Configuring ATM on the ATM Port Adapter for Cisco 7200 and 7500 Series Routers

This chapter describes how to configure ATM on the ATM port adapter in the Cisco 7200 series routers and on the second generation Versatile Interface Processor (VIP2) in Cisco 7500 series routers.

Note 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 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 on the ATM port adapter for a Cisco 7200 series router or Cisco 7500 series router, 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 Port Adapter Interface
- Configure PVCs
- Configure SVCs
- Configure Classical IP and ARP over ATM (optional)
- Customize the ATM Port Adapter Interface (optional)
- Configure Transparent Bridging for the ATM Port Adapter (optional)
- Monitor and Maintain the ATM Interface (optional)

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

Enable the ATM Port Adapter Interface

This section describes how to begin configuring the ATM port adapter interface. The Cisco 7500 series routers identify an ATM port adapter interface address by its slot number (0 to the maximum number of available slots), port adapter number (0 or 1), and port number in the format *slot*/*port-adapter*/*port*. The Cisco 7200 series routers identify an ATM port adapter interface address by its slot number and port number in the format *slot*/*port*. Because each ATM port adapter contains a single ATM interface, the port number is always 0. For example, the *slot*/*port-adapter*/*port* address of an ATM port adapter interface on a Cisco 7500 series router installed in slot 1, port adapter 1, is 1/1/0.

To begin to configure the ATM port adapter interface, start the following task in privileged EXEC mode:

Task		Command
Step 1	At the privileged EXEC prompt, enter configuration mode from the terminal.	**configure terminal**
Step 2	Specify an ATM port adapter interface.	
	• Cisco 7200 series router	**interface atm** *slot*/**0**
	• Cisco 7500 series router	**interface atm** *slot*/*port-adapter*/**0**
Step 3	If IP routing is enabled on the system, optionally assign a source IP address and subnet mask to the interface.	**ip address** *ip-address mask*

To enable the ATM port adapter interface, perform the following task in interface configuration mode:

Task	Command
Change the shutdown state to up and enable the ATM interface, thereby starting the segmentation and reassembly (SAR) operation on the interface.	**no shutdown**

The **no shutdown** command passes an **enable** command to the ATM port adapter interface, which then begins segmentation and reassembly (SAR) operations. It also causes the ATM port adapter 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.

All virtual circuit characteristics listed in the section “ATM Port Adapter Virtual Circuits” 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 port adapter interface. These PVCs are writable into the nonvolatile RAM (NVRAM) as part of the Route Switch Processor (RSP) and Network Processing Engine (NPE) configuration and are used when the images are 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 three tasks are required; the last two are optional.

- Create a PVC
- Map a Protocol Address to a PVC
- Configure Communication with the ILMI
- Configure ATM UNI Version Override (optional)
- Configure Transmission of Loopback Cells to Verify Connectivity (optional)

Create a PVC

To create a PVC on the ATM port adapter interface, perform the following task in interface configuration mode:

Task	Command
Create a PVC.	**atm pvc** *vcd vpi vci aal-encap* [**oam** *seconds*]

When you create a PVC, you create a virtual circuit descriptor (VCD*)* and attach it to the VPI and VCI. A VCD is an ATM interface-specific mechanism that identifies to the ATM interface which VPI-VCI pair to use for a particular packet. The ATM interface requires this feature to manage the packets for transmission. The number chosen for the VCD is independent of the VPI-VCI pair used.

When you create a PVC, you also specify the ATM adaptation layer (AAL) and encapsulation. If you specify AAL3/4-SMDS encapsulation, you have the option of setting the starting message identifier (MID) number and ending MID number using the *midlow* and *midhigh* arguments.

You can also configure the PVC for communication with the Interim Local Management Interface (ILMI) so the router can receive Simple Network Management Protocol (SNMP) traps and new network prefixes. Refer to the "Configure Communication with the ILMI" section of this chapter for details.

You can also optionally configure the PVC to send Operation, Administration, and Maintenance (OAM) F5 loopback cells to verify connectivity on the virtual circuit. The remote end must respond by echoing back such cells.

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 ATM address of remote hosts or routers. This address is specified as a virtual circuit descriptor (VCD) for a PVC (or an NSAP address for SVC operation). This section describes how to map a PVC to an address, which is a required task if you are configuring a PVC.

You enter mapping commands as groups. You first create a map list and then associate it with an interface. Begin the following tasks in global configuration mode:

Task		Command
Step 1	Create a map list by naming it, and enter map-list configuration mode.	**map-list** *name*
Step 2	Associate a protocol and address to a specific virtual circuit.	*protocol protocol-address* **atm-vc** *vcd* [**broadcast**]

Task		Command
Step 3	Associate a protocol and address to a different virtual circuit.	*protocol protocol-address* **atm-vc** *vcd* [**broadcast**]
Step 4	Specify an ATM port adapter interface and enter interface configuration mode.	
	• Cisco 7200 series router	**interface atm** *slot*/**0**
	• Cisco 7500 series router	**interface atm** *slot*/*port-adapter*/**0**
Step 5	Associate a map list to an interface.	**map-group** *name*

A map list can contain multiple map entries, as Steps 2 and 3 in the preceding task table illustrate. The **broadcast** keyword specifies that this map entry is to be used when the corresponding protocol sends broadcast packets to the interface (for example, any network routing protocol updates). If you do not specify **broadcast**, the ATM software is prevented from sending routing protocol updates to the remote hosts.

If you do specify **broadcast**, but do *not* set up point-to-multipoint signaling, pseudobroadcasting is enabled. To eliminate pseudobroadcasting and set up point-to-multipoint signaling on virtual circuits configured for broadcasting, see the "Configure Point-to-Multipoint Signaling" section in this chapter.

In step 5, associate the map list with the ATM interface you specified in step 4. Use the same *name* argument you used in the **map-list** command

You can create multiple map lists, but only one map list can be associated with an interface. Different map lists can be associated with different interfaces. See the examples at the end of this chapter.

Configure Communication with the ILMI

You can configure a PVC for communication with the Interim Local Management Interface (ILMI) so the router can receive SNMP traps and new network prefixes. The recommended vpi/vci for ILMI is 0 16. To configure ILMI communication, complete the following task in interface configuration mode:

Task	Command
Create an ILMI PVC on a major interface.	**atm pvc** *vcd vpi vci* **ilmi**

Note This ILMI PVC can be set up only on a major interface, not on the subinterfaces.

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

Optionally, enable ILMI keepalives and set the interval between keepalives.	**atm ilmi-keepalive** [*seconds*]

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.

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.

Task	Command
Override UNI version used by router.	**atm uni-version** *version number*

No other configuration steps are required.

Configure Transmission of Loopback Cells to Verify Connectivity

You can optionally configure the PVC to send OAM F5 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 system console displays a debug message indicating the failure of the PVC, provided the **debug atm errors** command is enabled. If you suspect that a PVC is faulty, enabling OAM cell generation and the **debug atm errors** command allows you to monitor the status of the PVC.

To configure the transmission of OAM F5 loopback cells, add the **oam** keyword to the **atm pvc** command, as shown in the following task:

Task	Command
Configure transmission of OAM F5 cells on the PVC.	**atm pvc** *vcd vpi vci aal-encap* [**oam** *seconds*]

Configure SVCs

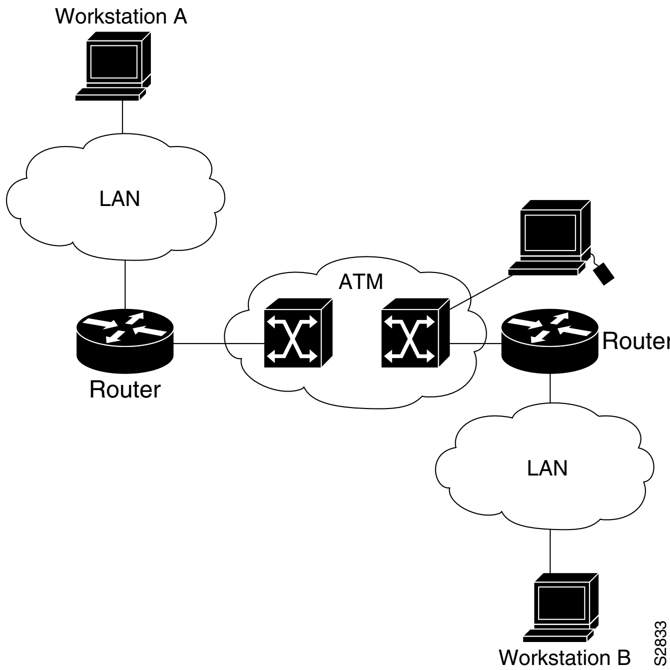
ATM switched virtual circuit (SVC) service operates much like X.25 SVC service, although ATM allows much higher throughput. Virtual circuits are created and released dynamically, providing user bandwidth on demand. This service requires a signaling protocol between the router and the switch.

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 7 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 7 Basic ATM Environment



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

- Configure the PVC That Performs SVC Call Setup
- Configure the NSAP Address

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.

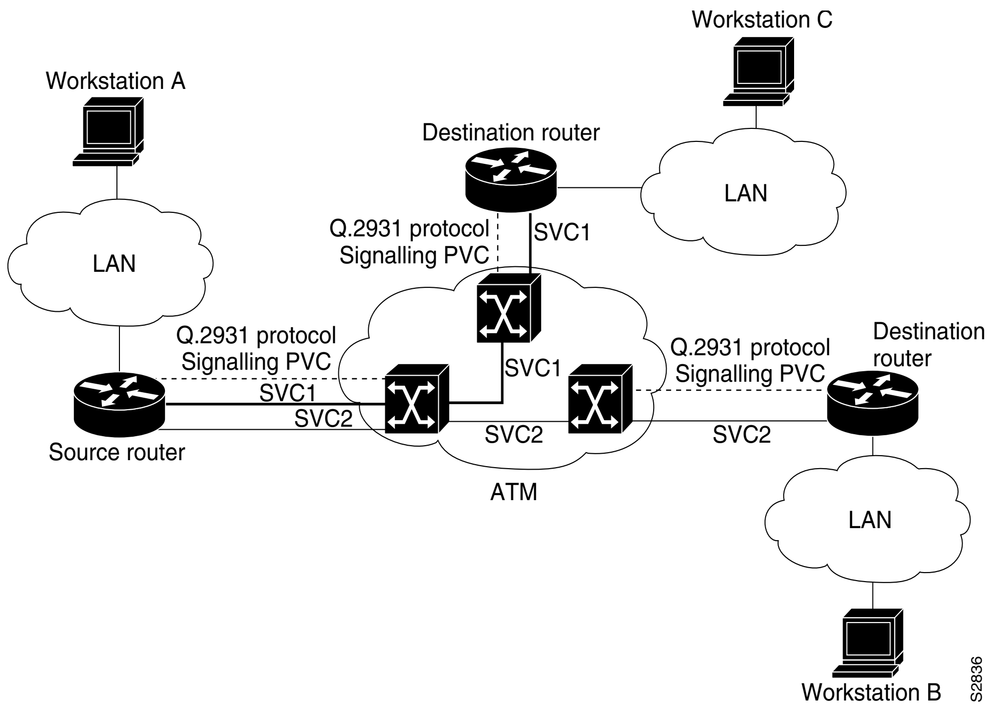
- Configure the Idle Timeout Interval
- Configure Point-to-Multipoint Signaling
- Configure IP Multicast over ATM Point-to-Multipoint Virtual Circuits
- Configure SSCOP
- Close an SVC

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 8 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 8 One or More SVCs Require a Signaling PVC



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

Task	Command
Configure the signaling PVC for a major interface that uses SVCs.	**atm pvc** *vcd vpi vci* **qsaal**

Note This signaling PVC can be set up only on a major interface, not on the subinterfaces.

The VPI and VCI values must be configured consistently with the local switch. The standard value of VPI is 0; the standard value of VCI is 5.

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 in one of the following sections:

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

Configure the Complete NSAP Address Manually

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, perform the following task in interface configuration mode:

Task	Command
Configure the ATM NSAP address for an interface.	**atm nsap-address** *nsap-address*

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.

Configure the ESI and Selector Fields

To configure the end station ID (ESI) and selector fields, 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.

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

Task		Command
Step 1	Configure a PVC for communicating with the switch via ILMI.	**atm pvc** *vcd* **0 16 ilmi**
Step 2	Enter the ESI and selector fields of the NSAP address.	**atm esi-address** *esi***.***selector*

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 ATM prefix (26 hexadecimal characters) is provided by the ATM switch. To get the prefix from the ATM switch, the ILMI PVC must be configured on the router and the ATM switch must be able to supply a prefix via ILMI.

The **atm esi-address** and **atm nsap-address** commands are mutually exclusive. Configuring the router with the **atm esi-address** command negates the **atm nsap-address** setting, and vice versa.

You can also specify a keepalive interval for the ILMI PVC. See the "Configure Communication with the ILMI" section of 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 "ATM ESI Address Example" at the end of this chapter.

Configure the Idle Timeout Interval

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

To change the idle timeout interval, perform the following task in interface configuration mode:

Task	Command
Configure the interval of inactivity after which an idle SVC will be disconnected.	**atm idle-timeout** *seconds*

The default idle timeout interval is 300 seconds (5 minutes).

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 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 existing static map entries 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 port adapter interface, complete the following tasks beginning in global configuration mode. The first task is required to configure this feature; the others are optional.

Task		Command
Step 1	Specify an ATM port adapter interface. • Cisco 7200 series router • Cisco 7500 series router	 **interface atm** *slot***/0** **interface atm** *slot***/***port-adapter***/0**
Step 2	Provide a protocol address for the interface.	*protocol protocol-address mask*
Step 3	Associate a map list to the interface.	**map-group** *name*
Step 4	Provide an ATM NSAP address for the interface.	**atm nsap-address** *nsap-address*
Step 5	Configure the signaling PVC for the interface that uses SVCs.	**atm pvc** *vcd vpi vci* **qsaal**
Step 6	Associate a map list with the map group.	**map-list** *name*
Step 7	Configure a broadcast protocol for the remote NSAP address on the SVC. Repeat this step for other NSAP addresses, as needed.	*protocol protocol-address* **atm-nsap** *atm-nsap-address* **broadcast**
Step 8	Enable multipoint signaling to the ATM switch.	**atm multipoint-signalling**
Step 9	Limit the frequency of sending AddParty messages (optional).	**atm multipoint-interval** *interval*

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 "SVCs with Multipoint Signaling Example" later in 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 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 10 seconds, perform the following task in interface configuration mode:

Task	Command
Set the poll timer.	**sscop poll-timer** *seconds*

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 30 seconds, perform the following task in interface configuration mode:

Task	Command
Set the keepalive timer.	**sscop keepalive-timer** *seconds*

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 10 seconds, perform the following task in interface configuration mode:

Task	Command
Set the connection control timer.	**sscop cc-timer** *seconds*

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

Task	Command
Set the number of times that SSCOP will retry to transmit BGN, END, or RS PDUs when they have not been acknowledged.	**sscop max-cc** *retries*

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, perform the following task in interface configuration mode:

Task	Command
Set the transmitter's window.	**sscop send-window** *packets*

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, perform the following task in interface configuration mode:

Task	Command
Set the receiver's window.	**sscop rcv-window** *packets*

Close an SVC

You can disconnect an idle SVC by completing the following task in EXEC mode:

Task	Command
Close the signaling PVC for an SVC.	
• Cisco 7200 series router	**atmsig close atm** *slot*/**0** *vcd*
• Cisco 7500 series router	**atmsig close atm** *slot*/*port-adapter*/**0** *vcd*

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 one of the following tasks:

- 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 performing the following tasks beginning in global configuration mode:

Task		Command
Step 1	Specify an ATM port adapter interface.	
	• Cisco 7200 series router	**interface atm** *slot*/**0**
	• Cisco 7500 series router	**interface atm** *slot*/*port-adapter*/**0**
Step 2	Specify the ATM address of the interface.	**atm nsap-address** *nsap-address*
Step 3	Specify the IP address of the interface.	**ip address** *address mask*
Step 4	Specify the ATM address of the ATM ARP server.	**atm arp-server nsap** *nsap-address*
Step 5	Enable the ATM interface.	**no shutdown**

You can designate the current router interface as the ATM ARP server in Step 4 by typing **self** instead the NSAP address. For an example of configuring the ATM ARP client, see the "ATM ARP Client Configuration in an SVC Environment Example" section later in this chapter.

Configure the Router as an ATM ARP Server

Cisco's implementation of the ATM ARP server supports a single, nonredundant server per logical IP subnetwork (LIS) and supports one ATM ARP server per subinterface. Thus, a single ATM port adapter interface can support multiple ARP servers by using multiple subinterfaces.

To configure the ATM ARP server, complete the following tasks beginning in global configuration mode:

Task		Command
Step 1	Specify an ATM port adapter interface.	
	• Cisco 7200 series router	**interface atm** *slot*/**0**
	• Cisco 7500 series router	**interface atm** *slot*/*port-adapter*/**0**
Step 2	Specify the ATM address of the interface.	**atm arp-server nsap** *nsap-address*
Step 3	Specify the IP address of the interface.	**ip address** *address mask*
Step 4	Identify the ATM ARP server for the IP subnetwork network and set the idle timer.	**atm arp-server time-out** *minutes*[1]
Step 5	Enable the ATM interface.	**no shutdown**

1. When you use this form of the **atm arp-server** command, it indicates that this interface will perform the ATM ARP server functions. When you configure the ATM ARP client (as described earlier), the **atm arp-server** command is used—with a different keyword and argument—to identify a different ATM ARP server to the client.

You can designate the current router interface as the ATM ARP server in Step 2 by typing **self** instead of the NSAP address.

The idle timer interval is the number of minutes a destination entry listed in the ATM ARP server's ARP table can be idle before the server takes any action to time out the entry.

For an example of configuring the ATM ARP server, see the "ATM ARP Server Configuration in an SVC Environment Example" section later in 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, configure the ATM Inverse ARP mechanism by performing the following tasks, beginning in global configuration mode:

Task		Command
Step 1	Specify an ATM port adapter interface and enter interface configuration mode.	
	• Cisco 7200 series router	**interface atm** *slot*/**0**
	• Cisco 7500 series router	**interface atm** *slot*/*port-adapter*/**0**
Step 2	Create a PVC and enable Inverse ARP on it.	**atm pvc** *vcd vci* **aal5snap** [**inarp** *minutes*][1]
Step 3	Enable the ATM interface.	**no shutdown**

1. Additional options are permitted in this command, but the order of options is important.

Repeat Step 2 for each PVC you want to create.

The **inarp** *minutes* interval specifies how often Inverse ARP datagrams will be sent on this virtual circuit. The default value is 15 minutes.

Note The ATM ARP and Inverse ATM ARP mechanisms work with IP only. All other protocols require **map-list** command entries to operate.

For an example of configuring the ATM Inverse ARP mechanism, see the "ATM Inverse ARP Configuration in a PVC Environment Example" section later in this chapter.

Customize the ATM Port Adapter Interface

You can customize the ATM port adapter 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 port adapter interface:

- Configure MTU Size
- Set the SONET PLIM
- Set Loopback Mode
- Limit the Number of Virtual Circuits
- Configure Buffer Sizes
- Set the VCI-to-VPI Ratio
- Set the Source of the Transmit Clock

Configure MTU Size

Each interface has a default maximum packet size or maximum transmission unit (MTU) size. On the ATM port adapter interface, this number defaults to 4470 bytes; the maximum is 17966 bytes. The MTU can be set on a per-subinterface basis as long as the interface MTU is as large or larger than the largest subinterface MTU. To set the maximum MTU size, perform the following task in interface configuration mode:

Task	Command
Set the maximum MTU size.	**mtu** *bytes*

Set the SONET PLIM

The default SONET PLIM is STS-3C. To set the SONET PLIM to STM-1, perform the following task in interface configuration mode:

Task	Command
Set the SONET PLIM to STM-1.	**atm sonet stm-1**

Set Loopback Mode

To loop all packets back to the ATM port adapter interface instead of the network, perform the following task in interface configuration mode:

Task	Command
Set loopback mode.	**loopback [diagnostic | line]**

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 the ATM port adapter 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), perform the following task in interface configuration mode:

Task	Command
Limit the number of virtual circuits.	**atm maxvc** *number*

Configure Buffer Sizes

The number of receive buffers determines the maximum number of reassemblies that the ATM port adapter 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, perform the following task in interface configuration mode:

Task	Command
Set the number of receive buffers.	**atm rxbuff** *number*

The number of transmit buffers determines the maximum number of fragmentations that the ATM port adapter 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, perform the following task in interface configuration mode:

Task	Command
Set the number of transmit buffers.	**atm txbuff** *number*

Set the VCI-to-VPI Ratio

By default, the ATM port adapter interface supports 1024 VCIs per VPI. This value can be any power of 2 in the range of 16 to 2048. This value controls the memory allocation on the ATM port adapter interface to deal 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, perform the following task in interface configuration mode:

Task	Command
Set the number of VCIs per VPI.	**atm vc-per-vp** *number*

Set the Source of the Transmit Clock

By default, the ATM port adapter interface expects the ATM switch to provide transmit clocking. To specify that the ATM port adapter interface generate the transmit clock internally for SONET and E3 PLIM operation, perform the following task in interface configuration mode:

Task	Command
Specify that the ATM port adapter interface generate the transmit clock internally.	**atm clock internal**

Configure Transparent Bridging for the ATM Port Adapter

Our implementation of transparent bridging over ATM on the ATM port adapter 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 following task table, AAL5-SNAP encapsulated bridge packets on a PVC are fast-switched.

Our bridging implementation supports IEEE 802.3 frame formats and IEEE 802.10 frame formats. 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 port adapter on Cisco 7500 series routers works only on AAL5-LLC/SNAP PVCs (fast-switched). AAL3/4-SMDS, AAL5-MUX, and AAL5-NLPID bridging are not yet supported on the Cisco 7500 series routers. Transparent bridging for ATM also does not operate in a switched virtual circuit (SVC) environment.

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

Task		Command
Step 1	Specify an ATM port adapter interface and, optionally, a subinterface.	
	• Cisco 7200 series router	**interface atm** *slot*/**0**
	• Cisco 7500 series router	**interface atm** *slot*/*port-adapter*/**0**
Step 2	Assign a source IP address and subnet mask to the interface, if needed.	**ip address** *ip-address mask*
Step 3	Create one or more PVCs using AAL5-SNAP encapsulation.	**atm pvc** *vcd vpi vci* **aal5snap** **atm pvc** *vcd vpi vci* **aal5snap** **atm pvc** *vcd vpi vci* **aal5snap**
Step 4	Assign the interface to a bridge group.	**bridge-group** *group*
Step 5	Return to global configuration mode.	**exit**
Step 6	Define the type of spanning tree protocol as DEC.	**bridge** *group* **protocol dec**

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 "Transparent Bridging on an AAL5-SNAP PVC Example" section.

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, perform the following tasks in EXEC mode:

Task	Command
Display ATM-specific information about the ATM port adapter interface.	
• Cisco 7200 series router	**show atm interface atm** *slot*/**0**
• Cisco 7500 series router	**show atm interface atm** *slot*/*port-adapter*/**0**
Display the configured list of ATM static maps to remote hosts on an ATM network.	**show atm map**
Display global traffic information to and from all ATM networks connected to the router. Display a list of counters of all ATM traffic on this router.	**show atm traffic**
Display ATM virtual circuit information about all PVCs and SVCs (or a specific virtual circuit).	**show atm vc** [*vcd*]
Display statistics for the ATM port adapter interface.	
• Cisco 7200 series router	**show interfaces atm** *slot*/**0**
• Cisco 7500 series router	**show interfaces atm** *slot*/*port-adapter*/**0**
Display SSCOP details for the ATM interface.	**show sscop**

ATM Configuration Examples

The examples in the following sections illustrate how to configure an ATM port adapter interface on the Cisco 7200 and 7500 series routers:

- PVC with AAL5 and LLC/SNAP Encapsulation Examples
- PVCs in a Fully Meshed Network Example
- SVCs in a Fully Meshed Network Example
- ATM NSAP Address Example
- ATM ESI Address Example
- SVCs with Multipoint Signaling Example
- Classical IP and ARP Examples
- Transparent Bridging on an AAL5-SNAP PVC Example
- ATM Port Adapters Connected Back-to-Back Example

PVC with AAL5 and LLC/SNAP Encapsulation Examples

The following example creates PVC 5 on ATM interface 3/0. It uses 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. The static map list named *atm* declares that the next node is a broadcast point for multicast packets from IP. For further information, refer to the related task section "Create a PVC" presented earlier in this chapter.

```
interface atm 3/0
 ip address 1.1.1.1 255.255.255.0
 atm pvc 5 0 10 aal5snap
 map-group atm
!
map-list atm
 ip 1.1.1.5 atm-vc 5 broadcast
```

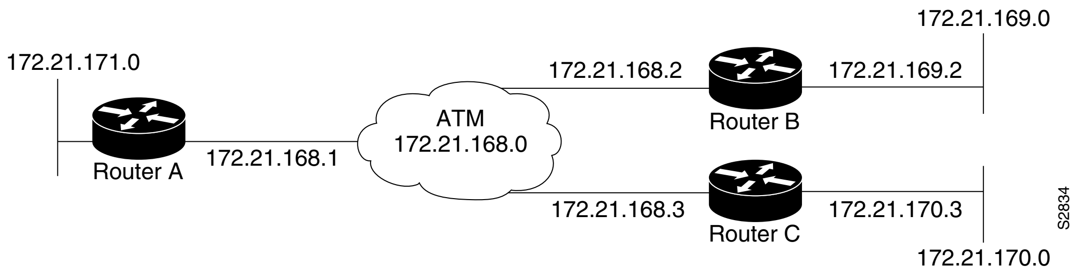
The following example is of a typical ATM configuration for a PVC:

```
interface atm 4/0
 ip address 172.21.168.112 255.255.255.0
 map-group atm
 atm pvc 1 1 1 aal5snap
 atm pvc 2 2 2 aal5snap
 atm pvc 6 6 6 aal5snap
 atm pvc 7 7 7 aal5snap
 decnet cost 1
 clns router iso-igrp comet
!
router iso-igrp comet
 net 47.0004.0001.0000.0c00.6666.00
!
router igrp 109
 network 172.21.0.0
!
ip domain-name CISCO.COM
!
map-list atm
 ip 172.21.168.110 atm-vc 1 broadcast
 clns 47.0004.0001.0000.0c00.6e26.00 atm-vc 6 broadcast
 decnet 10.1 atm-vc 2 broadcast
```

PVCs in a Fully Meshed Network Example

Figure 9 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 **map-list** statements configured in Router A identify the ATM addresses of Routers B and C. The two **map-list** statements in Router B identify the ATM addresses of Routers A and C. The two **map list** statements in Router C identify the ATM addresses of Routers A and B. For further information, refer to the related task section "Create a PVC" presented earlier in this chapter.

Figure 9 Fully Meshed ATM Configuration Example



Router A

```
ip routing
!
interface atm 4/0
 ip address 131.108.168.1 255.255.255.0
 atm rate-queue 1 100
 atm pvc 1 0 10 aal5snap
 atm pvc 2 0 20 aal5snap
 map-group test-a
!
map-list test-a
 ip 131.108.168.2 atm-vc 1 broadcast
 ip 131.108.168.3 atm-vc 2 broadcast
```

Router B

```
ip routing
!
interface atm 2/0
 ip address 131.108.168.2 255.255.255.0
 atm rate-queue 1 100
 atm pvc 1 0 20 aal5snap
 atm pvc 2 0 21 aal5snap
 map-group test-b
!
map-list test-b
 ip 131.108.168.1 atm-vc 1 broadcast
 ip 131.108.168.3 atm-vc 2 broadcast
```

Router C

```
ip routing
!
interface atm 4/0
 ip address 131.108.168.3 255.255.255.0
 atm rate-queue 1 100
 atm pvc 2 0 21 aal5snap
 atm pvc 4 0 22 aal5snap
 map-group test-c
!
map-list test-c
 ip 131.108.168.1 atm-vc 2 broadcast
 ip 131.108.168.2 atm-vc 4 broadcast
```

SVCs in a Fully Meshed Network Example

The following example is also a configuration for the fully meshed network shown in Figure 9, but this example uses SVCs. PVC 1 is the signaling PVC. For further information, refer to the related task section "Configure the PVC That Performs SVC Call Setup" presented earlier in this chapter.

Router A

```
interface atm 4/0
 ip address 131.108.168.1 255.255.255.0
 map-group atm
 atm nsap-address AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
 atm rate-queue 1 100
 atm maxvc 1024
 atm pvc 1 0 5 qsaal
!
map-list atm
 ip 131.108.168.2 atm-nsap BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.13
 ip 131.108.168.3 atm-nsap BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1224.12
```

Router B

```
interface atm 2/0
 ip address 131.108.168.2 255.255.255.0
 map-group atm
 atm nsap-address BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.13
 atm rate-queue 1 100
 atm maxvc 1024
 atm pvc 1 0 5 qsaal
!
map-list atm
 ip 131.108.168.1 atm-nsap AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
 ip 131.108.168.3 atm-nsap BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1224.12
```

Router C

```
interface atm 4/0
 ip address 131.108.168.3 255.255.255.0
 map-group atm
 atm nsap-address BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1224.12
 atm rate-queue 1 100
 atm maxvc 1024
 atm pvc 1 0 5 qsaal
!
map-list atm
 ip 131.108.168.1 atm-nsap AB.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12
 ip 131.108.168.2 atm-nsap BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1334.13
```

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 related task section "Configure the Complete NSAP Address Manually" presented 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.

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 related task section "Configure the ESI and Selector Fields" presented earlier in this chapter.

```
interface atm 4/0
 atm pvc 2 0 16 ilmi
 atm esi-address 345678901234.12
```

SVCs with Multipoint Signaling Example

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

```
interface atm 2/0
 ip address 4.4.4.6
 map-group atm_pri
 atm nsap-address de.cdef.01.234567.890a.bcde.f012.3456.7890.1234.12
 atm multipoint-signalling
 atm rate-queue 1 100
 atm maxvc 1024
 atm pvc 1 0 5 qsaal
!
map-list atm_pri
 ip 4.4.4.4 atm-nsap cd.cdef.01.234566.890a.bcde.f012.3456.7890.1234.12 broadcast
 ip 4.4.4.7 atm-nsap 31.3233.34.353637.3839.3031.3233.3435.3637.3839.30 broadcast
```

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 related task section "Configure the Router as an ATM ARP Client" presented 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
 atm pvc 1 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 related task section "Configure the Router as an ATM ARP Server" presented 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
```

```
 atm pvc 1 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 related task section “Configure Classical IP and Inverse ARP in a PVC Environment” presented earlier in this chapter.

```
interface atm 4/0
 ip address 172.21.1.111 255.255.255.0
 atm pvc 1 1 1 aal5snap inarp 5
 atm pvc 2 2 2 aal5snap inarp 5
 atm pvc 3 3 3 aal5snap inarp 5
 atm pvc 4 4 4 aal5snap inarp
```

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

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 related task section “Configure Transparent Bridging for the ATM Port Adapter” presented earlier in this chapter.

```
interface atm4/0
 ip address 1.1.1.1 255.0.0.0
 atm pvc 1 1 1 aal5snap
 atm pvc 2 2 2 aal5snap
 atm pvc 3 3 3 aal5snap
 bridge-group 1
!
bridge 1 protocol dec
```

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
 ip address 192.168.1.10 255.0.0.0
 no keepalive
 map-group atm-in
 atm clock internal
 atm pvc 1 1 5 aal5snap
!
map-list atm-in
 ip 192.168.1.20 atm-vc 1 broadcast
```

Router B

```
interface atm 3/0
 ip address 192.168.1.20 255.0.0.0
 no keepalive
 map-group atm-in
 atm clock internal
 atm pvc 1 1 5 aal5snap
!
map-list atm-in
 ip 192.168.1.10 atm-vc 1 broadcast
```