

# Configuring ATM

---

This chapter describes how to configure ATM on the Cisco 2600 series, Cisco 3600 series, Cisco 4500, Cisco 4700, Cisco 7200 series, and Cisco 7500 series routers.

To configure routers that use a serial interface for ATM access through an ATM data service unit (ADSU), see the section “Configure ATM Access over a Serial Interface” later in this chapter.

---

**Note** Beginning in 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.

---

For a complete description of the ATM commands in this chapter, refer to the “ATM Commands” chapter of the *Wide-Area Networking Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online.

For information about Switched Multimegabit Data Service (SMDS) support, refer to the “SMDS Commands” chapter in the *Wide-Area Networking Command Reference*.

For information about configuring LAN emulation (LANE) for ATM, refer to the “Configuring LAN Emulation” chapter in the *Cisco IOS Switching Services Configuration Guide*. For information about LANE commands, refer to the “LAN Emulation Commands” chapter in the *Cisco IOS Switching Services Command Reference*.

## ATM Configuration Task List

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.

- Enable the ATM Interface
- Configure PVCs
- Configure SVCs
- Configure VC Classes (optional)
- Configure VC Management (optional)
- Configure Classical IP and ARP over ATM (optional)
- Customize the ATM Interface (optional)
- Configure ATM Subinterfaces for SMDS Networks (optional)

- Configure Fast-Switched Transparent Bridging for SNAP PVCs (optional)
- Configure PPP over ATM (optional)
- Configure ATM E.164 Auto Conversion (optional)
- Configure Circuit Emulation Services (CES) (optional)
- Configure Network Clock Source and Priorities (optional)
- Configure Virtual Path Shaping (optional)
- Configure ATM Access over a Serial Interface (optional)
- Troubleshoot the ATM Interface (optional)
- Monitor and Maintain the ATM Interface (optional)

See the “ATM Configuration Examples” section at the end of this chapter for configuration examples.

## Enable the ATM Interface

This section describes how to begin configuring an ATM interface. For the 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.

To begin to configure the ATM interface, use the following commands beginning in privileged EXEC mode:

Step	Command	Purpose
1	<b>configure terminal</b>	At the privileged EXEC prompt, enter global configuration mode from the terminal.
2	<b>interface atm slot/0</b> or <b>interface atm slot/port-adapter/0</b> or <b>interface atm number</b>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
3	<b>ip address ip-address mask</b>	If IP routing is enabled on the system, optionally assign a source IP address and subnet mask to the interface.

1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

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

Command	Purpose
<b>no shutdown</b>	Change the shutdown state to up and enable 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.

## Configure 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 “Configure PVC Discovery” for more information.

---

All virtual circuit characteristics listed in the “Wide-Area Networking Overview” chapter apply to these PVCs. 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 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.

- Create a PVC
- Map a Protocol Address to a PVC
- Configure the AAL and Encapsulation Type (optional)
- Configure PVC Traffic Parameters (optional)
- Configure PVC Discovery (optional)
- Enable Inverse ARP (optional)
- Configure Generation of End-to-End F5 OAM Loopback Cells to Verify Connectivity (optional)
- Configure Broadcast on a PVC (optional)
- Assign a VC Class to a PVC (optional)

## Create 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
<code>pvc [name] vpi/vci [ilmi   qsaal   smds]</code>	Configure a new ATM PVC by assigning a name (optional) and VPI/VCI numbers. Enter interface-ATM-VC configuration mode. Optionally configure ILMI, QSAAL, or SMDS encapsulation.

---

**Note** After configuring the parameters for an ATM PVC, you must exit the 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 re-enter 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 “Configure 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.

## Map 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
<b>protocol</b> <i>protocol protocol-address</i> [[no] <b>broadcast</b> ]	Map 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.

## Configure 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
<b>encapsulation</b> <i>aal-encap</i>	Configure 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** command in the “ATM Commands” chapter of the *Wide-Area Networking Command Reference*. The global default is AAL5 with SNAP encapsulation.

## Configure 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
<b>abr</b> <i>output-pcr output-mcr</i>	Configure the Available Bit Rate (ABR). (ATM-CES port adapter only.)
<b>ubr</b> <i>output-pcr</i>	Configure the Unspecified Bit Rate (UBR).
<b>ubr+</b> <i>output-pcr output-mcr</i>	Configure the UBR and a minimum guaranteed rate.
<b>vbr-nrt</b> <i>output-pcr output-scr output-mbs</i>	Configure the Variable Bit Rate-Non Real Time (VBR-NRT) QOS.
<b>vbr-rt</b> <i>peak-rate average-rate burst</i>	Configure the real-time Variable Bit Rate (VBR). (Cisco MC3810 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 “Configure an ABR PVC Example” 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 “Configure 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
<b>atm abr rate-factors</b> [ <i>rate-increase-factor</i> ] [ <i>rate-decrease-factor</i> ]	Specify 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 “Configure an ABR PVC Example” later in this chapter.

## Configure 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:

Step	Command	Purpose
1	<b>interface atm</b> <i>slot/0</i> or <b>interface atm</b> <i>slot/port-adapter/0</i> or <b>interface atm</b> <i>number</i>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>pvc</b> [ <i>name</i> ] <b>0/16 ilmi</b>	Configure an ILMI PVC on the main interface.
3	<b>exit</b>	Return to interface configuration mode.
4	<b>atm ilmi-pvc-discovery</b> [ <b>subinterface</b> ]	Configure PVC Discovery on the main interface and optionally specify that discovered PVCs will be assigned to a subinterface.
5	<b>exit</b>	Return to global configuration mode.
6	<b>interface atm</b> <i>slot/0</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> } or <b>interface atm</b> <i>slot/port-adapter/0</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> } or <b>interface atm</b> <i>number</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }	Specify the ATM main interface or subinterface that discovered PVCs will be assigned to.
7	<b>ip address</b> <i>ip-address mask</i>	(Optional) Specify the protocol address for the subinterface.

1 Use the **interface atm** *slot/0* command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm** *slot/port-adapter/0* command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm** *number* command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

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 “Configure PVC Discovery Example” 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 “Configure PVC Discovery Example” at the end of this chapter.

## Enable 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:

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

1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

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 only necessary if you disabled Inverse ARP using the **no protocol** command. For more information about this command, refer to the “ATM Commands” chapter in the *Wide-Area Networking Command Reference*.

For an example of configuring Inverse ARP, see the section “Enable Inverse ARP Example” at the end of this chapter.

## Configure 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:

Steps	Command	Purpose
1	<b>oam-pvc</b> [ <b>manage</b> ] <i>frequency</i>	Configure transmission of end-to-end F5 OAM loopback cells on a PVC, specify how often loopback cells should be sent, and optionally enable OAM management of the connection.
2	<b>oam retry</b> <i>up-count down-count retry-frequency</i>	(Optional) Specify 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 “Configure OAM Management” later in this chapter.

For an example of OAM loopback cell generation, see the section “Configure Generation of End-to-End F5 OAM Loopback Cells Example” at the end of this chapter.

## Configure 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
<b>broadcast</b>	Send 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.

---

## Assign 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 “Configure 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
<code>class <i>vc-class-name</i></code>	Apply a VC class to a PVC.

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

## Configure SVCs

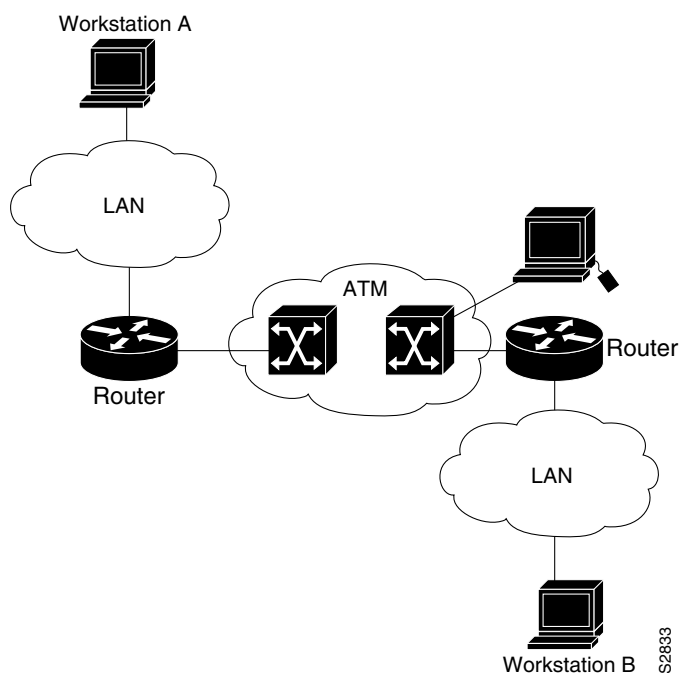
ATM switched virtual circuit (SVC) service operates much like X.25 SVC service, although ATM allows much higher throughput. Virtual circuits are created and released dynamically, providing user bandwidth on demand. This service requires a signaling protocol between the router and the switch.

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 2 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 2 Basic ATM Environment**



You must complete the tasks in the following sections to use SVCs:

- Configure Communication with the ILMI
- Configure the PVC that Performs SVC Call Setup
- Configure the NSAP Address
- Create an SVC

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 should not have to perform these tasks unless you need to customize your particular SVC connection.

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

- Configure SSCOP (optional)
- Close an SVC (optional)

---

**Note** SVC's are not supported on the 1-port ATM-25 network module.

---

## Configure Communication with the ILMI

In an SVC environment, you must configure a PVC for communication with the Integrated Local Management Interface (ILMI) so 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
<code>pvc [name] 0/16 ilmi</code>	Create 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
<code>atm ilmi-keepalive [seconds]</code>	Optionally, enable ILMI keepalives and set 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.

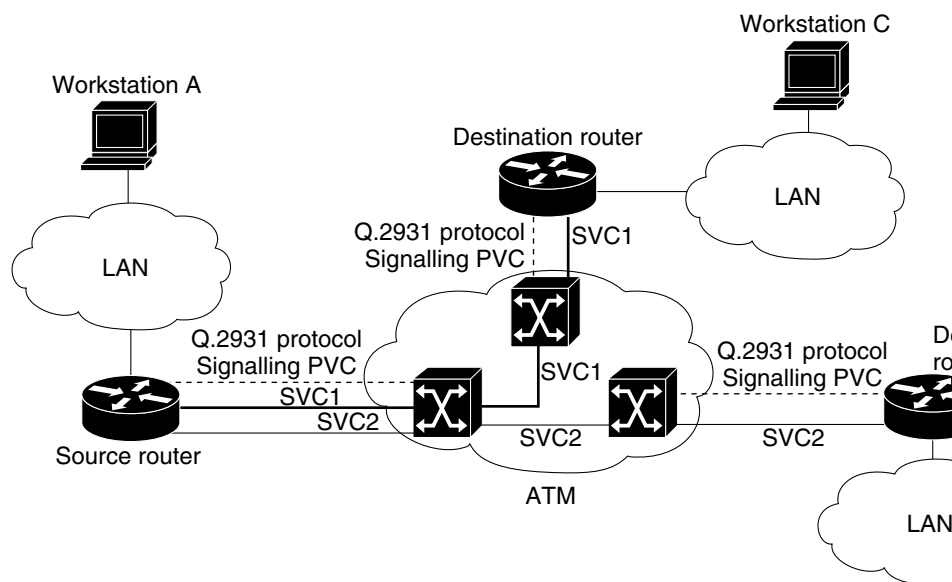
For an example of configuring ILMI, see the section “Configure Communication with the ILMI Example” at the end of this chapter.

## Configure 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 3 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 3 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
<code>pvc [name] vpi/vci qsaal</code>	Configure 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 value for VPI and VCI are 0 and 5, respectively.

See the section “SVCs in a Fully Meshed Network Example” at the end of this chapter for a sample ATM signaling configuration.

## Configure 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:

- Configure the ESI and Selector Fields
- Configure the Complete NSAP Address

## Configure the ESI and Selector Fields

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, 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:

Step	Command	Purpose
1	<b>pvc</b> <i>[name]</i> <b>0/16 ilmi</b>	Configure an ILMI PVC on an ATM main interface for communicating with the switch via ILMI.
2	<b>exit</b>	Return to interface configuration mode.
3	<b>atm esi-address</b> <i>esi.selector</i>	Enter 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 “Configure 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, go to the section “SVCs with Multipoint Signaling Example” at the end of this chapter.

## Configure the Complete NSAP Address

When you configure the ATM NSAP address manually, you must enter the entire address in hexadecimal format since 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 . 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
<b>atm nsap-address</b> <i>nsap-address</i>	Configure 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 previous section “Configure the ESI and Selector Fields.”

See an example of assigning an NSAP address to an ATM interface in the section “ATM NSAP Address Example” at the end of this chapter.

## Create an SVC

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

Steps	Command	Purpose
1	<code>svc [name] nsap address</code>	Create an SVC and specify the destination NSAP address.
2	<code>encapsulation aal-encap</code>	(Optional) Configure the ATM adaptation layer (AAL) and encapsulation type.
3	<code>protocol protocol protocol-address [[no] broadcast]</code>	Map a protocol address to an SVC.

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

For a list of AAL types and encapsulations supported for the *aal-encap* argument, refer to the **encapsulation** command in the “ATM Commands” chapter of the *Wide-Area Networking Command Reference*. The default is AAL5 with SNAP encapsulation.

## Configure 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
<code>atm uni-version version-number</code>	Override UNI version used by router.

No other configuration steps are required.

## Configure 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
<code>idle-timeout seconds [minimum-rate]</code>	Configure 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.

## Configure 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:

Step	Command	Purpose
1	<b>interface atm slot/0</b> or <b>interface atm slotport-adapter/0</b> or <b>interface atm number</b>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>pvc [name] 0/5 qsaal</b>	Configure the signaling PVC for an ATM main interface that uses SVCs.
3	<b>exit</b>	Return to interface configuration mode.
4	<b>pvc [name] 0/16 ilmi</b> and <b>exit</b>	(Optional) Configure an ILMI PVC on an ATM main interface and return 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.
5	<b>atm nsap-address nsap-address</b> or <b>atm esi-address esi.selector</b>	Configure the complete NSAP address manually. or Configure the ESI and selector fields. To use this method, you must configure Step 4 first.
6	<b>svc [name] nsap address</b>	Create an SVC and specify the destination NSAP address. Enter interface-ATM-VC mode.
7	<b>protocol protocol protocol-address broadcast</b>	Provide a protocol address for the interface and enable broadcasting.
8	<b>exit</b>	Return to interface configuration mode.
9	<b>atm multipoint-signalling</b>	Enable multipoint signaling to the ATM switch.
10	<b>atm multipoint-interval interval</b>	(Optional) Limit the frequency of sending AddParty messages.

<sup>1</sup> Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slotport-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

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 “SVCs with Multipoint Signaling Example” at the end of this chapter.

## Configure IP Multicast over ATM Point-to-Multipoint Virtual Circuits

This task is documented in the “Configuring IP Multicast Routing” chapter of the *Network Protocols Configuration Guide, Part 1*.

## Configure 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 *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 Non Real-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:

Step	Command	Purpose
1	<pre>interface atm slot/0[.subinterface-number] {multipoint   point-to-point} or interface atm slot/port-adapter/0[.subinterface-number] {multipoint   point-to-point} or interface atm number[.subinterface-number] {multipoint   point-to-point}</pre>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<pre>svc [name] nsap address</pre>	Create an SVC and specify the destination NSAP address.
3	<pre>protocol protocol protocol-address [[no] broadcast]</pre>	Map a destination protocol address to an SVC.

Step	Command	Purpose
4	<b>ubr</b> <i>output-pcr</i> [ <i>input-pcr</i> ]	Configure the Unspecified Bit Rate (UBR)
	or	or
	<b>ubr+</b> <i>output-pcr output-mcr</i> [ <i>input-pcr</i> ] [ <i>input-mcr</i> ]	Configure the UBR and a minimum guaranteed rate
	or	or
5	<b>vbr-nrt</b> <i>output-pcr output-scr output-mbs</i> [ <i>input-pcr</i> ] [ <i>input-scr</i> ] [ <i>input-mbs</i> ]	Configure the Variable Bit Rate-Non Real Time (VBR-NRT) QOS
	<b>exit</b>	Return to interface configuration mode and enable the traffic parameters on the SVC.

- 1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

**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 “Configure SVC Traffic Parameters Example” 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 “Configure VC Classes.”

## Configure 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
<b>atm sig-traffic-shaping strict</b>	Specify 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.

## Configure 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 “Configure 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:

Steps	Command	Purpose
1	<b>oam-svc</b> [ <b>manage</b> ] <i>frequency</i>	Configure transmission of end-to-end F5 OAM loopback cells on an SVC, specify how often loopback cells should be sent, and optionally enable OAM management of the connection.
2	<b>oam retry</b> <i>up-count down-count retry-frequency</i>	(Optional) Specify 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.

---

## Configure 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
<b>broadcast</b>	Send 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.

---

## Assign 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 “Configure 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
<b>class</b> <i>vc-class-name</i>	Apply a VC class to an SVC.

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

## Configure 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.

---

### Set 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
<b>sscop poll-timer</b> <i>seconds</i>	Set the poll timer.

### Set 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
<b>sscop keepalive-timer</b> <i>seconds</i>	Set the keepalive timer.

### Set 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
<code>sscop cc-timer seconds</code>	Set 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
<code>sscop max-cc retries</code>	Set the number of times that SSCOP will retry to transmit BGN, END, or RS PDUs when they have not been acknowledged.

### Set 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
<code>sscop send-window packets</code>	Set 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
<code>sscop receive-window packets</code>	Set the receiver's window.

### Close an SVC

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

Command	Purpose
<code>atmsig close atm slot0 vcd</code>	Close the signaling PVC for an SVC.

## Configure 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 following tasks:

- Create a VC Class
- Configure VC Parameters
- Apply a VC Class

## Create a VC Class

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

Command	Purpose
<b>vc-class atm</b> <i>name</i>	Create a VC class and enter vc-class configuration mode.

For examples of creating VC classes, see the section “Create a VC Class Examples” at the end of this chapter.

## Configure 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**
- **idle-timeout**
- **ilmi manage**
- **inarp**
- **oam-pvc**
- **oam retry**
- **oam-svc**
- **protocol**
- **ubr**
- **ubr+**
- **vbr-nrt**

Refer to the sections “Configure PVCs” and “Configure SVCs” for descriptions on 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 “Create a VC Class Examples” at the end of this chapter.

## Apply 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:

Step	Command	Purpose
1	<b>pvc</b> [ <i>name</i> ] <i>vpl/vci</i>	Specify an ATM PVC
	or	or
	<b>svc</b> [ <i>name</i> ] <b>nsap</b> <i>address</i>	Specify an ATM SVC
2	<b>class</b> <i>vc-class-name</i>	Apply 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:

Step	Command	Purpose
1	<b>interface atm</b> <i>slot/0</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }}	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
	or	
	<b>interface atm</b> <i>slot/port-adapter/0</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }}	
	or	
2	<b>interface atm</b> <i>number</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }}	Apply a VC class on an the ATM main interface or subinterface.
	<b>class</b> <i>vc-class-name</i>	

1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

For examples of applying a VC class to an ATM interface, see the section “Apply a VC Class Examples” later in this chapter.

## Configure 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:

- Configure ILMI Management
- Configure OAM Management

## Configure ILMI Management

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

Step	Command	Purpose
1	<b>interface atm</b> <i>slot0</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }] or <b>interface atm</b> <i>slotport-adapter0</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }] or <b>interface atm</b> <i>number</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }]	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>pvc</b> [ <i>name</i> ] 0/16 <b>ilmi</b>	Configure a PVC for communication with the ILMI.
3	<b>interface atm</b> <i>slot0.subinterface-number</i> <b>multipoint</b> or <b>interface atm</b> <i>slotport-adapter0.subinterface-number</i> <b>multipoint</b> or <b>interface atm</b> <i>number.subinterface-number</i> <b>multipoint</b>	(Optional) Specify the ATM subinterface of the PVC you want to manage.
4	<b>pvc</b> [ <i>name</i> ] <i>vpi/vci</i>	Specify the PVC to be managed.
5	<b>ilmi manage</b>	Enable ILMI management on the PVC.

<sup>1</sup> Use the **interface atm slot0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slotport-adapter0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

Repeat Steps 4 and 5 for each PVC you want to manage. Step 3 is only necessary if you wish 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 “ILMI Management on an ATM PVC Example” at the end of this chapter.

## Configure OAM Management

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

- OAM Management for PVCs
- OAM Management for SVCs

### OAM Management for PVCs

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

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

1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

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 “OAM Management on an ATM PVC Example” at the end of this chapter.

## OAM Management for SVCs

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

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

<sup>1</sup> Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

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) 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.

For an example of configuring OAM management on an SVC, see the section “OAM Management on an ATM SVC Example” at the end of this chapter.

## Configure 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.

### Configure 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:

- Configure the Router as an ATM ARP Client
- Configure the Router as an ATM ARP Server

#### Configure 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:

Step	Command	Purpose
1	<b>interface atm slot/0</b> or <b>interface atm slot/port-adapter/0</b> or <b>interface atm number</b>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>atm esi-address esi.selector</b>	Specify the ATM address of the interface.
3	<b>ip address address mask</b>	Specify the IP address of the interface.
4	<b>atm classic-ip-extensions BFI</b>	(Optional) Enables redundant ATM ARP servers.
5	<b>atm arp-server nsap nsap-address</b>	Specify the ATM address of the ATM ARP server.

Step	Command	Purpose
6	<b>no shutdown</b>	Enable the ATM interface.
1	Use the <b>interface atm slot/0</b> command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the <b>interface atm slotport-adapter/0</b> command with any ATM port adapter on the Cisco 7500 series routers. Use the <b>interface atm number</b> command with the NPM on the Cisco 4500 and 4700 routers. Use <b>interface atm 0</b> on the Cisco MC3810.	

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 “Configure Communication with the ILMI” earlier in this chapter.

For an example of configuring the ATM ARP client, see the section “ATM ARP Client Configuration in an SVC Environment Example” at the end of this chapter.

### Configure 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:

Step	Command	Purpose
1	<b>interface atm slot/0</b> or <b>interface atm slotport-adapter/0</b> or <b>interface atm number</b>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>atm esi-address esi.selector</b>	Specify the ATM address of the interface.
3	<b>ip address address mask</b>	Specify the IP address of the interface.
4	<b>atm classic-ip-extensions BFI</b>	(Optional) Enables redundant ATM ARP servers.
5	<b>atm arp-server self</b>	Identify the ATM ARP server for the IP subnetwork network.
6	<b>no shutdown</b>	Enable the ATM interface.
1	Use the <b>interface atm slot/0</b> command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the <b>interface atm slotport-adapter/0</b> command with any ATM port adapter on the Cisco 7500 series routers. Use the <b>interface atm number</b> command with the NPM on the Cisco 4500 and 4700 routers. Use <b>interface atm 0</b> on the Cisco MC3810.	

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 “Configure Communication with the ILMI” earlier in this chapter.

For an example of configuring the ATM ARP server, see the section “ATM ARP Server Configuration in an SVC Environment Example” at the end of this chapter.

## Configure 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:

Step	Command	Purpose
1	<b>interface atm slot/0</b> or <b>interface atm slot/port-adapter/0</b> or <b>interface atm number</b>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>ip address address mask</b>	Specify the IP address of the interface.
3	<b>pvc [name] vpi/vci</b>	Create a PVC.
4	<b>no shutdown</b>	Enable the ATM interface.

1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

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 “ATM Inverse ARP Configuration in a PVC Environment Example” at the end of this chapter.

## Customize 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. Perform the tasks in the following sections if you need to customize the ATM interface:

- Configure the Rate Queue
- Configure MTU Size

- Set the SONET PLIM
- Set Loopback Mode
- Set the Exception-Queue Length
- Configure the Maximum Number of Channels
- Limit the Number of Virtual Circuits
- Set the Raw-Queue Size
- Configure Buffer Size
- Set the VCI-to-VPI Ratio
- Set the Source of the Transmit Clock

## Configure 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.

---

### Use 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 “Configure a Permanent Rate Queue” for more information.

See the “Dynamic Rate Queue Examples” section for example configurations of different rate queues.

### Configure 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:

Step	Command	Purpose
1	<b>interface atm slot/0</b> or <b>interface atm slot/port-adapter/0</b> or <b>interface atm number</b>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>atm rate-queue tolerance svc [pvc] tolerance-value [strict]</b>	Configure a rate queue tolerance.

1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

The *tolerance-value* 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.

### Configure 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 “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
<b>atm rate-queue queue-number speed</b>	Configure a permanent rate queue, which defines the maximum speed at which an individual virtual circuit transmits data to a remote ATM host.

### Configure 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
<b>mtu bytes</b>	Set the maximum MTU size.

## Set 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
<b>atm sonet stm-1</b>	Set the OC-3c SONET PLIM to STM-1.
<b>atm framing [cbitadm   cbitplcp   m23adm   m23plcp]</b>	Set DS3 framing mode.
<b>atm framing [g751adm   g832 adm   g751plcp]</b>	Set E3 framing mode.

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

## Set 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
<b>loopback</b>	Set loopback mode.

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

Command	Purpose
<b>loopback line</b>	Set line loopback mode.

## Set 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 you will need to configure the exception queue length; if you do, use the following command in interface configuration mode:

Command	Purpose
<b>atm exception-queue <i>number</i></b>	Set the exception queue length.

**Note** This command is only supported on the AIP.

## Configure 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
<b>atm max-channels</b> <i>number</i>	Configure the maximum number of transmit channels.

---

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

---

## Limit 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
<b>atm maxvc</b> <i>number</i>	Limit the number of virtual circuits.

---

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

---

## Set 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
<b>atm rawq-size</b> <i>number</i>	Set the raw-queue size.

---

**Note** This command is only supported on the AIP.

---

## Configure 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
<b>atm rxbuff</b> <i>number</i>	Set 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
<b>atm txbuff</b> <i>number</i>	Set the number of transmit buffers.

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

## Set 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 *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
<b>atm vc-per-vp</b> <i>number</i>	Set the number of VCIs per VPI.

## Set the Source of the Transmit Clock

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

Command	Purpose
<b>atm clock internal</b>	Specify that the generate the transmit clock internally.

## Configure 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:

Step	Command	Purpose
1	<b>atm aal aal3/4</b>	Enable AAL3/4 support on the affected ATM subinterface.
2	<b>atm smds-address</b> <i>address</i>	Provide an SMDS E.164 unicast address for the subinterface.
3	<b>atm multicast</b> <i>address</i>	Provide an SMDS E.164 multicast address.
4	<b>atm vp-filter</b> <i>hexvalue</i>	Configure a virtual path filter for the affected ATM subinterface.
5	<b>pvc</b> [ <i>name</i> ] <i>vpi/vci</i> <b>smds</b>	Create 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 *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 *Network Protocols Configuration Guide, Part 1*, the *Network Protocols Configuration Guide, Part 2*, and the *Network Protocols Configuration Guide, Part 3*.

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

## Limit 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:

Steps	Command	Purpose
1	<b>atm mid-per-vc maximum</b>	Limit the number of message identifiers allowed per virtual circuit.
2	<b>pvc [name] vplvci smds</b>	Create an ATM PVC with SMDS encapsulation.
3	<b>mid midlow midhigh</b>	Limit 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 *midlow* and *midhigh* is zero.

## Set 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
<b>atm vp-filter hexvalue</b>	Set the virtual path filter register.

## Configure Fast-Switched Transparent Bridging for SNAP PVCs

Our 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.

Our 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:

Step	Command	Purpose
1	<b>interface atm</b> <i>slot</i> <b>0</b> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }]  or  <b>interface atm</b> <i>slot</i> / <i>port-adapter</i> <b>0</b> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }]  or  <b>interface atm</b> <i>number</i> [ <i>.subinterface-number</i> ] { <b>multipoint</b>   <b>point-to-point</b> }]	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>pvc</b> [ <i>name</i> ] <i>vpi</i> / <i>vci</i>	Create one or more PVCs using AAL5-SNAP encapsulation. Repeat these command as needed.
3	<b>exit</b>	Return to interface configuration mode.
4	<b>bridge-group</b> <i>group</i>	Assign the interface to a bridge group.
5	<b>exit</b>	Return to global configuration mode.
6	<b>bridge group protocol dec</b>	Define the type of spanning tree protocol as DEC.

1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

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 “Transparent Bridging on an AAL5-SNAP PVC Example” at the end of this chapter.

## Configure PPP over ATM

This section describes how to configure remote Point-to-Point Protocol (PPP) connections.

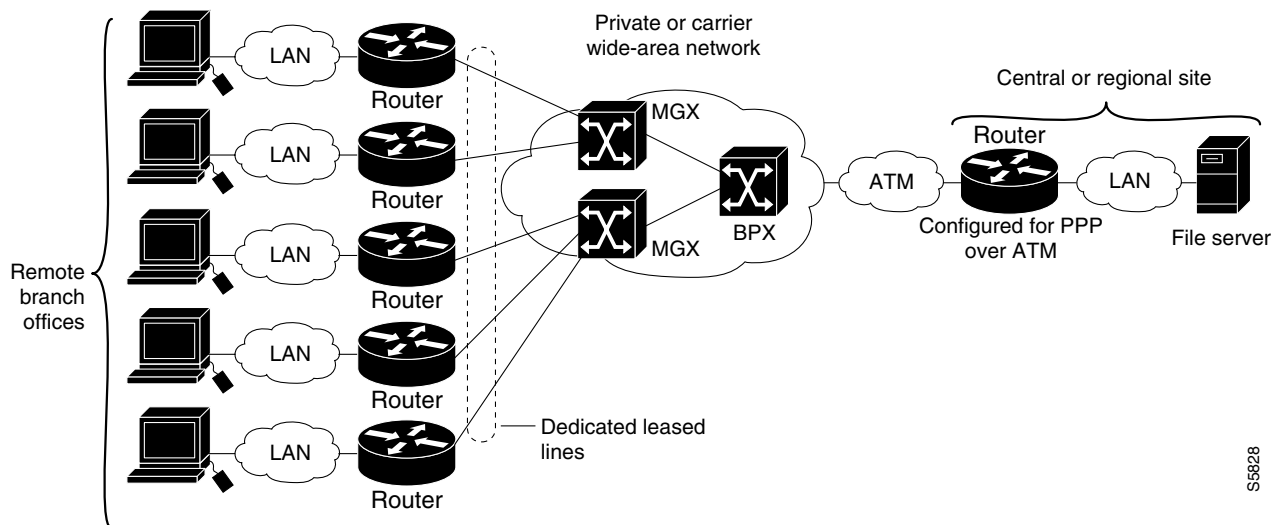
---

**Note** PPP over ATM is not supported on the ATM port adapter or enhanced ATM port adapter for Cisco IOS Release 12.0.

---

Before configuring PPP over ATM, the Cisco 7500 series routers must be equipped with Cisco IOS Release 11.2(4)F or later software. Remote branch offices must have PPP configured on PPP-compatible devices interconnecting directly to Cisco StrataCom’s ATM Switch Interface Shelf (AXIS) equipment through a leased-line connection. The shelves provide frame forwarding encapsulation and are terminated on BPX cores prior to connecting to a Cisco 7500 series router. Figure 4 shows a typical scenario for using PPP over ATM.

Figure 4 PPP-over-ATM Network Environment



**Note** If you need to configure the Cisco StrataCom AXIS shelf for frame forwarding at the remote sites, refer to the *AXIS 4 Command Supplement* for command line instructions or the *StrataView Plus Operations Guide* for StrataView Plus instructions. If you configure the AXIS using the command line interface, use the **addport** and **addchan** commands and select frame forwarding for the *port\_type* and *chan\_type* arguments, respectively.

When you configure PPP over ATM, a logical interface known as a virtual access interface associates each PPP connection to an ATM permanent virtual circuit (PVC). You can create this logical interface by configuring an ATM PVC as described in the “Create a PPP-over-ATM PVC” section. This configuration encapsulates each PPP connection in a separate PVC, allowing each PPP connection to terminate at the router ATM interface as if received from a typical PPP serial interface.

The virtual access interface for each PVC obtains its configuration from a virtual interface template (virtual template) when the PVC is created. Before creating the ATM PVC, we suggest you create and configure a virtual template as described in the “Create and Configure a Virtual Template” section.

To configure PPP over ATM, complete the tasks in the following sections. The first task is optional but recommended. The remaining tasks are required.

- Create and Configure a Virtual Template
- Specify an ATM Point-to-Point Subinterface
- Create a PPP-over-ATM PVC

See an example of configuring PPP over ATM in the section “PPP-over-ATM Example” at the end of this chapter.

## Create and Configure a Virtual Template

Prior to configuring the ATM PVC for PPP over ATM, you typically create and configure a virtual template. To create and configure a virtual template, use the following commands beginning in global configuration mode:

Step	Command	Purpose
1	<b>interface virtual-template</b> <i>number</i>	Create a virtual template, and enter interface configuration mode.
2	<b>encapsulation ppp</b>	Enable PPP encapsulation on the virtual template.
3	<b>ip unnumbered ethernet</b> <i>number</i>	Optionally, enable IP without assigning a specific IP address on the LAN.

Other optional configuration commands can be added to the virtual template configuration. For example, you can enable the PPP authentication on the virtual template using the **ppp authentication chap** command. Refer to the “Virtual Interface Template Service” chapter in the *Dial Solutions Configuration Guide* for additional information about configuring the virtual template.

All PPP parameters are managed within the virtual template configuration. Configuration changes made to the virtual template are automatically propagated to the individual virtual access interfaces. Multiple virtual access interfaces can spawn from a single virtual template; hence, multiple PVCs can use a single virtual template.

Cisco IOS software supports up to 25 virtual template configurations. If greater numbers of tailored configurations are required, an authentication, authorization, and accounting (AAA) server may be employed. Refer to the “Per-User Configuration” chapter in the *Dial Solutions Configuration Guide* for further information on configuring an AAA server.

If the parameters of the virtual template are not explicitly defined before configuring the ATM PVC, the PPP interface is brought up using default values from the virtual template identified. Some parameters (such as an IP address) take effect only if specified before the PPP interface comes up. Therefore, it is recommended that you explicitly create and configure the virtual template before configuring the ATM PVC to ensure such parameters take effect. Alternatively, if parameters are specified after the ATM PVC has already been configured, you should issue a **shutdown** command followed by a **no shutdown** command on the ATM subinterface to restart the interface; this restart will cause the newly configured parameters (such as an IP address) to take effect.

Network addresses for the PPP-over-ATM connections are not configured on the main ATM interface or subinterface. Instead, these are configured on the appropriate virtual template or obtained via AAA.

The virtual templates support all standard PPP configuration commands; however, not all configurations are supported by the PPP-over-ATM virtual access interfaces. These restrictions are enforced at the time the virtual template configuration is applied (cloned) to the virtual access interface. These restrictions are described in the following paragraphs.

Only standard first-in, first-out (FIFO) queuing is supported when applied to PPP-over-ATM virtual access interfaces. Other types of queuing which are typically configured on the main interface are not (for example, fair-queuing). If configured, these configuration lines are ignored when applied to a PPP-over-ATM interface.

While fast switching is supported, flow and optimum switching are not; these configurations are ignored on the PPP-over-ATM virtual access interface. Fast switching is enabled by default for the virtual template configuration. If fast switching is not desired, use the **no ip route-cache** command to disable it.

The PPP reliable link that uses Link Access Procedure, Balanced (LAPB) is not supported.

Because an ATM PVC is configured for this feature, the following standard PPP features are not applicable and should not be configured:

- Asynchronous interfaces
- Dialup connections
- Callback on PPP

## Specify an ATM Point-to-Point Subinterface

After you create a virtual template for PPP over ATM, you must specify a point-to-point subinterface per PVC connection. To specify an ATM point-to-point subinterface, use one of the following commands in global configuration mode:

Command	Purpose
<b>interface atm slot0.subinterface-number point-to-point</b> or <b>interface atm number.subinterface-number point-to-point</b>	Specify the ATM point-to-point subinterface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>

- 1 Use the **interface atm slot0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

## Create a PPP-over-ATM PVC

After you create a virtual template and specify a point-to-point subinterfaces for PPP over ATM, you must create a PPP-over-ATM PVC. To create a PPP-over-ATM PVC, use the following commands beginning in interface configuration mode:

Steps	Command	Purpose
1	<b>pvc [name] vpi/vci</b>	Create a PVC for PPP-over-ATM.
2	<b>encapsulation aal5ciscopp virtual-template number</b>	Specify PPP-over-ATM encapsulation.

The *peak* rate value is typically identical to the *average* rate or some suitable multiple thereof (up to 64 times for the Cisco 7500 series routers).

The *average* rate value should be set to the line rate available at the remote site, because the remote line rate will typically have the lowest speed of the connection. For example, if the remote site has a T1 link, set the line rate to 1.536 Mbps. Because the average rate calculation on the ATM PVC includes the cell headers, a line rate value plus 10 or 15 percent may result in better remote line utilization.

The *burst* size depends on the number of cells that can be buffered by receiving ATM switches and is coordinated with the ATM network connection provider. If this value is not specified, the default, which is the equivalent to one maximum length frame on the interface, is used.

Operations, Administration and Maintenance (OAM) F5 cell loopback is provided by the remote AXIS shelf so OAM may be enabled. However, PPP over ATM is not typically an end-to-end ATM connection, and therefore enabling OAM is not recommended.

Once you configure the router for PPP over ATM, the PPP subsystem starts and the router attempts to send a PPP configure request to the remote peer. If the peer does not respond, the router periodically goes into a “listen” state and waits for a configuration request from the peer. After a timeout (typically 45 seconds), the router again attempts to reach the remote router by sending configuration requests.

The virtual access interface remains associated with a PVC as long as the PVC is configured. If you deconfigure the PVC, the virtual access interface is marked as deleted. If you shut down the associated ATM interface, you will also cause the virtual access interface to be marked as down (within 10 seconds), and you will bring the PPP connection down. If you set a keepalive timer of the virtual template on the interface, the virtual access interface uses the PPP echo mechanism to verify the existence of the remote peer. If an interface failure is detected and the PPP connection is brought down, the virtual access interface remains up.

## Configure ATM E.164 Auto Conversion

E.164 is an International Telecommunications Union (ITU) 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 interconnect 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 E.164 Address Formats**

Address Type	Example
<b>Native E.164</b> A minimum of 7 and maximum of 15 ASCII-encoded decimal numbers.	1-800-555-1212
<b>E164_AESA</b> 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
<b>E164_ZDSP</b> 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 interface configuration mode:

Step	Command	Purpose
1	<b>interface atm</b> <i>slot/0</i> or <b>interface atm</b> <i>slotport-adapter/0</i> or <b>interface atm</b> <i>number</i>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>ip address</b> <i>ip-address mask</i>	If IP routing is enabled on the system, optionally assign a source IP address and subnet mask to the interface.
3	<b>pvc 0/5 qsaal</b>	Configure the signaling PVC for the ATM main interface that uses SVCs.
4	<b>exit</b>	Return to interface configuration mode.
5	<b>atm nsap-address</b> <i>nsap-address</i>	Set the AESA address for the ATM interface using E164_AESA or E164_ZDSP address format.
6	<b>atm e164 auto-conversion</b>	Enable E.164 auto conversion on the interface.
7	<b>exit</b>	Return to interface configuration mode.
8	<b>svc [name] nsap address</b>	Specify the destination NSAP address using E164_AESA or E164_ZDSP address format.
9	<b>protocol ip protocol-address</b>	Specify the destination IP address of the SVC.

1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slotport-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

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 “Configure ATM E.164 Auto Conversion Example” at the end of this chapter.

## Configure Circuit Emulation Services (CES)

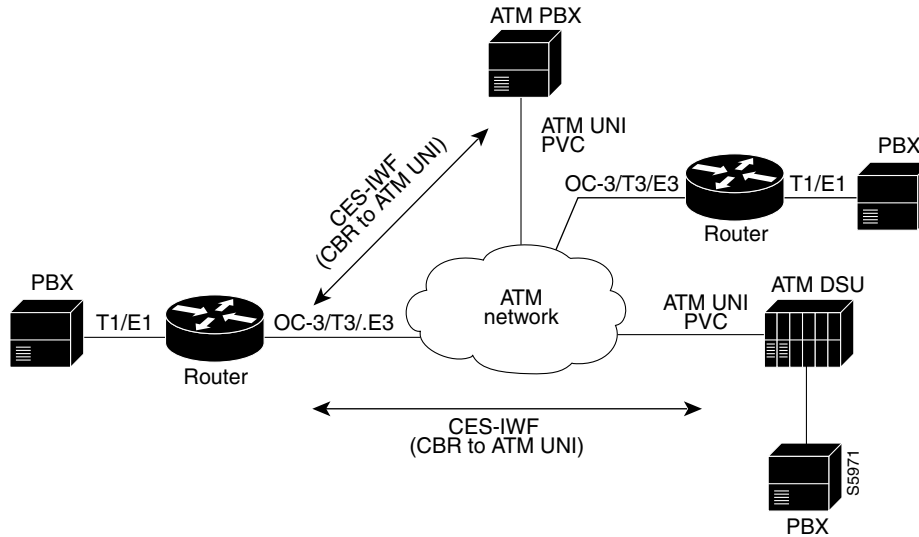
This section includes an overview of Circuit Emulation Services for ATM and a description of the configuration tasks.

### CES Overview

Circuit emulation service internetworking function (CES-IWF) is a service based on ATM Forum standards that allows communications to occur between CBR and ATM UNI interfaces, that is, between non-ATM telephony devices (such as classic PBXs or TDMS) and ATM devices (such as Cisco 7200 series routers). Thus, 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**



Voice and video services (circuit emulation) allow you to interconnect existing T1 or E1 interfaces and other kinds of constant bit rate (CBR) equipment. CBR services include 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.

The ATM-CES port adapter offers two types of services:

- Circuit emulation service internetworking function (CES-IWF)
- Network timing

The target application of 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.

## CES Configuration Task List

To configure the T1/E1 interfaces on the ATM-CES port adapter for unstructured CES services, use the commands described in the first section listed below. To configure structured CES services, use the commands described in the second section. The third section is optional if structured CES services are already configured.

- Configure Unstructured (Clear Channel) CES Services
- Configure Structured (N x 64) CES Services
- Configure Channel-Associated Signaling (for Structured CES Services Only)

---

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

---

For an example of configuring CES, see the section “Configure Circuit Emulation Services Example” at the end of this chapter.

### Configure 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:

Step	Command	Purpose
1	<b>interface cbr</b> <i>slot/port</i>	Specify the ATM-CES port adapter interface.
2	<b>ces aal1 service</b> [ <b>structured</b>   <b>unstructured</b> ]	Configure the port to perform unstructured CES services. The default is unstructured.
3	<b>ces aal1 clock</b> { <b>adaptive</b>   <b>srts</b>   <b>synchronous</b> }	Optionally, select the clock method. The default is synchronous.
4	<b>ces dsx1 clock source</b> { <b>loop-timed</b>   <b>network-derived</b> }	If synchronous clocking is selected, configure the clock source.
5	<b>ces circuit 0</b> [ <b>circuit-name</b> <i>name</i> ]	Specify the circuit number for unstructured services and optionally specify the logical name of the PVC. If you do not specify a circuit name, the default is CBRx/x:x.
6	<b>ces pvc 0 interface atm</b> <i>slot/port vci number vpi number</i>	Define the particular ATM destination port for the PVC.
7	<b>no shutdown</b>	Change the shutdown state to up and enable the ATM interface, thereby beginning the segmentation and reassembly (SAR) operation on the interface.
8	<b>no ces circuit 0 shutdown</b>	Enable the PVC.

### Configure 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(s) 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:

Step	Command	Purpose
1	<b>interface cbr</b> <i>slot/port</i>	Specify the ATM-CES port adapter interface.
2	<b>ces aal1 service</b> [ <b>structured</b>   <b>unstructured</b> ]	Configure the port to perform structured CES services. The default is unstructured.
3	<b>ces aal1 clock</b> { <b>adaptive</b>   <b>srts</b>   <b>synchronous</b> }	Optionally, select the clock method. The default is synchronous. Adaptive and SRTS are only available for unstructured mode.
4	<b>ces dsx1 clock source</b> { <b>loop-timed</b>   <b>network-derived</b> }	If synchronous clocking is selected, configure the clock source.
5	<b>ces dsx1 linecode</b> { <b>ami</b>   <b>b8zs</b> } (for T1) <b>ces dsx1 linecode</b> { <b>ami</b>   <b>hdb3</b> } (for E1)	Specify the line code format used for the physical layer. The default is AMI.
6	<b>ces dsx1 framing</b> { <b>esf</b>   <b>sf</b> } (for T1) <b>ces dsx1 framing</b> { <b>e1_crc_mfCASlt</b>   <b>e1_crc_mf_lt</b>   <b>e1_lt</b>   <b>e1_mfCAS_lt</b> } (for E1)	Specify the framing format. The default for T1 is ESF and for E1 is E1_LT.
7	<b>ces dsx1 lbo</b> <i>length</i>	Optionally, specify 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	Command	Purpose
8	<b>ces circuit</b> <i>circuit-number</i> [ <b>circuit-name</b> <i>name</i> ]	Specify the circuit number for structured services and optionally specify 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.
9	<b>ces circuit</b> <i>circuit-number</i> <b>timeslots</b> <i>range</i>	Specify the timeslots 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 dash to indicate a range (for example 1-24). Use a comma to separate the timeslot (for example, 1,3,5).
10	<b>ces circuit</b> <i>circuit-number</i> <b>cdv</b> <i>range</i>	Optionally, configure the circuit cell delay variation. Range is 1 through 65535 milliseconds. The default range is 2000 milliseconds.
11	<b>ces pvc</b> <i>circuit-number</i> <b>interface atm</b> <i>slot/port</i> <b>vpi</b> <i>number</i> <b>vci</b> <i>number</i>	Define the particular ATM destination port for the PVC.
12	<b>no shutdown</b>	Change the shutdown state to up and enable the ATM interface, thereby beginning the segmentation and reassembly (SAR) operation on the interface.
13	<b>no ces circuit</b> <i>circuit-number</i> <b>shutdown</b>	Enable the PVC.

**Note** You need not specify individual circuit options on a separate command line, even though that is done in and above. 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.

## Configure 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 permanent virtual connection (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 "Configure Structured (N x 64) CES Services" section and then use the following commands beginning in global configuration mode:

Step	Command	Purpose
1	<b>interface</b> <i>cbr slot/port</i>	Specify the ATM-CES port adapter interface.
2	<b>ces circuit</b> <i>circuit-number cas</i>	Enable channel associated signaling.
3	<b>ces dsx1 signalmode robbedbit</b>	Optionally, enable the signal mode as robbed bit.
4	<b>ces circuit</b> <i>circuit-number on-hook-detection hex-number</i>	Optionally, enable on-hook detection.

## Configure 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 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 “Configure 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:

Step	Command	Purpose
1	<b>network-clock-select 1 {atm   cbr} slot/port</b>	Establish a priority 1 clock source.
2	<b>network-clock-select 2 {atm   cbr} slot/port</b>	Establish a priority 2 clock source.
3	<b>network-clock-select 3 {atm   cbr} slot/port</b>	Establish a priority 3 clock source.
4	<b>network-clock-select 4 {atm   cbr} slot/port</b>	Establish a priority 4 clock source.

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

---

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

---

For an example of configuring the network clock source and priority, see the section “Configure Network Clock Source Priority Example” at the end of this chapter.

## Configure Virtual Path Shaping

The ATM-CES port adapter supports multiplexing of one or more PVCs over a virtual path (VP) that is shaped at a constant bandwidth. To use this feature, you 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** The number of CES PVCs that are multiplexed depends on the bandwidth requirement. Because of this requirement, the CES PVCs cannot be oversubscribed. The CES PVC will fail if there is no bandwidth available. Data PVCs use the bandwidth that is unused by the CES PVCs.

---

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

Step	Command	Purpose
1	<b>atm pvp vpi [peak-rate]</b>	Create a PVP and optionally specify the peak rate.
2	<b>pvc [name] vpi/vci</b>	Optionally, create a PVC with a VPI that matches the VPI specified in Step 1.

Step	Command	Purpose
3	<code>exit</code>	Exit interface configuration mode.
4	<code>interface cbr slot/port</code> <code>ces circuit circuit-number</code> <code>ces pvc circuit-number interface atm slot/port vpi</code> <code>number vci number</code>	Optionally, create a CES PVC with a VPI that matches the VPI specified in Step 1.

---

**Note** Virtual path shaping is only available on the ATM-CES port adapter.

---

The *vpi* value is the virtual path identifier to be associated with the PVP (valid values are in the range 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.

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.

The `pvc` command is rejected if a non-multiplexed 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.

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

---

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

---

For an example of virtual path shaping, see the section “Configure Virtual Path Shaping” at the end of this chapter.

## Configure 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 permanent virtual circuit (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. Our] 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.

- Enable the Serial Interface
- Enable ATM-DXI Encapsulation
- Set Up the ATM-DXI PVC
- Map Protocol Addresses to the ATM-DXI PVC
- Monitor and Maintain the ATM-DXI Serial Interface (optional)

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

## Enable the Serial Interface

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

Step	Command	Purpose
1	<b>interface serial</b> <i>number</i>	Enable the serial interface.
2	<b>appletalk address</b> <i>network.node</i> <b>ip address</b> <i>address mask</i> <b>ipx network</b> <i>number</i>	For each protocol to be carried, assign 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 *Network Protocols Configuration Guide, Part 1*, the *Network Protocols Configuration Guide, Part 2*, or the *Network Protocols Configuration Guide, Part 3*.

## Enable 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
<b>encapsulation atm-dxi</b>	Enable ATM-DXI encapsulation.

## Set 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
<b>dxi pvc</b> <i>vpi vci</i> [ <b>snap</b>   <b>nlpid</b>   <b>mux</b> ]	Define the ATM-DXI PVC and the encapsulation method.

The MUX (multiplex) option defines the PVC to carry one protocol only; each protocol must be carried over a different PVC. The SNAP (Subnetwork Access Protocol) 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.

---

## Map Protocol Addresses to the ATM-DXI PVC

This section describes how to map protocol addresses to the virtual channel identifier (VCI) and the virtual path identifier (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
<code>dxl map protocol protocol-address vpi vci [broadcast]</code>	Map 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 “ATM Access over a Serial Interface Example” section later in this chapter.

## Monitor and Maintain 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
<code>show interfaces atm [slot/port]</code>	Display the serial ATM interface status.
<code>show dxi pvc</code>	Display the ATM-DXI PVC information.
<code>show dxi map</code>	Display the ATM-DXI map information.

## Troubleshoot 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:

Step	Command	Purpose
1	<b>interface atm slot/0</b> or <b>interface atm slot/port-adapter/0</b> or <b>interface atm number</b>	Specify the ATM interface using the appropriate format of the <b>interface atm</b> command. <sup>1</sup>
2	<b>atm oam flush</b>	Specify that incoming OAM cells be dropped on the ATM interface.

1 Use the **interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **interface atm 0** on the Cisco MC3810.

## Monitor and Maintain the ATM Interface

After configuring the new 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
<b>show arp</b>	Display entries in the ARP table.
<b>show atm class-links</b> [ <i>vpilvci</i>   <i>name</i> ]	Display PVC and SVC parameter configurations and where the parameter values are inherited from.
<b>show atm interface atm slot/0</b> <b>show atm interface atm slot/port-adapter/0</b> <b>show atm interface atm number</b>	Display ATM-specific information about the ATM interface using the appropriate format of the <b>show atm interface atm</b> command. <sup>1</sup>
<b>show atm map</b>	Display the list of all configured ATM static maps to remote hosts on an ATM network.
<b>show atm pvc</b> [ <i>vpilvci</i>   <i>name</i>   <b>interface atm interface_number</b> ]	Display all active ATM PVCs and traffic information.
<b>show atm svc</b> [ <i>vpilvci</i>   <i>name</i>   <b>interface atm interface_number</b> ]	Display all active ATM SVCs and traffic information.
<b>show atm traffic</b>	Display 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.
<b>show atm vc</b> [ <i>vcd</i> ]	Display all active ATM virtual circuits (PVCs and SVCs) and traffic information.

Command	Purpose
<b>show interfaces atm</b> <b>show interfaces atm slot/0</b> <b>show interfaces atm slot/port-adapter/0</b>	Display statistics for the ATM interface using the appropriate format of the <b>show interfaces atm</b> command. <sup>2</sup>
<b>show network-clocks</b>	Display the clock signal sources and priorities that you established on the router.
<b>show sscop</b>	Display SSCOP details for the ATM interface.

- 1 Use the **show atm interface atm slot/0** command with the AIP on Cisco 7500 series routers, any ATM port adapter on the Cisco 7200 series routers, and the 1-port ATM-25 network module on the Cisco 2600 and 3600 series routers. Use the **show atm interface atm slot/port-adapter/0** command with any ATM port adapter on the Cisco 7500 series routers. Use the **show atm interface atm number** command with the NPM on the Cisco 4500 and 4700 routers. Use **show interface atm 0** on the Cisco MC3810.
- 2 The description in the table footnote above applies for the **show interfaces atm** command.

## 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 above:

- Create a PVC Example
- PVC with AAL5 and LLC/SNAP Encapsulation Examples
- PVCs in a Fully Meshed Network Example
- Configure an ABR PVC Example
- Configure PVC Discovery Example
- Enable Inverse ARP Example
- Configure Generation of End-to-End F5 OAM Loopback Cells Example
- Configure Communication with the ILMI
- SVCs in a Fully Meshed Network Example
- ATM ESI Address Example
- ATM NSAP Address Example
- SVCs with Multipoint Signaling Example
- Configure SVC Traffic Parameters Example
- Create a VC Class Examples
- Apply a VC Class Examples
- ILMI Management on an ATM PVC Example
- OAM Management on an ATM PVC Example
- OAM Management on an ATM SVC Example
- Classical IP and ARP Examples
- Dynamic Rate Queue Examples

- PVC with AAL3/4 and SMDS Encapsulation Examples
- Transparent Bridging on an AAL5-SNAP PVC Example
- PPP-over-ATM Example
- Configure ATM E.164 Auto Conversion Example
- Configure Circuit Emulation Services Example
- Configure Network Clock Source Priority Example
- Configure Virtual Path Shaping Example
- ATM Access over a Serial Interface Example
- ATM Port Adapters Connected Back-to-Back Example

## Create a PVC Example

The following example creates 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 “Create a PVC” and “Configure PVC Traffic Parameters” earlier in this chapter.

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

## PVC with AAL5 and LLC/SNAP Encapsulation Examples

The following example creates PVC 0/50 on ATM interface 3/0. It uses the global default LLC/SNAP encapsulation over AAL5. The interface is at IP address 1.1.1.1 with 1.1.1.5 at the other end of the connection. For further information, refer to the sections “Create a PVC” and “Map a Protocol Address to a PVC” earlier in this chapter.

```
interface atm 3/0
  ip address 1.1.1.1 255.255.255.0
  pvc 0/50
  protocol ip 1.1.1.5 broadcast
  exit
!
ip route-cache cbus
```

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

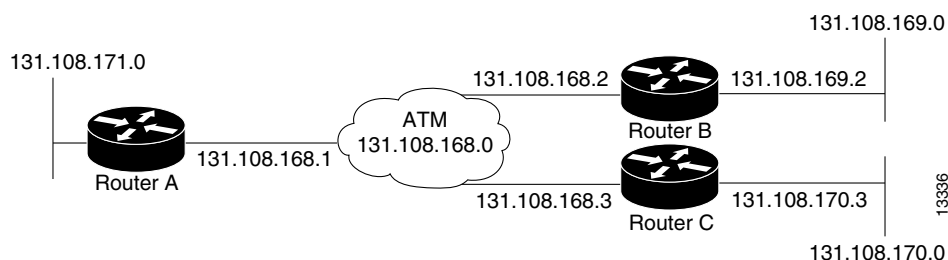
```

interface atm 4/0
 ip address 172.21.168.112 255.255.255.0
 atm maxvc 512
 pvc 1/51
 protocol ip 171.21.168.110
 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
    
```

## PVCs in a Fully Meshed Network Example

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 “Create a PVC” and “Map 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 131.108.168.1 255.255.255.0
 pvc 0/32
  protocol ip 131.108.168.2 broadcast
 exit
!
 pvc 0/33
  protocol ip 131.108.168.3 broadcast
 exit
```

### Router B

```
ip routing
!
interface atm 2/0
 ip address 131.108.168.2 255.255.255.0
 pvc test-b-1 0/32
  protocol ip 131.108.168.1 broadcast
 exit
!
 pvc test-b-2 0/34
  protocol ip 131.108.168.3 broadcast
 exit
```

### Router C

```
ip routing
!
interface atm 4/0
 ip address 131.108.168.3 255.255.255.0
 pvc 0/33
  protocol ip 131.108.168.1 broadcast
 exit
!
 pvc 0/34
  protocol ip 131.108.168.2 broadcast
 exit
```

## Configure an ABR PVC Example

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 “Configure PVC Traffic Parameters” earlier in this chapter.

```
interface atm 4/0
 ip address 1.1.1.1 255.255.255.0
 pvc 0/34
  atm abr rate-factor 32 32
 no shutdown
 exit
```

## Configure PVC Discovery Example

The following example enables PVC Discovery on the 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 “Configure 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
```

## Enable Inverse ARP Example

The following example enables Inverse ARP on an ATM interface and specifies an Inverse ARP time period of 10 minutes. For further information, refer to the section “Enable Inverse ARP” earlier in this chapter. For further information, refer to the section “Enable Inverse ARP” earlier in this chapter.

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

## Configure Generation of End-to-End F5 OAM Loopback Cells Example

The following example enables 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 “Configure 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
```

## Configure Communication with the ILMI Example

The following example configures the ILMI protocol on an ATM main interface. For further information, refer to the section “Configure Communication with the ILMI” earlier in this chapter.

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

## SVCs in a Fully Meshed Network Example

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:

- Configure the PVC that Performs SVC Call Setup
- Configure the NSAP Address
- Create 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 172.16.168.3
 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
```

## ATM ESI Address Example

The following example on a Cisco 7500 series router assigns the ESI and selector field values and sets up the ILMI PVC. For further information, refer to the section “Configure the ESI and Selector Fields” earlier in this chapter.

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

## ATM NSAP Address Example

The following example assigns 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 “Configure 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.

## SVCs with Multipoint Signaling Example

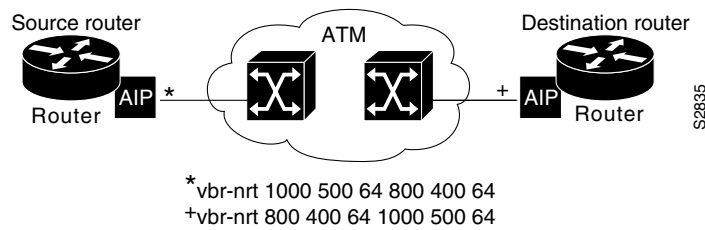
The following example configures an ATM interface for SVCs using multipoint signaling. For further information, refer to the section “Configure Point-to-Multipoint Signaling” earlier in this chapter.

```
interface atm 2/0
  ip address 4.4.4.6 255.255.255.0
  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 4.4.4.4 broadcast
  exit
!
  svc mcast-2 nsap 31.3233.34.352637.3839.3031.3233.3435.3637.3839.30 broadcast
  protocol ip 4.4.4.7 broadcast
  exit
!
  atm multipoint-signalling
  atm maxvc 1024
```

## Configure SVC Traffic Parameters Example

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 specifies VBR-NRT traffic parameters on the source router. For further information, refer to the section “Configure 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 Have Corresponding Traffic Settings**

## Create a VC Class Examples

The following example creates a VC class named main and configures UBR and encapsulation parameters. For further information, refer to the sections “Create a VC Class” and “Configure VC Parameters” earlier in this chapter.

```
vc-class atm main
ubr 10000
encapsulation aal5mux ip
```

The following example creates a VC class named sub and configures UBR and PVC management parameters. For further information, refer to the sections “Create a VC Class” and “Configure VC Parameters” earlier in this chapter.

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

The following example creates a VC class named pvc and configures VBR-NRT and encapsulation parameters. For further information, refer to the sections “Create a VC Class” and “Configure VC Parameters” earlier in this chapter.

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

## Apply a VC Class Examples

The following example applies the VC class named main to the ATM main interface 4/0. For further information, refer to the section “Apply a VC Class” earlier in this chapter.

```
interface atm 4/0
class main
exit
```

The following example applies the VC class named sub to the ATM subinterface 4/0.5:

```
interface atm 4/0.5 multipoint
class sub
exit
```

The following example applies the VC class named pvc directly on the PVC 0/56:

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

### ILMI Management on an ATM PVC Example

The following example first configures 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 “Configure 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
```

### OAM Management on an ATM PVC Example

The following example enables 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 “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
```

### OAM Management on an ATM SVC Example

The following example enables 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 “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
```

## Classical IP and ARP Examples

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.

### ATM ARP Client Configuration in an SVC Environment Example

This example configures 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 “Configure the Router as an ATM ARP Client” earlier in this chapter.

```
interface atm 2/0.5
  atm nsap-address ac.2456.78.040000.0000.0000.0000.0000.0000.0000.00
  ip address 10.0.0.2 255.0.0.0
  pvc 0/5 qsaal
  atm arp-server nsap ac.1533.66.020000.0000.0000.0000.0000.0000.0000.00
```

## ATM ARP Server Configuration in an SVC Environment Example

The following example configures 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 “Configure 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.1533.66.020000.0000.0000.0000.0000.0000.0000.00
 atm rate-queue 1 100
 atm maxvc 1024
 pvc 0/5 qsaal
 atm arp-server self
```

## ATM Inverse ARP Configuration in a PVC Environment Example

The following example configures 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 “Configure Classical IP and Inverse ARP in a PVC 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
```

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

## Dynamic Rate Queue Examples

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 “Use Dynamic Rate Queues” earlier in this chapter.

In the following example, the software sets 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
```

In the following example, the software creates 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
```

In the following example, the software creates a 15-Mbps rate queue and sets the average rate to the peak rate:

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

The following example configures 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
```

## PVC with AAL3/4 and SMDS Encapsulation Examples

The following example provides 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 “Configure 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.

## Transparent Bridging on an AAL5-SNAP PVC Example

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 “Configure Fast-Switched Transparent Bridging for SNAP PVCs” earlier in this chapter.

```
interface atm 4/0
 ip address 1.1.1.1 255.0.0.0
 pvc 1/33
 pvc 1/34
 pvc 1/35
 bridge-group 1
 !
 bridge 1 protocol dec
```

## PPP-over-ATM Example

The following example configures PPP over ATM to use PPP unnumbered link and Challenge Handshake Authentication Protocol (CHAP) authentication. For further information, refer to the section “Configure PPP over ATM” earlier in this chapter.

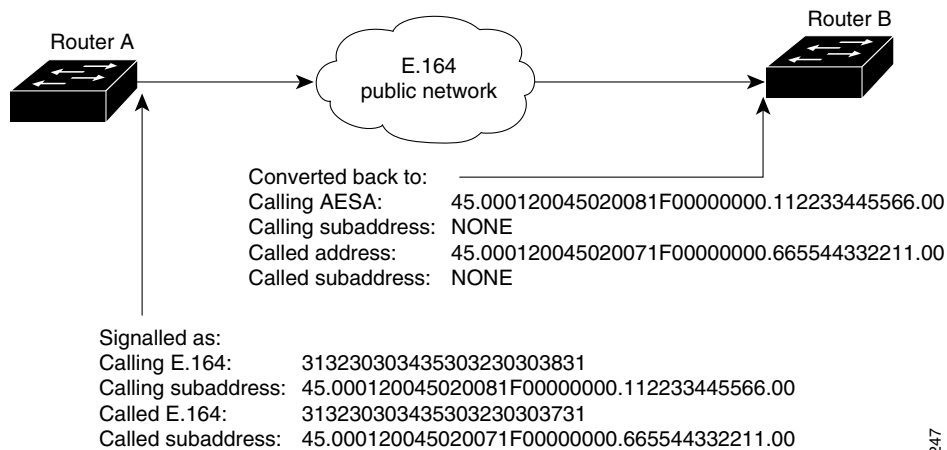
```
configure terminal
 !
 interface virtual-template 2
 encapsulation ppp
 ip unnumbered ethernet 0/0
 ppp authentication chap
 !
 interface atm 2/0.2 point-to-point
 pvc 0/34
 encapsulation aal5ciscopp virtual-template 2
 exit
```

## Configure ATM E.164 Auto Conversion Example

The following example configures ATM E.164 auto conversion on an ATM interface. Figure 8 illustrates this example. For further information, refer to the section “Configure ATM E.164 Auto Conversion” earlier in this chapter.

```
interface atm 0 multipoint
 ip address 120.45.20.81 255.255.255.0
 pvc 0/5 qsaal
 exit
 !
 atm nsap-address 45.000120045020081F00000000.112233445566.00
 atm e164 auto-conversion
 svc nsap 45.000120045020071F00000000.665544332211.00
 protocol ip 120.45.20.71
 exit
```

**Figure 8 E164\_AESA Address Auto Conversion Example**



12247

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 to E.164 addresses upon entering the E.164 network, and converted back to E164\_ZDSP addresses upon leaving the network.

## Configure Circuit Emulation Services Example

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 “Configure Circuit Emulation Services (CES)” 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
```

## Configure 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 “Configure Network Clock Source Priority Example” earlier in this chapter.

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

## Configure Virtual Path Shaping Example

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 “Configure Virtual Path Shaping Example” earlier in this chapter.

```
interface atm 6/0
 ip address 2.2.2.2 255.255.255.0
 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
```

## ATM Access over a Serial Interface Example

The example in this section illustrates 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
 dxl pvc 10 10 mux
 dxl map ip 172.21.178.4 10 10 broadcast
```

## ATM Port Adapters Connected Back-to-Back Example

The following example shows the configuration needed to connect two ATM port adapters back to back. Two routers, each containing an ATM port adapter, is connected directly with a standard cable, that 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
```

## ATM Configuration Examples

---

```
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
```