ping** command fails, check the following possible reasons for the connectivity problem:

- The interface is down, causing a “no ip route” error message.
- The PVC or SVC does not include proper mapping configured for the destination address, causing an “encapsulation failure” error. For more information about configuring encapsulation, see the section “[Configuring IMA Groups](#)” earlier in this chapter and the **encapsulation aal5** command in the *Cisco IOS Asynchronous Transfer Mode Command Reference*.
- If there is a firmware problem, the **show controller atm** command shows whether an interface is able to transmit and receive cells. For sample output, see the earlier section “[Verifying an ATM Interface Configured for IMA Operation](#).”

**Tip**

Use the **ping** command when the network is functioning properly to see how the command works under normal conditions and to compare the results when troubleshooting.

If a communication session is closing when it should not be, an end-to-end connection problem can be the cause. The **debug ip packet** command is useful for analyzing the messages traveling between the local and remote hosts. IP debugging information includes packets received, generated, and forwarded. Because the **debug ip packet** command generates a significant amount of output, use it only when traffic on the IP network is low, so other activity on the system is not adversely affected.

Bandwidth Considerations

When planning IMA groups and payload bandwidth requirements, consider the overhead required for ATM cell headers, service-layer encapsulation such as RFC 1483, AAL5 encapsulation, and ICP cells. [Table 1](#) and [Table 2](#) show approximate values for T1 and E1 IMA groups, respectively, with a frame length of 128, estimating ATM overhead at about 10 percent. The effective payload bandwidth varies according to packet size because the packets must be divided into an integer number of ATM cells leaving the last cell padded with filler bytes.

**Note**

Control the bandwidth threshold to activate an IMA group by using the **ima active-links-minimum** command.

Table 1 **T1 IMA AAL5 Payload Bandwidth with IMA Frame Size 128**

Number of Links in the Group	Total Bandwidth	Payload Bandwidth
1	1.536	1.38
2	3.072	2.76
3	4.608	4.14
4	6.144	5.52
5	7.68	6.91
6	9.216	8.28
7	10.752	9.66
8	12.288	11.04

Table 2 *E1 IMA AAL5 Payload Bandwidth with IMA Frame Size 128*

Number of Links in the Group	Total Bandwidth	Payload Bandwidth
1	1.92	1.74
2	3.84	3.47
3	5.76	5.21
4	7.68	6.95
5	9.60	8.69
6	11.52	10.43
7	13.44	12.17
8	15.36	13.90

Related Documents

For information about the physical characteristics of the ATM T1/E1 IMA network modules or port adapters, or for instructions on how to install the network or modem modules or port adapters, either see the installation guidelines that came with your network module or port adapter or view the up-to-date information on Cisco.com.

Configuring ATM E.164 Auto Conversion

E.164 is an International Telecommunications Union Telecommunication Standardization Sector (ITU-T) specification for the ISDN international telephone numbering plan, which has traditionally only been used in telephone networks. The ATM Forum has defined three different 20-byte ATM End System Address (AESA) formats, along with the native E.164 format, for use in ATM networks. One of these 20-byte formats is the embedded E.164 AESA (E164_AESA) format.

With ATM E.164 auto conversion enabled, networks that operate based on ATM addressing formats can internetwork with networks based on E.164 addressing formats. The conversion requires components from addressing, routing, and signaling to perform properly.

For more information about E.164 and ATM address formats, see ATM Forum UNI 3.0, 3.1, and 4.0, and ITU E.164. [Table 3](#) lists the ATM and E.164 address formats supported by ATM E.164 auto conversion.

Table 3 *ATM and E1.64 Address Formats*

Address Type	Example
Native E.164 A minimum of 7 and maximum of 15 ASCII-encoded decimal numbers.	1-800-555-1212

Table 3 **ATM and E.164 Address Formats**

Address Type	Example
E164_AESA E.164 ATM End System Address is an ATM address that contains an embedded E.164 number. Format AFI E164 HO-DSP ESI SEL AFI = 45	45.000018005551212F00000000.112233445566.00
E164_ZDSP E.164 Zero Domain Specific Part is an ATM address that contains all zeros in the Domain Specific Part of the address. Format AFI E164 HO-DSP ESI SEL AFI = 45 The remaining bytes in HO-DSP, ESI, and SEL are 0.	45.000018005551212F00000000.000000000000.00

When ATM E.164 auto conversion is enabled, a Cisco router sets up ATM SVC connections based on E.164 addresses. The router uses ATM E164_AESA addresses to set up E.164 calls in a way similar to using ATM AESA addresses to set up ATM SVCs. The ATM AESA address on an interface and the ATM AESA address of a static map must be in E164_AESA format.

To configure ATM E.164 auto conversion, you must configure the ATM interface using E164_AESA or E164_ZDSP format. To enable E.164 auto conversion, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/0 or Router(config)# interface atm slot/port-adapter/0 or Router(config)# interface atm number	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
Step 2	Router(config-if)# ip address ip-address mask	If IP routing is enabled on the system, optionally assigns a source IP address and subnet mask to the interface.
Step 3	Router(config-if)# pvc 0/5 qsaal	Configures the signaling PVC for the ATM main interface that uses SVCs.
Step 4	Router(config-if-atm-vc)# exit	Returns to interface configuration mode.
Step 5	Router(config-if)# atm nsap-address nsap-address	Sets the AESA address for the ATM interface using E164_AESA or E164_ZDSP address format.
Step 6	Router(config-if)# atm e164 auto-conversion	Enables E.164 auto conversion on the interface.
Step 7	Router(config-if)# svc [name] nsap address	Specifies the destination NSAP address using E164_AESA or E164_ZDSP address format.
Step 8	Router(config-if-atm-vc)# protocol ip protocol-address	Specifies the destination IP address of the SVC.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

Use the **show interfaces atm** command to verify that ATM E.164 auto conversion is running.

For an example of configuring ATM E.164 auto conversion, refer to the section “[Example: Configuring ATM E.164 Auto Conversion](#)” at the end of this chapter.

Configuring Circuit Emulation Services

For overview information and configuration tasks for Circuit Emulation Services (CES) for ATM, see the following sections:

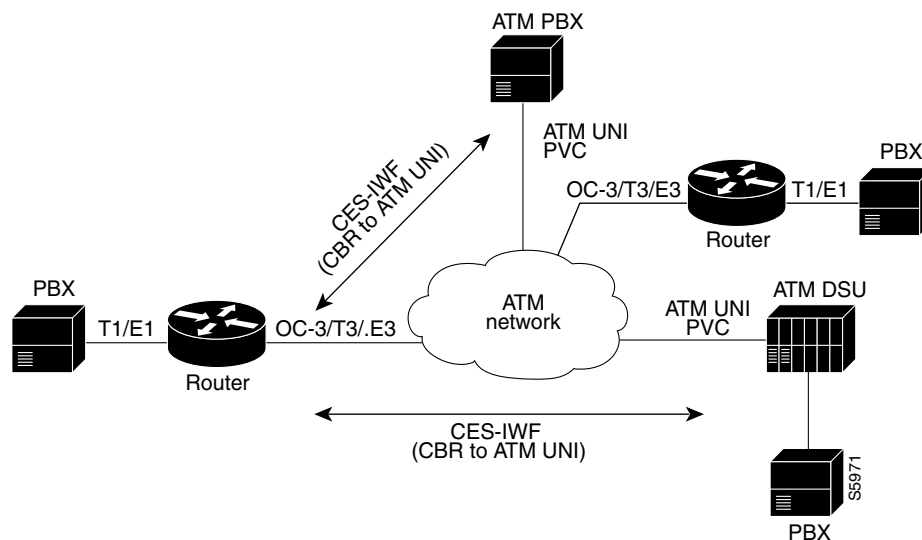
- [CES Overview](#)
- [Configuring CES on the OC-3/STM-1 ATM Circuit Emulation Service Network Module](#)
- [Configuring CES on the ATM-CES Port Adapter](#)
- [Configuring Virtual Path Shaping](#)

CES Overview

Circuit emulation service internetworking function (CES-IWF) is a service based on ATM Forum standards that allows communications to occur between CBR or AAL1 CES and ATM UNI interfaces; that is, between non-ATM telephony devices (such as classic PBXs or TDMs) and ATM devices (such as Cisco 3600 or 7200 series routers). Thus, a Cisco 3600 series router equipped with an OC-3/STM-1 ATM Circuit Emulation Service network module or a Cisco 7200 series router equipped with an ATM-CES port adapter offers a migration path from classic T1/E1 CBR data communications services to emulated CES T1/E1 unstructured (clear channel) services or structured (N x 64) services in an ATM network.

[Figure 5](#) shows a simplified representation of CES-IWF functions in an ATM network.

Figure 5 *Typical CES-IWF Operations in an ATM Network*



CES allows you to interconnect existing T1 or E1 interfaces and other kinds of constant bit rate (CBR) equipment. CES includes such features as PBX interconnect, consolidated voice and data traffic, and video conferencing.

With circuit emulation, data received from an external device at the edge of an ATM network is converted to ATM cells, sent through the network, reassembled into a bit stream, and passed out of the ATM network to its destination. T1/E1 circuit emulation does not interpret the contents of the data stream. All the bits flowing into the input edge port of the ATM network are reproduced at one corresponding output edge port.

An emulated circuit is carried across the ATM network on a PVC, which is configured through the network management system or the router command line interface (CLI).

The target application of the OC-3/STM-1 ATM Circuit Emulation Service network module and the ATM-CES port adapter is access to a broadband public or private ATM network where multiservice consolidation of voice, video, and data traffic over a single ATM link is a requirement.

Configuring CES on the OC-3/STM-1 ATM Circuit Emulation Service Network Module

To configure CES on the OC-3/STM-1 ATM Circuit Emulation Service network module, familiarize yourself with the restrictions in the first of the following sections and perform the tasks in the second, third, and fourth sections. Each task is identified as required or optional.

- [OC-3/STM-1 ATM Circuit Emulation Service Network Module Restrictions](#)
- [Configuring the ATM Interface](#) (required)
- [Configuring the T1/E1 Controller](#) (required)
- [Activating the Connection](#) (required)
- [Verifying CES Configuration on the OC-3/STM-1 ATM Circuit Emulation Service Network Module](#) (Optional)



Note

The configuration tasks in these sections are supported only on the OC-3/STM-1 ATM Circuit Emulation Service network module.

For an example of configuring CES on an OC-3/STM-1 ATM Circuit Emulation Service network module, see the section “[Example: Configuring CES on an OC-3/STM-1 ATM Circuit Emulation Services Network Module](#)” at the end of this chapter.

OC-3/STM-1 ATM Circuit Emulation Service Network Module Restrictions

The OC-3/STM-1 ATM CES network module can be configured with the following restrictions:

- The OC-3/STM-1 ATM CES network module requires Cisco IOS Release 12.1(2)T or later.
- On-hook detection is not supported.
- If you configure an ABR VC, either in a vc-class or in vc mode, the minimum guaranteed cell rate (MCR) value you enter is ignored, and an MCR of 0 is used, although this is not apparent from the configuration. Additionally, ABR PCR values are configurable in a range from 0 to line rate. However, the MCR is honored. Currently, the OC-3/STM-1 ATM CES network module rounds the configured value down to one of the following values:

- 64 Kbps
 - 384 K
 - 768 K
 - 1,534 K
 - 2 M
 - 4 M
 - 10 M
 - 16 M
 - 25.6 M
 - 44 M
 - 75 M
 - 100 M
 - 125 M
 - 149 M
- When you configure a UBR+ VC, the Cisco CLI requires that you specify a peak cell rate (PCR). Because of a hardware limitation, any value you enter is ignored by the OC-3/STM-1 ATM CES network module and a value of 155 Mbits per second is used.
 - The OC-3/STM-1 ATM CES network module does not allow configuring interfaces and subinterfaces by using the **traffic-shape** parameter. That is because the OC-3/STM-1 ATM CES network module supports traffic shaping through native ATM means by making a traffic class for UBR, UBR+, ABR, VBR-rt, VBR-ntr, and CBR.

Configuring the ATM Interface

To configure the ATM interface on the OC-3/STM-1 ATM Circuit Emulation Service network module, perform the tasks in the following sections:

- [Configuring PVCs for CES Operation](#)
- [Configuring SVCs for CES Operation](#)

This section does not explain all possible ATM interface configuration options. For more information, see the sections “[Configuring PVCs](#)” and “[Configuring SVCs](#)” earlier in this chapter.

Configuring PVCs for CES Operation

To use a permanent virtual circuit (PVC), you must configure the PVC into both the router and the ATM switch. A PVC remains active until it is removed from either configuration. To configure the ATM interface with PVCs, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/port	Selects the ATM interface to be configured.
Step 2	Router(config-if)# pvc [name] vpi/vci [ces]	Configures a new ATM PVC by assigning a name (optional) and VPI/VCI numbers, and enters interface-ATM-VC configuration mode. The ces keyword configures CES encapsulation, which is equivalent to creating a CBR class of service.
Step 3	Router(config-if-ces-vc) # ces-cdv time	Configures the cell delay variation. The <i>time</i> argument specifies the maximum tolerable cell arrival jitter with a range of 1 to 65535 microseconds.
Step 4	Router(config-if-ces-vc) # exit	Exits back to interface configuration mode.
Step 5	Router(config-if) # exit	Returns to global configuration mode.

Configuring SVCs for CES Operation

ATM switched virtual circuit (SVC) services are created and released dynamically, providing user bandwidth on demand. This service requires a signaling protocol between the router and the switch. To configure the ATM interface with SVCs, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/port	Selects the ATM interface to be configured.
Step 2	Router(config-if)# pvc name vpi/vci [qsaal ilmi]	Configures a new ATM PVC for signaling. One dedicated PVC is required between the router and the ATM switch, over which all SVC call establishment and call termination requests flow. Assign a name (optional) and VPI/VCI numbers. Specify qsaal to configure a signaling PVC. Specify ilmi to configure a PVC for communication with the Integrated Local Management Interface (ILMI). Enters interface-ATM-VC configuration mode.
Step 3	Router(config-if-atm-vc) # exit	Exits back to interface configuration mode.
Step 4	Router(config-if) # svc [name] nsap address ces Router(config-if) # svc [name] ces	Configures the active SVC and the ATM network service access point (NSAP) address. A passive SVC can be configured to only receive calls. The SVC name is required for this command. Enters interface-ATM-VC configuration mode.
Step 5	Router(config-if-atm-vc) # ces-cdv time	Configures the cell delay variation. The <i>time</i> argument specifies the maximum tolerable cell arrival jitter with a range of 1 to 65535 microseconds.

	Command	Purpose
Step 6	Router(config-if-atm-vc) # atm esi-address esi.selector	Configures the endstation ID (ESI) and selector fields. This command is effective only if the switch is capable of delivering the NSAP address prefix to the router via ILMI and the router is configured with a PVC for communication with the switch via ILMI.
Step 7	Router(config-if-atm-vc) # exit	Exits back to interface configuration mode.
Step 8	Router(config-if) # exit	Returns to global configuration mode.

Configuring the T1/E1 Controller

The T1/E1 controller on the OC-3/STM-1 ATM Circuit Emulation Service network module provides T1 or E1 connectivity to PBXs or to a central office (CO). To configure the T1 or E1 controller on the OC-3/STM-1 ATM Circuit Emulation Service network module, perform the tasks in the following section. One of the first two tasks is required; the third task is optional:

- [Configuring Unstructured Circuit Emulation Service](#) (required)

or

- [Configuring Structured Circuit Emulation Service](#) (required)
- [Configuring Channel-Associated Signaling for Structured CES](#) (optional)

For information about configuring the CES clock or echo cancellation, see the [Cisco IOS Voice, Video, and Fax Configuration Guide](#).

For more information about configuring the T1/E1 interface on the OC-3/STM-1 ATM Circuit Emulation Service network module, see the [Configuring 1- and 2-Port T1/E1 Multiflex Voice/WAN Interface Cards on Cisco 2600 and 3600 Series Routers](#) Cisco IOS Release 12.0(5)XK online document.

Configuring Unstructured Circuit Emulation Service

This circuit consumes the entire bandwidth of the port, which is provisioned manually at the time you set up the unstructured circuit and remains dedicated to that port, whether that port is actively transmitting data or not.

A CES module converts non-ATM telephony traffic into ATM cells for propagation through an ATM network. The ATM cell stream is directed to an outgoing ATM port or non-ATM telephony port.

To configure the T1/E1 port for unstructured CES, follow this procedure starting in global configuration mode:

	Command	Purpose
Step 1	Router(config) # controller {T1 E1} slot/port	Enters controller configuration mode for the T1 or E1 controller at the specified <i>slot/port</i> location. The prompt changes again to show that you are in controller configuration mode.
Step 2	Router(config-controller) # ces-clock [adaptive srts synchronous]	Selects the clock method. The default is synchronous.

	Command	Purpose
Step 3	Router(config-controller)# tdm-group <i>tdm-group-no unstructured</i>	Configures a TDM channel group for the T1 interface.
Step 4	Router(config-controller)# exit	Returns to global configuration mode.

Configuring Structured Circuit Emulation Service

Structured CES differs from unstructured CES services in that the structured services allow you to allocate the bandwidth in a highly flexible and efficient manner. With the structured services, you use only the bandwidth actually required to support the active structured circuit(s) that you configure.

To configure the T1/E1 port for structured CES, follow this procedure starting in global configuration mode:

	Command	Purpose
Step 1	Router(config)# controller {T1 E1} <i>slot/port</i>	Enters controller configuration mode for the T1 or E1 controller at the specified <i>slot/port</i> location. The prompt changes again to show that you are in controller configuration mode.
Step 2	Router(config-controller)# clock source {line internal}	Specifies which end of the circuit provides clocking for the T1 or E1 interface. The clock source can be set to use internal clocking for most applications.
Step 3	Router(config-controller)# framing {sf esf} or Router(config-controller)# framing {crc4 no-crc4} [australia]	Sets the framing to SuperFrame (SF) or Extended SuperFrame (ESF) format, according to service provider requirements. Sets the framing to cyclic redundancy check 4 (CRC4) or no CRC4, according to service provider requirements. The australia optional keyword specifies Australian Layer 1 Homologation for E1 framing.
Step 4	Router(config-controller)# linecode {b8zs ami hdb3}	Sets the line encoding according to your service provider's instructions. Bipolar-8 zero substitution (B8ZS), available only for T1 lines, encodes a sequence of eight zeros in a unique binary sequence to detect line coding violations. Alternate mark inversion (AMI), available for T1 or E1 lines, represents zeros using a 01 for each bit cell, and ones are represented by 11 or 00, alternately, for each bit cell. AMI requires that the sending device maintain ones density. Ones density is not maintained independently of the data stream. For E1, sets the line coding to either AMI or high-density bipolar 3 (HDB3), the default.

	Command	Purpose
Step 5	Router(config-controller)# ces-clock synchronous	Specifies the type of clocking used for T1 interfaces using structured CES. Only synchronous clocking can be used with structured CES.
Step 6	Router(config-controller)# tdm-group <i>tdm-group-no unstructured</i>	Configures a time-division multiplexing (TDM) channel group for the T1 interface.
Step 7	Router(config-controller)# exit	Returns to global configuration mode.

Configuring Channel-Associated Signaling for Structured CES

Because the CES deck emulates constant bit rate services over ATM networks, it is capable of providing support for handling channel-associated signaling (CAS) information introduced into structured CES circuits by PBXs and time-division multiplexing (TDM) devices.



Note

Only structured CES can support CAS.

The signaling supported depends on the WAN/voice interface card that is inserted in the CES deck. The signaling method depends on the connection that you are making:

- The receive and transmit (E&M) interface allows connection for PBX trunk lines (tie lines) and telephone equipment. The wink and delay settings both specify confirming signals between the transmitting and receiving ends, whereas the immediate setting stipulates no special offhook/onhook signals.
- The FXO interface is for connection of a central office (CO) to a standard PBX interface where permitted by local regulations; the interface is often used for off-premises extensions.
- The FXS interface allows connection of basic telephone equipment and PBXs.

To configure the T1/E1 port for channel associated signaling, first perform the tasks in the [“Configuring Structured Circuit Emulation Service”](#) section, and then use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# controller {T1 E1} slot/port	Enters controller configuration mode for the T1 or E1 controller at the specified slot/port location. The prompt changes again to show that you are in controller configuration mode.
Step 2	Router(config-controller)# tdm-group tdm-group-no timeslots timeslot-list type [e&m fxs [loop-start ground-start] fxo [loop-start ground-start]	Configures a TDM channel group for the T1 interface, including the signaling type. <i>tdm-group-no</i> is a value from 0 to 23 for T1 and from 0 to 30 for E1; it identifies the group. <i>timeslot-list</i> is a single number, numbers separated by commas, or a pair of numbers separated by a hyphen to indicate a range of time slots. The valid range is from 1 to 24 for T1. For E1, the range is from 1 to 31. Note The group numbers for controller groups must be unique. For example, a TDM group should not have the same ID number as a DS0 group or channel group.
Step 3	Router(config-controller)# exit	Returns to global configuration mode.

Activating the Connection

Once the ATM interface and T1 or E1 controllers are configured, activate the connection by using the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# connect connection-name atm slot/port [name of PVC/SVC vpi/vci] T1 slot/port TDM-group-number	Sets the connection to be activated.
Step 2	Router(config-connect)# exit	Exits config-connect mode. After exiting the config-connect mode, the connection is activated.

Verifying CES Configuration on the OC-3/STM-1 ATM Circuit Emulation Service Network Module

To verify CES configuration on the OC-3/STM-1 ATM Circuit Emulation Service network module, use one or more of the following commands in EXEC mode:

Command	Purpose
Router# show ces [slot/port]	Displays detailed information about the CES connection
Router# show ces [slot/port] clock-select	Displays the setting of the network clock for the specified port.
Router# show connection all	Displays detailed information about the connections created by the connect command.
Router# show controllers	Displays all network modules and their interfaces.

Command	Purpose
Router# show interfaces [<i>type slot/port</i>]	Displays statistics for the interfaces configured on a router or access server. Verify that the first line of the display shows the interface with the correct slot and port number, and that the interface and line protocol are in the correct state, up or down.
Router# show protocols	Displays the protocols configured for the entire router and for individual interfaces.
Router# show version	Displays the router hardware configuration. Check that the list includes the new interface.

Configuring CES on the ATM-CES Port Adapter

To configure the T1/E1 interfaces on the ATM-CES port adapter for CES, perform the tasks in the following sections. One of the first two tasks is required:

- [Configuring Unstructured \(Clear Channel\) CES Services](#) (required)
- [Configuring Structured \(N x 64\) CES Services](#) (required)

The following tasks are optional:

- [Configuring Channel-Associated Signaling \(for Structured CES Services Only\)](#) (optional)
- [Configuring Network Clock Source and Priorities](#) (optional)



Note

The configuration tasks in these sections are supported only on the ATM-CES port adapter.

For an example of configuring CES on the ATM-CES port adapter, see the section “[Example: Configuring CES on an ATM-CES Port Adapter](#)” at the end of this chapter.

Configuring Unstructured (Clear Channel) CES Services

A circuit that you set up on a CBR port for unstructured service is always identified as “circuit 0” because only one such circuit can be established on any given CBR port. Such a circuit consumes the entire bandwidth of the port, which is provisioned manually at the time you set up the unstructured circuit and remains dedicated to that port whether that port is actively transmitting CBR data or not.

A CES module converts CBR traffic into ATM cells for propagation through an ATM network. The ATM cell stream is directed to an outgoing ATM port or CBR port. If the outgoing port is an ATM port on the same Cisco 7200 series router, the PVC is called a *hard PVC*. As a general rule when setting up a hard PVC, you must interconnect a CBR port and the ATM port in the same ATM-CES port adapter. Only hard PVCs are supported in the Cisco 7200 series router.

To configure the T1/E1 port on the ATM-CES port adapter for unstructured (clear channel) CES services, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface cbr slot/port	Specifies the ATM-CES port adapter interface.
Step 2	Router(config-if)# ces aal1 service [structured unstructured]	Configures the port that is to perform unstructured CES services. The default is unstructured.
Step 3	Router(config-if)# ces aal1 clock {adaptive srts synchronous}	Optionally, selects the clock method. The default is synchronous.
Step 4	Router(config-if)# ces dsx1 clock source {loop-timed network-derived}	If synchronous clocking is selected, configures the clock source.
Step 5	Router(config-if)# ces circuit 0 [circuit-name name]	Specifies the circuit number for unstructured services and optionally specifies the logical name of the PVC. If you do not specify a circuit name, the default is CBRx/x:x.
Step 6	Router(config-if)# ces pvc 0 interface atm slot/port vci number vpi number	Defines the particular ATM destination port for the PVC.
Step 7	Router(config-if)# no shutdown	Changes the shutdown state to up and enables the ATM interface, thereby beginning the segmentation and reassembly (SAR) operation on the interface.
Step 8	Router(config-if)# no ces circuit 0 shutdown	Enables the PVC.

Configuring Structured (N x 64) CES Services

Structured (N x 64 kbps) CES services differ from unstructured CES services in that the structured services allow you to allocate the bandwidth in a highly flexible and efficient manner. With the structured services, you use only the bandwidth actually required to support the active structured circuit that you configure.

For example, in configuring an ATM-CES port adapter for structured service, you can define multiple hard PVCs for any given ATM-CES port adapter's T1/E1 port. The ATM-CES port adapter provides up to 24 time slots per T1 port and up to 31 time slots per E1 for defining structured CES circuits. To see the bandwidth that is required on an ATM link for this particular circuit, use the **show ces circuit** command.



Note

In the ATM-CES port adapter, any bits not available for structured CES services are used for framing and out-of-band control.

For simplicity in demonstrating configuration tasks for structured CES services, the procedures in this section are directed primarily at setting up a single CES circuit per T1/E1 port. However, these procedures outline the essential steps and command syntax that you would use if you were to set up multiple CES circuits on a T1/E1 port.

Structured CES services require network clock synchronization by means of the synchronous clocking mode. You must select the clock source and define its priority locally for each Cisco 7200 series router in your network. You do this by means of the **network-clock-select** command.

To configure the T1/E1 port on the ATM-CES port adapter for structured (N x 64 kbps) CES services without CAS, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface <i>cbr slot/port</i>	Specifies the ATM-CES port adapter interface.
Step 2	Router(config-if)# ces aal1 service [structured unstructured]	Configures the port to perform structured CES services. The default is unstructured.
Step 3	Router(config-if)# ces aal1 clock { adaptive srts synchronous }	Optionally, selects the clock method. The default is synchronous. Adaptive and SRTS are available only for unstructured mode.
Step 4	Router(config-if)# ces dsx1 clock source { loop-timed network-derived }	If synchronous clocking is selected, configures the clock source.
Step 5	Router(config-if)# ces dsx1 linecode { ami b8zs } (for T1) or Router(config-if)# ces dsx1 linecode { ami hdb3 } (for E1)	Specifies the line code format used for the physical layer. The default is AMI.
Step 6	Router(config-if)# ces dsx1 framing { esf sf } (for T1) or Router(config-if)# ces dsx1 framing { e1_crc_mfCASlt e1_crc_mf_lt e1_lt e1_mfCAS_lt } (for E1)	Specifies the framing format. The default for T1 is ESF and for E1 is E1_LT.
Step 7	Router(config-if)# ces dsx1 lbo <i>length</i>	Optionally, specifies the line build out (cable length). Values are (in feet): 0_110, 110_220, 220_330, 330_440, 440_550, 550_660, 660_above, and square_pulse. The default is 0_110 feet.
Step 8	Router(config-if)# ces circuit <i>circuit-number</i> [circuit-name <i>name</i>]	Specifies the circuit number for structured services and optionally specifies the logical name of the PVC. For T1 structured service, the range is 1 through 24. For E1 structured service, the range is 1 through 31. If you do not specify a circuit name, the default is CBRx/x:x.
Step 9	Router(config-if)# ces circuit <i>circuit-number</i> timeslots <i>range</i>	Specifies the time slots to be used by the PVC. For T1, the range is 1 through 24. For E1 structured service, the range is 1 through 31. Use a hyphen to indicate a range (for example, 1-24). Use a comma to separate the time slot (for example, 1,3,5).
Step 10	Router(config-if)# ces circuit <i>circuit-number</i> cdv <i>range</i>	Optionally, configures the circuit cell delay variation. Range is 1 through 65535 milliseconds. The default range is 2000 milliseconds.
Step 11	Router(config-if)# ces pvc <i>circuit-number</i> interface atm <i>slot/port</i> vpi <i>number</i> vci <i>number</i>	Defines the particular ATM destination port for the PVC.

	Command	Purpose
Step 12	Router(config-if)# no shutdown	Changes the shutdown state to up and enables the ATM interface, thereby beginning the segmentation and reassembly (SAR) operation on the interface.
Step 13	Router(config-if)# no ces circuit <i>circuit-number</i> shutdown	Enables the PVC.

**Note**

You need not specify individual circuit options on a separate command line. If you want, you can specify all the desired circuit options on the same command line, provided that you observe the following rules: (1) specify the DS0 time slots as the first option; (2) specify each desired option thereafter in strict alphabetic order; and (3) separate consecutive command line options with a space. You can display the options available for any structured CES circuit by typing the **ces circuit** *circuit-number* ? command, which displays in alphabetic order all the options available for use in the command line.

Configuring Channel-Associated Signaling (for Structured CES Services Only)

Because the ATM-CES port adapter emulates constant bit rate services over ATM networks, it must be capable of providing support for handling channel-associated signaling (CAS) information introduced into structured CES circuits by PBXs and time-division multiplexing (TDM) devices. The **ces circuit cas** interface command provides this feature.

With respect to the CAS information carried in a CBR bit stream, an ATM-CES port adapter can be configured to operate as follows:

- Without the CAS feature enabled (the default state)

In this case, the ATM-CES port adapter does not sense the CAS information (carried as so-called “ABCD” bits in the CBR bit stream) and provides no support for CAS functions.

- With the CAS feature enabled, but without the (Cisco-proprietary) “on-hook detection” feature enabled

In this case, in addition to packaging incoming CBR data into ATM AAL1 cells in the usual manner for transport through the network, the ATM-CES port adapter in the ingress node senses the ABCD bit patterns in the incoming data, incorporates these patterns in the ATM cell stream, and propagates the cells to the next node in the network. The ATM cells are transported across the network from link to link until the egress node is reached.

At the egress node, the ATM-CES port adapter strips off the ABCD bit patterns carried by the ATM cells, reassembles the CAS ABCD bits and the user’s CBR data into original form, and passes the frames out of the ATM network in the proper DS0 time slot.

All these processes occur transparently without user intervention.

- With both the CAS and on-hook detection features enabled

In this case, the CAS and on-hook detection features work together to enable an ingress node in an ATM network to monitor on-hook and off-hook conditions for a specified 1 x 64 structured CES circuit. As implied by the notation “1 x 64,” the on-hook detection (or bandwidth-release) feature is supported only in a structured CES circuit that involves a single time slot at each end of the connection.

The time slot configured for the structured CES circuit at the ingress node (time slot 2) can be different from the DS0 time slot configured at the egress node (time slot 4). Only one such time slot can be configured at each end of the circuit when the on-hook detection feature is used.

When you invoke this feature, the ingress ATM-CES port adapter monitors the ABCD bits in the incoming CBR bit stream to detect on-hook and off-hook conditions in the circuit. In an “off-hook” condition, all the bandwidth provisioned for the specified CES circuit is used for transporting ATM AAL1 cells across the network from the ingress node to the egress node.

In an on-hook condition, the network periodically sends dummy ATM cells from the ingress node to the egress node to maintain the connection. However, these dummy cells consume only a fraction of the circuit’s reserved bandwidth, leaving the rest of the bandwidth available for use by other AAL5 network traffic. This bandwidth-release feature enables the network to make more efficient use of its resources.

When the CAS feature is enabled for a CES circuit, the bandwidth of the DS0 channel is limited to 56 kbps for user data, because CAS functions consume 8 kbps of channel bandwidth for transporting the ABCD signaling bits. These signaling bits are passed transparently from the ingress node to the egress node as part of the ATM AAL1 cell stream.

In summary, when the optional CAS and on-hook detection features are enabled, the following conditions apply:

- The PVC provisioned for the CES circuit always exists.
- During an on-hook state, most of the bandwidth reserved for the CES circuit is not in use. (Dummy cells are sent from the ingress node to the egress node to maintain the connection.) Therefore, this bandwidth becomes available for use by other AAL5 network traffic, such as available bit rate (ABR) traffic.
- During an off-hook state, all the bandwidth reserved for the CES circuit is dedicated to that circuit.

To configure the T1/E1 port on the ATM-CES port adapter for channel-associated signaling, first use the commands in the section “[Configuring Structured \(N x 64\) CES Services](#)”, and then use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface cbr <i>slot/port</i>	Specifies the ATM-CES port adapter interface.
Step 2	Router(config-if)# ces circuit <i>circuit-number</i> cas	Enables channel-associated signaling.
Step 3	Router(config-if)# ces dsx1 signalmode robbedbit	(Optional) Enables the signal mode as robbed bit.
Step 4	Router(config-if)# ces circuit <i>circuit-number</i> on-hook-detection <i>hex-number</i>	(Optional) Enables on-hook detection.

Configuring Network Clock Source and Priorities

You can specify up to four network clock sources for a Cisco 7200 series router. The highest-priority active port in the chassis supplies the primary reference source to all other chassis interfaces that require network clock synchronization services. The fifth network clock source is always the local oscillator on the ATM-CES port adapter.

To direct a CBR port to use the network-derived clock, you must configure the CBR port with the **ces dsx1 clock source network-derived** interface command. For information on configuring the CBR port, refer to the section “[Configuring Unstructured \(Clear Channel\) CES Services](#)” earlier in this chapter.

To establish the sources and priorities of the requisite clocking signals for an ATM-CES port adapter in a Cisco 7200 series router, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# network-clock-select 1 {atm cbr} slot/port	Establishes a priority 1 clock source.
Step 2	Router(config)# network-clock-select 2 {atm cbr} slot/port	Establishes a priority 2 clock source.
Step 3	Router(config)# network-clock-select 3 {atm cbr} slot/port	Establishes a priority 3 clock source.
Step 4	Router(config)# network-clock-select 4 {atm cbr} slot/port	Establishes a priority 4 clock source.

To verify the clock signal sources and priorities that you have established for your ATM-CES port adapter, use the **show network-clocks** privileged EXEC command.

**Note**

The commands in this section are supported only on the ATM-CES port adapter.

For an example of configuring the network clock source and priority, see the section “[Example: Configuring Network Clock Source Priority Example](#)” at the end of this chapter.

Configuring Virtual Path Shaping

The OC-3/STM-1 ATM Circuit Emulation Service Network Module and ATM-CES port adapter support multiplexing of one or more PVCs over a virtual path (VP) that is shaped at a constant bandwidth. To use this feature, you must configure a permanent virtual path (PVP) with a specific virtual path identifier (VPI). Any PVCs that are created subsequently with the same VPI are multiplexed onto this VP; the traffic parameters of individual PVCs are ignored.

The traffic shaping conforms to the peak rate that is specified when you create the VP. Any number of data PVCs can be multiplexed onto a VP.

**Note**

In the case of local switching, you cannot configure VP with interworking.

To create a PVP, use the following commands beginning in interface configuration mode:

	Command	Purpose
Step 1	Router(config-if)# atm pvp vpi [peak-rate]	Creates a PVP and optionally specifies the peak rate.
Step 2	Router(config-if)# pvc [name] vpi/vci	(Optional) Creates a PVC with a VPI that matches the VPI specified in Step 1.
Step 3	Router(config-if)# exit	Exits interface configuration mode.

The value of the *vpi* argument is the virtual path identifier to be associated with the PVP (valid values are in the range from 0 to 255 inclusive). The *peak-rate* argument is the maximum rate (in kbps) at which the PVP is allowed to transmit data. Valid values are in the range 84 kbps to line rate. The default peak rate is the line rate.

**Note**

If you change the peak rate online, the ATM port will go down and then up.

When you create a PVP, two PVCs are created (with VCI 3 and 4) by default. These PVCs are created for VP end-to-end loopback and segment loopback OAM support.

**Note**

If you create a PVP for performing local switching of an L2 transport protocol, or for the **xconnect** command configuration, the OAM PVCs are created only if the PVP is successfully created.

The **pvc** command is rejected if a nonmultiplexed PVC with the specified VPI value already exists. This could happen if you first create a PVC with a given VPI value, and then you subsequently enter this command.

**Note**

Range VCs are not supported in ATM PVP.

To display information about the PVP, use the **show atm vp EXEC** command.

For an example of virtual path shaping, see the section “[Example: Configuring Virtual Path Shaping](#)” at the end of this chapter.

Configuring ATM Access over a Serial Interface

This section describes how to configure routers that use a serial interface for ATM access through an ATM data service unit (ADSU). The configuration tasks include the steps necessary to enable Asynchronous Transfer Mode-Data Exchange Interface (ATM-DXI) encapsulation, select a multiprotocol encapsulation method using ATM-DXI, and set up a PVC for the selected encapsulation.

In routers with a serial interface, an ADSU is required to provide the ATM interface to the network, convert outgoing packets into ATM cells, and reassemble incoming ATM cells into packets.

Any serial interface can be configured for multiprotocol encapsulation over ATM-DXI, as specified by RFC 1483. At the ADSU, the DXI header is stripped off, and the protocol data is segmented into cells for transport over the ATM network.

RFC 1483 describes two methods of transporting multiprotocol connectionless network interconnect traffic over an ATM network. One method allows multiplexing of multiple protocols over a single PVC. The other method uses different virtual circuits to carry different protocols. Cisco’s implementation of RFC 1483 supports both methods and supports transport of Apollo Domain, AppleTalk, Banyan VINES, DECnet, IP, Novell IPX, ISO CLNS, and XNS traffic.

To configure ATM access over a serial interface, complete the tasks in the following sections. The first four tasks are required.

- [Enabling the Serial Interface](#) (required)
- [Enabling ATM-DXI Encapsulation](#) (required)
- [Setting Up the ATM-DXI PVC](#) (required)
- [Mapping Protocol Addresses to the ATM-DXI PVC](#) (required)
- [Monitoring and Maintaining the ATM-DXI Serial Interface](#) (optional)

For an example of configuring ATM access over a serial interface, see the section “[Example: ATM Access over a Serial Interface](#)” at the end of this chapter.

Enabling the Serial Interface

To configure the serial interface for ATM access, enable the serial interface by using the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface <i>serial number</i>	Enables the serial interface.
Step 2	Router(config-if)# appletalk <i>address network.node</i> or Router(config-if)# ip <i>address address mask</i> or Router(config-if)# ipx <i>network number</i>	For each protocol to be carried, assigns a protocol address to the interface. (The commands shown are a partial list for the supported protocols.)

The supported protocols are Apollo Domain, AppleTalk, Banyan VINES, DECnet, IP, Novell IPX, ISO CLNS, and XNS.

For information about the addressing requirements of a protocol, see the relevant protocol configuration chapter in the [Cisco IOS IP Configuration Guide](#), the [Cisco IOS AppleTalk and Novell IPX Configuration Guide](#), or the [Cisco IOS Apollo Domain, Banyan VINES, DECnet, ISO CLNS, and XNS Configuration Guide](#).

Enabling ATM-DXI Encapsulation

To enable ATM-DXI encapsulation on a serial or High-Speed Serial Interface (HSSI), use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# encapsulation atm-dxi	Enables ATM-DXI encapsulation.

Setting Up the ATM-DXI PVC

An ATM-DXI PVC can be defined to carry one or more protocols as described by RFC 1483, or multiple protocols as described by RFC 1490.

To set up the ATM-DXI PVC and select an encapsulation method, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# dxi pvc <i>vpi vci</i> [snap nlpid mux]	Defines the ATM-DXI PVC and the encapsulation method.

The multiplex (MUX) option defines the PVC to carry one protocol only; each protocol must be carried over a different PVC. The Subnetwork Access Protocol (SNAP) option is LLC/SNAP multiprotocol encapsulation, compatible with RFC 1483; SNAP is the current default option. The network layer protocol identification (NLPID) option is multiprotocol encapsulation, compatible with RFC 1490; this option is provided for backward compatibility with the default setting in earlier versions in the Cisco IOS software.



Note

The default encapsulation was NLPID in software earlier than Release 10.3. Beginning in that release, the default encapsulation is SNAP. Select the **nlpid** keyword now if you had previously selected the default.

Mapping Protocol Addresses to the ATM-DXI PVC

This section describes how to map protocol addresses to the VCI and the VPI of a PVC that can carry multiprotocol traffic. The protocol addresses belong to the host at the other end of the link. To map a protocol address to an ATM-DXI PVC, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# dx i map <i>protocol protocol-address vpi vci</i> [broadcast]	Maps a protocol address to the ATM-DXI PVC's VPI and VCI.

Repeat this task for each protocol to be carried on the PVC.

The supported protocols are Apollo Domain, AppleTalk, Banyan VINES, DECnet, IP, Novell IPX, ISO CLNS, and XNS.

For an example of configuring a serial interface for ATM, see the section “[Example: ATM Access over a Serial Interface](#)” later in this chapter.

Monitoring and Maintaining the ATM-DXI Serial Interface

After configuring the serial interface for ATM, you can display the status of the interface, the ATM-DXI PVC, or the ATM-DXI map. To display interface, PVC, or map information, use the following commands in EXEC mode:

Command	Purpose
Router# show interfaces atm [<i>slot/port</i>]	Displays the serial ATM interface status.
Router# show dxi pvc	Displays the ATM-DXI PVC information.
Router# show dxi map	Displays the ATM-DXI map information.

Troubleshooting the ATM Interface

The **atm oam flush** command is a diagnostic tool that drops all OAM cells that are received on an ATM interface. To drop all incoming OAM cells on an ATM interface, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# interface atm slot/0	Specifies the ATM interface using the appropriate format of the interface atm command. ¹
	or	
	Router(config)# interface atm slot/port-adapter/0	
	or	
Step 2	Router(config)# interface atm number	
	Router(config-if)# atm oam flush	

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

Monitoring and Maintaining the ATM Interface

After configuring an ATM interface, you can display its status. You can also display the current state of the ATM network and connected virtual circuits. To show current virtual circuits and traffic information, use the following commands in EXEC mode:

Command	Purpose
Router# show arp	Displays entries in the ARP table.
Router# show atm class-links {vpi/vci name}	Displays PVC and SVC parameter configurations and where the parameter values are inherited from.
Router# show atm interface atm slot/0 Router# show atm interface atm slot/port-adapter/0 Router# show atm interface atm number	Displays ATM-specific information about the ATM interface using the appropriate format of the show atm interface atm command. ¹
Router# show atm map	Displays the list of all configured ATM static maps to remote hosts on an ATM network.
Router# show atm pvc [vpi/vci name interface atm interface_number]	Displays all active ATM PVCs and traffic information.
Router# show atm svc [vpi/vci name interface atm interface_number]	Displays all active ATM SVCs and traffic information.
Router# show atm traffic	Displays global traffic information to and from all ATM networks connected to the router, OAM statistics, and a list of counters of all ATM traffic on this router.
Router# show atm vc [vcd-number [range lower-limit-vcd upper-limit-vcd] [interface ATM interface-number] [detail [prefix {vpi/vci vcd interface vc_name }}] [connection-name] signalling [freed-svcs [cast-type {p2mp p2p}] [detail] [interface ATM interface-number]] summary ATM interface-number]	Displays all active ATM virtual circuits (PVCs and SVCs) and traffic information. Note The SVCs and the signalling keyword are not supported on the Cisco ASR 1000 series routers.
Router# show controllers atm [slot/ima group-number]	Displays information about current settings and performance at the physical level.
Router# show ima interface atm [slot]/ima [group-number] [detail]	Displays general or detailed information about IMA groups and the links in those groups.

Command	Purpose
Router# show interfaces atm Router# show interfaces atm slot/0 Router# show interfaces atm slot/port-adapter/0	Displays statistics for the ATM interface using the appropriate format of the show interfaces atm command.
Router# show network-clocks	Displays the clock signal sources and priorities that you established on the router.
Router# show sscop	Displays SSCOP details for the ATM interface.

1. To determine the correct form of the **interface atm** command, consult your ATM network module, port adapter, or router documentation.

ATM Configuration Examples

The examples in the following sections illustrate how to configure ATM for the features described in this chapter. The examples below are presented in the same order as the corresponding configuration task sections presented earlier in this chapter:

- [Example: Creating a PVC Example](#)
- [Examples: PVC with AAL5 and LLC/SNAP Encapsulation](#)
- [Example: PVCs in a Fully Meshed Network](#)
- [Example: Configuring an ABR PVC](#)
- [Example: Configuring PVC Discovery](#)
- [Example: Enabling Inverse ARP](#)
- [Example: Configuring Generation of End-to-End F5 OAM Loopback Cells](#)
- [Example: Configuring PVC Trap Support](#)
- [Example: Configuring Communication with the ILMI](#)
- [Example: SVCs in a Fully Meshed Network](#)
- [Example: ATM ESI Address](#)
- [Example: ATM NSAP Address](#)
- [Example: SVCs with Multipoint Signaling](#)
- [Example: Configuring SVC Traffic Parameters](#)
- [Example: Creating a VC Class](#)
- [Example: Applying a VC Class](#)
- [Example: ILMI Management on an ATM PVC](#)
- [Example: OAM Management on an ATM PVC](#)
- [Example: OAM Management on an ATM SVC](#)
- [Examples: Classical IP and ARP](#)
- [Examples: Dynamic Rate Queue](#)
- [Examples: PVC with AAL3/4 and SMDS Encapsulation](#)
- [Example: Transparent Bridging on an AAL5-SNAP PVC](#)
- [Examples: Inverse Multiplexing over ATM](#)
- [Example: Configuring ATM E.164 Auto Conversion](#)

- [Examples: Circuit Emulation Service](#)
- [Example: ATM Access over a Serial Interface](#)
- [Example: ATM Port Adapters Connected Back-to-Back](#)

Example: Creating a PVC Example

The following example shows how to create a PVC on an ATM main interface with AAL5/MUX encapsulation configured and a VBR-NRT QOS specified. For further information, refer to the sections [“Creating a PVC”](#) and [“Configuring PVC Traffic Parameters”](#) earlier in this chapter.

```
interface 2/0
 pvc cisco 1/40
 encapsulation aal5mux ip
 vbr-nrt 100000 50000 20
 exit
```

Examples: PVC with AAL5 and LLC/SNAP Encapsulation

The following example shows how to create a PVC 0/50 on ATM interface 3/0. It uses the global default LLC/SNAP encapsulation over AAL5. The interface is at IP address 10.1.1.1 with 10.1.1.5 at the other end of the connection. For further information, refer to the sections [“Creating a PVC”](#) and [“Mapping a Protocol Address to a PVC”](#) earlier in this chapter.

```
interface atm 3/0
 ip address 10.1.1.1 255.255.255.0
 pvc 0/50
 protocol ip 10.1.1.5 broadcast
 exit
!
 ip route-cache cbus
```

The following example is a typical ATM configuration for a PVC:

```
interface atm 4/0
 ip address 172.21.168.112 255.255.255.0
 atm maxvc 512
 pvc 1/51
 protocol ip 172.21.168.110
 exit
!
 pvc 2/52
 protocol decnet 10.1 broadcast
 exit
!
 pvc 3/53
 protocol clns 47.004.001.0000.0c00.6e26.00 broadcast
 exit
!
 decnet cost 1
 clns router iso-igrp comet
 exit
!
router iso-igrp comet
 net 47.0004.0001.0000.0c00.6666.00
 exit
!
router igrp 109
 network 172.21.0.0
```

```

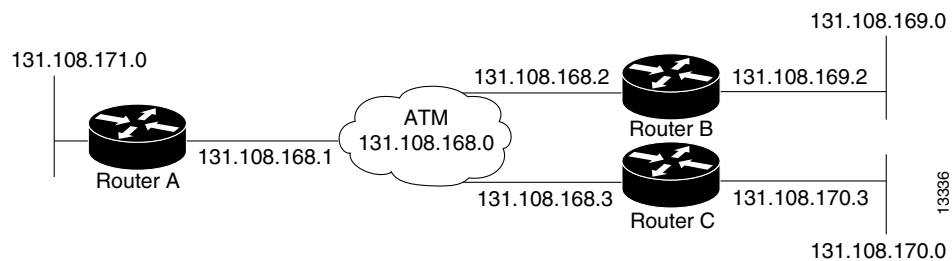
exit
!
ip domain-name CISCO.COM

```

Example: PVCs in a Fully Meshed Network

Figure 6 illustrates a fully meshed network. The configurations for routers A, B, and C follow the figure. In this example, the routers are configured to use PVCs. *Fully meshed* indicates that any workstation can communicate with any other workstation. Note that the two **protocol** statements configured in router A identify the ATM addresses of routers B and C. The two **protocol** statements in router B identify the ATM addresses of routers A and C. The two **protocol** statements in router C identify the ATM addresses of routers A and B. For further information, refer to the sections “[Creating a PVC](#)” and “[Mapping a Protocol Address to a PVC](#)” earlier in this chapter.

Figure 6 Fully Meshed ATM Configuration Example



Router A

```

ip routing
!
interface atm 4/0
 ip address 172.108.168.1 255.255.255.0
 pvc 0/32
  protocol ip 172.108.168.2 broadcast
 exit
!
 pvc 0/33
  protocol ip 172.108.168.3 broadcast
 exit

```

Router B

```

ip routing
!
interface atm 2/0
 ip address 172.108.168.2 255.255.255.0
 pvc test-b-1 0/32
  protocol ip 172.108.168.1 broadcast
 exit
!
 pvc test-b-2 0/34
  protocol ip 172.108.168.3 broadcast
 exit

```

Router C

```

ip routing
!

```

```
interface atm 4/0
 ip address 172.108.168.3 255.255.255.0
 pvc 0/33
 protocol ip 172.108.168.1 broadcast
 exit
!
 pvc 0/34
 protocol ip 172.108.168.2 broadcast
 exit
```

Example: Configuring an ABR PVC

The following example shows a typical ABR PVC configuration for the ATM-CES port adapter on a Cisco 7200 series router. In this example, the default peak cell rate and minimum cell rate is used (default PCR is the line rate and MCR is 0), and the ABR rate increase and decrease factor is set to 32. For further information, refer to the section “[Configuring PVC Traffic Parameters](#)” earlier in this chapter.

```
interface atm 4/0
 ip address 10.1.1.1 255.255.255.0
 pvc 0/34
 atm abr rate-factor 32 32
 no shutdown
 exit
```

Example: Configuring PVC Discovery

The following example shows how to enable PVC Discovery on an ATM main interface 2/0. The keyword **subinterface** is used so that all discovered PVCs with a VPI value of 1 will be assigned to the subinterface 2/0.1. For further information, refer to the section “[Configuring PVC Discovery](#)” earlier in this chapter.

```
interface atm 2/0
 pvc RouterA 0/16 ilmi
 exit
 atm ilmi-pvc-discovery subinterface
 exit
!
interface atm 2/0.1 multipoint
 ip address 172.21.51.5 255.255.255.0
```

Example: Enabling Inverse ARP

The following example shows how to enable Inverse ARP on an ATM interface and specifies an Inverse ARP time period of 10 minutes. For further information, refer to the section “[Enabling Inverse ARP](#)” earlier in this chapter.

```
interface atm 2/0
 pvc 1/32
 inarp 10
 exit
```

Example: Configuring Generation of End-to-End F5 OAM Loopback Cells

The following example shows how to enable OAM management on an ATM PVC. The PVC is assigned the name routerA and the VPI and VCI are 0 and 32, respectively. OAM management is enabled with a frequency of 3 seconds between OAM cell transmissions. For further information, refer to the section [“Configuring Generation of End-to-End F5 OAM Loopback Cells to Verify Connectivity”](#) earlier in this chapter.

```
interface atm 2/0
 pvc routerA 0/32
 oam-pvc manage 3
 oam retry 5 5 10
```

Example: Configuring PVC Trap Support

The following example shows how to configure PVC trap support on your Cisco router:

```
!For PVC trap support to work on your router, you must first have SNMP support and
!an IP routing protocol configured on your router:
Router(config)# snmp-server community public ro
Router(config)# snmp-server host 172.69.61.90 public
Router(config)# ip routing
Router(config)# router igrp 109
Router(config-router)# network 172.21.0.0
!
!Enable PVC trap support and OAM management:
Router(config)# snmp-server enable traps atm pvc interval 40 fail-interval 10
Router(config)# interface atm 1/0.1
Router(config-if)# pvc 0/1
Router(config-if-atm-vc)# oam-pvc manage
!
! Now if PVC 0/1 goes down, host 171.69.61.90 will receive traps.
```

For further information, refer to the [“Configuring PVC Trap Support”](#) section earlier in this chapter.

Example: Configuring Communication with the ILMI

The following example shows how to configure the ILMI protocol on an ATM main interface. For further information, refer to the section [“Configuring Communication with the ILMI”](#) earlier in this chapter.

```
interface 2/0
 pvc cisco 0/16 ilmi
 exit
```

Example: SVCs in a Fully Meshed Network

The following example is also a configuration for the fully meshed network shown in [Figure 6](#), but this example uses SVCs. PVC 0/5 is the signaling PVC.



Note

Configuring explicit ATM NSAP addresses on the routers in this example also requires configuring static call routing on the ATM switch in order to route the calls properly. For more information on how to configure static call routing, refer to your switch documentation.

For further information, see the following sections earlier in this chapter:

- [Configuring the PVC That Performs SVC Call Setup](#)
- [Configuring the NSAP Address](#)
- [Creating an SVC](#)

Router A

```
interface atm 4/0
 ip address 172.16.168.1 255.255.255.0
 atm nsap-address AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
 atm maxvc 1024
 pvc 0/5 qsaal
 exit
!
 svc svc-1 nsap BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.13
 protocol ip 172.16.168.2
 exit
!
 svc svc-2 nsap CA.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.12
 protocol ip 172.108.168.3
 exit
```

Router B

```
interface atm 2/0
 ip address 172.16.168.2 255.255.255.0
 atm nsap-address BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.13
 atm maxvc 1024
 pvc 0/5 qsaal
 exit
!
 svc svc-1 nsap AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
 protocol ip 172.16.168.1
 exit
!
 svc svc-2 nsap CA.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.12
 protocol ip 172.16.168.3
 exit
```

Router C

```
interface atm 4/0
 ip address 172.16.168.3 255.255.255.0
 atm nsap-address CA.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.12
 atm maxvc 1024
 pvc 0/5 qsaal
 exit
!
 svc nsap AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
 protocol ip 172.16.168.1
 exit
!
 svc nsap BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.13
 protocol ip 172.16.168.2
 exit
```

Example: ATM ESI Address

The following example shows how to set up the ILMI PVC and how to assign the ESI and selector field values on a Cisco 7500 series router. For further information, refer to the section “[Configuring the ESI and Selector Fields](#)” earlier in this chapter.

```
interface atm 4/0
 pvc 0/16 ilmi
 atm esi-address 345678901234.12
```

Example: ATM NSAP Address

The following example shows how to assign NSAP address AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12 to ATM interface 4/0. For further information, refer to the section “[Configuring the Complete NSAP Address](#)” earlier in this chapter.

```
interface atm 4/0
 atm nsap-address AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
```

You can display the ATM address for the interface by executing the **show interface atm** command.

Example: SVCs with Multipoint Signaling

The following example shows how to configure an ATM interface for SVCs using multipoint signaling. For further information, refer to the section “[Configuring Point-to-Multipoint Signaling](#)” earlier in this chapter.

```
interface atm 2/0
 ip address 10.4.4.6 255.255.255.0
 pvc 0/5 qsaal
 exit
 !
 pvc 0/16 ilmi
 exit
 !
 atm esi-address 3456.7890.1234.12
 !
 svc mcast-1 nsap cd.cdef.01.234566.890a.bcde.f012.3456.7890.1234.12 broadcast
 protocol ip 10.4.4.4 broadcast
 exit
 !
 svc mcast-2 nsap 31.3233.34.352637.3839.3031.3233.3435.3637.3839.30 broadcast
 protocol ip 10.4.4.7 broadcast
 exit
 !
 atm multipoint-signalling
 atm maxvc 1024
```

Example: Configuring SVC Traffic Parameters

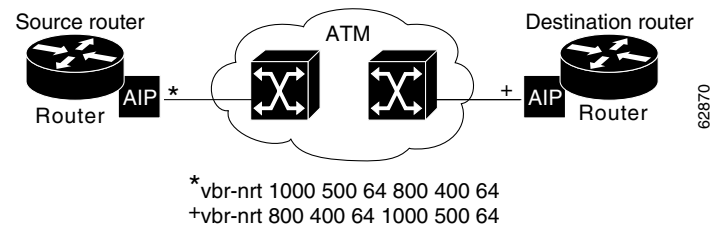
[Figure 7](#) illustrates a source and destination router implementing traffic settings that correspond end-to-end. The output values for the source router correspond to the input values for the destination router. The following example shows how to specify VBR-NRT traffic parameters on the source router. For further information, refer to the section “[Configuring SVC Traffic Parameters](#)” earlier in this chapter.

```

interface atm 4/0
  svc svc-1 nsap 47.0091.81.000000.0041.0B0A.1581.0040.0B0A.1585.00
  vbr-nrt 1000 500 64 800 400 64
exit

```

Figure 7 Source and Destination Routers with Corresponding Traffic Settings



Example: Creating a VC Class

The following example shows how to create a VC class named main and how to configure UBR and encapsulation parameters. For further information, refer to the sections “[Creating a VC Class](#)” and “[Configuring VC Parameters](#)” earlier in this chapter.

```

vc-class atm main
  ubr 10000
  encapsulation aal5mux ip

```

The following example shows how to create a VC class named sub and how to configure UBR and PVC management parameters. For further information, refer to the sections “[Creating a VC Class](#)” and “[Configuring VC Parameters](#)” earlier in this chapter.

```

vc-class atm sub
  ubr 15000
  oam-pvc manage 3

```

The following example shows how to create a VC class named pvc and how to configure VBR-NRT and encapsulation parameters. For further information, refer to the sections “[Creating a VC Class](#)” and “[Configuring VC Parameters](#)” earlier in this chapter.

```

vc-class atm pvc
  vbr-nrt 10000 5000 64
  encapsulation aal5snap

```

Example: Applying a VC Class

The following example shows how to apply the VC class named main to the ATM main interface 4/0. For further information, refer to the section “[Applying a VC Class](#)” earlier in this chapter.

```

interface atm 4/0
  class-int main
exit

```

The following example shows how to apply the VC class named sub to the ATM subinterface 4/0.5:

```

interface atm 4/0.5 multipoint
  class-int sub
exit

```

The following example shows how to apply the VC class named pvc directly on the PVC 0/56:

```
interface atm 4/0.5 multipoint
pvc 0/56
class-vc pvc
exit
```

Example: ILMI Management on an ATM PVC

The following example first shows how to configure an ILMI PVC on the main ATM interface 0/0. ILMI management is then configured on the ATM subinterface 0/0.1. For further information, refer to the section [“Configuring ILMI Management”](#) earlier in this chapter.

```
interface atm 0/0
pvc routerA 0/16 ilmi
exit
!
interface atm 0/0.1 multipoint
pvc 0/60
ilmi manage
```

Example: OAM Management on an ATM PVC

The following example shows how to enable OAM management on an ATM PVC. The PVC is assigned the name routerA and the VPI and VCI are 0 and 32, respectively. OAM management is enabled with a frequency of 3 seconds between OAM cell transmissions. For further information, refer to the section [“Configuring OAM Management for PVCs”](#) earlier in this chapter.

```
interface atm 2/0
pvc routerA 0/32
oam-pvc manage 3
oam retry 5 5 10
```

Example: OAM Management on an ATM SVC

The following example shows how to enable OAM management on an ATM SVC. The SVC is assigned the name routerZ and the destination NSAP address is specified. OAM management is enabled with a frequency of 3 seconds between OAM cell transmissions. For further information, refer to the section [“Configuring OAM Management for SVCs”](#) earlier in this chapter.

```
interface atm 1/0
svc routerZ nsap 47.0091.81.000000.0040.0B0A.2501.ABC1.3333.3333.05
oam-svc manage 3
oam retry 5 5 10
```

Examples: Classical IP and ARP

This section provides three examples of classical IP and ARP configuration, one each for a client and a server in an SVC environment, and one for ATM Inverse ARP in a PVC environment.

Example: Configuring ATM ARP Client in an SVC Environment

This example shows how to configure an ATM ARP client in an SVC environment. Note that the client in this example and the ATM ARP server in the next example are configured to be on the same IP network. For further information, refer to the section [“Configuring the Router as an ATM ARP Client”](#) earlier in this chapter.

```
interface atm 2/0.5
 atm nsap-address ac.2456.78.040000.0000.0000.0000.0000.0000.00
 ip address 10.0.0.2 255.0.0.0
 pvc 0/5 qsaal
 atm arp-server nsap ac.1533.66.020000.0000.0000.0000.0000.0000.00
```

Example: Configuring ATM ARP Server in an SVC Environment

The following example shows how to configure ATM on an interface and configures the interface to function as the ATM ARP server for the IP subnetwork. For further information, refer to the section [“Configuring the Router as an ATM ARP Server”](#) earlier in this chapter.

```
interface atm 0/0
 ip address 10.0.0.1 255.0.0.0
 atm nsap-address ac.1533.66.020000.0000.0000.0000.0000.0000.00
 atm rate-queue 1 100
 atm maxvc 1024
 pvc 0/5 qsaal
 atm arp-server self
```

Example: Configuring ATM Inverse ARP in a PVC Environment

The following example shows how to configure ATM on an interface, and then configures the ATM Inverse ARP mechanism on the PVCs on the interface, with Inverse ARP datagrams sent every 5 minutes on three of the PVCs. The fourth PVC will not send Inverse ATM ARP datagrams, but will receive and respond to Inverse ATM ARP requests. For further information, refer to the section [“Configuring Classical IP and ARP in an SVC Environment”](#) earlier in this chapter.

```
interface atm 4/0
 ip address 172.21.1.111 255.255.255.0
 pvc 0/32
 inarp 5
 exit
!
 pvc 0/33
 inarp 5
 exit
!
 pvc 0/34
 inarp 5
 exit
!
interface atm 4/0.1 point-to-point
 pvc 0/35
 exit
```

No **map-group** and **map-list** commands are needed for IP.

Examples: Dynamic Rate Queue

The following examples assume that no permanent rate queues have been configured. The software dynamically creates rate queues when a **pvc** command creates a new PVC that does not match any user-configured rate queue. For further information, refer to the section “[Using Dynamic Rate Queues](#)” earlier in this chapter.

The following example shows how to set the peak rate to the maximum that the PLIM will allow. Then, it creates a rate queue for the peak rate of this VC.

```
interface 2/0
  pvc 1/41
  exit
```

The following example shows how to create a 100-Mbps rate queue with an average rate of 50 Mbps and a burst size of 64 cells:

```
interface 2/0
  pvc 2/42
  vbr-nrt 100000 50000 64
  exit
```

The following example shows how to create a 15-Mbps rate queue and set the average rate to the peak rate:

```
interface 2/0
  pvc 3/43
  ubr 15000
  exit
```

The following example shows how to configure a rate queue tolerance on the ATM interface with slot 2 and port 0. A *tolerance-value* of 20 is specified, which will apply to SVCs, discovered VCs, and PVCs.

```
interface atm 2/0
  atm rate-queue tolerance svc pvc 20
```

Examples: PVC with AAL3/4 and SMDS Encapsulation

The following example shows how to create a minimal configuration of an ATM interface to support AAL3/4 and SMDS encapsulation; no protocol configuration is shown. For further information, refer to the section “[Configuring ATM Subinterfaces for SMDS Networks](#)” earlier in this chapter.

```
interface atm 3/0
  atm aal aal3/4
  atm smds-address c140.888.9999
  atm vp-filter 0
  atm multicast e180.0999.9999
  atm pvc 30 0 30 aal34smds
```

The following example shows how IP dynamic routing might coexist with static routing of another protocol:

```
interface atm 3/0
  ip address 172.21.168.112 255.255.255.0
  atm aal aal3/4
  atm smds-address c140.888.9999
  atm multicast e180.0999.9999
  atm vp-filter 0
  atm pvc 30 0 30 aal34smds
  map-group atm
  appletalk address 10.1
  appletalk zone atm
```

```
!
map-group atm
atalk 10.2 smds c140.8111.1111 broadcast
```

This example shows that IP configured is dynamically routed, but that AppleTalk is statically routed. An AppleTalk remote host is configured at address 10.2 and is associated with SMDS address c140.8111.1111.

AAL3/4 associates a protocol address with an SMDS address, as shown in the last line of this example. In contrast, AAL5 static maps associate a protocol address with a PVC number.

Example: Transparent Bridging on an AAL5-SNAP PVC

In the following example, three AAL5-SNAP PVCs are created on the same ATM interface. The router will broadcast all spanning tree updates to these AAL5-SNAP PVCs. No other virtual circuits will receive spanning tree updates. For further information, refer to the section “[Configuring Fast-Switched Transparent Bridging for SNAP PVCs](#)” earlier in this chapter.

```
interface atm 4/0
 ip address 10.1.1.1 255.0.0.0
 pvc 1/33
 pvc 1/34
 pvc 1/35
 bridge-group 1
!
bridge 1 protocol dec
```

Examples: Inverse Multiplexing over ATM

For examples of inverse multiplexing over ATM (IMA) configuration, see the following sections:

- [Example: E1 IMA on Multiport T1/E1 ATM Network Module](#)
- [Example: T1 IMA on Multiport T1/E1 ATM Network Module](#)
- [Example: T1 IMA on Multiport T1/E1 ATM Port Adapter](#)

Example: E1 IMA on Multiport T1/E1 ATM Network Module

The following example shows the setup of ATM interfaces, IMA groups, PVCs, and SVCs for E1 IMA on a Multiport T1/E1 ATM Network Module:

```
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname IMARouter
!
logging buffered 4096 debugging
!
ip subnet-zero
no ip domain-lookup
ip host 10.11.16.2
ip host 10.11.16.3
ip host 10.11.55.192
ip host 10.11.55.193
ip host 10.11.55.195
```

```

ip host 10.11.55.196
!
!
!
!
interface Ethernet0/0
 ip address 10.17.12.100 255.255.255.192
 no ip directed-broadcast
!

```

ATM interface 1/0 includes a PVC, but the specified link is not included in an IMA group. In this example, impedance and scrambling are set at their default values for E1 links and must match the far-end setting. The broadcast setting on the PVC takes precedence (addresses are fictitious).

```

interface ATM1/0
 ip address 10.1.1.26 255.255.255.1
 no ip directed-broadcast
 no atm oversubscribe
 pvc 1/40
  protocol ip 10.10.10.10 broadcast
!
 scrambling-payload
 impedance 120-ohm
 no fair-queue
!

```

The eight-port ATM IMA E1 network module is in slot 1, and the interface commands below specify three links as members of IMA group 0.

```

interface ATM1/1
 no ip address
 no ip directed-broadcast
 no atm oversubscribe
 ima-group 0
 scrambling-payload
 impedance 120-ohm
 no fair-queue
!
interface ATM1/2
 no ip address
 no ip directed-broadcast
 no atm oversubscribe
 ima-group 0
 scrambling-payload
 impedance 120-ohm
 no fair-queue
!
interface ATM1/3
 no ip address
 no ip directed-broadcast
 no atm oversubscribe
 ima-group 0
 scrambling-payload
 impedance 120-ohm
 no fair-queue
!

```

Four links are members of IMA group 1.

```

interface ATM1/4
 no ip address
 no ip directed-broadcast

```

```

no atm oversubscribe
ima-group 1
scrambling-payload
impedance 120-ohm
no fair-queue
!
interface ATM1/5
no ip address
no ip directed-broadcast
no atm oversubscribe
ima-group 1
scrambling-payload
impedance 120-ohm
no fair-queue
!
interface ATM1/6
no ip address
no ip directed-broadcast
no atm oversubscribe
ima-group 1
scrambling-payload
impedance 120-ohm
no fair-queue
!
interface ATM1/7
no ip address
no ip directed-broadcast
no atm oversubscribe
ima-group 1
scrambling-payload
impedance 120-ohm
no fair-queue
!

```

The following commands specify parameters for the two IMA groups. For each group, a PVC is created and assigned an IP address.

```

interface ATM1/IMA0
ip address 10.18.16.123 255.255.255.192
no ip directed-broadcast
ima clock-mode common port 2
no atm oversubscribe
pvc 1/42
protocol ip 10.10.10.10 broadcast
!
!
interface ATM1/IMA1
ip address 10.19.16.123 255.255.255.192
no ip directed-broadcast
no atm oversubscribe
ima active-links-minimum 3
pvc 1/99
protocol ip 10.10.10.10 broadcast
!
!
ip classless
ip route 0.0.0.0 0.0.0.0 10.18.16.193
ip route 10.91.0.1 255.255.255.255 10.1.0.2
no ip http server
!
!
!
line con 0

```

```

exec-timeout 0 0
history size 100
transport input none
line aux 0
line vty 0 4
  exec-timeout 0 0
  password lab
  login
history size 100

```

Example: T1 IMA on Multiport T1/E1 ATM Network Module

The following example shows the setup of ATM interfaces, IMA groups, PVCs, and SVCs for T1 IMA on a Multiport T1/E1 ATM Network Module:

```

version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
no service dhcp
!
hostname router
!
ip subnet-zero
!

```

There are four links in IMA group 3. The **no scrambling-payload** command is actually unnecessary because this is the default for T1 links. The T1 automatic B8ZS line encoding is normally sufficient for proper cell delineation, so **no scrambling-payload** is the usual setting for T1 links. The scrambling setting must match the far end.

```

interface ATM0/0
  no ip address
  no ip directed-broadcast
  no atm ilmi-keepalive
  ima-group 3
  no scrambling-payload
  no fair-queue
!
interface ATM0/1
  ip address 10.18.16.121 255.255.255.192
  no ip directed-broadcast
  no atm ilmi-keepalive
  !
  ima-group 3
  no scrambling-payload
  no fair-queue
!
interface ATM0/2
  no ip address
  no ip directed-broadcast
  no atm ilmi-keepalive
  ima-group 3
  no scrambling-payload
  no fair-queue
!
interface ATM0/3
  no ip address
  no ip directed-broadcast
  no atm ilmi-keepalive
  ima-group 3

```

```

no scrambling-payload
no fair-queue
!

```

IMA group 3 has PVCs that are set up for SVC management and signaling. Two SVCs and a communications PVC are also set up on the group interface.

```

interface ATM0/IMA3
no ip address
no ip directed-broadcast
no atm ilmi-keepalive
pvc 0/16 ilmi
!
pvc 0/5 qsaal
!
!
pvc first 1/43
vbr-rt 640 320 80
encapsulation aal5mux ip
!
!

svc second nsap 47.0091810000000050E201B101.00107B09C6ED.FE
abr 4000 3000
!
!
svc nsap 47.0091810000000002F26D4901.444444444444.01
!

```

The IMA commands below specify that three links must be active in order for the group to be operational. The common clock source is the first link, ATM 0/1, and ATM 0/2 is the test link. The differential delay maximum is set to 50 milliseconds.

```

ima active-links-minimum 3
ima clock-mode common 1
ima differential-delay-maximum 50
ima test link 2
!
interface Ethernet1/0
no ip address
no ip directed-broadcast
shutdown
!
interface Ethernet1/1
no ip address
no ip directed-broadcast
shutdown
!
ip classless
no ip http server
!
!
!
line con 0
exec-timeout 0 0
transport input none
line aux 0
line vty 0 4
login
!
!
end

```

Example: T1 IMA on Multiport T1/E1 ATM Port Adapter

The following configuration example shows the setup of ATM interfaces, IMA groups, PVCs, and SVCs for T1 IMA on a Multiport T1/E1 ATM Port Adapter:

```
version 12.1
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
no service dhcp
!
hostname router
!
!
!
ip subnet-zero
!
!
```

There are four links in IMA group 3. The **no scrambling cell-payload** command is actually unnecessary, as it is the default for T1 links. Because the T1 default binary-eight zero substitution (B8ZS) line encoding is normally sufficient for proper cell delineation, this is the usual setting for T1 links. The scrambling setting must match the far-end receiver.

```
interface ATM0/0
no ip address
no ip directed-broadcast
no atm ilmi-keepalive
ima-group 3
no scrambling cell-payload
no fair-queue
!
interface ATM0/1
ip address 10.1.1.2 255.0.0.0
no ip directed-broadcast
no atm ilmi-keepalive
ima-group 3
no scrambling-payload
no fair-queue
!
interface ATM1/2
no ip address
no ip directed-broadcast
no atm ilmi-keepalive
ima-group 3
no scrambling-payload
no fair-queue
!
interface ATM0/3
no ip address
no ip directed-broadcast
no atm ilmi-keepalive
ima-group 3
no scrambling-payload
no fair-queue
!
```

IMA group 3 has PVCs that are set up for SVC management and signaling. Two SVCs and a communications PVC are also set up on the group interface.

```
interface ATM0/IMA3
```



```

no ip address
no ip directed-broadcast
no atm ilmi-keepalive
pvc 0/16 ilmi
!
pvc 0/5 qsaal
!
!
interface ATM0/IMA3.1 point-to-point
ip address 10.1.1.1 255.255.255.0
pvc first 1/13
vbr-nrt 640 320 80
encapsulation aal5mux ip
!
!
svc nsap 47.0091810000000002F26D4901.444444444444.01
!

```

The group commands below specify that three links must be active for the group to be operational. The common clock source is the first link, ATM 0/0, and ATM 0/1 is the test link. The differential delay maximum is set to 50 milliseconds (ms).

```

ima active-links-minimum 3
ima clock-mode common 0
ima differential-delay-maximum 50
ima test link 1
!
interface Ethernet1/0
no ip address
no ip directed-broadcast
shutdown
!
interface Ethernet1/1
no ip address
no ip directed-broadcast
shutdown
!
ip classless
no ip http server
!
!
!
line con 0
exec-timeout 0 0
transport input none
line aux 0
line vty 0 4
login
!
!

```

Example: Configuring ATM E.164 Auto Conversion

The following example shows how to configure ATM E.164 auto conversion on an ATM interface. [Figure 8](#) illustrates this example. For further information, refer to the section “[Example: Configuring ATM E.164 Auto Conversion](#)” earlier in this chapter.

```

interface atm 0 multipoint
ip address 172.45.20.81 255.255.255.0
pvc 0/5 qsaal
exit

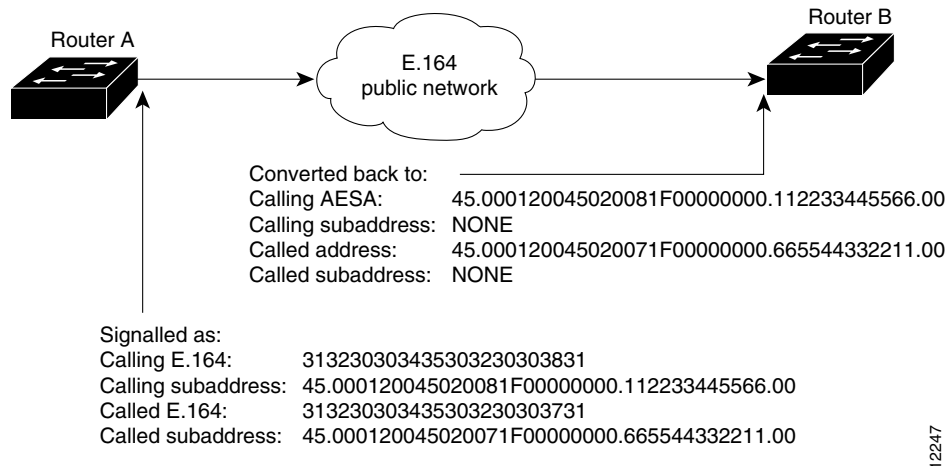
```

```

!
atm nsap-address 45.000120045020081F00000000.112233445566.00
atm e164 auto-conversion
svc nsap 45.000120045020071F00000000.665544332211.00
protocol ip 172.45.20.71
exit

```

Figure 8 *E164_AESA Address Auto Conversion Example*



Upon entering an E.164 network at Router A, the destination E.164 address, extracted from the E164_AESA of the static map, is signaled in the Called Party Address. The destination E164_AESA address from the E164_AESA of the static map is signaled in the Called Party Subaddress.

The source E.164 address, extracted from the E164_AESA of the interface, is signaled in the Calling Party Address. The source E164_AESA address from the E164_AESA of the interface is signaled in the Calling Party Subaddress.

Upon leaving the E.164 network, the original Called and Calling Party addresses are extracted from the subaddresses and moved into the Called and Calling Parties. The call is then forwarded.

E164_ZDSP addresses are simply converted into E.164 addresses upon entering the E.164 network, and converted back to E164_ZDSP addresses upon leaving the network.

Examples: Circuit Emulation Service

For examples of circuit emulation service (CES) configuration, see the following sections:

- [Example: Configuring CES on an OC-3/STM-1 ATM Circuit Emulation Services Network Module](#)
- [Example: Configuring CES on an ATM-CES Port Adapter](#)
- [Example: Configuring Network Clock Source Priority Example](#)
- [Example: Configuring Virtual Path Shaping](#)

Example: Configuring CES on an OC-3/STM-1 ATM Circuit Emulation Services Network Module

In the following example, the ATM interface clock is being used. The PVC is used by AAL1 CES and is connected to a TDM group to form a CES connection. The CES connection is between ATM interface 1/0 and T1 controller 1/0 using CES PVC 1/101 and TDM group 0. TDM Group 0 has four time slots.

```
hostname vpd2005
!
logging buffered 4096 debugging
no logging console
!
!
ces 1/0
clock-select 1 em1/0
! this is the default

!
ip subnet-zero
ip host lab 172.18.207.11
ip host rtplab 172.18.207.11
ip host rtpss20 172.18.207.11
ip host dev 172.18.207.10
ip host rtpdev 172.18.207.10
!
isdn voice-call-failure 0
cns event-service server
!
controller T1 1/0
    clock source internal
    tdm-group 0 timeslots 4-8
!
controller T1 1/1
    clock source internal
    tdm-group 1 timeslots 1
!
!
interface Ethernet0/0
    ip address 172.18.193.220 255.255.255.0
    no ip directed-broadcast
!
interface Ethernet0/1
    no ip address
    no ip directed-broadcast
!
interface Ethernet0/2
    no ip address
    no ip directed-broadcast
!
interface Ethernet0/3
    no ip address
    no ip directed-broadcast
!
interface ATM1/0
    ip address 10.7.7.7 255.255.255.0
    no ip directed-broadcast
    no atm ilmi-keepalive
    pvc 1/101 ces
    pvc 1/200
        protocol ip 10.7.7.8 broadcast
!
ip classless
ip route 10.0.0.0 0.0.0.0 Ethernet0/0
ip route 10.0.0.0 0.0.0.0 172.18.193.1
ip route 10.0.0.0 255.0.0.0 10.1.1.1
no ip http server
!

connect test ATM1/0 1/101 T1 1/0 0
!
line con 0
```

```

exec-timeout 0 0
transport input none
line aux 0
line vty 0 4
  password lab
  login
!
end

```

Example: Configuring CES on an ATM-CES Port Adapter

The following example shows how to configure the T1 port on the ATM-CES port adapter for unstructured (clear channel) CES services. In this example, the T1 port uses adaptive clocking and the circuit name “CBR-PVC-A.” For further information, refer to the section “[Configuring Circuit Emulation Services](#)” earlier in this chapter.

```

interface cbr 6/0
  ces aall service unstructured
  ces aall clock adaptive
  atm clock internal
  ces dsx1 clock network-derived
  ces circuit 0 circuit-name CBR-PVC-A
  ces pvc 0 interface atm 6/0 vpi 0 vci 512
  no shutdown
  no ces circuit 0 shutdown
exit

```

Example: Configuring Network Clock Source Priority Example

The following example shows how to establish the T1 port on the ATM-CES port adapter as the first clocking priority and the ATM port as the second clocking priority. For further information, refer to the section “[Configuring Network Clock Source and Priorities](#)” earlier in this chapter.

```

network-clock-select 1 cbr 6/0
network-clock-select 2 atm 6/0
exit

```

Example: Configuring Virtual Path Shaping

The following example shows a typical configuration for the ATM-CES port adapter with VP shaping on a Cisco 7200 series router. In this example, a VP is created with the VPI value of 1 and with a peak rate of 2000 kbps. The subsequent VCs created, one data VC and one CES VC, are multiplexed onto this VP. For further information, refer to the section “[Configuring Virtual Path Shaping](#)” earlier in this chapter.

```

interface atm 6/0
  ip address 10.2.2.2 255.255.255.0
  atm pvp 1 2000
  pvc 1/33
  no shutdown
  exit
interface cbr 6/1
  ces circuit 0
  ces pvc 0 interface atm6/0 vpi 1 vci 100
  exit

```

Example: ATM Access over a Serial Interface

The following example shows how to configure a serial interface for ATM access.

In the following example, serial interface 0 is configured for ATM-DXI with MUX encapsulation. Because MUX encapsulation is used, only one protocol is carried on the PVC. This protocol is explicitly identified by a **dxl map** command, which also identifies the protocol address of the remote node. This PVC can carry IP broadcast traffic.

```
interface serial 0
 ip address 172.21.178.48
 encapsulation atm-dxi
 dxi pvc 10 10 mux
 dxi map ip 172.21.178.4 10 10 broadcast
```

Example: ATM Port Adapters Connected Back-to-Back

The following example shows how to connect two ATM port adapters back to back. Two routers, each containing an ATM port adapter, are connected directly with a standard cable, which allows you to verify the operation of the ATM port or to directly link the routers to build a larger node.

By default, the ATM port adapter expects a connected ATM switch to provide transmit clocking. To specify that the ATM port adapter generates the transmit clock internally for SONET PLIM operation, add the **atm clock internal** command to your configuration.

Router A

```
interface atm 3/0
 ip address 192.168.1.10 255.0.0.0
 no keepalive
 atm clock internal
 pvc 1/35
 !
 protocol ip 192.168.1.20 broadcast
```

Router B

```
interface atm 3/0
 ip address 192.168.1.20 255.0.0.0
 no keepalive
 atm clock internal
 pvc 1/35
 !
 protocol ip 192.168.1.10 broadcast
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	<i>Cisco IOS Master Commands List, All Releases</i>
Configuring routers that use a serial interface for ATM access through an ATM data service unit (ADSU)	“Configuring ATM Access over a Serial Interface” section in this chapter
Referencing Switched Multimegabit Data Service (SMDS) support	“SMDS Commands” chapter in the <i>Cisco IOS Wide-Area Networking Command Reference</i>
Configuring LAN emulation (LANE) for ATM	“Configuring LAN Emulation” chapter in the <i>Cisco IOS Switching Services Configuration Guide</i>
Configuring IP to ATM class of service (CoS)	“IP to ATM CoS Overview” and “Configuring IP to ATM CoS” chapters in the <i>Cisco IOS Quality of Service Solutions Configuration Guide</i>
Configuring PPP over ATM	“Configuring PPP over ATM” section in the “Configuring Broadband Access: PPP and Routed Bridge Encapsulation” chapter in this book
Configuring PPP over Ethernet (PPPoE) over ATM	“Configuring PPPoE over ATM” section in the “Configuring Broadband Access: PPP and Routed Bridge Encapsulation” chapter in this book

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