Doc. No. 78-3486-01

Catalyst 5000 Series ATM LAN Emulation Module Installation and Configuration Note

Product Number: WS-X5153, WS-X5154, WS-X5155 for Single PHY; WS-X5156, WS-X5157, WS-X5158 for Dual PHY

This document contains instructions for installing and configuring the Catalyst 5000 series Asynchronous Transfer Mode (ATM) LAN Emulation module (Single and Dual PHY) for ATM software release 3.1. This document also provides onfiguration examples.

The ATM LAN Emulation module, Dual PHY, compensates for a failure of the primary physical module by providing a mechanism that automatically switches over to a secondary PHY interface.

For a complete description of commands used to configure and maintain the Catalyst 5000 series switch, refer to the *Catalyst 5000 series Configuration Guide and Command Reference* publication. For complete hardware configuration and maintenance procedures, refer to the *Catalyst 5000 series Installation Guide* publication. These documents are available on a CD-ROM called Cisco Connection Documentation, Enterprise Series, or in print.

Sections in this document include the following:

- Catalyst 5000 series Switch Overview
- ATM LAN Emulation Module Overview
- Specifications
- LEDs
- Preparing Network Connections
- Following Safety Recommendations
- Installing and Configuring Modules
- Accessing the ATM LAN Emulation Module
- Configuring the ATM LAN Emulation Module

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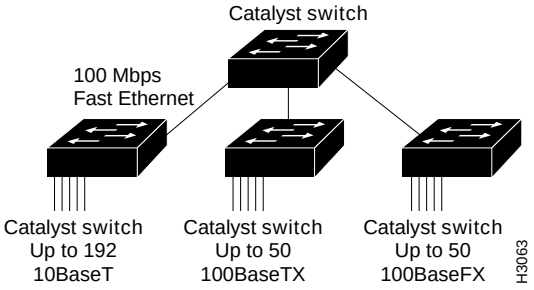
- Implementing LAN Emulation
- LANE Configuration Examples
- How LANE Works
- Using UNI 3.1 Signaling Support
- Using VLAN Trunk Protocol
- Configuring PVC-supported VLANs
- Cisco Connection Online

Warning Only trained and qualified personnel should be allowed to install or replace this equipment.

Catalyst 5000 Series Switch Overview

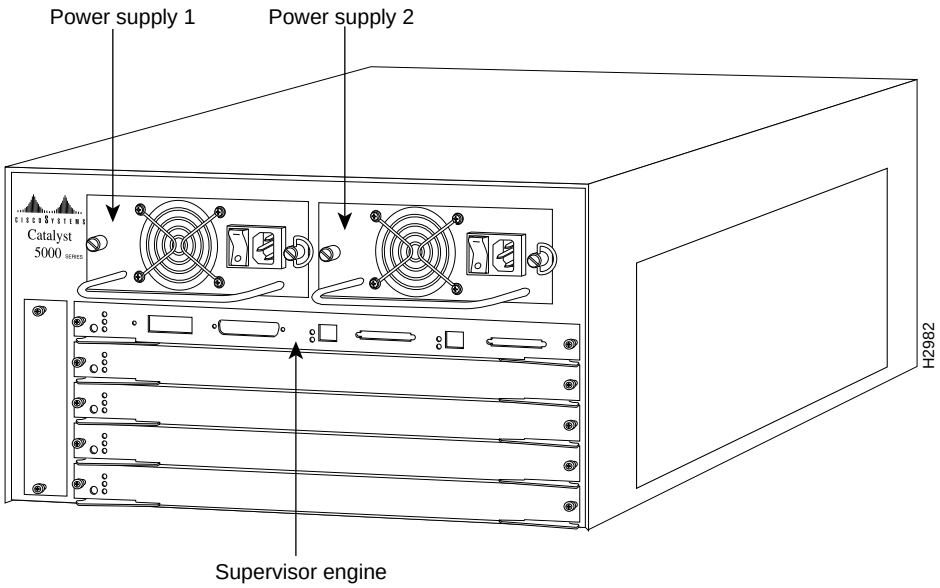
The Catalyst 5000 series switch provides high-density switched Ethernet and Fast Ethernet for both wiring closet and data center applications. The switch includes a single, integrated 1.2-Gbps switching backplane that supports switched 10-Mbps Ethernet with repeater connections, and 100-Mbps Fast Ethernet with backbone connections, Fiber Distributed Data Interface (FDDI), and Asynchronous Transfer Mode (ATM), Copper Distributed Data Interface (CDDI), and Asynchronous Transfer Mode (ATM). The Catalyst 5000 provides switched connections to individual workstations, servers, LAN segments, backbones, or other Catalyst 5000 switches using shielded twisted-pair (STP), unshielded twisted-pair (UTP), and fiber-optic cable. Figure 1 is an example of a configuration using the Catalyst 5000 series switch.

Figure 1 Cascaded Switches Using Fast Ethernet Interfaces



The Catalyst 5000 series switch chassis has five slots. Slot 1 is reserved for the Supervisor engine, which provides Layer 2 switching, local and remote management, and dual Fast Ethernet interfaces. The remaining four slots are used for any combination of modules for additional Ethernet, Fast Ethernet, CDDI/FDDI, and ATM connections. Figure 2 shows the rear view of the Catalyst 5000 series switch, which provides access to the Supervisor engine, all switching modules, power supplies, and fan assembly.

Figure 2 Catalyst 5000 Series Switch Chassis Rear View



ATM LAN Emulation Module Overview

The following section contains an overview of the Catalyst 5000 series ATM LAN Emulation module for ATM software release 3.1.

ATM LAN Emulation Module Hardware

The ATM LAN Emulation Module offers the following hardware options:

- Dual single mode
- Dual multi-mode
- Dual unshielded twisted-pair (UTP)

Note The ATM LAN Emulation module, Dual PHY, provides redundancy only of the physical connection. Only one ATM interface can be active at any time.

ATM LAN Emulation Software for Release 3.1

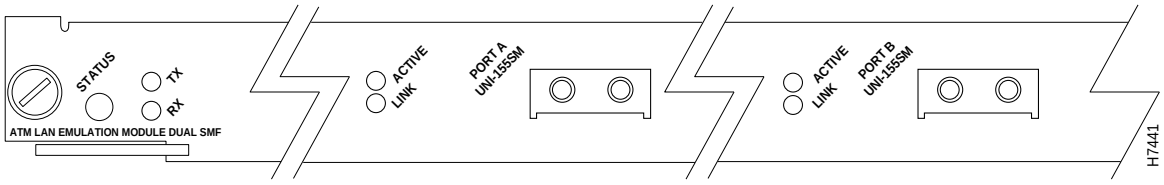
Software release 3.1 for the Catalyst 5000 series LAN Emulation module contains the following features:

- Reassembly of up to 256 packets simultaneously
- Suport for up to 4096 virtual circuits
- Support for ATM adaptation layer AAL5
- ATM LANE 1.0, including LEC. LES. BUS, and LECS
- UNI 3.1 signaling
- LES/BUS/LECS redundancy
- PVC support using RFC 1483 LLC/SNAP encapsulation
- VLAN Trunk Protocol (VTP)
- Output throttling

Note This software requires Supervisor software version 2.1 (3) or later.

ATM LAN Emulation module, Dual PHY (Single Mode)

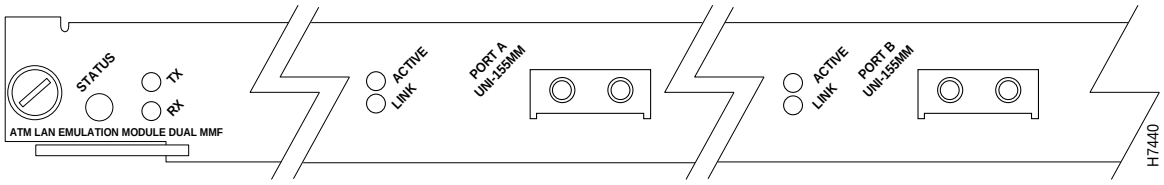
Figure 3 ATM LAN Emulation Module, Dual PHY (Single Mode Fiber)



The ATM LAN Emulation module, Dual PHY (Single Mode Fiber) provides a direct connection between the ATM network and the switch using a single mode fiber-optic connector. The LEDs provide status information for the module and individual port connections. The physical layer interface module (PLIM) on the ATM LAN Emulation module determines the type of ATM connection. There are no restrictions on slot locations or sequence. An ATM LAN Emulation module can be installed in any available module slot.

ATM LAN Emulation Module, Dual PHY (Multimode)

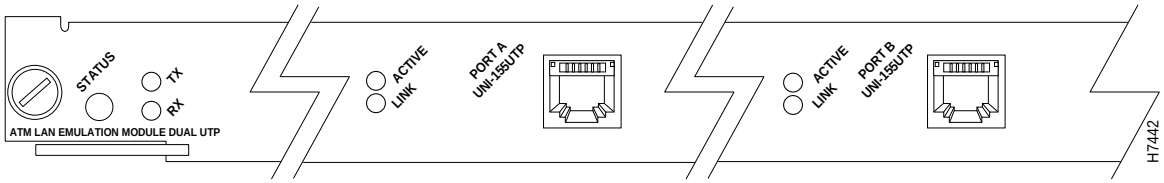
Figure 4 ATM LAN Emulation Module, Dual PHY (Multimode Fiber)



The ATM LAN Emulation module, Dual PHY (Multimode Fiber) provides a direct connection between the ATM network and the switch using a multimode fiber-optic connector. The LEDs provide status information for the module and individual port connections. The physical layer interface module (PLIM) on the ATM LAN Emulation module, Dual PHY, determines the type of ATM connection. There are no restrictions on slot locations or sequence. An ATM LAN Emulation module, Dual PHY, can be installed in any available module slot.

ATM LAN Emulation Module, Dual PHY (UTP)

Figure 5 ATM LAN Emulation Module, Dual PHY (UTP)



The ATM LAN Emulation module, Dual PHY (UTP) provides a direct connection between the ATM network and the switch using one RJ-45 connector. The LEDs provide status information for the module and individual ATM port connection. The PLIM on the ATM LAN Emulation module, Dual PHY determines the type of ATM connection. There are no restrictions on slot locations or sequence. An ATM LAN Emulation module can be installed in any available module slot.

Specifications

Following are the ATM LAN Emulation Module, Dual PHY specifications:

Table 1 ATM LAN Emulation Module, Dual PHY Specifications

Description	Specification
Dimensions (H x W x D)	1.2 x 14.4 x 16 in (3 x 35.6 x 40.6 cm)
Weight	Minimum: 3 lb (1.36 kg) Maximum: 5 lb (2.27 kg)
Environmental Conditions: Operating temperature Nonoperating temperature Humidity	 32 to 104 F (0 to 40 C) -40 to 167 F (-40 to 75 C) 10 to 90%, noncondensing
Connectors	Multimode fiber-optic: SC Single-mode fiber-optic: SC Category 5 UTP[1]: RJ-45
RAM buffer memory	1.192 MB per interface
Maximum station-to-station cabling distance	Multimode fiber: 1.2 miles (2 km) Single-mode fiber: 6.25 miles (10 km) Category 5 UTP: 328' (100 m)
Frame-to-cell conversion	AAL5, 4096 virtual circuits, 256 concurrent reassembly
Network management	SNMP[2] agent
Agency approvals: Safety EMI[3]	 UL[4] 1950, CSA[5]-C22.2 No. 950-93, and EN60950 FCC Part 15 Class A, EN55022 Class B, and VCCI Class 2 with single-mode and multimode fiber, and unshielded twisted pair

1. UTP = unshielded twisted pair
2. SNMP = Simple Network Management Protocol
3. EMI = electromagnetic interference
4. UL = Underwriters Laboratory
5. CSA = Canadian Standards Association

The five available interface slots on the Catalyst 5000 series switch support the Supervisor engine, and any combination of network interface modules (slots 2 through 5), providing a maximum port density of up to three ATM LAN Emulation modules. Slot 1 is reserved for the Supervisor engine.

ATM LAN Emulation Module LEDs

Each module contains a status LED. When on, this LED indicates that the module is powered up and operational. It does not necessarily mean that the interface ports are functional or enabled.

The LEDs on the faceplate of the ATM LAN Emulation Module, Dual PHY, are described in Table 2.

Table 2 ATM LAN Emulation Module, Dual PHY LEDs

LED	Description
Status	The switch performs a series of self-tests and diagnostic tests. If all the tests pass, the status LED is green. If a test other than an individual port test fails, the status LED is red. During system boot or if the module is disabled, the LED is orange. During self-test diagnostics, the LED is orange. If the module is disabled, the LED is orange.
TX (Transmit)	Whenever a port is transmitting a packet, the transmit (TX) LED is green for approximately 50 ms otherwise, it is off.
RX (Receive)	Whenever a port is receiving a packet, the receive (RX) LED is green for approximately 50 ms[1]; otherwise, it is off.
Link	The link LEDs display the link integrity status of an ATM port. If the integrity is good, the link LED is green.
Active	The Active LEDs are present on the ATM LAN Emulation module, Dual PHY. When green, it indicates that the specified port is active. If the LED is off, the specified port is the standby port.

1. ms = milliseconds.

Preparing Network Connections

When preparing your site for network connections to the switch, you need to consider some factors related to each type of interface:

- Type of cabling required for each type (fiber, or twisted-pair cabling)
- Distance limitations for each signal type
- Specific cables you need to connect each interface
- Any additional interface equipment you need, such as transceivers and converters

Before installing the switch, have all additional external equipment and cables on hand. If you intend to build your own cables, refer to the cable pinouts in the appendix "Cabling Specifications" in the *Catalyst 5000 Series Installation Guide*. For ordering information, contact a customer service representative.

Approximating the ATM LAN Emulation Module Power Margin

The LED used for a multimode transmission light source creates multiple propagation paths of light, each with a different path length and time requirement to cross the optical fiber, causing signal dispersion (smear). Higher-order mode loss (HOL) results from light from the LED entering the fiber and being radiated into the fiber cladding. A worst-case estimate of the power margin (PM) for multimode transmissions assumes minimum transmitter power (PT), maximum link loss (LL), and minimum receiver sensitivity (PR). The worst-case analysis provides a margin of error, although not all the parts of an actual system will operate at the worst-case levels.

See Table 3 for maximum cable distances used with the ATM LAN Emulation module.

Table 3 ATM Maximum Transmission Distances

Transceiver Type	Maximum Distance between Stations
Multimode	1.2 miles (2 km)
Single-mode	6.25 miles (10 km)
Category 5 UTP	328 feet (100 meters)

The power budget (PB) is the maximum possible amount of power transmitted. The following equation lists the calculation of the power budget:

PB = PT – PR

PB = –18.5 dBm – 30 dBm

PB = 11.5 dB

The power margin calculation is derived from the power budget and subtracts the link loss, as follows:

PM = PB – LL

If the power margin is positive, as a rule, the link will work.

Table 4 lists the factors that contribute to link loss and the estimate of the link loss value attributable to those factors.

Table 4 Estimating Link Loss

Link Loss Factor	Estimate of Link Loss Value
Higher-order mode losses	0.5 dB
Clock recovery module	1 dB
Modal and chromatic dispersion	Dependent on fiber and wavelength used
Connector	0.5 dB
Splice	0.5 dB

Link Loss Factor	Estimate of Link Loss Value
Fiber attenuation	1 dB/km

The power budget minus the data link loss should be greater than zero. Results less than zero may have insufficient power to operate the receiver.

Multimode Power Budget Examples

Example 1: Sufficient Power for Transmission

The following example shows the calculation of multimode power budget based on the following variables:

Length of multimode link = 3 kilometers (km)

4 connectors

3 splices

Higher order loss (HOL)

Clock recovery module (CRM)

Estimate the power budget as follows:

PB = 11.5 dB – 3 km (1.0 dB/km) – 4 (0.5 dB) – 3 (0.5 dB) – 0.5 dB (HOL) – 1 dB (CRM)

PB = 11.5 dB – 3 dB – 2 dB – 1.5 dB – 0.5 dB – 1 dB

PB = 2.5 dB

The value of 2.5 dB indicates that this link would have sufficient power for transmission.

Example 2: Dispersion Limit

The following example has the same parameters as the previous example but includes a multimode link distance of 4 km:

PB = 11.5 dB – 4 km (1.0 dB/km) – 4 (0.5 dB) – 3 (0.5 dB) – 0.5 dB (HOL) – 1 dB (CRM)

PB = 11.5 dB – 4 dB – 2 dB – 1.5 dB – 0.5 dB – 1 dB

PB = 1.5 dB

The value of 1.5 dB indicates that this link would have sufficient power for transmission. However, because of the dispersion limit on the link (4 km x 155.52 MHz > 500 MHz/km), this link would not work with multimode fiber. In this case, single-mode fiber would be the better choice.

Using Statistics to Estimate the Power Budget

Statistical models determine the power budget more accurately than the worst-case method. Determining the link loss with statistical methods requires accurate knowledge of variations in the data link components. Statistical power budget analysis is beyond the scope of this document. For further information, refer to User-Network Interface (UNI) Forum specifications, ITU-T standards, and your equipment specifications.

Note The ITU-T carries out the function of the former Consultative Committee for International Telegraph and Telephone (CCITT).

The following publications contain information on determining attenuation and power budget:

- T1E1.2/92-020R2 ANSI, the Draft American National Standard for Telecommunications entitled “Broadband ISDN Customer Installation Interfaces: PHYsical Layer Specification.”
- *Power Margin Analysis, AT&T Technical Note, TN89-004LWP, May 1989.*

ATM LAN Emulation Module Connection Equipment

All ATM interfaces are full-duplex. You must use the appropriate ATM interface cable to connect the ATM single-mode, multimode, or UTP module with an external ATM network.

The ATM LAN Emulation module, Dual PHY, provides an interface to ATM switching fabrics for transmitting and receiving data at rates of up to 155 Mbps bidirectionally. The ATM LAN Emulation Module- Dual PHY can support PLIMs that connect to the following physical layers:

- Synchronous Optical Network (SONET) 155-Mbps multimode fiber optic—STS-3C
- SONET 155-Mbps single-mode, fiber-optic—STS-3C/STM-1
- UTP Category 5 RJ-45—STS-3C/STM-1

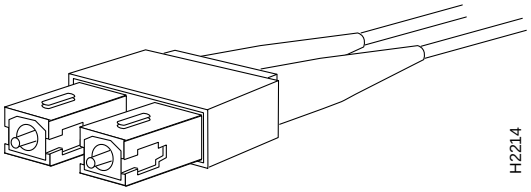
The ATM LAN Emulation Module- Dual PHY supports RFC 1213 interface MIBs as specified in the ATM MIB V.2 specification.

The ATM interface cable is used to connect the switch to an ATM network. Cables can be obtained from the following cable vendors:

- AT&T
- Siemens
- Red-Hawk
- Anixter
- AMP

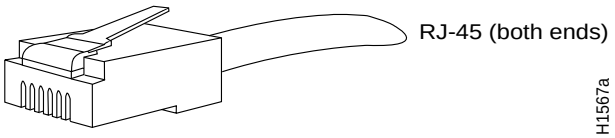
For traffic over single-mode or multimode fiber, use the SC type connector shown in Figure 6 to connect the ATM LAN Emulation Module- Dual PHY with the external switch.

Figure 6 Fiber-Optic Network Interface Connector (SC Type)



For UTP, use the RJ-45 male connectors shown in Figure 7 to connect to the ATM LAN emulation network.

Figure 7 ATM Dual-PHY UTP RJ-45 Interface Cable Connectors



The following table lists the signals for the ATM LAN Emulation Module- Dual PHY RJ-45 UTP connector.

Table 5 ATM LAN Emulation Module- Dual PHY (UTP) RJ-45 Port Pinouts

Pin	Signal	Description
1	TxD+	Transmit data +
2	TxD–	Transmit data –
3	NC	No connection
4	NC	No connection
5	NC	No connection
6	NC	No connection
7	RxD+	Receive data +
8	RxD–	Receive data –

Following Safety Recommendations

The following guidelines will help to ensure your safety and protect the equipment. This list is not inclusive of all potentially hazardous situations that you may be exposed to as you install the switch, so *be alert*.

- Never try to lift the chassis by yourself; *two people are required* to lift the switch.
- Always turn off all power supplies and unplug all power cords before removing the chassis front panel.
- Always unplug all power cords before installing or removing a chassis.
- Keep the chassis area clear and dust free during and after installation.
- Keep tools and chassis components away from walk areas.
- Do not wear loose clothing, jewelry (including rings and chains), or other items that could get caught in the chassis. Fasten your tie, scarf, or sleeves.

Warning Metal objects heat up when connected to power and ground, and can cause serious burns.

Safety with Electricity

The Supervisor engine, switching modules, and redundant power supplies are designed to be removed and replaced while the system is operating without presenting an electrical hazard or damage to the system. However, removing a supervisor engine module while the system is operating

will cause the system to halt. Before removing a redundant power supply, ensure that the primary supply is powered on. However, you must shut down the system before removing or replacing any of the replaceable components inside the front panel; for example, the backplane. Never install equipment that appears damaged.

Follow these basic guidelines when working with any electrical equipment:

- Before beginning any procedures requiring access to the chassis interior, locate the emergency power-off switch for the room in which you are working.
- Disconnect all power and external cables before installing or removing a chassis.
- Do not work alone when potentially hazardous conditions exist.
- Never assume that power has been disconnected from a circuit; always check.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.
- Carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.

In addition, use the following guidelines when working with any equipment that is disconnected from a power source but still connected to telephone wiring or other network cabling

- Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
- Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.

Use caution when installing or modifying telephone lines.

Warning Do not work on the system or connect or disconnect cables during periods of lightning activity.

Preventing Electrostatic Discharge Damage

Electrostatic Discharge (ESD) damage occurs when electronic or components are improperly handled, resulting in complete or intermittent failures. The Supervisor engine and switching modules each consist of a printed circuit board (PCB) fixed in a metal carrier. Electromagnetic interference (EMI) shielding, connectors, and a handle are integral components of the carrier. Although the metal carrier helps to protect modules from ESD, use a preventive antistatic strap whenever you handle the Supervisor engine or switching modules. Handle the carriers by the handles and the carrier edges only, never touch the modules or connector pins.

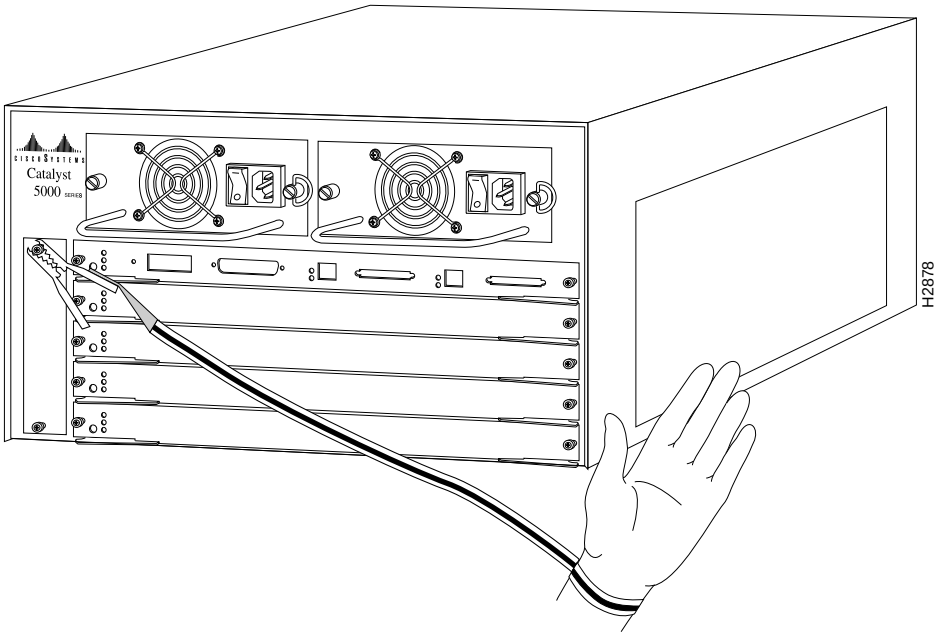
Caution Always tighten the captive installation screws on the Supervisor engine module and modules when you are installing them. These screws prevent accidental removal, provide proper grounding for the system, and help to ensure that the bus connectors are properly seated in the backplane.

Following are guidelines for preventing ESD damage:

- Always use an ESD wrist strap or ankle strap, and ensure that it makes good skin contact.

- When removing the Supervisor engine or switching modules, connect the equipment end of the strap to one of the captive installation screws on an installed switching module, power supply, or fan assembly. (See Figure 8.) When replacing internal components, such as the Supervisor engine, that are accessible from the rear of the chassis, connect the strap to an unpainted inner surface of the chassis, such as the inner frame that is exposed when a module is removed.
- When installing a Supervisor engine or switching module, use the ejector levers to properly seat the bus connectors in the backplane, then tighten both captive installation screws. These screws prevent accidental removal, provide proper grounding for the system, and help to ensure that the bus connectors are seated in the backplane.

Figure 8 Placement of ESD Wrist Strap



- When removing a Supervisor engine or switching module, use the ejectors levers to release the bus connectors from the backplane. Grasp the captive screws and pull the carrier out slowly, using your hand along the bottom of the carrier to guide it straight out of the slot.
- Handle carriers by the handles and carrier edges only; avoid touching the module or any connector pins.
- When removing a switching module, place the printed circuit board (PCB) side up on an antistatic surface or in a static shielding bag. If the component will be returned to the factory, immediately place it in a static shielding bag.
- Handle bare boards by the edges only.

Caution For safety, periodically check the resistance value of the antistatic strap. The measurement should be between 1 and 10 megohms.

Installing and Configuring Modules

All switching modules support hot swapping, letting you install, remove, replace, and rearrange them without turning off the system power. When the system detects that a switching module has been installed or removed, it automatically runs diagnostic and discovery routines, acknowledges the presence or absence of the module, and resumes system operation without any operator intervention.

Performing Hot Swapping

The hot-swap feature allows you to remove and replace modules while the system is operating; you do not need to notify the software or shut down the system power.

Caution The supervisor engine module is a required system component. Removing a supervisor engine module while the system is operating will cause the system to halt.

The hot-swap feature lets you remove and replace switching modules while the system is operating. You do not need to notify the software or shut down the system power. All switching modules support hot swapping.

The switching module contains a bus-type connector that connects to the backplane. Each connector consists of a set of tiered pins in two lengths. The pins send specific signals to the system as they make contact with the backplane. The system assesses the signals it receives and the order in which it receives them to determine what event is occurring and what task it needs to perform, such as reinitializing new interfaces or shutting down removed ones.

For example, when inserting the switching module, the longest pins make contact with the backplane first, and the shortest pins make contact last. The system recognizes the signals and the sequence in which it receives them. The system expects to receive signals from individual pins in this logical sequence.

When you remove or insert a switching module, the backplane pins send signals to notify the system, and performs as follows:

1. Rapidly scans the backplane for configuration changes.
2. Initializes all newly inserted switching modules, noting any removed interfaces and placing them in the administratively shut-down state.
3. Brings all previously configured interfaces on the Supervisor engine and switching modules back to the state they were in before the module was removed. Any newly inserted interfaces are put in the administratively shut-down state, as if they were present, but unconfigured, at boot time. If a switching module has been reinserted into a slot, then its ports are configured and brought on line up to the port count of the original switching module.

Note If the switching module is different from the original, the default configuration is used to bring it on line.

When you insert a new switching module, the system runs a diagnostic test on the new interfaces and compares them to the existing configuration. If this initial diagnostic fails, the system remains off line for another 15 seconds while it performs a second set of diagnostic tests to determine whether or not the switching module is faulty and if normal system operation is possible.

If the second diagnostic test passes, indicating that the system is operating normally and a new switching module is faulty, the system resumes normal operation but leaves the new interfaces disabled.

If the second diagnostic test fails, the system crashes, which usually indicates that the new Supervisor engine or a switching module created a problem in the bus and should be removed.

Caution To avoid erroneous failure messages, allow at least 15 seconds for the system to reinitialize and note the current configuration of all interfaces before you remove or insert another module.

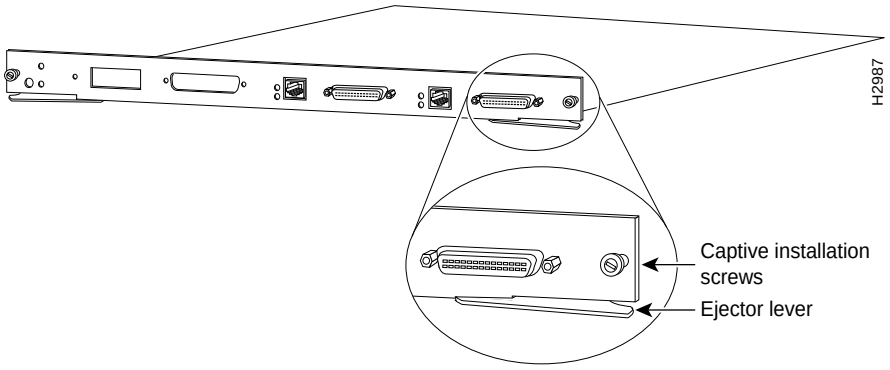
Avoiding Problems When Inserting and Removing Switching Modules

The function of the ejector levers (see Figure 9) on the switching module is to align and seat the board connectors in the backplane. Failure to use the ejector levers and insert the switching module properly can disrupt the order in which the pins make contact with the backplane. Follow the installation and removal instructions carefully, and review the following examples of *incorrect* insertion practices and results:

- Using the faceplate to force a switching module all the way into the slot can pop the ejector levers out of their springs. If you try to use the ejector levers to seat the switching module, the first layer of pins making contact with the backplane can disconnect and make contact with the backplane. The system interprets this as a failure.
- Using the faceplate to force or slam the switching module all the way into the slot can damage the pins on the module connectors if they are not aligned properly with the backplane.
- When using the faceplate, rather than the ejector levers, to seat the switching module in the backplane, you may need to pull the switching module back out and push it in again to align it properly. Even if the connector pins are not damaged, the pins making contact with and disconnecting from the backplane will cause the system to interpret a failure. Using the ejector levers ensures that the module connector makes contact with the backplane in one continuous movement.
- Using the faceplate to insert or remove a switching module, or failing to push the ejector levers to the full 90-degree position, can leave some, but not all, of the connector pins making contact with the backplane—a state that will suspend the system. Using the ejector levers and making sure they are properly seated into position, ensures that all layers of pins are making contact with the backplane.

It is also important to use the ejector levers when removing a switching module, ensuring that its connector pins disconnect from the backplane in the logical sequence expected by the system. A switching module partially connected to the backplane can hang the bus. Detailed steps for correctly performing a hot swap are included in the following procedures for installing and removing a switching module.

Figure 9 Ejector Levers and Captive Installation Screws (Supervisor Engine Module Shown)



Tools Required

You need a flat-blade screwdriver to remove any filler (blank) switching modules and to tighten the captive installation screws that secure the modules in their slots. Whenever you handle switching modules, use a wrist strap or other grounding device to prevent ESD damage.

Removing Modules

Take the following steps to remove a switching module:

Step 1 If you do not plan to immediately reinstall the switching module after removing it, disconnect any network interface cables attached to the switching module ports.

Step 2 Use a screwdriver to loosen the switching module's captive installation screws.

Step 3 Place your thumbs on the left and right ejector levers and simultaneously push the levers outward to release the module from the backplane connector.

Step 4 Grasp the switching module handle with one hand and place your other hand under the carrier to support and guide the it out of the slot. Avoid touching the module.

Step 5 Carefully pull the switching module straight out of the slot, keeping your other hand under the carrier to guide it. Keep the switching module oriented horizontally.

Step 6 Place the switching module on an antistatic mat or antistatic foam or immediately install it in another slot.

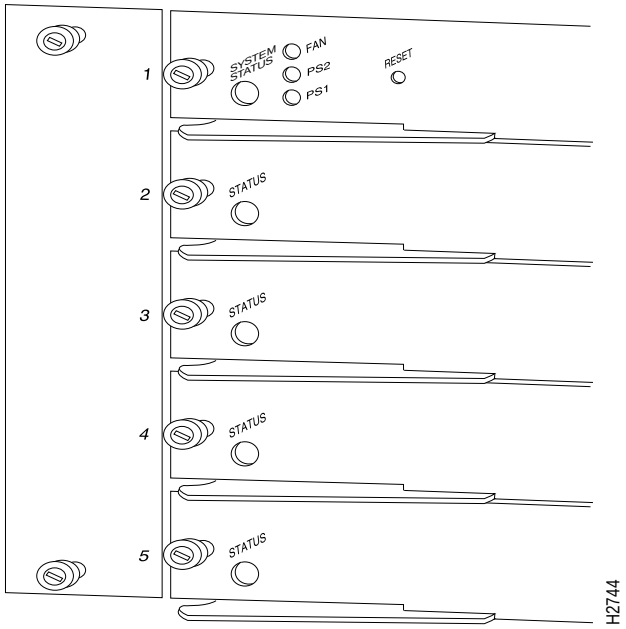
Step 7 If the slot is to remain empty, install a switching module filler plate (part number 800-00292-01) to keep dust out of the chassis and to maintain proper airflow through the switching module compartment.

Caution Always install the module filler plate in empty module slots to maintain the proper flow of cooling air across the cards.

Installing Modules

You can install switching modules in any of the four switching module slots, numbered 2 through 5 from top to bottom, when viewing the chassis from the rear. (See Figure 10.) The top slot contains the Supervisor engine—a required system component. Switching module fillers, blank switching module carriers, are installed in slots without switching modules to maintain consistent airflow through the switching module compartment.

Figure 10 Module Slot Numbers



Follow these steps to installing a module.

Caution Handle modules by the carrier edges only to prevent ESD damage.

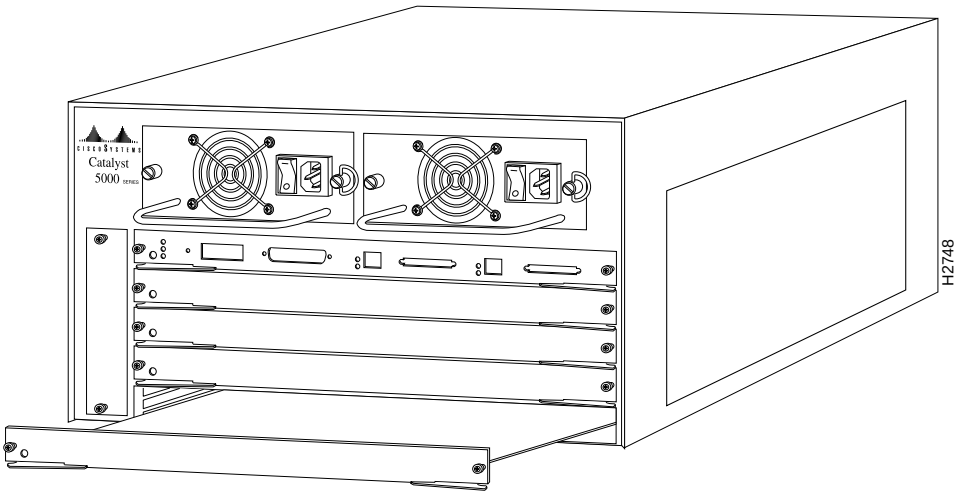
Step 1 Choose a slot for the new switching module and ensure that there is enough clearance to accommodate any interface equipment that you will connect directly to the switching module ports. If possible, place switching modules between empty slots that contain only switching module filler plates.

Step 2 Switching modules are secured with two captive installation screws. Use a flat-blade screwdriver to loosen the captive installation screws and remove the switching module filler or the existing switching module from the slot you want to use.

Step 3 Hold the switching module handle with one hand, and place your other hand under the carrier to support the switching module and guide it into the slot. Avoid touching the board.

Step 4 Place the back of the switching module in the slot and align the notch on the sides of the switching module carrier with the groove in the slot. (See Figure 11.)

Figure 11 Module Installation



Step 5 While keeping the switching module oriented horizontally, carefully slide the module into the slot until the its faceplate makes contact with the ejector levers.

Step 6 Using the thumb and forefinger of each hand, simultaneously push the left lever and the right lever in to fully seat the switching module in the backplane connector.

Note Always use the ejector levers when installing or removing modules. A module that is partially seated in the backplane will cause the system to halt and subsequently crash.

Step 7 Use a screwdriver to tighten the captive installation screws on the left and right ends of the switching module.

Step 8 Attach network interface cables or other devices to the interface ports.

Step 9 Check the status of the interfaces as follows:

- If this installation is a replacement switching module, use the **show module** or **show port** [*mod_num/port_num*] command to verify that the system has acknowledged the new interfaces and brought them up.
- If the interfaces are new, use the **set module** command and the **set module name** command facility to configure the new interface(s). This does not have to be done immediately, but the interfaces will not be available until you configure them. See the *Catalyst 5000 Series Advanced Configuration Guide* for information on how to configure new interfaces.

Accessing the ATM LAN Emulation Module

You can open a session with the ATM module in the Catalyst 5000 series switch by entering the **session** *mod_num* command from the Supervisor console> prompt. After opening the session, you see the **ATM>** prompt. You then have direct access only to the ATM module with which you have established a session.

The ATM module uses a subset of the Cisco Internetwork Operating System (IOS) software. Generally, the IOS software works the same on the ATM module as it does on routers. Refer to the *Catalyst 5000 Series Advanced Configuration Guide* for information about using the ATM module command line.

Configuring the ATM LAN Emulation Module

To enter configuration mode, enter the EXEC command **configure** at the privileged-level EXEC prompt. The ATM module responds with the following prompt asking you to specify the terminal, nonvolatile memory (NVRAM), or a file stored on a network server as the source of configuration commands:

```
Configuring from terminal, memory, or network [terminal]?
```

Terminal configuration means changing the runtime configuration. You can save the runtime configuration into the NVRAM. When you configure from memory, the runtime configuration is updated from the NVRAM. When you configure from the network, the runtime configuration is updated from a file in a server on the network.

Note The network method is not available in this release.

The ATM module accepts one configuration command per line. You can enter as many configuration commands as you want.

You can add comments to a configuration file describing the commands you have entered. Precede a comment with an exclamation point (!). Comments are *not* stored in NVRAM or in the active copy of the configuration file. In other words, comments do not appear when you list the active configuration with the **write terminal** EXEC command or list the configuration in NVRAM with the **show configuration** EXEC command. Comments are stripped out of the configuration file when it is loaded to the ATM module.

Configuring from the Terminal

To configure the ATM module from the terminal, complete the following steps:

Task		Command
Step 1	Enter configuration mode, selecting the terminal option.	**configure terminal**
Step 2	Enter the necessary configuration commands.	*Refer to the* Catalyst 5000 Series Command Reference *for information about specific commands.*
Step 3	Quit configuration mode.	**Ctrl-Z**
Step 4	Save the configuration file modifications to NVRAM.	**write memory**

In the following example, the ATM module is configured from the terminal. The **interface atm 0** command is issued to designate that atm interface 0 is to be configured. Then, the **lane client ethernet** *vlan# elan-name* command is issued to link VLAN 1 to the manufacturing (man) ELAN. By pressing Ctrl-Z, the user quits configuration mode. The **write memory** command loads the configuration changes into nonvolatile memory (NVRAM) on the ATM module.

```
ATM# configure terminal
ATM (config)# interface atm 0
ATM (config)# lane client ethernet 1 man
Ctrl-Z
ATM (config)# write memory
```

Nonvolatile memory stores the current configuration information in text format as configuration commands, recording only nondefault settings. The memory is checksummed to guard against corrupted data.

As part of its startup sequence, the ATM module startup software always checks for configuration information in NVRAM. If NVRAM holds valid configuration commands, the ATM module executes the commands automatically at startup. If the ATM module detects a problem with the nonvolatile memory or the configuration it contains, the card goes into default configuration. Problems can include a bad checksum for the information in NVRAM or the absence of critical configuration information.

Configuring from Nonvolatile Memory

You can configure the ATM module from NVRAM by re-executing the configuration commands stored in NVRAM. To do so, complete the following step in EXEC mode:

Task		Command
Step 1	Configure the ATM module from NVRAM.	**configure memory**

Implementing LAN Emulation

The implementation of LAN Emulation (LANE) makes an ATM interface look like one or more Ethernet interfaces.

LANE is an ATM service defined by the ATM Forum specification “LAN Emulation over ATM,” ATM_FORUM 94-0035. This service emulates the following LAN-specific characteristics:

- Connectionless services
- Multicast services
- LAN MAC driver services

LANE service provides connectivity between ATM-attached devices and LAN-attached devices. This includes connectivity between ATM-attached stations and LAN-attached stations, as well as connectivity between LAN-attached stations across an ATM network.

Because LANE connectivity is defined at the MAC layer, upper-protocol layer functions of LAN applications can continue unchanged when the devices join Emulated LANs (ELANs). This feature protects corporate investments in legacy LAN applications.

An ATM network can support multiple independent ELANs. Membership of an end system in any of the ELANs is independent of the physical location of the end system. This characteristic simplifies hardware moves and changes. In addition, the end systems can move easily from one ELAN to another, independent from whether the hardware moves.

In this release, Cisco supports only emulated Ethernet LANs. This release does not support emulation of Token Ring networks.

This release of LANE is supported on Catalyst 5000 series switches containing ATM modules and on Cisco routers with ATM interfaces installed; it requires a switch that supports User-Network Interface (UNI) 3.0 or 3.1 and point-to-multipoint signaling—for example, the Cisco LightStream family of switches.

LANE Components

An unlimited number of ELANs can be set up in an ATM cloud. A Catalyst 5000 ATM module can participate in multiple ELANs.

LANE is defined on a client-server LAN model as follows:

- LANE client (LEC)

  An LEC emulates a LAN interface to higher-layer protocols and applications. It forwards data to other LANE components and performs LANE address-resolution functions.

  Each LEC is a member of only one ELAN. However, a router or a Catalyst 5000 ATM module can include LECs for multiple ELANs—one LEC for *each* ELAN of which it is a member.

  If a router has LECs for multiple ELANs, the router can route traffic between the ELANs.

- LANE server (LES)

  The LES for an ELAN is the control center. It provides joining, address resolution, and address registration services to the LECs in that ELAN. LECs can register destination unicast and multicast MAC addresses with the LES. The LES also handles LANE ARP (LE ARP) requests and responses.

- LANE broadcast-and-unknown server (BUS)

  The LANE BUS sequences and distributes multicast and broadcast packets and handles unicast flooding. At least one combined LES and BUS is required per ELAN.

- LANE configuration server (LECS)

  The LECS contains the database that determines to which ELAN a device belongs. Each configuration LES can have a differently named database. Each LEC consults the LECS just once, when it joins an ELAN to determine which ELAN it should join. The LECS returns the ATM address of the LES for that ELAN.

  At least one LECS is required per ATM LANE switch cloud.

  The LECS database can have the following four types of entries:

  — {*ELAN name*, *ATM address of LES*} pairs

  — {*LEC MAC address*, *ELAN name*} pairs

  — {*LEC ATM template*, *ELAN name*} pairs

  — Default ELAN name

    ELAN names must be unique on an interface. If two interfaces participate in LANE, the second interface may be in a different switch cloud.

Note Multiple LES, BUS and LECS can exist for the same ELAN, to provide redundancy. For more information on redundancy, refer to the section “Configuring LES/BUS/LECS Redundancy” in this configuration note.

Before You Begin Configuring LANE

Before implementing LANE, be aware that:

- All ATM switches have identical lists of the global LECS addresses in the identical priority.
- The operating LECSs must use exactly the same configuration database. Load the configuration table data using the “config net” command. This method minimizes errors and enables the database to be maintained centrally.
- In the event of an underlying ATM network failure, there may be multiple master LECs and multiple active LESs for the same ELAN, yielding a partitioned network. Clients continue to operate normally, but transmission between different partitions of the networkis not possible. The system recovers when the network break is repaired.
- The LANE subsystem can handle up to 16 LECS addresses.
- The number of LESs that can be defined per ELAN is unlimited.
- In the event of an LECS switchover, no previously joined clients are affected.
- In the event of an LES/BUS switchover, there is a momentary loss of clients until all clients are transferred to the new LES/BUS.
- LECSs automatically come up as masters until a higher level LECS tells them otherwise.
- A higher priority LES coming on line bumps the current LES off the same ELAN. For a short period of tine after a powerup, there may be some changing of clients from one LES to another, depending upon the order of the LESs coming up.
- If none of the specified LESs are up or connected to the master LECS, and more than one LES is defined for an ELAN, the LECS rejects any configuration request for that specific ELAN.
- Changes made to the list of LECS addresses on ATM switches may take up to a minute to propagate through the network. Changes made to the configuration database regarding LES addresses take effect almost immediately.
- If none of the designated LECSs are operational or reachable, the ATM Forum-defined “well known” LECS address is used.
- The LECS to be used can be overridden on any subinterface by using the following commands:

  — **lane auto-config-atm-address**

  — **lane fixed-config-atm-address**

  — **lane config-atm-address ADDRESS**

  To avoid affecting the LES/BUS/LEC redundancy, do not override any LECS, LES, or BUS addresses.

LANE Configuration Prerequisites

Before configuring LANE, perform the following tasks:

- Create a LANE plan.

  Begin by drawing up a plan and a worksheet for your own LANE scenario. Determine the LANE components you want to use, their locations, their associated VLANs, and the necessary redundancy features. Show the following information and leave space for noting the ATM address of each LANE component on each subinterface of each participating device.

  — The Catalyst 5000 and interface where the LANE configuration server will be located

  - The Catalyst 5000 interface and subinterface where the LANE server and broadcast-and-unknown server for each ELAN will be located
  - The Catalyst 5000 ATM modules, subinterfaces, and VLANs where the clients for each ELAN will be located
  - The name of the default ELAN in the LECS database (optional)
- Decide whether to set up one or multiple ELANs. If you set up multiple ELANs, decide where the LES/BUSs and LECs will be located, and whether you will restrict the LECs that can belong to each ELAN.

LANE Configuration Procedures

This section contains the following procedures for configuring LANE:

- Displaying ATM Adddresses
- Configuring the LECS ATM Address on an LS1010
- Setting Up the LES/BUS
- Setting Up the LECS Database
  - Setting Up the LECS Database for the Default ELAN
  - Setting Up the LECS Database for Unrestricted Membership ELANs
  - Setting Up the LECS Database for Restricted Membership ELANs
- Starting and Binding the LECS
- Setting Up the LECs
- Verifying the Setup

Displaying ATM Addresses

You can display the ATM addresses that are used by default for the LECS, LES, BUS, and LEC on the card. Use this information to configure LECS addresses in the ATM switch and configure the LECS database.

Procedure for Dual PHYs Connected to the Same Switch

To display default ATM addresses, enter the following command:

```
show lane default-atm-addresses
```

You see the following screen:

```
ATM#show lane default-atm-addresses
interface ATM0:
LANE Client:        47.00918100000000613E5D1101.00400BF00440.**
LANE Server:        47.00918100000000613E5D1101.00400BF00441.**
LANE Bus:           47.00918100000000613E5D1101.00400BF00442.**
LANE Config Server: 47.00918100000000613E5D1101.00400BF00443.00
```

where ** is the subinterface number byte in hex. Take note of the addresses returned for later use.

Procedure for Dual PHYs Connected to Different Switches

If the two PHYs of the ATM Dual PHY card are connected to different switches, you must determine the addresses that will be used if the first PHY goes down. Take note of the address for later use. Use the following procedure:

Task	Command
Change the preferred PHY to the one not currently in use.	**atm preferred phy <A or B>**
Display the default ATM addresses	**show lane default-atm-addresses**
Determine the active PHY.	**show interface**

Diagnostics

Ensure that the card is connected to the switch, that the interface is up, and that ILMI PVC is enabled.

The following screen indicates that the card could not get the ATM prefix through ILMI from the switch.

```
ATM#show lane default-atm-addresses
interface ATM0:
LANE Client:        ...00400BF00440.**
LANE Server:        ...00400BF00441.**
LANE Bus:           ...00400BF00442.**
LANE Config Server: ...00400BF00443.00
```

Note Displaying the ATM addresses of LESs and LECs as you configure them can save you the time and effort of computing the addresses. This savings can be considerable when you set up the LECS database—especially for ELANs with restricted membership. Make a note of the LECS ATM address so you can configure it on each ATM subinterface where an LES and BUS is configured.

Configuring the LECS ATM Address on an LS1010

You must program all LECS addresses into each ATM switch that is connected to a participant in your LANE network. Programming the addresses allows the LESs and LECs to determine the LECs addresses dynamically through ILMI.

To configure a server ATM address on an LS1010, perform the following steps on each LS1010:

Task		Command
Step 1	Enter the configuration mode.	**configure terminal**
Step 2	Enter the address of the LEC.	**atm lecs-address <atm-address>**
Step 3	Verify the address entered.	**show atm ilmi-configuration**

Setting Up the LES/BUS

To set up the LES/BUS for an ELAN, perform the following steps beginning in interface configuration mode:

Task		Command
Step 1	Enter the configure mode.	**configure terminal**
Step 2	Specify the subinterface for the first ELAN on this card.	**interface atm 0.<*subinterface-number*>**
Step 3	Enable the LES/BUS on the subinterface.	**lane server-bus ethernet <*elan-name*>**
Step 4	Repeat steps 2 and 3 for all other ELANs on this card.	

If the ELAN in step 2 is intended to have restricted membership, you may not want to specify the name here. You need to specify the name in the LECS database when it is set up. However, if you link the LEC to an ELAN in this step and, through some mistake, it does not match the database entry linking the LEC to an ELAN, this LEC will not be allowed to join this ELAN or any other. You might consider this as either a helpful check that the configuration is correct, or as a problem to overcome.

If you do decide to include the name of the ELAN linked to the LEC and later want to associate that LEC with a different ELAN, make the change in the LECS database before you make the change for the LEC on this subinterface.

Setting Up the LECS Database

Complete the steps in this section to set up the LECS database. If you have more than one LECS, all databases must be identical. If you have more than one server in an ELAN, the servers take precedence in the order they are entered. If a Dual PHY card acts as a server, you need to enter both of the predetermined addresses.

Procedure for Setting Up the Database for the Default ELAN

When you configure a Catalyst 5000 switch as the LECS for one default ELAN, you provide a name for the database, the ATM address of the LES for the ELAN, and a default name for the ELAN. In addition, you indicate that the LECS ATM address is to be computed automatically.

When you set up a database of only a default, unrestricted ELAN, you need not specify where the LANE LECs are located. That is, when you set up the LECS database for a single default ELAN, you need not provide any database entries that link the ATM addresses of any LECs with the ELAN name.

To set up the LECS for the default ELAN, complete the following steps:

Task		Commands
Step 1	Create a named database for the LANE configuration LECS.	**lane database** *database-name*
Step 2	In the configuration database, bind the name of the ELAN to the ATM address of the LES.	**name** *elan-name* **server-atm-address** *atm-address*
Step 3	In the configuration database, provide a default name of the ELAN.	**default-name** *elan-name*
Step 4	Exit from database configuration mode and return to global configuration mode.	**exit**

In Step 2, enter the ATM address of the LES for the specified ELAN as noted in your worksheet.

If you are setting up only a default ELAN, the *elan-name* value in Step 2 is the same as the default ELAN name you provide in Step 3.

Note If you are using both PHYs on the ATM LAN Emulation module, Dual PHY, you must use LES/BUS/LECS redundancy.

Procedure for Setting Up the Database for Unrestricted Membership ELANs

When you set up a database for unrestricted ELANs, you create database entries that link the name of each ELAN to the ATM address of its LES.

However, you may choose *not* to specify where the LECs are located. That is, when you set up the LECS database, you do not have to provide any database entries that link the ATM addresses or MAC addresses of any LECs with the ELAN name.

To configure a router as the LECS for multiple ELANs with unrestricted membership, complete the following steps beginning in global configuration mode:

Task		Command
Step 1	Create a named database for the LANE configuration LECS.	**lane database** *database-name*
Step 2	In the configuration database, bind the name of the first ELAN to the ATM address of the LES for that ELAN.	**name** *elan-name1* **server-atm-address** *atm-address*
Step 3	In the configuration database, bind the name of the second ELAN to the ATM address of the LES. Repeat this step, providing a different ELAN name and an ATM address, for each additional ELAN in this switch cloud.	**name** *elan-name2* **server-atm-address** *atm-address*
Step 4	(Optional) Specify a default ELAN for LECs not explicitly bound to an ELAN.	**default name** *elan-name*
Step 5	Exit from database configuration mode and return to global configuration mode.	exit

In Steps 2 and 3, enter the ATM address of the LES for the specified ELAN, as noted in your worksheet.

Procedure for Setting Up the Database for Restricted Membership ELANs

When you set up the database for restricted-membership ELANs, you create database entries that link the name of each ELAN to the ATM address of its *LES*.

However, you *also* must specify where the LECs are located. That is, for each restricted-membership ELAN, you provide a database entry that explicitly links the ATM address or MAC address of each *LEC* of that ELAN with the name of that ELAN.

Those LEC database entries specify the LECs that are allowed to join the ELAN. When an LEC requests that the LECS indicate which ELAN it is to join, the LECS consults its database and then responds as configured.

When LECs for the same restricted-membership ELAN are located in multiple Catalyst 5000 ATM modules, each LEC ATM address or MAC address must be linked explicitly with the name of the ELAN. As a result, you must configure as many LEC entries (Step 5 in the following procedure) as you have LECs for ELANs in all the ATM modules of Catalyst 5000 switches. Of course, each LEC will have a different ATM address in the database entries.

To set up the LECS for ELANs with restricted membership, perform the following steps, beginning in global configuration mode:

Task		Command
Step 1	Create a named database for the LECS.	**lane database** *database-name*
Step 2	In the configuration database, bind the name of the first ELAN to the ATM address of the LES for that ELAN.	**name** *elan-name1* **server-atm-address** *atm-address* **restricted**
Step 3	In the configuration database, bind the name of the second ELAN to the ATM address of the LES. Repeat this step, providing a different name and a different ATM address, for each additional ELAN.	**name** *elan-name2* **server-atm-address** *atm-address* [**restricted**]
Step 4	(Optional) Specify a default ELAN for LECs not explicitly bound to an ELAN.	**default name** *elan-name*
Step 5	Add a database entry associating a specific LEC ATM address with a specific restricted-membership ELAN. Repeat this step for each of the LECs of each of the restricted-membership ELANs on this switch cloud, in each case specifying that LEC ATM address and the name of the ELAN with which it is linked.	**client-atm-address** *atm-address* **name** *elan-name*
Step 6	Exit from database configuration mode and return to global configuration mode.	exit

Note An ELAN named “default” must be available for VLAN Trunk Protocol (VTP) management.

Starting and Binding the LECS

To start and bind the LECS, perform the following steps:

Task		Command
Step 1	Enter the configuration mode.	**configure terminal**
Step 1	Select the ATM interface.	**interface atm0**
Step 2	Specify the name of the LECS.	**lane config test**
Step 3	Specify the address of the LECS.	**lane config auto-config-atm-address**
Step 4	Bind the interface.	**lane config database** <*database-name*>
Step 5	Exit the configuration mode.	**end**

Setting up the LECs

On any given Catalyst 5000 series switch, you can set up one LEC for one ELAN or multiple LECs for multiple ELANs. You can set up a client for a given ELAN on any Catalyst 5000 you choose to participate in that ELAN. After you set up the interface for the VLAN, you must link the VLAN number with the ELAN name.

To set up only a client for an ELAN, perform the following steps beginning in interface configuration mode:

Task		Command
Step 1	Specify the subinterface for a VLAN on this switch.	**interface atm 0.***subinterface-number*
Step 2	Enable a LANE client for the first ELAN.	**lane client ethernet** *vlan# elan-name*

Verifying the Setup

Once you have set up the clients as needed on the subinterfaces of an ATM module, you can display their ATM addresses by completing the following step in EXEC mode:

Task		Command
Step 1	Display the server, broadcast-and-unknown server, and client ATM addresses.	**show lane**

The output of this command shows all subinterfaces configured for LANE. For each subinterface, the command displays and clearly labels the ATM addresses that respectively belong to the server, the broadcast-and-unknown server, and the client.

When you look at each ATM address, you will notice the following:

- The prefix is the one you set up on the switch
- The ESI field reflects the base address of the pool of MAC addresses assigned to the ATM interface plus a value that represents the specific LANE component
- The selector byte is the same number as the subinterface.

Repeat this step on each Catalyst 5000 series switch before you proceed to set up the clients on the next Catalyst 5000.

Print the display or make a note on your LANE worksheet of these ATM addresses so you can use it when you set up the configuration server's database.

At this point in the configuration process, the clients are normally not operational.

Configuring Specialized Features

This section describes the configuring of specialized features, such as LES/BUS/LECS redundancy.

Configuring LES/BUS/LECS Redundancy

LES/BUS/LECS redundancy allows you to configure redundant LAN Emulation Servers (LESs) and Broadcast Unknown Servers (BUSs) so that the LAN Emulation Clients (LECs) in an ELAN can automatically switch to a backup LES in case of a failure of the primary LES. The priority of the LES/BUS pairs is established by the order in which they are entered in the LECS database.

The LANE protocol does not specify where any of the ELAN server entities should be located, but for the purpose of reliability and performance, Cisco implements these server components on its routers and LAN switches.

With Phase I LANE, only one LAN Emulation Configuration Server (LECS), capable of serving multiple ELANs, and only one LAN Emulation Server (LES) per ELAN could exist for an ATM cloud. The Phase I LANE protocol did not allow for multiple LAN Emulation Servers within an ELAN. Therefore, these components represented both single points of failure and potential bottlenecks for LANE service.

LANE LES/BUS/LECS redundancy corrects these limitations by allowing backup LECS and LES servers for an ELAN. LANE LES/BUS/LECS redundancy is always enabled. An administrator uses this redundancy feature by configuring multiple servers.

LES/BUS/LECS redundancy works only with Cisco LECS and LES combinations. Third party LANE components continue to interoperate with the LECS and LES function of Cisco routers but cannot take advantage of the redundancy features.

The following three servers are single points of failure in the ATM LAN Emulation System:

- The LECS (configuration server)
- The LES (ELAN server)
- The BUS

LES/BUS/LEC redundancy eliminates these single points of failure.

Procedure

To enable redundant LECSs, enter the multiple LECS addresses to the end ATM switches, which are used as central locations for the list of LECS addresses. After entering the LECS addresses, LANE components connected to the switches can obtain the global list of LECS addresses.

To configure LES/BUS/LECS redundancy, you must enable multiple/redundant/standby LECSs and multiple/redundant/standby LES/BUSs. Cisco LANE operates seamlessly with other vendors' LANE components, although LES/BUS/LECS redundancy is not effective in this situation. To enable LES/BUS/LEC redundancy, complete the following steps.

Task		Command
Step 1	On the ATM switch, enter all the multiple LECS addresses.	**set configserver** *index.address mask (for the Cisco LS100). The <index> determines the priority. 0 is the highest priority.* **atm lecs-address** *address***(**for the Cisco LS1010).
Step 2	On the ATM module, specify redundant LES/BUSs. Enter the command for each LES address on the ELAN.	**name** <*elan-name*> **server-atm-address** <*les-address*>

Note The LES/BUS/LEC redundancy configuration procedure guards against hardware failure on which LANE components are running, including all Catalyst 5000 switches. The configuration procedure is not effective for ATM network switch failures.

Enabling ILMI Keepalive Timeout

If enabled, ILMI sends keep-alive messages on an ongoing basis on the active PHY to the switch, and the switch responds. If the response is not obtained for the last four polls, then ILMI times out. The DUALPHY has a feature by which it can switch from active PHY to backup PHY if the ILMI timer times out. This feature is useful only if the two PHY's are connected to two different switches. (Refer to Scenario 3).

By Default this feature is disabled. To enable it, session to the ATM module using the session command, and type the following commands:

```
ATM>enable
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#int atm0
ATM(config-if)#atm ilmi-keepalive 4
ATM(config-if)#end
ATM#
```

The above commands enable the transmission of ILMI keep-alive and set the time between two ILMI keepalive messages to four seconds.

Monitoring and Maintaining LANE Components

After configuring LANE components on an interface or any of its subinterfaces, on a specified subinterface, or on an ELAN, you can display their status. To show LANE information, perform the following steps in EXEC mode:

Task		Command
Step 1	Display the global and per-VCC LANE information for all the LANE components and ELANs configured on an interface or any of its subinterfaces.	**show lane** [**interface atm 0** [**.***subinterface-number*] | **name** *elan-name*] [**brief**]
Step 2	Display the global and per-VC LANE information for the BUS configured on any subinterface or ELAN.	**show lane bus** [**interface atm 0** [**.***subinterface-number*] | **name** *elan-name*] [**brief**]
Step 3	Display the global and per-VC LANE information for all LECs configured on any subinterface or ELAN.	**show lane client** [**interface atm 0** [**.***subinterface-number*] | **name** *elan-name*] [**brief**]
Step 4	Display the global and per-VC LANE information for the LECS configured on any interface.	**show lane config** [**interface atm 0**]
Step 5	Display the LANE LECS database.	**show lane database** [*database-name*]
Step 6	Display the LANE ARP table of the LECs configured on the specified subinterface or ELAN.	**show lane le-arp** [**interface atm 0** [**.***subinterface-number*] | **name** *elan-name*]
Step 7	Display the global and per-VC LANE information for the LES configured on a specified subinterface or ELAN.	**show lane server** [**interface atm 0** [**.***subinterface-number*] | **name** *elan-name*] [**brief**]

LANE Configuration Examples

The examples in this section show the steps in setting up an ATM LANE configuration in a Catalyst 5000 series ATM module.

Example 1

Figure 12 LES/BUS/LECS Configuration

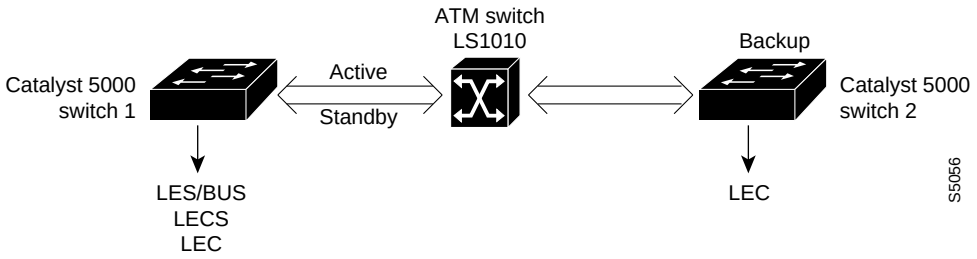


Figure 12 shows a configuration composed of two Catalyst 5000 series Ethernet switches, Catalyst 5000 Ethernet Switch 1 and Catalyst 5000 Ethernet Switch 2, and an ATM switch.

Example Configuration Assumptions

For this example, the following assumptions apply:

- The ATM Switch used in this example is a Cisco LightStream 1010.
- Catalyst 5000 series switches with the ATM modules installed are running software version 3.1 or later.
- Catalyst 5000 Switch 1 runs the LECS, LES/BUS on interface atm0 and the LEC on interface atm0.1.
- Catalyst 5000 Switch 2 runs LEC on interface atm0.1.
- The ATM module is in slot 4.
- You can change the ELAN name by using the **set vlan vlan_num [name]** command.
- The following ELAN names are used:

vlan number	ELAN name
1	default
2	VLAN0002
3	VLAN0003
4	VLAN0004

Example Configuration Procedure

Suppose you want to set up LANE on the configuration in Figure 12. Perform the following steps:

Set up the prefix of the ATM address.

Step 1 Set up the prefix of the ATM NSAP address for the switch.

The LS1010 ATM switch provides a default prefix.

Display the ATM addresses for LECS, LES/BUS, and LECs on Switch 1.

Step 2 To start a session to the ATM module, enter the **Session 4** command. You see the following screen:

```
Catalyst> session 4
Trying ATM-4...
Connected to ATM-4.
Escape character is '^]'.
```

Step 3 To obtain the addresses of the LES and LES/BUS for later use, enter the **show lane default** command at the ATM prompt. You see the folowing display:

```
ATM>
ATM>enable
ATM#
ATM#show lane default
interface ATM0:
LANE Client:        47.009181000000061705b7701.00400BFF0010.**
LANE Server:        47.009181000000061705b7701.00400BFF0011.**
LANE Bus:           47.009181000000061705b7701.00400BFF0012.**
LANE Config Server: 47.009181000000061705b7701.00400BFF0013.00
ATM#
```

Note ** is the subinterface number byte in hex.

Configure the LECS ATM address on the LS1010 switch.

Step 4 Set the address of the default LECS in the LS1010 switch using the LECS address obtained in step 3. To tell the ATM switch the LECS address, enter the **configure terminal** and **atm lecs-address <atm-address>** commands on the console of the LS1010 switch. You see the following screen.

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#atm lecs-address 47.009181000000061705b7701.00400BFF0013.00 1
Switch(config)#end
Switch#
```

The above set of commands configures the address of the LECS in the switch. The LECS's ATM NSAP address is 47.009181000000061705b7701.00400BFF0013.00. You can obtain the address by entering the commands in step 2. The sequence number of this LECS address, which is 1, means it is the first LECS in this switch.

Step 5 Save the configuration to NVRAM.

```
ATM#write memory
```

Set up the LES/BUS.

Step 6 To start up a LES/BUS on Catalyst 5000 series Switch 1, enter the **interface atm0** and the **lane server-bus ethernet default** commands. You see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0
ATM(config-subif)#lane server-bus ethernet default
ATM(config-subif)#end
```

The above set of commands starts a LES/BUS pair. The ELAN name is "default," and the interface on which this LES/BUS pair is configured is "atm0"

Step 7 Save the configuration in the NVRAM.

```
ATM#write mememory
```

Set up the LECS database.

Step 8 Set up the LECS database on the Catalyst 5000 series Switch 1.

Use the LANE Server address obtained in step 3 and replace the ** with the subinterface number of the interface in which the LES/BUS is to be configured. In this example, that number is 00. Enter the **lane database** ***database-name*** command, the **name** ***elan-name*** **server-atm-address** ***atm address*** command, and the **default-name** ***elan-name*** commands at the ATM prompt. You see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#lane database test
ATM(lane-config-database)#name default server-atm-address
                                47.009181000000061705b7701.00400BFF0011.00
ATM(lane-config-database)#default-name default
ATM(lane-config-database)#end
```

The above set of commands creates the LECS database. The name of the database is "test." The name of the ELAN is "default." The LES's ATM NSAP address is 47.009181000000061705b7701.00400BFF0011.00.

Step 9 Save the configuration in the NVRAM.

```
ATM#write memory
```

Start and bind the LECS.

Step 10 To start and bind the LECS on the Catalyst 5000 series Switch 1, enter the **interface atm0** command, the **lane config database <*database name*>** command, and the **lane configure auto-config-atm-address** command at the ATM prompt. You see the following screen.

```
ATM#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0
ATM(config-if)#lane configure test
ATM(config-if)#lane configure auto-config-atm-address
ATM(config-if)#end
ATM#
```

The above set of commands starts the LECS. The database to use is "test." The interface on which the LECS is configured is "atm0".

Step 11 Save the configuration in the NVRAM.

```
ATM#write memory
```

Start the LEC.

Step 12 To start the LEC on the Catalyst 5000 series Switch 1 and Switch 2, enter the **interface atm0.1 command** and the **lane client ethernet 1 default** command on the consoles of Switches 1 and 2. These commands start an LEC. The interface on which the LEC is configured is atm0.1. The ELAN name is "default" and it is configured to emulate Ethernet. You see the following screen.

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0.1
ATM(config-subif)#lane client ethernet 1 default
ATM(config-subif)end
```

Step 13 Save the configuration in the NVRAM.

```
ATM#write memory
```

Configure VLAN 2.

Step 14 To create an LES/BUS pair on Catalyst 5000 series Switch 1 for VLAN 2, enter the **interface atm0.2** command and the **lane server-bus ethernet VLAN0002** command.

```
ATM#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config-subif)#interface atm0.2
ATM(config-subif)#lane server-bus ethernet VLAN0002
ATM(config-subif)#end
ATM#
```

Step 15 Save the configuration in the NVRAM.

```
ATM#write memory
```

Configure the address of the LES/BUS pair on Switch 1.

Step 16 To configure the address of the new LES/BUS pair in the LECS database on the Catalyst 5000 series Switch 1, enter the **lane database test** command and the **name VLAN0002 server-atm-address *atm address*** command.

```
ATM#configure terminal
ATM(config)#lane database test
ATM(lane-config-database)#name VLAN0002 server-atm-address
                              47.009181000000061705b7701.00400BFF0011.02
ATM(lane-config-database)#end
ATM#
```

Step 17 Save the configuration in the NVRAM.

```
ATM#write mememory
```

Start the LECon Switch 2.

Step 18 To start the new LEC on the Catalyst 5000 series Switch 2, enter the **interface atm0.2** command and the **lane client ethernet 2 VLAN0002** command at the ATM prompt.

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0.2
ATM(config-subif)#lane client ethernet 2 VLAN0002
ATM(config-subif)end
```

Step 19 Save the configuration in the NVRAM.

```
ATM#write memory
```

Example 2

Figure 13 LES/BUS/LECS Redundancy

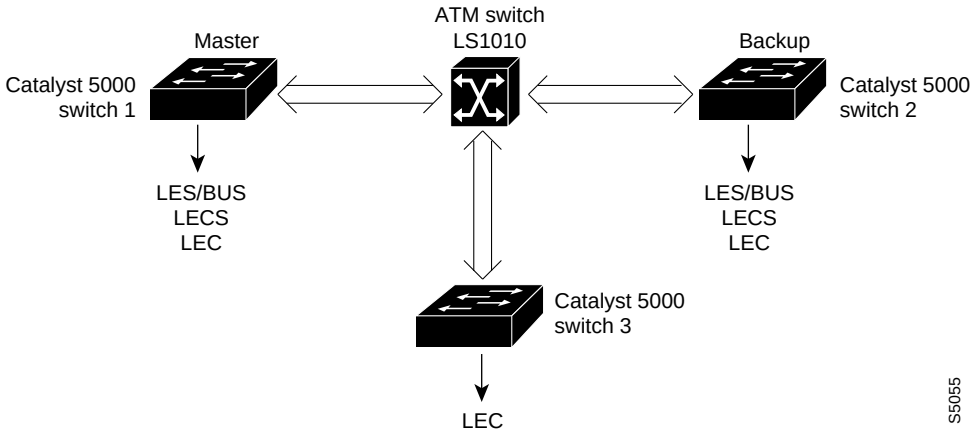


Figure 13 shows three Catalyst 5000 series switches, Catalyst 5000 Switch 1, Switch 2, and Switch 3, and an ATM switch, which is an LS1010. LES/BUS/LECS redundancy is configured. Switch 1 and Switch 2 both have one LES/BUS/LECS running for every ELAN. Switch 1 is the master server, and Switch 2 is the backup server. If Switch 1 fails, then Switch 2 provides the LES/BUS/LECS components of the ELAN. Once Switch 1 recovers, it becomes the master server again.

Example Configuration Assumptions

For this example, the following assumptions apply:

- The Catalyst 5000 series Switch 1 is the master. It runs the LECS and LES/BUS on interface atm0, and runs the LEC on interface atm0.1.
- The Catalyst 5000 series Switch 2 is the backup server. It runs LECS and LES/BUS on interface atm0, and runs the LEC on interface atm0.1.
- The Catalyst 5000 series Switch 3 runs the LEC on interface atm0.1.

Example Configuration Procedure

To set up the configuration in Figure 13, perform the following steps:

Set up the prefix of the ATM address.

Step 1 Setup the prefix of the ATM NSAP Address for the switch.

The LS1010 ATM Switch provides a default prefix.

Display the ATM addresses for the LECS, LES/BUS, and LECs on Switch 1 and Switch 2.

Step 2 To session to the ATM module from Switch 1, enter the **Session 4** command. You see the following screen:

```
Catalyst> session 4
Trying ATM-4...
Connected to ATM-4.
Escape character is '^]'.
```

Step 3 To obtain the addresses of the LES and LES/BUS for later use, enter the **show lane default** command at the ATM prompt. You see the following screen:

```
ATM>
ATM>enable
ATM#
ATM#show lane default
interface ATM0:
LANE Client:        47.009181000000061705b7701.00400BFF0010.**
LANE Server:        47.009181000000061705b7701.00400BFF0011.**
LANE Bus:           47.009181000000061705b7701.00400BFF0012.**
LANE Config Server: 47.009181000000061705b7701.00400BFF0013.00
ATM#
```

The subinterface number byte is displayed in hex.

Step 4 To session to the ATM module from Switch 2, enter the **Session 4** command.You see the following screen:

```
Catalyst> session 4
Trying ATM-4...
Connected to ATM-4.
Escape character is '^]'.
```

Step 5 To obtain the addresses of the LES and LES/BUS for later use, enter the **show lane default** command at the ATM prompt. You see the following screen:

```
ATM>
ATM>enable
ATM#
ATM#show lane default
interface ATM0:
LANE Client:        47.009181000000061705b7701.00400B583040.**
LANE Server:        47.009181000000061705b7701.00400B583041.**
LANE Bus:           47.009181000000061705b7701.00400B583042.**
LANE Config Server: 47.009181000000061705b7701.00400B583043.00
ATM#
```

The subinterface number byte is displayed in hex.

Set up the LECS databases.

Step 6 Set up the LECS database on Switch 1 and Switch 2. Use the LANE Server addresses obtained in steps 3 and 5 and replace the ** with the subinterface numbers of the interfaces in which the LES/BUS is to be configured. In this example, that number is 00. Enter the **lane database** ***database-name*** command, the **name** ***elan-name*** **server-atm-address** ***atm address*** command, and the **default-name** ***elan-name*** commands at the ATM prompt of both Switch 1 and Switch 2. You see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#lane database test
ATM(lane-config-database)#name default server-atm-address
                          47.009181000000061705b7701.00400BFF0011.00
ATM(lane-config-database)#name default server-atm-address
                          47.009181000000061705b7701.00400B583041.00
ATM(lane-config-database)#default-name default
ATM(lane-config-database)#end
```

The above set of commands creates the LECS database.The name of the database is "test." The name of the ELAN is "default." The first entry is the primary LES. The second entry is the backup LES. The primary LES's ATM NSAP address is 47.009181000000061705b7701.00400BFF0011.00.The backup LES's ATM NSAP Address 47.009181000000061705b7701.00400B583041.00.

Note The order of the entries is critical and should be the same on both the primary and secondary Catalyst Series 5000 switch for this configuration to work effectively.

Step 7 Save the configuration in the NVRAM.

```
write memory
```

Start and bind the LECS.

Step 8 To start and bind the LECS on both the Catalyst 5000 series Switch 1 and Switch 2, enter the **interface atm0** command, the **lane config database <*database name*>** command, and the **lane configure auto-config-atm-address** command at the ATM prompt on both Switch 1 and Switch 2. These commands start the LECS on both Switch 1 and Switch 2. The database name is "test." The interface on which the LECS is configured is "atm0." You see the following screen.

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0
ATM(config-if)#lane config test
ATM(config-if)#lane config auto-config-atm-address
ATM(config-if)#lane config
ATM(config-if)#end
ATM#
```

Step 9 Save the configuration in the NVRAM.

```
write memory
```

Start the LES/BUSs.

Step 10 To start up a LES/BUS on Switch 1 and Switch 2, enter the **interface atm0** command and the **lane server-bus ethernet default** command on the consoles of Switch 1 and Switch 2. These commands start a LES/BUS pair. The ELAN name is "default." The interface on which this LES/BUS pair is configured is "atm0." You see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0
ATM(config-subif)#lane server-bus ethernet default
ATM(config-subif)#end
```

Step 11 Save the configuration in the NVRAM.

```
write memory
```

Set the address of the LECS in the STM (LS1010) switch.

Step 12 To set the addresses of the LECS on Switch 1 and Switch 2 in the ATM switch, enter the **atm lecs-address <atm address>** commands for each Catalyst 5000 series switch on the console of the LS1010 switch. These commands configure the address of the primary and the backup LECSs in the ATM switch, in the order presented on the screen. Use the LANE Config Server address obtained in step 3 and step 5. You see the following screen:

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#atm lecs-address 47.009181000000061705b7701.00400BFF0013.00 1
Switch(config)#atm lecs-address 47.009181000000061705b7701.00400B583043.00 2
Switch(config)#end
Switch#
```

Step 13 Save the configuration in the NVRAM.

```
write memory
```

Start the LECs.

Step 14 To start the LEC on Switch 1, 2, and 3, enter the **interface atm0.1** command and the **lane client ethernet 1 default** command on the consoles of Switches 1, 2, and 3. These commands entered on each switch start the LECs. The interface on which the LEC is configured is "atm0.1." The ELAN name is "default," and it is configured to emulate Ethernet. You see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0.1
ATM(config-subif)#lane client ethernet 1 default
ATM(config-subif)end
```

Step 15 Save the configuration in the NVRAM.

```
write memory
```

Note To use VTP to create the LEC refer to the section “Using VLAN Trunk Protocol.”

Configure VLAN 2.

Step 16 Create a LES/BUS pair on Switch 1 and Switch 2 for VLAN 2. Enter the **interface atm0.2** command and the **lane server-bus ethernet VLAN 0002** command on the consoles of Switch 1 and Switch 2. You see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config-subif)#interface atm0.2
ATM(config-subif)#lane server-bus ethernet VLAN0002
ATM(config-subif)#end
ATM#
```

Step 17 Save the configuration in the NVRAM.

```
write memory
```

Step 18 Configure the address of the new LES/BUS pair in the LECS database on Switch 1. Enter the **name *elan-name* server-atm-address *atm address*** commands at the ATM prompt.

```
ATM#configure terminal
ATM(config)#lane database test
ATM(lane-config-database)#name VLAN0002 server-atm-address
                          47.009181000000061705b7701.00400BFF0011.02
ATM(lane-config-database)#name VLAN0002 server-atm-address
                          47.009181000000061705b7701.00400B583041.02
ATM(lane-config-database)#end
ATM#
```

Step 19 Save the configuration in the NVRAM.

```
write memory
```

Step 20 Start the new LEC on Switch 3 by entering the **interface atm0.2** command and the **lane client ethernet 2 VLAN0002** command on the console of Switch 3.

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0.2
ATM(config-subif)#lane client ethernet 2 VLAN0002
ATM(config-subif)end
```

Step 21 Save the configuration in the NVRAM.

```
write memory
```

Example 3

Figure 14 LES/BUS/LECS Renundancy with Dual PHYs

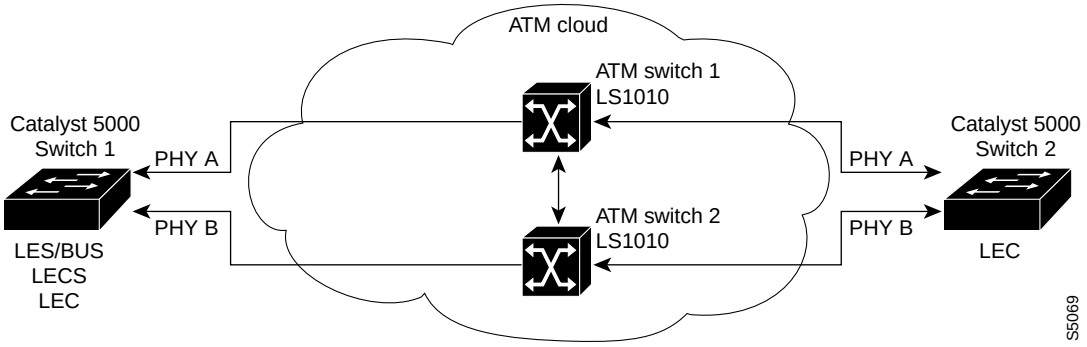


Figure 14 shows two ATM switches in an ATM cloud. ATM Switch 1 is connected to two Catalyst 5000 series switches (Switch 1 and Switch 2), which have ATM Dual-PHY modules. ATM Switch 2 is also connected to Switch 1 and Switch 2. If the PHY A on Switch 1 is lost, data continues to flow to Switch 2 on PHY B, showing Dual-PHY redundancy.

Example Configuration Assumptions

For this example, the following assumptions apply:

- The ATM Switch used in this example is a Cisco Light-Stream 1010.
- Catalyst 5000 series switches with the ATM modules installed are running software version 3.1 or later.
- Catalyst 5000 Switch 1 runs the LECS and LES/BUS on interface atm0 and the LEC on interface atm0.1.
- Catalyst 5000 Switch 2 runs LEC on interface atm0.1.
- The ATM module is in slot 4.
- You can change the ELAN name by using the **set vlan vlan_num [name]** command.

Example Configuration Procedure

To set up LANE on the configuration in Figure 14, perform the following steps:

Set up the prefix of the ATM address.

Step 1 Setup the prefix of the ATM NSAP Address for the switch.

The LS1010 ATM Switch provides a default prefix.

Display the ATM addresses for LECS, LES/BUS, and LECs on Switch 1 through path A.

Step 2 To session to the ATM module, enter the **Session 4** command. You see the following screen:

```
Catalyst> session 4
Trying ATM-4...
Connected to ATM-4.
Escape character is '^]'.
```

Step 3 To obtain the addresses of the LES and LES/BUS for later use, enter the **show lane default** command at the ATM prompt. You see the folowing display:

```
ATM>
ATM>enable
ATM#
ATM#show lane default
interface ATM0:
LANE Client:        47.009181000000061705b7701.00400BFF0010.**
LANE Server:        47.009181000000061705b7701.00400BFF0011.**
LANE Bus:           47.009181000000061705b7701.00400BFF0012.**
LANE Config Server: 47.009181000000061705b7701.00400BFF0013.00
ATM#
```

Note ** is the subinterface number byte in hex.

Display the ATM addresses for LECS, LES/BUS, and LECs on Switch 1 through path B.

Step 4 To access path B, enter the **interface atm0 command** and the **atm preferred phy B** command. You see the following screen:

```
ATM>enable
ATM#
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0
ATM(config-subif)#atm preferred phy B
ATM(config-subif)#end
ATM#
```

Step 5 Wait for approximately one minute while the PHY B comes up. Enter the show **lane default** command. The symbol ** represents the subinterface number byte in hex. You see the following screen:

```
ATM#show lane default
interface ATM0:
LANE Client:        47.009181000000061705b8301.00400BFF0010.**
LANE Server:        47.009181000000061705b8301.00400BFF0011.**
LANE Bus:           47.009181000000061705b8301.00400BFF0012.**
LANE Config Server: 47.009181000000061705b8301.00400BFF0013.00
ATM#
```

Return to PHY A.

Step 6 To return to PHY A, enter the **interface atm0 command** and the **atm preferred phy B** command. You see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0
ATM(config-subif)#atm preferred phy B
ATM(config-subif)#end
ATM#
```

Set the address of default LECS in the ATM switches.

Step 7 To set the address of the default LECS in the ATM switches, use the addresses obtained in steps 3 and 4. Enter the **atm lecs-address <atm address>** commands on the console of the LS 1010 Switch 1. These commands configure the address of the primary and the backup LECSs in the ATM switches in the specific order entered. Only one LECS runs on the Catalyst 5000 series switch 1, but the address (the first 13 bytes) changes if PHY B is used instead of PHY A. After entering the commands, you see the following screen

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#atm lecs-address 47.00918100000000061705b7701.00400BFF0013.00 1
Switch(config)#atm lecs-address 47.00918100000000061705b8301.00400BFF0013.00 2
Switch(config)#end
Switch#
```

Step 8 Save the configuration in the NVRAM.

```
Switch#write memory
```

Start up a LES/BUS on Catalyst 5000 series Switch 1.

Step 9 Enter the **interface atm0** command and the **lane server-bus ethernet default** command on the console of Catalyst 5000 series Switch 1. These commands starts a LES/BUS pair. The ELAN name is "default." The interface on which this LES/BUS pair is configured is atm0. You see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface and the atm0
ATM(config-subif)#lane server-bus ethernet default
ATM(config-subif)#end
```

Step 10 Save the configuration in the NVRAM.

```
ATM#write memory
```

Configure the LECS database on Catalyst 5000 series Switch 1.

Step 11 To configure the LECS database of the Catalyst 5000 series Switch 1, enter the **lane database** ***database name*** command, the **name** ***elan-name*****- server-atm-address** ***atm address*** command, and the **default-name** ***elan-name*** command.

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#lane database test
ATM(lane-config-database)#name default server-atm-address
                          47.00918100000000061705b7701.00400BFF0011.00
ATM(lane-config-database)#name default server-atm-address
                          47.00918100000000061705b8301.00400BFF0011.00
ATM(lane-config-database)#default-name default
ATM(lane-config-database)#end
```

Use the LANE server addresses obtained in steps 3 and 4. Replace the symbol ** with the subinterface number of the interface in which the LES/BUS is to be configured. In this example, the number is 00. These commands creates the LECS database. The name of the database is "test." The name of the ELAN is "default."

The ATM NSAP address of the LES is 47.009181000000006170 5b7701.00400BFF0011.00. The screen display in step 3 shows this LANE Bus address.

The ATM NSAP address of the LES is 47.009181000000006170 5b8301.00400BFF0011.00. The screen display in step 4 shows this LANE Bus address.

Step 12 Save the configuration in the NVRAM.

```
ATM#write memory
```

Start and bind the LECS on the Catalyst 5000 series Switch 1.

Step 13 To start and bind the LECS on the Catalyst 5000 series Switch 1, enter the **interface atm0** command, the **lane configure database <*database name*>** command, and the **lane configure auto-config-atm-address** command at the ATM prompt. These commands start and bind the LECS. The database name is "test." The interface on which the LECS is configured is "atm0." After entering these commands, you see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0
ATM(config-if)#lane configure test
ATM(config-if)#lane configure auto-config-atm-address
ATM(config-if)#end
ATM#
```

Step 14 Save the configuration in the NVRAM.

```
ATM#write memory
```

Start the LEC on the Catalyst 5000 series Switch 1 and Switch 2.

Step 15 On the consoles of Catalyst 5000 series Switch 1 and Switch 2 enter the **interface atm0.1** command and the **lane client ethernet 1 default** command. These commands start an LEC. The interface on which the LEC is configured is "atm0.1." The ELAN name is "default," and it is configured to emulate Ethernet. After entering the commands, you see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0.1
ATM(config-subif)#lane client ethernet 1 default
ATM(config-subif)end
```

Step 16 Save the configuration in the NVRAM.

```
ATM#write memory
```

Note To use VTP to create the LEC, refer to the section “Using VLAN Trunk Protocol.”

Configure VLAN 2.

Step 17 Create an LES/BUS pair on the Catalyst Series Switch 1 for VLAN 2, by entering the **interface atm0.2** command and the **lane server-bus ethernet VLAN0002** command.

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config-subif)#interface atm0.2
ATM(config-subif)#lane server-bus ethernet VLAN0002
ATM(config-subif)#end
ATM#
```

Step 18 Save the configuration in the NVRAM.

```
ATM#write memory
```

Step 19 Configure the address of the new LES/BUS pair in the LECS database on the Catalyst Series Switch 1 by entering the enter the **lane database** ***database name*** command and the **name** ***elan-name*****- server-atm-address** ***atm address*** commands. You see the following screen:

```
ATM#configure terminal
ATM(config)#lane database test
ATM(lane-config-database)#name VLAN0002 server-atm-address
                          47.00918100000000061705b7701.00400BFF0011.02
ATM(lane-config-database)#name VLAN0002 server-atm-address
                          47.00918100000000061705b8301.00400BFF0011.02
ATM(lane-config-database)#end
ATM#
```

Step 20 Save the configuration in the NVRAM.

```
ATM#write memory
```

Step 21 Start the new LEC on the Catalyst Series Switch 2 by entering the **interface atm0.2** and the **lane client ethernet 2 VLAN0002** command on the console of the Catalyst Series Switch 2. You see the following screen:

```
ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#interface atm0.2
ATM(config-subif)#lane client ethernet 2 VLAN0002
ATM(config-subif)end
```

Step 22 Save the configuration in the NVRAM.

```
ATM#write memory
```

How LANE Works

The following section includes typical LANE scenarios and conceptual information about how LANE works.

Examining LANE Scenarios

In typical LANE cases, one or more Catalyst 5000 series switches or Cisco routers with ATM interfaces are attached to a Cisco LightStream ATM switch. For distributing multiple ELANs within a network, you can use Catalyst 5000 switches with ATM interfaces to configure the LANE LECS, LES, and LANE BUS.

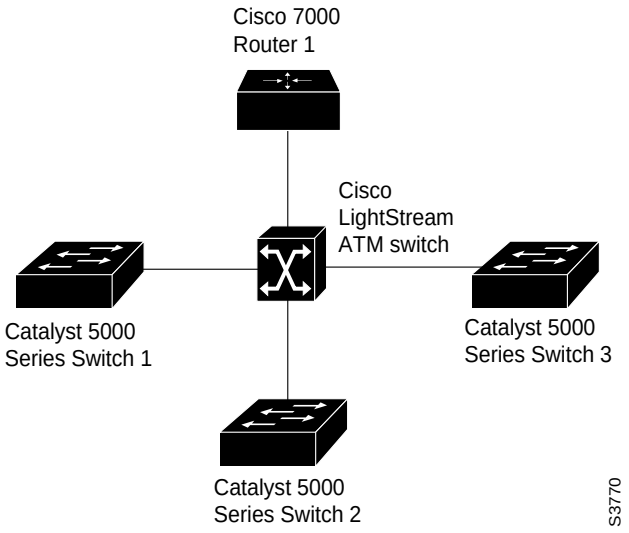
The physical layout and the physical components of an emulated network might not differ for the single and the multiple ELAN cases. The differences are in the software configuration for the number of ELANs and the assignment of LANE components to the different physical components.

LANE configurations that use routers typically have one or more Catalyst 5000 series switches or Cisco routers with ATM interfaces attached to a Cisco LightStream ATM switch. The Cisco LightStream ATM switch provides connectivity to the broader ATM network switch cloud. The routers are configured to support one or more ELANs. One of the routers is configured to perform the LECS functions. A router is configured to perform the LES function and the BUS function for each ELAN. (One router can perform the LES and the BUS functions for several ELANs.) Routers and Catalyst 5000 series switches can act as an LEC for one or more ELANs.

Note A Catalyst 5000 series Switch can also be used as an LES, an LECS, and BUS.

This section presents two scenarios using a router, Catalyst 5000 series switches, and a Cisco LightStream ATM switch. Figure 15 illustrates this typical layout of one Cisco LightStream ATM switch, with a Cisco router and three Catalyst 5000 series switches; it illustrates both the single and the multiple ELAN cases.

Figure 15 Typical ELAN Layout



Single ELAN Scenario with Catalyst 5000 Switches and Routers

In a single ELAN scenario, the LANE components might be assigned as follows:

- Router 1 includes the following LANE components:
  - LECS (one per LANE switch cloud)
  - LES and BUS for the manufacturing ELAN
- Catalyst 5000 series switch 1 includes an LEC for the manufacturing ELAN.
- Catalyst 5000 series switch 2 includes an LEC for the manufacturing ELAN.
- Catalyst 5000 series switch 3 includes an LEC for the manufacturing ELAN.

Multiple ELAN Scenario with Catalyst 5000 Switches and Routers

In a multiple LAN scenario, one ATM switch, one router, and three Catalyst 5000 series switches are used, but multiple ELANs are configured. In the following scenario, three ELANs are configured on a router and three Catalyst 5000 series switches.

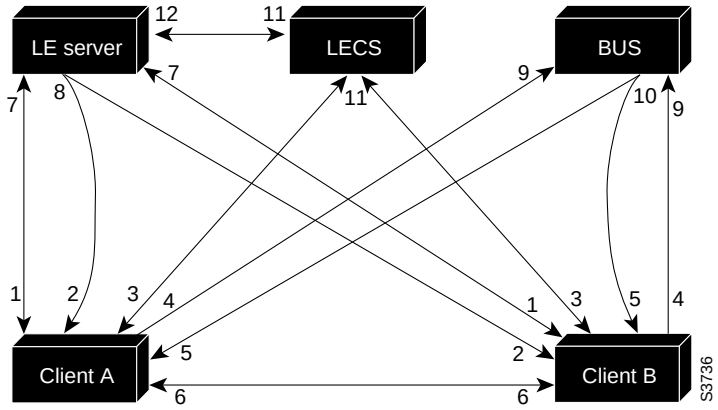
The LANE components are assigned as follows:

- Router 1 includes the following LANE components:
  - LECS (one per LANE switch cloud)
  - LES and BUS for the manufacturing ELAN
  - LES and BUS functions for the engineering ELAN
  - LEC for the manufacturing ELAN
  - LEC for the engineering ELAN
- Catalyst 5000 series switch 1 includes the following LANE components:
  - LES and BUS for the marketing ELAN
  - LEC for the manufacturing ELAN
  - LEC for the marketing ELAN
- Catalyst 5000 series switch 2 includes only the LECs for the manufacturing ELAN and engineering ELAN.
- Catalyst 5000 series switch 3 includes only the LECs for the manufacturing ELAN and marketing ELAN.

Defining LANE Operation and Communication

Communication among LANE components is ordinarily handled by several types of switched virtual circuits (SVCs). Some SVCs are unidirectional; others are bidirectional. Some are point-to-point and others are point-to-multipoint. Figure 16 illustrates the various types of SVCs.

Figure 16 LANE VCC Types



1–7	Control Direct	4–9	Multicast Send
2–8	Control Distribute	5–10	Multicast Forward
3–11	Configure Direct (client)	6–6	Data Direct
		11-12	Configure Direct (server)

The following section describes LANE Operation and Communication processes, starting with an LEC requesting to join an ELAN after the component Catalyst 5000 series switches have been installed.

Comparing VLANs and ELANs

On the Catalyst 5000 series switch, a VLAN is a logical group of end stations, independent of physical location, with a common set of requirements. Currently, the Catalyst 5000 series switch supports a port-centric VLAN configuration. All end stations connected to ports belong to the same VLAN and are assigned to the same VLAN number. The VLAN number is only significant to the Catalyst 5000 series switch.

On an ATM network, an emulated LAN is called an ELAN and is designated by a name. You can configure some ELANs from a router and some from a Catalyst 5000 switch. You can configure some ELANs with unrestricted membership and some ELANs with restricted membership. You can also configure a default ELAN, which must have unrestricted membership.

To create a VLAN that spans multiple Catalyst 5000 series switches on an ATM network, you must assign the VLAN on each Catalyst 5000 series switch to the same ELAN. Use the **lane client ethernet** *vlan# elan-name* command to link the VLAN number with the ELAN name. You must use a router to allow communication between two or more ELANs, whether they are on the same or on different Catalyst 5000 series switches.

Joining an LEC to an ELAN

The following process (illustrated in Figure 16) normally occurs after an LEC has been enabled on the ATM module in a Catalyst 5000 series switch:

1 The LEC requests to join an ELAN.

The LEC sets up a connection to the LECS (bidirectional point-to-point Configure Direct VCC, link 1-7 in Figure 16) to find the ATM address of the LES for its ELAN.

The LECs find the LECS by using the following interface and addresses in the listed order:

- Locally configured ATM address
- Interim Local Management Interface (ILMI)
- Fixed address defined by the ATM Forum

2 The LECS identifies the LES.

Using the same VCC, the LECS returns the ATM address and the name of the LES for the LEC ELAN.

3 The LEC tears down Configure Direct VCC.

4 The LEC contacts the LES for its LAN.

The LEC sets up a connection to the LES for its ELAN (bidirectional point-to-point Control Direct VCC, link 1-7 in Figure 16) to exchange control traffic.

When a Control Direct VCC is established between an LEC and an LES, it remains established.

5 The LES verifies that the LEC is allowed to join the ELAN.

The LES for the ELAN sets up a connection to the LECS to verify that the LEC is allowed to join the ELAN (bidirectional point-to-point Server Configure VCC, link 11-12 in Figure 16). The LES configuration request contains the LEC MAC address, its ATM address, and the name of the ELAN. The LECS checks its database to determine whether the LEC can join that LAN; then it uses the same VCC to inform the LES whether the LEC is allowed to join.

6 The LES allows or does not allow the LEC to join the ELAN.

7 If allowed, the LES adds the LEC to the unidirectional point-to-multipoint Control Distribute VCC (link 2-8 in Figure 16) and confirms the join over the bidirectional point-to-point Control Direct VCC (link 1-7 in Figure 16). If not allowed, the LES rejects the join over the bidirectional point-to-point Control Direct VCC (link 1-7 in Figure 16).

8 The LEC sends LE ARP packets for the broadcast address, which is all 1s.

Sending LE ARP packets for the broadcast address returns the ATM address of the BUS. Then the LEC sets up the multicast send VCC (link 4-9 in Figure 16) and the BUS adds the LEC to the multicast forward VCC (link 5-10 in Figure 16) to and from the BUS.

Resolving ELAN Addressing

As communication occurs on the ELAN, each LEC dynamically builds a local LANE ARP (LE ARP) table. An LEC LE ARP table can also have static, preconfigured entries. The LE ARP table maps MAC addresses to ATM addresses.

Note LE ARP is not the same as IP ARP. IP ARP maps IP addresses (Layer 3) to Ethernet MAC addresses (Layer 2); LE ARP maps ELAN MAC addresses (Layer 2) to ATM addresses (Layer 2).

When an LEC first joins an ELAN, its LE ARP table has no dynamic entries, and the LEC has no information about destinations on or behind its ELAN. To learn about a destination when a packet is to be sent, the LEC begins the following process to find the ATM address corresponding to the known MAC address:

1. The LEC sends an LE ARP request to the LES for this ELAN (point-to-point Control Direct VCC, link 1-7 in Figure 16).
2. If the MAC address is registered with the LES, it returns the corresponding ATM address. If not, the LES forwards the LE ARP request to all LECs on the ELAN (point-to-multipoint Control Distribute VCC, link 2-8 in Figure 16).
3. Any LEC that recognizes the MAC address responds with its ATM address (point-to-point Control Direct VCC, link 1-7 in Figure 16).
4. The LES forwards the response (point-to-multipoint Control Distribute VCC, link 2-8 in Figure 16).
5. The LEC adds the MAC address-ATM address pair to its LE ARP cache.
6. The LEC can establish a VCC to the desired destination and transmit packets to that ATM address (bidirectional point-to-point Data Direct VCC, link 6-6 in Figure 16).

For unknown destinations, the LEC sends a packet to the BUS, which forwards the packet to all LECs. The BUS floods the packet because the destination might be behind a bridge that has not yet learned this particular address.

Sending Multicast Traffic

When an LEC sends broadcast, multicast, or unicast traffic with an unknown address, the following process occurs:

- The LEC sends the packet to the BUS (unidirectional point-to-point Multicast Send VCC, link 4-9 in Figure 16).
- The BUS forwards (floods) the packet to all LECs (unidirectional point-to-multipoint Multicast Forward VCC, link 5-10 in Figure 16).

  This VCC branches at each switch. The switch forwards such packets to multiple outputs. (The switch does not examine the MAC addresses; it simply forwards all packets it receives.)

Addressing

On a LAN, packets are addressed by the MAC-layer addresses of the destination and source stations. To provide similar functionality for LANE, MAC-layer addressing must be supported. Every LEC must have a MAC address. In addition, every LANE component (LECS, LES, BUS, and LEC) must have a unique ATM address.

In this release, all LECs on the same interface have the same, automatically assigned MAC address. That MAC address is also used as the end-system identifier (ESI) part of the ATM address, as explained in the following section. Although LEC MAC addresses are not unique, all ATM addresses are unique.

Defining LANE ATM Addressing Structure

A LANE ATM address has the same syntax as an NSAP, but it is not a network-level address. It consists of the following:

- A 13-byte prefix that includes the following fields defined by the ATM Forum: AFI (Authority and Format Identifier) field (1 byte), DCC (Data Country Code) or ICD (International Code Designator) field (2 bytes), DFI field (Domain Specific Part Format Identifier) (1 byte), Administrative Authority field (3 bytes), Reserved field (2 bytes), Routing Domain field (2 bytes), and Area field (2 bytes)
- A 6-byte end-system identifier (ESI)
- A 1-byte selector field

Automatically Assigning ATM Addresses

Cisco provides the following standard method of constructing and assigning ATM and MAC addresses for use in an LECS database. A pool of MAC addresses is assigned to each ATM module. The pool contains 16 MAC addresses. For constructing ATM addresses, the following assignments are made to the LANE components:

- The prefix fields are the same for all LANE components in routers and the Catalyst 5000 ATM modules; the prefix indicates the identity of the switch. The prefix value must be configured on the switch.
- The ESI field value assigned to every *LEC* on the interface is the first of the pool of MAC addresses assigned to the interface.
- The ESI field value assigned to every *LES* on the interface is the second of the pool of MAC addresses.
- The ESI field value assigned to the *BUS* on the interface is the third of the pool of MAC addresses.
- The ESI field value assigned to the *LECS* is the fourth of the pool of MAC addresses.
- The selector field value is set to the subinterface number of the LANE component—except for the LECS, which has a selector field value of 0.

Because the LANE components are defined on different subinterfaces of an ATM interface, the value of the selector field in an ATM address is different for each component. The result is a unique ATM address for each LANE component, even within the same Catalyst 5000 series switch. For more information about assigning components to subinterfaces, see the “Assigning Components to Interfaces and Subinterfaces” section later in this chapter.

For example, if the MAC addresses assigned to an interface are 0800.200C.1000 through 0800.200C.100F, the ESI part of the ATM addresses are assigned to LANE components as follows:

- Any LEC gets the ESI 0800.200c.1000
- Any LES gets the ESI 0800.200c.1001
- The BUS gets the ESI 0800.200c.1002
- The LECS gets the ESI 0800.200c.1003

Using ATM Address Templates

ATM address templates can be used in many LANE commands that assign ATM addresses to LANE components (thus overriding automatically assigned ATM addresses), or that link LEC ATM addresses to ELANs. The use of templates can greatly simplify the use of these commands. The syntax of address templates, the use of address templates, and the use of wildcard characters within an address template for LANE are very similar to those of address templates for ISO CLNS.

Note E.164-format ATM addresses do not support the use of LANE ATM address templates.

LANE ATM address templates can use two types of wildcards: an asterisk (*) to match any single character, and an ellipsis (...) to match any number of leading or trailing characters.

In LANE, a *prefix template* explicitly matches the prefix but uses wildcards for the ESI and selector fields. An *ESI template* explicitly matches the ESI field but uses wildcards for the prefix and selector. Table 6 indicates how the values of unspecified bytes are determined when an ATM address template is used.

Table 6 ATM Address Template Values

Unspecified Digits	Where to Obtain Value
Prefix (first 13 bytes)	Switch via ILMI, or configured locally if ILMI is not supported on the switch.
ESI (next 6 bytes)	Slot MAC address[1] plus • 0—LANE LEC • 1—LANE LES • 2—LANE BUS • 3—LECS
Selector field (last 1 byte)	Subinterface number, in the range 0 through 255.

1. The Catalyst 5000 series switch ATM card has a pool of 16 MAC addresses.

Assigning Components to Interfaces and Subinterfaces

The following rules apply to assigning LANE components on the major ATM interface and its subinterfaces:

- The LECS is always assigned to the major interface.

  Assigning any other component to the major interface is identical to assigning that component to the .0 subinterface.

- The LES and the LEC of the *same* ELAN can be configured on the same subinterface.
- LECs of two *different* ELANs cannot be configured on the same subinterface.
- Servers of two *different* ELANs cannot be configured on the same subinterface.

Registering ILMI Address

The Catalyst 5000 ATM module uses ILMI registration to build its ATM address and to register this address with the ATM switch. To build its ATM address, the Catalyst 5000 obtains its ATM address prefix from the ATM switch. Then it combines the ATM address prefix with its own MAC address and the LEC subinterface number. Once the Catalyst ATM module has determined its ATM address, it uses ILMI registration to register this address with the ATM switch.

Using the **atm vc-per-vp** command, you can configure the maximum number of VCIs per VPI. If this value is configured, when the Catalyst 5000 ATM module registers with the ATM switch, the maximum number of VCIs per VPI is also passed to the ATM switch. In this way, the ATM switch will not assign a VCI value for an SVC to the Catalyst 5000 that is out of the ATM switch's range. The default is 10 VCI bits, and 2 VPI bits on the Catalyst 5000 ATM module. Any change from the default requires an ATM module reset.

Using UNI 3.1 Signaling Support

The ATM LAN Emulation module, Dual PHY, supports backward compatibility with ATM switches for User- Network Interface version 3.1. The version, 3.0 or 3.1, is negotiated on startup by Interim Local Management Interface (ILMI) upon startup and requires no configuration. When Interim Local Management Interface link auto-determination is enabled on the interface and is successful, the router accepts the UNI-version returned by ILMI. If the ILMI link auto-determination is unsuccessful or ILMI is disabled, UNI-version defaults to 3.0. You can override the version number using the atm uni-version command. When you use the **no** value of the command and if ILMI is enabled, the UNI-version is set to the version returned by ILMI and the link auto-determination is successful. Otherwise, the version reverts to 3.0. Use the following command to override the UNI-version:

[no] atm uni-version [3.0 | 3.1]

Using VLAN Trunk Protocol

When VLANs are added to a Catalyst 5000 series switch in a management domain, VLAN Trunk Protocol (VTP) automatically distributes information to other trunks of all of the devices in the domain. The VTP is transmitted on all trunk connections, including Interswitch Link (ISL) and 802.10, and LANE. VTP is disabled by default on your Catalyst 5000 series ATM switch and must be explicitly enabled. VTP functionality works only with the Network Management Processor (NMP) software version 2.1 or later and ATM software version 3.1 or later.

Setting Up an LEC Using VTP

VTP running on the Catalyst 5000 series Supervisor module allows you to set up VLAN-to-LEC/ELAN mapping and establish LECs on the ATM module. This section describes the procedure for creating an LEC on each ATM module of a Catalyst 5000 series switch.

Procedure for Setting Up an LEC with VTP

You can create an LEC on each ATM module of every Catalyst 5000 series module in a specificified VTP domain. The following procedure sets up an LEC for VLAN 1:

Task		Command
Step 1	Enable VTP.	Enter the commands shown in the section "Setting Up VTP."
Step 2	From the Supervisor module, create an LEC on each ATM module of all Catalyst 5000 switches on a specified VTP domain.	**set vlan** <*vlan#*> default The name "default" is the ELAN name for VLAN 1.

The value <*vlan_num*> represents the vlan number to configure, and the *elan-name* is the name of the ELAN.

You can use VTP to set up an LEC in transparent mode or nontransparent mode. When VTP is enabled and your switch is in transparent mode, entering the **set vlan <*vlan#*> [name <*elan name*>]** command creates LECs on all ATM modules of only the switch on which you enter the command.

In nontransparent mode, the **set vlan <*vlan#*> [name <*elan -name*>]** command entered from the Supervisor module of any Catalyst 5000 series switch automatically creates an LEC for that VLAN/ELAN-name pair on all ATM modules on Catalyst 5000 series switches in that VTP domain.

To find your current mode and domain, use the **show vtp domain** command.

Setting Up VTP

This section describes the prerequisites and procedures for setting up VTP.

Prerequisites

When you set up an LEC using VTP, the following prerequisites apply:

- Make sure you have properly configured the LECS/LES/BUS using the ATM module command line interface (CLI) for each VLAN before creating an LEC. VTP sets up only LECs. It does not set up the LECS/LES/BUS.
- You can change all ELAN names with the exception of VLAN #1, whose ELAN name must remain "default." You cannot override the ELAN name for VLAN 1 (default) by using the **[name** <*elan name*>**]** parameter. You can assign all other VLANs any name.

  When you enter the **set vlan** <*vlan#*> **[name <*e*lan *name*>]** command in transparent mode and do not specify the optional name <*elan name*>, the software uses the following names by default:

VLAN #	ELAN Name
1	default
2	VLAN0002
3	VLAN0003
4	VLAN0004
5	VLAN0005
...1005	...VLAN1005

- If you currently have a different ELAN name for VLAN 1, then you must change the ELAN name to “default” in the LECS database.The following example screen display indicates the location of the name changes.

  For example, you may have the following old configuration in your LECS database:

```
lane database test
name marktng server-atm-address 47.00918100000000061705B8301.00400B020011.01
!
interface ATM0
no ip address
no ip route-cache
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane config auto-config-atm-address
lane config database test
!
interface ATM0.1 multipoint
no ip route-cache
lane server-bus ethernet marktng
lane client ethernet 1 marktng
```

  You need to modify the old configuration in the following way, where the name “marktng” is replaced with the name “default” in the second and last lines of the display:

```
lane database test
name default server-atm-address 47.00918100000000061705B8301.00400B020011.01
!
interface ATM0
no ip address
no ip route-cache
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane config auto-config-atm-address
lane config database test
!
interface ATM0.1 multipoint
no ip route-cache
lane server-bus ethernet default
lane client ethernet 1 default
```

  The last line of the above screen display appears automatically after VTP is enabled.

Procedure for Setting Up VTP

To enable VTP for VLAN 1, enter the following commands:

Task		Command
Step 1	Session to the ATM module.	**session** ***mod_num***
Step 2	Activate the privileged mode on the ATM module.	**enable**
Step 3	Enter the configuration mode.	**configure terminal**
Step 4	Enable VTP.	**vtp enable**
Step 5	Exit the configuration mode.	**CNTL/Z**
Step 6	Write the current configuration to NVRAM.	**write memory**
Step 7	Return to the Supervisor console.	**exit**

Note Cisco recommends that you reboot the ATM module for VTP to take effect.

To disable VTP, enter the following command:

no vtp enable

Configuring PVC-supported VLANs on a Catalyst 5000 Series ATM Module

To use permanent Virtual Circuits (PVCs), you must configure PVCs into both the Catalyst 5000 series ATM module and the ATM switch cloud. PVCs remain active until the circuit is removed from either configuration.

PVC-based ATM link functionality allows Catalyst 5000 series switches connectivity to each other through ATM interfaces over PVCs. One or more PVCs can be configured for each VLAN on every Catalyst 5000 series ATM module. Connectivity can be back-to-back or through an ATM switch cloud. RFC 1483-compliant bridged LLC/SNAP packet encapsulation is used.

When you create a PVC, you create a virtual circuit descriptor (VCD*)* and attach it to the Virtual Path Identifier (VPI) and Virtual Channel Identifier(VCI). A VCD is a mechanism that identifies which VPI-VCI pair to use for a particular packet. The Catalyst 5000 ATM module requires this feature to manage the packets for transmission. The number chosen for the VCD is independent of the VPI-VCI pair used.

This functionality is compatible with Switched Virtual Connection (SVC)-based LANE with the following restrictions:

- You can configure a VLAN using either LANE or PVCs. You cannot configure the same VLAN to use both PVCs and LANE simultaneously.
- Only RFC 1483 bridged Ethernet LLC/SNAP encapsulation is supported.
- If two PVCs are configured on the same VLAN on the same ATM module, packets received from one PVC are not forwarded to the other PVC.

Setting Up a PVC within the ATM Cloud

To configure a PVC within the ATM cloud, refer to the appropriate manual from your switch vendor.

Setting Up a VLAN over PVCs

The ATM module supports a VLAN using either LANE or Permanent Virtual Circuits (PVCs).This section describes the procedure and gives an example for setting up a VLAN to run over PVCs on the Catalyst 5000 series ATM module.

Procedure for Setting Up VLANs over PVCs

Use the following procedure to set up a VLAN to run over PVCs on the Catalyst 5000 series ATM module.

Task		Commands
Step 1	Activate the privileged mode on the Supervisor module.	**enable**

Task		Commands
Step 2	Enter your password.	*password*
Step 3	Assign an Ethernet port to the specified VLAN.	**set vlan *vlan_num***
Step 4	Start a session to the ATM module.	**session** *mod_num*
Step 5	Activate the privileged mode on the ATM module.	**enable**
Step 6	Enter the configuration mode.	**configure terminal**
Step 7	Select the ATM interface.	**interface atm0**
Step 8	Set up the PVCs.	**atm pvc** <*vcd*> <*vpi*> <*vci*> **aal5snap**
Step 9	Bind the PVCs to the VLAN.	**atm bind pvc vlan <vcd>** <*vlan number*>
Step 10	Set up other PVCs for the same VLAN if needed by repeating steps 8 and 9.	
Step 11	Exit configuration mode.	**CNTL/Z**
Step 12	Verify the setup.	**show atm vlan** **show atm vc**
Step 13	Write the configuration to NVRAM.	**write memory**

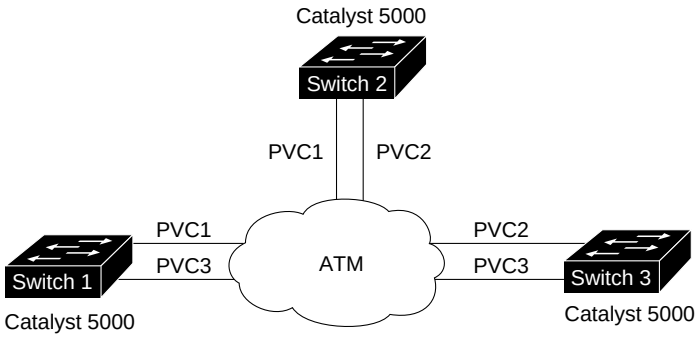
If you have enabled VTP in the ATM module, the Catalyst 5000 series ATM module creates LECs for each VLAN configured on the Supervisor module. The ATM module software also automatically deletes a previously existing LEC for a particular VLAN when that LEC subsequently is configured to run over a PVC.

Note The **atm bind pvc vlan <*vcd*> <*vlanid*>** command is valid only for the current software release and may change in future releases.

Example Configuration

Figure 17 is an example of setting up a VLAN to run over a PVC on the Catalyst 5000 series ATM module.

Figure 17 VLANs over PVCs



PVC	VLAN	VPI	VCI
1	5	0	31
2	5	0	32
3	5	0	33

Example Configuration Assumptions

The following assumptions apply to this example:

- All prerequisite tasks have been performed.
- The configuration in Figure 17 involves the following VLAN and switch connections:

Table 7 PVC Connections in Figure 17

PVC	VLAN/Switch Connections
1	Connects VLAN 5 on Switch 1 to VLAN 5 on Switch 2
2	Connects VLAN 5 on Switch 2 to VLAN 5 on Switch 3
3	Connects VLAN 5 on Switch 1 to VLAN 5 on Switch 3

- PVC3 is required for Switch 1 to communicate with Switch 3, because the ATM Module on Switch 2 does not forward packets received from Switch 1 on PVC1 to Switch 3 on PVC2.
- The ATM module is in slot 2.

Example Prerequisites

Before configuring the VLAN over PVCs, you must have performed the following tasks:

- Verified that you have Catalyst 5000 ATM module software version 3.1 or greater in order to run a VLAN over the PVC
- Obtained the VLAN number to be configured
- Obtained the Virtual Path Identifier (VPI) and Virtual Channel Identifier (VCI) for each of the PVCs to be configured
- Set up PVCs within the ATM cloud

Example Configuration Procedure

You must configure one PVC connection between each pair of Catalyst 5000 ATM switches for each VLAN on a particular Catalyst 5000 ATM module. Follow these steps at Switch 1 to configure a VLAN to run over a PVC:

Step 1 Activate the privileged mode on the Supervisor module:

```
enable
```

Step 2 Enter your password.

Step 3 Assign an Ethernet port to VLAN 5:

```
set vlan 5
```

Step 4 Start a session to the ATM module:

```
session 2
```

Step 5 Activate the privileged mode on the ATM module:

```
enable
```

You see the example screen:

```
Console> enable
Console> (enable) session 2
Trying ATM-2...
Connected to ATM-2.
Escape character is '^]'.
```

Step 6 Enter the configuration mode:

```
configure terminal
```

Step 7 Select the ATM interface:

```
interface atm0
```

All PVC-related configurations for VLANs can be performed on **atm0**, the major interface, since the subinterface number has no significance in the case of PVC-supported VLANs.

Step 8 Set up the PVCs for Switch 1:

```
atm pvc 10 0 31 aal5snap
atm pvc 11 0 31 aal5snap
```

The Virtual Circuit Descriptor (VCD) numbers 10 and 11 can be any unused VCDs.To find unused VCDs, enter the command **show atm vc**.

You see the example screen of the ATM module below.

```
ATM>enable
ATM#configure terminal
ATM(config)#interface atm0
ATM(config-if)#atm pvc 10 0 31 aal5snap
ATM(config-if)#atm pvc 11 0 33 aal5snap
```

Step 9 Bind the PVCs by entering the following commands at the ATM module:

(a) Bind PVC 10 to VLAN 5.

```
atm bind pvc vlan 10 5
```

(b) Bind PVC 11 to VLAN 5.

```
atm bind pvc vlan 11 5
```

You see the following screen:

```
ATM(config-if)#atm bind pvc vlan 10 5
ATM(config-if)#atm bind pvc vlan 11 5
```

Be sure to use the VCD numbers applied in step 2. The last value in the syntax (5) represents the VLAN number.

Performing this step deletes a previously configured LEC for VLAN 5. You can bind any number of PVCs to the same VLAN by performing steps 3 and 4. To prevent loops, you each PVC must uniquely connect a VLAN group between two Catalyst 5000 series switches.

Step 10 Exit the configuration mode:

```
CNTL/Z
```

Step 11 Verify the setup by displaying all VLANs and virtual circuits:

```
show atm vlan
show atm vc
```

The ATM module always sets up the AAL5-SAAL and AAL5-ILMI PVCs, even if LANE is not running. You see the example screen below.

```
ATM(config-if)#end
ATM#show atm vlan
VCD     VLAN-ID
10     5
11     5
ATM#show atm vc
                                        AAL /         Peak   Avg.  Burst
Interface     VCD   VPI   VCI Type  Encapsulation  Kbps   Kbps  Cells Status
ATM0            1     0     5  PVC  AAL5-SAAL          0      0     0 ACTIVE
ATM0            2     0    16  PVC  AAL5-ILMI          0      0     0 ACTIVE
ATM0           10     0    31  PVC  AAL5-SNAP          0      0     0 ACTIVE
ATM0           11     0    33  PVC  AAL5-SNAP          0      0     0 ACTIVE

ATM#wr mem
Building configuration...
[OK]
ATM#
```

Step 12 Write the configuration to NVRAM and restart Switch 1:

```
write memory
```

Step 13 Configure Switch 2 and Switch 3 by repeating steps 1 through 6 using appropriate values for each switch.

Removing Previously Assigned PVCs from a VLAN

You can remove and unbind a previously assigned PVC from a VLAN. You can also unbind a previously assigned PVC from a VLAN without removing the PVC itself. If you do not remove the PVC itself, you can bind the PVC to a different VLAN.

Procedures for Removing Previously Assigned PVCs

To remove a previously assigned PVC from a VLAN, perform the following tasks:

Task		Command
Step 1	Activate the privileged mode on the ATM module.	**enable**
Step 2	Enter the configuration mode.	**configure terminal**
Step 3	Select the ATM interface.	**interface atm0**
Step 4	Remove the PVC from the VLAN.	**no atm pvc** <*vcd*>
Step 5	End the session.	**CTRL/Z**

To unbind a previously assigned PVC from a VLAN without removing the PVC itself, perform the following tasks:

Task		Command
Step 1	Activate the privileged mode on the ATM module.	**enable**
Step 2	Enter the configuration mode.	**configure terminal**
Step 3	Select the ATM interface.	**interface atm0**
Step 4	Unbind the PVC from the VLAN.	**no atm bind pvc vlan** <*vcd*> <*vlan number*>
Step 5	End the session.	**CTRL/Z**

Output Throttling

This section contains procedures for configuring output throttling. You can configure output throttling on your Catalyst 5000 series ATM module. Output throttling applies to both LANE and to PVCs. Per-VC pacing is not supported.

Procedures for Output Throttling

To throttle the output of the entire interface, perform the following tasks:

Task		Command
Step 1	Activate the privileged mode on the ATM module.	**enable**
Step 2	Select the ATM interface.	**interface atm0**
Step 3	Apply output throttling.	**atm traffic-shape rate** <*number between 1-155 indicating Mbps*>
Step 4	End the session.	**CTRL/Z**

To put the output rate to the default of 155 MBps, perform the following tasks:

Task		Command
Step 1	Activate the privileged mode on the ATM module.	**enable**
Step 2	Select the ATM interface.	**interface atm0**
Step 3	Disable output throttling	**no atm traffic-shape rate** <*number between 1-155 indicating Mbps*>
Step 4	End the session.	**CTRL/Z**

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- WWW: `http://www.cisco.com`.
- Telnet: `cco.cisco.com`.
- Modem: From North America, 408 526-8070; from Europe, 33 1 64 46 40 82. Use the following terminal settings: VT100 emulation; databits: 8; parity: none; stop bits: 1; and baud rates up to 14.4 kbps.

For a copy of CCO's Frequently Asked Questions (FAQ), contact `cco-help@cisco.com`. For additional information, contact `cco-team@cisco.com`.

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This document is to be used in conjunction with the *Catalyst 5000 series Switch Installation Guide* publication.

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