Doc. No. 78-2941-03

Catalyst 5000 Series Release Notes for ATM Software Release 2.2

This release note describes the features, caveats, and modifications for the Catalyst 5000 series ATM Software Release 2.2. It contains the following sections:

Catalyst 5000 Series Documentation

The following documents are available for the Catalyst 5000 series switch:

- *Catalyst 5000 Series Installation Guide*
- *Catalyst 5000 Series Hardware Installation and Maintenance*
- *Catalyst 5000 Series Configuration Guide and Command Reference*
- *Catalyst 5000 Series Release Notes*

These documents are available in printed form and in electronic form on UniverCD.

New Features in ATM Software Release 2.2

The following two modifications have been made in ATM Module Software Release 2.2:

- ATM module software release 2.2 contains corrections for offline manufacturing diagnostics.
- The LE-ARP control timer (C7) has been reduced to 10 seconds for faster LE-ARP retries in ATM module software release 2.2.

New Features in ATM Software Release 2.1

Some commands have been changed and new commands added in ATM Module Software Release 2.1. These commands were created or modified to support LAN emulation (LANE), that is, emulated LANs (ELANs). Using a Catalyst 5000 ATM module, you can now directly set up the following client and servers:

- LANE server (LES)
- LANE broadcast-and-unknown server (BUS)
- LANE configuration server (LECS)
- LANE client (LEC)

Although the Cisco routers with ATM interfaces can still supply all LANE functions, you are no longer required to use a router to configure the LES, BUS, and LECS.

Implementation of LAN Emulation (LANE)

The implementation of 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 of whether the hardware moves.

Network Support

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

Hardware Support

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

LANE Components

An unlimited number of ELANs can be set up in an ATM switch 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 clients 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. Clients can register destination unicast and multicast MAC addresses with the LES. The LES also handles LANE ARP (LE ARP) requests and responses.

  The current Cisco implementation has a limit of one LES per ELAN.

- LANE broadcast-and-unknown server (BUS)

  The LANE BUS sequences and distributes multicast and broadcast packets and handles unicast flooding.

  One combined LES and BUS is required per ELAN.

- LANE configuration server (LECS)

The LECS contains the database that determines which ELAN a device belongs to (each configuration server 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.

One LECS is required per ATM LANE switch cloud.

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

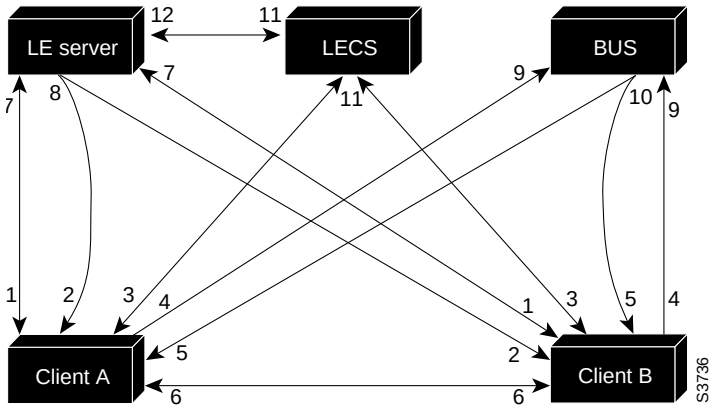
- {*ELAN name*, *ATM address of LES*} pairs
- {*LEC MAC address*, *ELAN name*} pairs
- {*LEC ATM template*, *ELAN name*} pairs
- Default ELAN name

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

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 1 illustrates the various types of SVCs. In this figure, *LECS* stands for the LECS, and *BUS* stands for the LANE BUS.

Figure 1 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 a client requesting to join an ELAN after the component Catalyst 5000 series switches have been installed.

How a Client Joins an ELAN

The following process (illustrated in Figure 1) normally occurs after a LEC has been enabled on the ATM module in a Catalyst 5000 series switch:

1. The client requests to join an ELAN.

   The client sets up a connection to the LECS (bidirectional point-to-point Configure Direct VCC, link 1-7 in Figure 1) 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 configuration server identifies the LES.

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

3. The client tears down Configure Direct VCC.

4. The client contacts the server for its LAN.

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

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

5. The server verifies that the client is allowed to join the ELAN.

   The server for the ELAN sets up a connection to the LECS to verify that the client is allowed to join the ELAN (bidirectional point-to-point Server Configure VCC, link 11-12 in Figure 1). The server's configuration request contains the client's MAC address, its ATM address, and the name of the ELAN. The LECS checks its database to determine whether the client can join that LAN; then it uses the same VCC to inform the server whether the client is allowed to join.

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

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

7. 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 client sets up the multicast send VCC (link 4-9 in Figure 1) and the BUS adds the client to the multicast forward VCC (link 5-10 in Figure 1) to and from the BUS.

Address Resolution

As communication occurs on the ELAN, each client dynamically builds a local LANE ARP (LE ARP) table. A client's 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 (also layer 2).

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

1. The client sends an LE ARP request to the LES for this ELAN (point-to-point Control Direct VCC, link 1-7 in Figure 1).
2. If the MAC address is registered with the server, it returns the corresponding ATM address. If not, the LES forwards the LE ARP request to all clients on the ELAN (point-to-multipoint Control Distribute VCC, link 2-8 in Figure 1).
3. Any client that recognizes the MAC address responds with its ATM address (point-to-point Control Direct VCC, link 1-7 in Figure 1).
4. The LES forwards the response (point-to-multipoint Control Distribute VCC, link 2-8 in Figure 1).
5. The client adds the MAC address-ATM address pair to its LE ARP cache.
6. The client 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 1).

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

Multicast Traffic

When a LEC has broadcast or multicast traffic, or unicast traffic with an unknown address to send, the following process occurs:

- The client sends the packet to the BUS (unidirectional point-to-point Multicast Send VCC, link 4-9 in Figure 1).
- The BUS forwards (floods) the packet to all clients (unidirectional point-to-multipoint Multicast Forward VCC, link 5-10 in Figure 1).

  This VCC branches at each ATM 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 (server, client, BUS, and configuration server) 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 client MAC addresses are not unique, all ATM addresses are unique.

LANE ATM Addresses

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 a 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 *client* on the interface is the first of the pool of MAC addresses assigned to the interface.
- The ESI field value assigned to every *server* 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 *configuration server* 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 “Rules for 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 client gets the ESI 0800.200c.1000.
- Any server gets the ESI 0800.200c.1001.
- The BUS gets the ESI 0800.200c.1002.
- The LECS gets the ESI 0800.200c.1003.

Refer to the example sections "Multiple ELANs with Unrestricted Membership" and "Multiple ELANs with Restricted Membership" for examples using MAC address values as ESI field values in ATM addresses, and for examples using subinterface numbers as Selector field values in ATM addresses.

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 client 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 1 indicates how the values of unspecified bytes are determined when an ATM address template is used.

Table 1 ATM Address Template Values

Unspecified Digits In	Value Is
Prefix (first 13 bytes)	Obtained from ATM switch via ILMI, or configured locally if ILMI is not supported on the ATM switch.
ESI (next 6 bytes)	Filled with the slot MAC address[1] plus • 0—LANE client (LEC) • 1—LANE server (LES) • 2—LANE broadcast-and-unknown server (BUS) • 3—Configuration server
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.

Rules for 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.

  If any other component is assigned to the major interface, it is identical to assigning that component to the .0 subinterface.

- The server and the client of the *same* ELAN can be configured on the same subinterface.
- Clients of two *different* ELANs cannot be configured on the same subinterface.
- Servers of two *different* ELANs cannot be configured on the same subinterface.

ILMI Address Registration

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 0 VPI bits on the Catalyst 5000 ATM module. Any change from the default requires an ATM module reset.

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. 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.

Typical 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 instead of Cisco routers with ATM interfaces to configure the LECS (LECS), LANE server (LES), and LANE BUS.

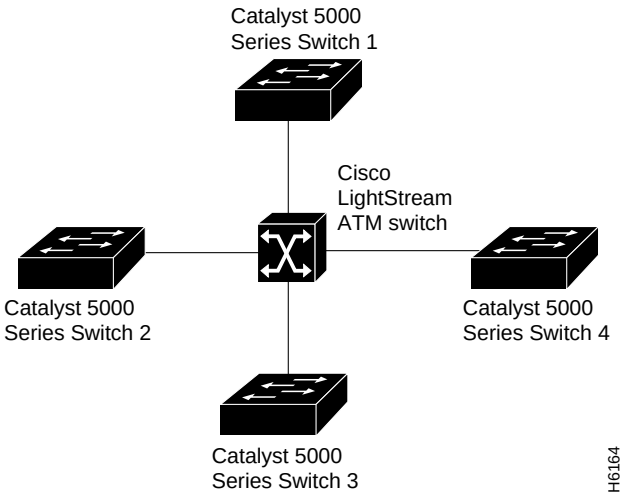
The physical layout and the physical components of an emulated network might not differ for the single and the multiple ELAN cases. The differences are in the software configuration for the number of ELANs and the assignment of LANE components to the different physical components.

LANE Scenarios with Catalyst 5000 Switches Only

In typical LANE cases using Catalyst 5000 series switches only, one or more Catalyst 5000 series switches are attached to a Cisco LightStream ATM switch. The Cisco LightStream ATM switch provides connectivity to the broader ATM network switch cloud. The Catalyst 5000 series switches are configured to support one or more ELANs. One of the Catalyst 5000 series switches is configured to perform the LECS functions. Another Catalyst 5000 series switch is configured to perform the server function and the BUS function for each ELAN. (One Catalyst 5000 series switch can perform the server and the BUS functions for several ELANs.) A Catalyst 5000 series switch can act as a LEC for one or more ELANs.

This section presents two scenarios using Catalyst 5000 series switches and a Cisco LightStream ATM switch. Figure 2 illustrates the use of four Catalyst 5000 series switches and one Cisco LightStream ATM switch; it illustrates both the single and the multiple ELAN cases.

Figure 2 ELAN Layout with Catalyst 5000 Switches Only



Single ELAN Scenario with Catalyst 5000 Switches Only

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

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

Multiple ELAN Scenario with Catalyst 5000 Switches Only

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

The LANE components are assigned as follows:

- Catalyst 5000 Switch 1 includes the following LANE components:
  - The LECS (one per LANE switch cloud)
  - The LES and BUS for the manufacturing ELAN
  - An LEC for the manufacturing ELAN
  - An LEC for the engineering ELAN
- Catalyst 5000 series switch 2 includes the following LANE components:
  - The LES and BUS for the marketing ELAN
  - An LEC for the manufacturing ELAN
  - An LEC for the marketing ELAN
- Catalyst 5000 series switch 3 includes the following LANE components:
  - The LES and BUS functions for the engineering ELAN
  - An LEC for the manufacturing ELAN
  - An LEC for the engineering ELAN
- Catalyst 5000 series switch 4 includes only the LECs for the manufacturing ELAN and marketing ELAN.

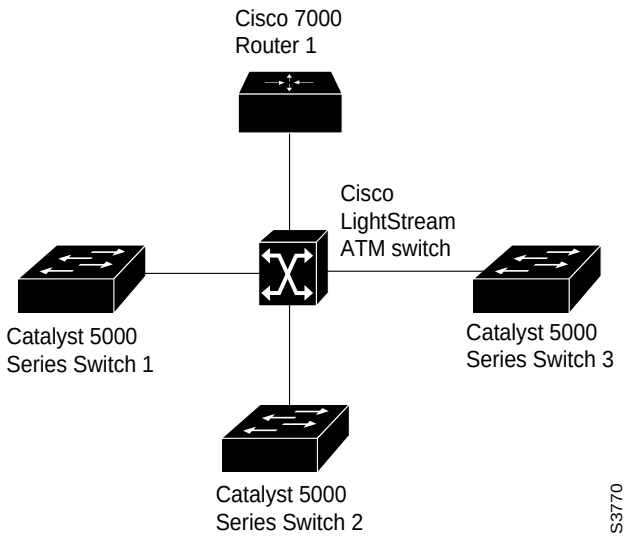
LANE Scenarios with Catalyst 5000 Switches and Routers

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 server function and the BUS function for each ELAN. (One router can perform the server and the BUS functions for several ELANs.) Routers and Catalyst 5000 series switches can act as a LEC for one or more ELANs.

Note A Catalyst 5000 Series Switch can also be used as a LES and BUS.

This section presents two scenarios using a router, Catalyst 5000 series switches, and a Cisco LightStream ATM switch. Figure 3 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 3 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:
  - The LECS (one per LANE switch cloud)
  - The LES and BUS for the manufacturing ELAN
- Catalyst 5000 series switch 1 includes a LEC for the manufacturing ELAN.
- Catalyst 5000 series switch 2 includes a LEC for the manufacturing ELAN.
- Catalyst 5000 series switch 3 includes a LEC for the manufacturing ELAN.

Refer to the "Default Configuration for a Single ELAN" section for an illustrated example of this scenario.

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. Refer to the example sections "Multiple ELANs with Unrestricted Membership" and "Multiple ELANs with Restricted Membership" for detailed examples.

The LANE components are assigned as follows:

- Router 1 includes the following LANE components:
  - The LECS (one per LANE switch cloud)
  - The LES and BUS for the manufacturing ELAN
  - The LES and BUS functions for the engineering ELAN
  - An LEC for the manufacturing ELAN
  - An LEC for the engineering ELAN

- Catalyst 5000 series switch 1 includes the following LANE components:
  - The LES and BUS for the marketing ELAN
  - An LEC for the manufacturing ELAN
  - An 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.

LANE Configuration Task List

Before you begin to configure LANE, you must decide whether you want to set up one or multiple ELANs and, if multiple, where the servers and clients will be located, and whether to restrict the clients that can belong to each ELAN. Once you have made those basic decisions, you can proceed to configure LANE. Some of the tasks required to configure LANE are performed on a Cisco LightStream ATM switch.

The following sections describe the tasks required to configure LANE:

- Create a LANE Plan and Worksheet.
- Configure the Prefix on the ATM Switch.
- Set Up LESs and Display Their ATM Addresses.
- Set Up LECs and Display Their ATM Addresses.
- Set Up the Configuration Server's Database.
- Enable the Configuration Server and Display Its ATM Address.
- Enter the Configuration Server's ATM Address on the Cisco LightStream ATM switch.

Note The order of tasks in this section is designed to take advantage of the ability of the Catalyst 5000 to display ATM addresses. Displaying the ATM addresses of servers and clients 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 configuration server's database—especially for ELANs with restricted membership.

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.

Once LANE is configured, you can monitor and maintain the components in the participating Catalyst 5000 ATM modules and optional routers by completing the tasks in the "Monitor and Maintain the LANE Components" section.

Create a LANE Plan and Worksheet

It might help you to begin if you draw up a plan and a worksheet for your own LANE scenario; include the following information, and leave space for the ATM address of each LANE component on each subinterface of each participating device. The last three items in this list are very important; they determine how you set up each ELAN in the configuration server's database:

- The Catalyst 5000 series switch and interface where the LECS will be located
- The Catalyst 5000 series switch and interface where the LES 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)
- The names of the ELANs that will have unrestricted membership
- The names of the ELANs that will have restricted membership

Configure the Prefix on a Cisco LightStream ATM Switch

Before you configure LANE components on Catalyst 5000 switches, you must configure a Cisco LightStream ATM switch with the ATM address prefix to be used by all LANE components in the switch cloud.

To set the ATM address prefix, complete the following steps on the Cisco LightStream ATM switch:

Task	Command
Set the local node ID (prefix of the ATM address).	**set local** *name ip-address mask prefix*[1]
Save the configuration values permanently.	**save**

1. On the Cisco LightStream ATM Switch, the ATM address prefix is called the node ID. Prefixes must be 26 digits long. If you provide fewer than 26 digits, zeros are added to the right of the specified value to fill it to 26 digits.

Note LANE prefixes must start with 39 or 47.

On the Cisco LightStream ATM Switch, you can display the current prefix by using the **show network** command.

Note If you do not save the configured value permanently, it will be lost when the switch is reset or powered off.

Set Up and Display Addresses for LESs and Clients

For each Catalyst 5000 series switch that will participate in LANE, set up the necessary clients for each ELAN; then display and record the client ATM addresses. Be sure to keep track of the Catalyst 5000 series switch or router interface where the LECS will eventually be located.

If you are going to have only one default ELAN, you will have only one server to set up. If you are going to have multiple ELANs, you can set up the server for another ELAN on a different subinterface on the same interface of this router—or you can place it on a different Catalyst 5000 switch.

To set up only a client on a subinterface, complete the steps in the "Set Up the Signaling and ILMI PVCs" section and the "Set Up Only a Client on a Subinterface" section.

Client location is important, because any router with clients for multiple ELANs can route frames between those ELANs.

To set up the server, BUS, and a client on the same subinterface, complete the steps in the following sections:

- Set Up the Signaling and ILMI PVCs
- Set Up the Server, BUS, and a Client on a Subinterface

To set up only a client on a subinterface, complete the steps in the following sections:

- Set Up the Signaling and ILMI PVCs
- Set Up Only a Client on a Subinterface

Once you have set up the components, you can display their ATM addresses by completing the task in the "Display the Client ATM Addresses" section.

Set Up the Signaling and ILMI PVCs

Set up the signaling and the ILMI PVC that will communicate with the ILMI on the major ATM interface of any Catalyst 5000 series switch that will participate in LANE. Complete this task only once for a major interface. You do not need to repeat this task on the same interface even though you might configure LECs on several of its subinterfaces.

To set up these PVCs, complete the following tasks, beginning in global configuration mode:

Task		Command
Step 1	Specify the major ATM interface and enter interface configuration mode.	**interface atm 0**
Step 2	Set up the signaling PVC that sets up and tears down SVCs; the *vpi* and *vci* values are usually set to 0 and 5, respectively.	**atm pvc** *vcd vpi vci* **qsaal**[1]
Step 3	Set up a PVC to communicate with the ILMI; the *vpi* and *vci* values are usually set to 0 and 16, respectively.	**atm pvc** *vcd vpi vci* **ilmi**

1. This command is documented in the "ATM Commands" chapter of the Router Products Command Reference publication.

Set Up the Server, BUS, and a Client on a Subinterface

To set up the server and broadcast-and-unknown server (BUS) for an ELAN, perform the following steps beginning in interface configuration mode:

Task		Command
Step 1	Specify the subinterface for the first ELAN on this switch.	**interface atm 0.***subinterface-number*
Step 2	Enable an LES and a LANE BUS for the first ELAN.	**lane server-bus ethernet** *elan-name*
Step 3	(Optional) Enable a LANE client (LEC) for the first ELAN.	**lane client ethernet** [*vlan-1*] [*elan-name*]

If the ELAN in Step 3 is intended to have *restricted membership*, consider carefully whether you want to specify its name here. You will specify the name in the LECS database when it is set up. However, if you link the client to an ELAN in this step and, through some mistake, it does not match the database entry linking the client to an ELAN, this client 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 client in Step 3 and later want to associate that client with a different ELAN, make the change in the configuration server's database before you make the change for the client on this subinterface.

Set Up Only a Client on a Subinterface

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

You must first set up the signaling and ILMI PVCs on the major ATM interface, as described earlier in the "Set Up the Signaling and ILMI PVCs" section, before you set up the client.

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 (LEC) for the first ELAN.	**lane client ethernet** *vlan# elan-name*

Display the Client ATM Addresses

Once you have set up the clients as needed on the subinterfaces of an ATM module on the Catalyst 5000 series switch, you can display their ATM addresses by completing the following step in EXEC mode:

Task	Command
Display the server, BUS, 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 belong to the server, the BUS, 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.

This automatic assignment of ATM address values was explained in the section "Automatically Assigning ATM Addresses," earlier in this chapter.

Repeat the **show lane** 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, the clients will not yet be operational. That is normal for this stage of LANE configuration.

Set Up the Configuration Server's Database

After you have set up all the servers, BUSs, and clients on all the ATM subinterfaces on all Catalyst 5000 series switches or routers that will participate in LANE and have displayed their ATM addresses, you can use the information to populate the configuration server's database.

You can set up a default ELAN, no matter whether you set up any other ELANs. You can also set up some ELANs with restricted membership and others with unrestricted membership.

To set up the database, complete the steps in the following sections as appropriate for your ELAN plan and scenario:

- Set Up the Signaling and ILMI PVCs (if not already set up on this interface)
- Set Up the Database for the Default ELAN Only
- Set Up the Database for Unrestricted-Membership ELANs
- Set Up the Database for Restricted-Membership LANs

Set Up the Signaling and ILMI PVCs

If you have already set up the signaling and ILMI PVCs on this interface, skip to the next section.

You must set up the signaling PVC and the PVC that will communicate with the ILMI on the major ATM interface of any router that will participate in LANE.

Complete this task only once for a major interface. You need not repeat this task on the same interface, even though you might configure LESs and clients on several of its subinterfaces.

To set up these PVCs, complete the following steps, beginning in global configuration mode:

Task		Command
Step 1	Specify the major ATM interface, and enter interface configuration mode.	**interface atm 0**
Step 2	Set up the signaling PVC that sets up and tears down SVCs; the *vpi* and *vci* values are usually set to 0 and 5, respectively.	**atm pvc** *vcd vpi vci* **qsaal**[1]
Step 3	Set up a PVC to communicate with the ILMI; the *vpi* and *vci* values are usually set to 0 and 16, respectively.	**atm pvc** *vcd vpi vci* **ilmi**[1.]

1. This command is documented in the "ATM Commands" chapter of the *Router Products Command Reference* publication.

Set Up the Database for the Default ELAN Only

When you configure a Catalyst 5000 switch as the configuration server for one default ELAN, you provide a name for the database, the ATM address of the server for the ELAN, and a default name for the ELAN. In addition, you indicate that the configuration server's 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 *clients* are located. That is, when you set up the configuration server's database for a single default ELAN, you need not provide any database entries that link the ATM addresses of any clients with the ELAN name.

To set up the configuration server for the default ELAN, complete the following steps beginning in global configuration mode:

Task		Commands
Step 1	Create a named database for the LANE configuration server (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 server 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.

Set 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 *server.*

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

To configure a router as the configuration server 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 server (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 LANE clients (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 server for the specified ELAN, as noted in your worksheet.

Set Up the Database for Restricted-Membership LANs

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 *server.*

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 *client* of that ELAN with the name of that ELAN.

Those client database entries specify the clients that are allowed to join the ELAN. When a client requests that the configuration server indicate which ELAN it is to join, the configuration server consults its database and then responds as configured.

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

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

Task		Command
Step 1	Create a named database for the LANE configuration server. (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 LANE clients (LECs) not explicitly bound to an ELAN.	**default name** *elan-name*
Step 5	Add a database entry associating a specific client's ATM address with a specific restricted-membership ELAN. Repeat this step for each of the clients of each of the restricted-membership ELANs on this switch cloud, in each case specifying that client's 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**

Enable and Display the ATM Address of the Configuration Server

Once you have created the database entries as appropriate to the type and the membership conditions of the ELANs, you can enable the configuration server on the selected ATM interface and Catalyst 5000 ATM module, and then display its ATM address by completing the following tasks:

Task		Command
Step 1	If you are not currently configuring the interface, specify the major ATM interface where the configuration server is located.	**interface atm 0**
Step 2	Link the configuration server's database name to the specified major interface and enable the configuration server.	**lane config** *database-name*
Step 3	Specify that the configuration server's ATM address will be computed by our automatic method.	**lane auto-config-atm-address**
Step 4	Exit interface configuration mode.	**exit**
Step 5	Return to EXEC mode.	**Ctrl-Z**
Step 6	Display the configuration server's ATM address.	s**how lane config**

Make a note of the configuration server's ATM address so you can configure it on each ATM subinterface where a server and BUS is configured.

Enter the Configuration Server's ATM Address on a Cisco LS100 ATM Switch

You must enter the configuration server's ATM address into the Cisco LS100 ATM switch, and save it permanently, so that the value will not be lost when the switch is reset or powered off.

To enter the configuration server's ATM address into the Cisco LS100 ATM Switch and save it there permanently, complete the following steps on the Cisco LS100 ATM Switch:

Task		Command
Step 1	Specify the LANE configuration server (LECS) ATM address.	**set configserver 0** *atm-address*
Step 2	Save the configuration value permanently.	**save**

In Step 1, you must specify the full 40-digit ATM address.

Monitor and Maintain the 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 tasks in EXEC mode:

Task	Command
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**]
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**]
Display the global and per-VC LANE information for all LANE clients (LECs) configured on any subinterface or ELAN.	**show lane client** [**interface atm 0** [**.***subinterface-number*] | **name** *elan-name*] [**brief**]
Display the global and per-VC LANE information for the configuration server configured on any interface.	**show lane config** [**interface atm 0**]
Display the LANE configuration server (LECS) database.	**show lane database** [*database-name*]
Display the LANE ARP table of the LANE client (LECs) configured on the specified subinterface or ELAN.	**show lane le-arp** [**interface atm 0** [**.***subinterface-number*] | **name** *elan-name*]
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**]

QuickStart Configuration Procedure

This section provides a specific operating example of how to set up a single ATM ELAN (LANE) and configure the LAN Emulation components. Substitute your own values in each step to configure the LANE module in your system. This procedure includes the following tasks:

- Define Values for Configuring the LANE Module
- Configure the ATM Address Prefix on a Cisco LS100 ATM Switch
- Start an ATM Session
- Set Up the Signaling and ILMI Permanent Virtual Circuits
- Display the Default LANE Module Network Service Access Points
- Set Up the Cisco LS100 ATM Switch with the Default LECS Address
- Set Up the LECS, LES, and BUS Servers
- Set Up the LAN Emulation Client

The example below assumes you have:

- A Cisco LightStream ATM switch, with software version 3.1 or higher.
- One or more Catalyst 5000 switches with ATM modules installed.
- A Catalyst 5000 supervisor engine module with software version 1.4 or later.

Define Values for Configuring the LANE Module

Step 1 Obtain a 13-byte ATM address prefix identifier for your ATM switch. This example assumes that the ATM address prefix is:

```
39000000000000000000000000
```

Step 2 Obtain an IP address for the ATM switch. This is only necessary if you are going to connect the Ethernet interface on the ATM switch to your network.

Step 3 Decide on an Emulated LAN (ELAN) name. This example uses the name **one**.

Step 4 Decide on a LAN emulation client server (LECS) database name. This example uses the name **test**.

Step 5 Determine the slot number of the ATM Module in the Catalyst 5000 chassis. This example uses the number **5**.

Step 6 Decide on a host name for the ATM switch. This example uses the host name **ATMSW**.

Step 7 Determine which interface and subinterface will be used for LES and BUS. This example uses subinterface **1**.

Configure the ATM Address Prefix on a Cisco LS100 ATM Switch

Configure the default LS100 ATM address prefix of all edge devices connected to the switch. If you do not intend to connect the LS100 ATM switch to the Ethernet network, use **0.0.0.0** as the IP address and **255.255.255.255** as the network mask.

```
ATMSW>enable
Input the password:
ATMSW>#set local ATMSW IP address mask 39000000000000000000000000
```

Start an ATM Session

After you assign an IP address to the supervisor engine module's sc0 interface, start a session with the ATM module on the console for the Catalyst 5000 as follows. The following example assumes the ATM module is in slot 5.

```
Catalyst 5000> session 5
```

Set Up the Signaling and ILMI Permanent Virtual Circuits

Set up the signaling and ILMI permanent virtual circuits (PVCs) by typing the following commands:

```
ATM>en
ATM#config terminal
ATM(config)#int atm 0
ATM(config-if)#atm pvc 1 0 5 qsaal
ATM(config-if)#atm pvc 2 0 16 ilmi
ATM(config-if)#end
```

Display the Default LANE Module Network Service Access Points

Display the default ATM network service access points (NSAPs):

```
ATM#show lane default-atm-addresses
interface ATM1/0:
LANE Client:         39.000000000000000000000000.00000C302A3C.**
LANE Server:         39.000000000000000000000000.00000C302A3D.**
LANE Bus:            39.000000000000000000000000.00000C302A3E.**
LANE Config Server:  39.000000000000000000000000.00000C302A3F.00
note: ** is the subinterface number byte, in hex
```

Note This example assumes that the LAN Emulation Server (LES) is configured on subinterface 1.

Set Up the Cisco LS100 ATM Switch with the Default LECS Address

To set up the Cisco LS100 ATM switch with the default LECS address, perform the steps below:

Step 1 Specify the LECS NSAP address to the Cisco LS100 ATM switch as follows:

```
ATMSW#set configserver 0
39000000000000000000000000000000C302A3F00
```

Note The parameter **0** after the **configserver** command is the index into the LECS address table in the ATM switch. The switch can accommodate up to four LECS addresses: index 0 through 3.

Step 2 Save the configuration entered on the Cisco LS100 ATM switch to NVRAM. Following is an example:

```
ATMSW#save
```

Set Up the LECS, LES, and BUS Servers

This section describes how to set up the LAN emulation configuration server (LECS), LAN emulation server (LES), and the broadcast and unknown server (BUS).

Step 1 Set up the LECS database using the LES address displayed in the section "Display the Default LANE Module Network Service Access Points," as follows:

```
ATM#config terminal
ATM(config)#lane database test
ATM(lane-config-database)#name one server-atm-address
39.000000000000000000000000.00000C302A3D.01
ATM(lane-config-database)#default-name one
```

Consider these important points:

- The database name is **test**.
- The **server-atm-address** is the one displayed in the command above. For the last byte, use the subinterface number (**config-subif**) you plan to use in Step 3, below.
- In this case, this ELAN is also designated as the default ELAN, using the **default-name** command. If the LANE module client is brought up with no ELAN specified, it will join ELAN **one**. (See Step 2 in the section "Set Up the LAN Emulation Client," below.)

Step 2 Start the LECS as follows:

```
ATM(config)#int atm 0
ATM(config-if)#lane config test
ATM(config-if)#lane auto-config-atm-address
```

Step 3 Start the LES and BUS as follows:

```
ATM(config-if)#int atm 0.1
ATM(config-subif)#lane server-bus ethernet one
```

Step 4 Write the configuration you have entered to NVRAM:

```
ATM(config-subif)#end
ATM#wr mem
```

Set Up the LAN Emulation Client

Step 1 To set up a LAN Emulation Client (LEC) on an ATM module, use the console of the Catalyst 5000 to start a session with the ATM module:

```
C5000>(enable)session 5
```

Consider these important points:

- This example assumes that the ATM module is in slot 5.
- An IP address must be assigned to the supervisor engine module's **sc0** interface before running the **session** command.

Step 2 Start up the LEC as follows:

```
ATM>enable
ATM#config terminal
ATM(config)#int atm 0
ATM(config-if)#no shutdown
ATM(config-if)#atm pvc 1 0 5 qsaal
ATM(config-if)#atm pvc 2 0 16 ilmi
ATM(config-if)#int atm 0.1
ATM(config-subif)#lane client ethernet 1 one
```

Consider these important points:

- The name of the default ELAN is **one**, so you can omit it from the command above. However, you must provide the ELAN name if you are joining an ELAN that has not been designated as the default ELAN. The default was set up in Step 1 in the "Set Up the Signaling and ILMI Permanent Virtual Circuits" section.
- The command to bring up a LEC on a Catalyst 5000 is:

  lane client ethernet *vlan_# elan_name*

  In this example, all ports on VLAN 1 of the Catalyst 5000 are assigned to the ELAN named **one**.

Step 3 Write the configuration to NVRAM as follows:

```
ATM(config-subif)#end
ATM#wr mem
```

LANE Configuration Examples

The examples in the sections below illustrate how to configure LANE for the following cases:

- Default Configuration for a Single ELAN
- Multiple ELANs with Unrestricted Membership
- Multiple ELANs with Restricted Membership

All examples use the automatic ATM address assignment method described in the section "Automatically Assigning ATM Addresses" earlier in these chapters.

These examples show the resulting configuration, not the process of determining and entering the ATM addresses appropriately, as described earlier.

Default Configuration for a Single ELAN

The following example configures one Cisco router and three Catalyst 5000 series switches for one ELAN. Router 1 contains the configuration server, the server, the broadcast-and-unknown server, and a client. The remaining Catalyst 5000 series switches each contain a client for the ELAN. This example accepts all default settings that are provided. For example, it does not explicitly set ATM addresses for the different LANE components that are co-located on Catalyst 5000 series switch 1. Membership in this LAN is not restricted.

Catalyst 5000 Series Switch 1

```
lane database example1
name eng server-atm-address 39.0000014155551211.0800200c1001.01
default-name eng
interface atm 0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane auto-config-atm-address
lane config example1
interface atm 0.1
lane server-bus ethernet eng
lane client ethernet 1
```

Catalyst 5000 Series Switch 2

```
interface atm 0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 0.1
lane client ethernet 1
```

Catalyst 5000 Series Switch 3

```
interface atm 0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 0.1
lane client ethernet 1
```

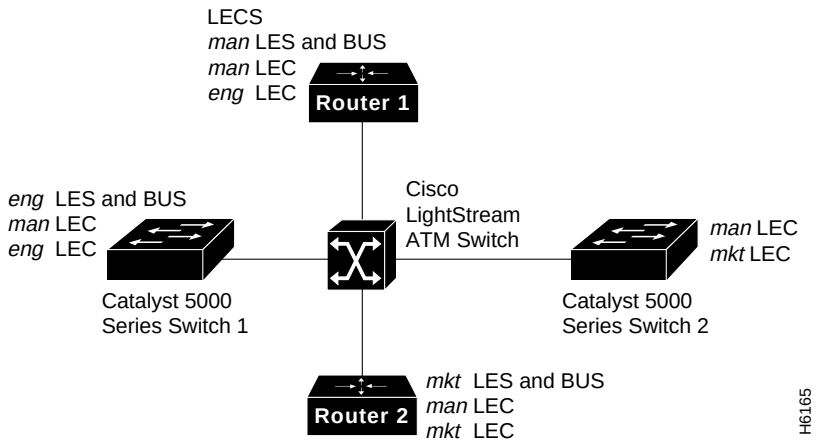
Catalyst 5000 Series Switch 4

```
interface atm 0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 0.1
lane client ethernet 1
```

Multiple ELANs with Unrestricted Membership

The following example configures two Cisco routers and two Catalyst 5000 series switches for three ELANS for engineering, manufacturing, and marketing, as illustrated in Figure 4. This example does not restrict membership in the ELANs.

Figure 4 Multiple ELANs



In this example, Router 1 has the following LANE components:

- The LECS (there is one configuration server for this group of ELANs)
- The LES and BUS for the ELAN for manufacturing (*man*)
- An LEC for the ELAN for manufacturing (*man*)
- An LEC for the ELAN for engineering (*eng*)

Router 2 has the following LANE components:

- The LES and BUS for the ELAN for marketing (named *mkt* in the following example)
- An LEC for the ELAN for manufacturing (*man*)
- An LEC for the ELAN for marketing (*mkt*)

Catalyst 5000 series switch 1 has the following LANE components:

- The LES and BUS for the ELAN for engineering (named *eng* in the following example)
- An LEC for the ELAN for manufacturing (*man*)
- An LEC for the ELAN for engineering on VLAN 2 (*eng*)

Catalyst 5000 series switch 2 has the following LANE components:

- An LEC for the ELAN for manufacturing on VLAN 1 (*man*)
- An LEC for the ELAN for marketing on VLAN 3 (*mkt*)

For the purposes of this example, the Catalyst 5000 series switches and routers are assigned the following ATM address prefixes and base ESI:

Router	ATM Address Prefix	ESI Base
Router 1	39.0000014155551211	0800.200c.1000
Catalyst 5000 series switch 1	39.0000014155551211	0800.200c.2000[1]
Catalyst 5000 series switch 2	39.0000 014155551211	0800.200c.3000[1.]
Router 2	39.0000014155551211	0800.200c.4000

1. The ESI part of the ATM address is derived from the first MAC address of the Catalyst 5000 ATM module shown in the example.

Router 1

Router 1 has the configuration server and its database, the server and BUS for the manufacturing ELAN, a client for manufacturing, and a client for engineering. Router 1 is configured as follows:

```
!The following lines name and configure the configuration server's database.
lane database example2
name eng server-atm-address 39.0000014155551211.0800200c2001.02
name man server-atm-address 39.0000014155551211.0800200c1001.01
name mkt server-atm-address 39.0000014155551211.0800200c4001.01
default-name man
!
! The following lines bring up the configuration server and associate
! it with a database name.
interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane auto-config-atm-address
lane config example2
!
! The following 3 lines configure the manufacturing server, broadcast-and-unknown server,
! and the client on atm subinterface 1/0.1. The client is assigned to the default
! emulated lan.
interface atm 1/0.1
ip address 172.16.0.1 255.255.255.0
lane server-bus ethernet man
lane client ethernet
!
! The following 3 lines configure the "eng" client on atm subinterface 1/0.2. The client
! is assigned to the engineering emulated lan. Each emulated LAN is a different
! subnetwork, so the "eng" client has an IP address on a different subnetwork than the
! "man" client.
interface atm 1/0.2
ip address 172.16.1.1 255.255.255.0
lane client ethernet eng
```

Router 2

Router 2 has the server and BUS for the marketing ELAN, a client for marketing, and a client for manufacturing. Because the default ELAN name is *man*, the second client is linked to that ELAN name by default. Router 2 is configured as follows:

```
interface atm 3/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 3/0.1
lane server-bus ethernet mkt
lane client ethernet mkt
interface atm 3/0.2
lane client ethernet
```

Catalyst 5000 Series Switch 1

Catalyst 5000 series switch 1 is configured for the server and BUS for the engineering ELAN, a client of the manufacturing ELAN, and a client of the engineering ELAN. Because the default ELAN name is *man*, the first client is linked to that ELAN name by default.

```
interface atm 0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 0.1
lane client ethernet 1
interface atm 0.2
lane server-bus ethernet eng
lane client ethernet 2 eng
```

Catalyst 5000 Series Switch 2

Catalyst 5000 series switch 2 is configured for a client of the manufacturing ELAN and a client of the marketing ELAN. Because the default ELAN name is *man*, the first client is linked to that ELAN name by default.

```
interface atm 0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 0.1
lane client ethernet 1
interface atm 0.2
lane client ethernet 3 mkt
```

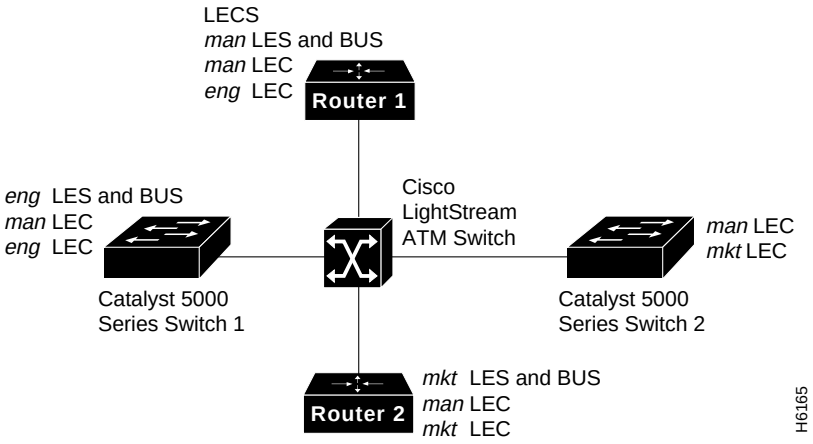
Multiple ELANs with Restricted Membership

The following example, illustrated in Figure 5, configures the Cisco router for three ELANS for engineering, manufacturing, and marketing.

The same components are assigned to the four routers as in the previous example. The ATM address prefixes and MAC addresses are also the same as in the previous example.

However, this example restricts membership in the ELANs. In this example, the LECS database has explicit entries binding the ATM addresses of LECs to specified, named, ELANs. In such cases, the client asks the configuration server which ELAN it belongs to; the configuration server checks its database and informs the client to which ELAN it belongs.

Figure 5 Multiple ELANs with Restricted Membership



Router 1

Router 1 has the configuration server and its database, the server and BUS for the manufacturing ELAN, a client for manufacturing, and a client for engineering. It also has explicit database entries binding the ATM addresses of LECs to specified, named ELANs. Router 1 is configured as follows:

```
! The following lines name and configure the configuration server's database.
lane database example3
name eng server-atm-address 39.0000014155551211.0800200c2001.02 restricted
name man server-atm-address 39.0000014155551211.0800200c1001.01
name mkt server-atm-address 39.0000014155551211.0800200c4001.01 restricted
default-name man
!
! The following lines add database entries binding specified client ATM
! addresses to emulated LANs. In each case, the Selector byte corresponds
! to the subinterface number on the specified router.
! The next command binds the client on Router 1's subinterface 2 to the eng ELAN.
client-atm-address 39.0000014155551211.0800200c1000.02 name eng
! The next command binds the client on Router 2's subinterface 2 to the eng ELAN.
client-atm-address 39.0000014155551211.0800200c2000.02 name eng
! The next command binds the client on Router 3's subinterface 2 to the mkt ELAN.
client-atm-address 39.0000014155551211.0800200c3000.02 name mkt
! The next command binds the client on Router 4's subinterface 1 to the mkt ELAN.
client-atm-address 39.0000014155551211.0800200c4000.01 name mkt
!
! The following two lines bring up the configuration server and associate
! it with a database name.
interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane auto-config-atm-address
lane config example3
!
! The following 3 lines configure the "man" server/broadcast-and-unknown server,
! and the client on atm subinterface 1/0.1. The client is assigned to the default
! emulated lan.
interface atm 1/0.1
ip address 172.16.0.1 255.255.255.0
lane server-bus ethernet man
lane client ethernet
!
```

```
! The following 3 lines configure the “eng” client on atm subinterface 1/0.2. The
! configuration server assigns the client to the engineering emulated lan.
interface atm 1/0.2
ip address 172.16.1.1 255.255.255.0
lane client ethernet eng
```

Router 2

Router 2 has the server and BUS (BUS) for the marketing ELAN, a client for marketing, and a client for manufacturing. The first client is listed in the database as linked to the *mkt* ELANs. The second client is not listed in the database, but is linked to the *man* ELAN name by default. Router 2 is configured as follows:

```
interface atm 3/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
! The first client is explicitly entered in the configuration server’s
! database as linked to the “mkt” ELAN.
interface atm 3/0.1
ip address 172.16.2.4 255.255.255.0
lane server-bus ethernet mkt
lane client ethernet mkt
! The following client is not entered in the database, so it is linked to the
! “man” ELAN by default.
interface atm 3/0.2
ip address 172.16.0.4 255.255.255.0
lane client ethernet
```

Catalyst 5000 Series Switch 1

Catalyst 5000 series switch 1 is configured for the server and BUS for the engineering ELAN, a client of the manufacturing ELAN, and a client of the engineering ELAN. Because the default ELAN name is *man*, the first client is linked to that ELAN name by default.

```
interface atm 0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 0.1
lane client ethernet 1
! A client for the following interface is entered in the configuration
! server’s database as linked to the “eng” ELAN.
interface atm 0.2
lane server-bus ethernet eng
lane client ethernet 2 eng
```

Catalyst 5000 Series Switch 2

Catalyst 5000 series switch 2 is configured for a client of the manufacturing ELAN and a client of the marketing ELAN. Because the default ELAN name is *man*, the first client is linked to that ELAN name by default. The second client is listed in the database as linked to the *mkt* ELAN.

```
interface atm 0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
! The first client is not entered in the database, so it is linked to the
! “man” ELAN by default.
interface atm 0.1
lane client ethernet 1
! The second client is explicitly entered in the configuration server’s
! database as linked to the “mkt” ELAN.
interface atm 0.2
lane client ethernet 3 mkt
```

Configuring VPI and VCI Bits on an LS100 Switch

On an LS100, configure the valid VPI and VCI bits for the ports to which a Catalyst 5000 ATM module is connected by entering the following commands:

```
ls100# set int ?
<Line>          Line number 0-15
<Inf_Type>      pri_UNI(0) , pri_NNI(1) or pub_UNI(2)
<Forum/ITU>     Forum(0) or ITU(1)
<VVP>           Valid VPI 0-12 bit(s)
<VVC>           Valid VCI 0-12 bit(s)
<LBO>           Line Built Out 0-225feet(1) or 225-450feet(0)
<PLCP>          PLCP(0) or Direct Mapping(1)
<Scramble>      Payload_Not_Scrambled(0) or Payload_Scrambled(1)
ls100# set int Catalyst_5000_ATM_port_num 0 0 0 10 1 1 1
```

This command sets the valid VPI bits to 0 and valid VCI bits to 10, to match the default settings on the Catalyst 5000 ATM module.

ATM Module Software Caveats and Modifications

This section describes possible, unexpected behavior and other miscellaneous caveats for ATM module software releases. The caveats listed here describe only serious problems. This section also describes ATM module software modifications that correct caveats in earlier ATM module software versions.

ATM Module Software Version 2.2 Modifications

This section describes possible, unexpected behavior and other miscellaneous caveats for ATM module software version 2.2. Caveats existing in ATM module software version 1.1 and not resolved in versions 1.2, 1.3, or 2.1 are also present in ATM module software version 2.2. The caveats listed here describe only serious problems.

The LEC has been modified; the control distribute virtual circuit (VC) is now optional. Additionally, the LEC does not accept the VC after processing a “join” response. When the control or multicast VC does not come up due to an incorrect B-LLI (Broadband Low Layer Information) or wrong calling party, the LEC removes all associated VCs and returns to the IDLE state. (CSCdi43013)

ATM Module Software Version 2.1 Modifications

This section describes possible, unexpected behavior and other miscellaneous caveats for ATM module software version 2.1. Caveats existing in ATM module software version 1.1 and not resolved in versions 1.2 or 1.3 are also present in ATM module software version 2.1. The caveats listed here describe only serious problems. This section also describes ATM module software version 2.1 modifications that correct caveats in earlier ATM module software versions.

- The LEC LE-ARP cache reverification timer does not update changed entries. In ATM module software release 2.1, this problem is corrected. (CSCdi50465)
- The Catalyst 5000 uses an incorrect Object Identifier (OID) to get the LECS address from an ATM switch. In ATM module software release 2.1, this problem is corrected. (CSCdi50537)
- The LEC cannot receive messages from the BUS on the point-to-point multicast send VCC. Although the ATM Forum specification allows for the BUS to send packets to the LEC on this VCC, Cisco's BUS is not implemented in this way. This LEC problem is corrected in ATM module software release 2.1. (CSCdi50945)
- The LEC software must be modified to allow it to operate with a Cisco LS2020 ATM switch. This problem is corrected in ATM module software release 2.1. (CSCdi51791)
- The ATM module may stop forwarding packets if it receives a normally-sized packet that has an incorrect, very large value in the AAL5 length field. In ATM module software release 2.1, this problem is corrected. (CSCdi51872)
- If you remove the media cable from an active module, stale entries in the transmitter's content-addressable memory (TSAR CAM) can cause a race condition that forces traffic to a specific MAC address through the BUS instead of through a data direct virtual connection (VC). In ATM module software release 2.1, this problem is corrected.

New Features for ATM Module Software Version 1.3

ATM Module Software Version 1.3 contains improved startup system diagnostics for manufacturability.

ATM Module Software Version 1.2 Modifications

This section describes ATM module software version 1.2 modifications that correct caveats in ATM module software version 1.1.

- Sometimes CRC errors result when the ATM module transmits certain sizes of frame combinations. In ATM module software release 1.2, this problem is corrected. (CSCdi47110)
- If a data VC on an ATM card receives a CRC error in a LANE control frame, the ATM card may reset. This problem is corrected in ATM module software release 1.2. (CSCdi47110)

ATM Module Software Version 1.1 Caveats

This section describes possible, unexpected behavior and other miscellaneous caveats for ATM module software version 1.1. The caveats listed here describe only serious problems.

- When you enter the **write memory** command from the ATM module, an ARP entry appears in the configuration file. Do not delete this ARP entry. (CSCdi37977)
- After entering the **session** command to access the ATM module, enter the **terminal monitor** command so that additional informational messages are displayed. (CSCdi41337)

- When you remove or hot-swap an ATM module while the system is operating, the port number and virtual circuit addresses in the CAM table become invalid. Use the **clear cam** command to delete them. (CSCdi42681)
- You cannot use the **show cam** *mod_num/port_num* command to display all CAM entries on an ATM port because the *port_num* on an ATM module corresponds to a virtual circuit number instead of a port number. An error is produced if you use this command on an ATM port. For example:

  ```
  Console> (enable) show cam dynamic 4/301
  Module 4 Port number must be in the range 1..1
  ```
  (CSCdi44444)

- You cannot use the **session** command for an ATM card if the supervisor engine module IP address is not set (that is, if the supervisor engine module IP address is set to 0.0.0.0). To determine whether the supervisor engine module IP address is set, use the **show interface** command. (CSCdi44641)
- On the ATM module, the **copy**, **configure network**, and **write network** commands do not function. Do not use these commands. (CSCdi44899)
- When an ATM module link goes down, the Catalyst 5000 does not generate a link-down trap, to indicate that the ATM link is down. (CSCdi45044)
- Do not hot-swap faulty ATM modules if you are using supervisor engine module software releases 1.1, 1.2. 1.3, and 1.4. In these releases, modules remain off line if faulty ATM modules have been hot-swapped from their slots. To bring the modules on line, you must reset the Catalyst 5000. This problem has been fixed in Catalyst 5000 supervisor engine module software release 1.5. (CSCdi45212)
- The Catalyst 5000 does not support PVCs for LAN emulation in the ATM 1.1 software release.
- Sometimes CRC errors result when the ATM module transmits certain sizes of frame combinations. (CSCdi47110)
- If a data VC on an ATM card receives a CRC error in a LANE control frame, the ATM card may reset. (CSCdi47110)
- The LEC LE-ARP cache reverification timer does not update changed entries. (CSCdi50465)
- The Catalyst 5000 uses an incorrect Object Identifier (OID) to get the LECS address from an ATM switch. (CSCdi50537)
- The LEC cannot receive messages from the BUS on the point-to-point multicast send VCC. Although the ATM Forum specification allows for the BUS to send packets to the LEC on this VCC, Cisco's BUS is not implemented in this way. (CSCdi50945)
- The LEC software must be modified to allow it to operate with a Cisco LS2020 ATM switch. (CSCdi51791)
- The ATM module may stop forwarding packets if it receives a normally-sized packet that has an incorrect, very large value in the AAL5 length field. (CSCdi51872)
- If you remove the media cable from an active module, stale entries in the transmitter's content-addressable memory (TSAR CAM) can cause a race condition that forces traffic to a specific MAC address through the BUS instead of through a data direct virtual connection (VC).
- When you insert or replace ATM modules, clear the module configuration information, using the command **clear config all** or **clear config** *mod_num*, to obtain the correct spanning tree parameters for the modules.

Cisco Information Online

Cisco Connection Online (CCO), formerly Cisco Information Online (CIO), is Cisco Systems' primary, real-time support channel. Maintenance customers and partners can self-register on CCO to obtain additional content and services.

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CCO serves a wide variety of users through two interfaces that are updated and enhanced simultaneously—a character-based version and a multimedia version that resides on the World Wide Web (WWW). The character-based CCO supports Zmodem, Kermit, Xmodem, FTP, Internet e-mail, and fax download options, and is excellent for quick access to information over lower bandwidths. The WWW version of CCO provides richly formatted documents with photographs, figures, graphics, and video, as well as hyperlinks to related information.

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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`.

Note If you are a network administrator and need personal technical assistance with a Cisco product that is under warranty or covered by a maintenance contract, contact Cisco's Technical Assistance Center (TAC) at 800 553-2447, 408 526-7209, or `tac@cisco.com`. To obtain general information about Cisco Systems, Cisco products, or upgrades, contact 800 553-6387, 408 526-7208, or `cs-rep@cisco.com`.

This document is to be used in conjunction with *Catalyst 5000 Series Configuration and Command Reference* and the *Catalyst 5000 Series Installation Guide* publications.