Configuring LAN Emulation (LANE)

This chapter describes how to configure LAN emulation (LANE) in Cisco 7500 series, Cisco 7000 series, and Cisco 4500 routers containing an ATM Interface Processor (AIP) and connected to a Cisco switch. LANE requires software version 3.1 or later on the ATM switch. For routing between emulated LANs, IP, IPX, and AppleTalk are supported.

For a complete description of the commands in this chapter, refer to the LANE Commands chapter of the *Wide-Area Networking Command Reference*.

What is LAN Emulation (LANE) on ATM?

The ATM Forum defined the LAN Emulation (LANE) specification to allow legacy LAN users to take advantage of ATM's benefits without requiring modifications to end-station hardware or software.

ATM is connection-oriented networking, not a broadcast medium. ATM uses connection-oriented service with point-to-point signaling or multicast signaling between source and destination devices. However, LAN-based protocol suites use connectionless service. LANs use broadcasts so source devices can find one or more destination devices.

LANE emulates a broadcast environment like IEEE 802.3 Ethernet on top of an ATM network that is a point-to-point environment. Client devices such as routers, ATM workstations, and LAN switches use LANE server functions to emulate a LAN across ATM.

LANE defines a service interface for network layer protocols that is identical to existing MAC layers. No changes are required to existing upper layer protocols and applications. Data sent across the ATM network is encapsulated in the appropriate LAN MAC packets. LANE essentially bridges LAN traffic across ATM. The LANE protocol defines the operation of an emulated LAN.

LANE runs on ATM interface-capable hardware. This includes the Cisco 4500, Cisco 7500 series, and Cisco 7000 series routers with an ATM Interface Processor (AIP) module; LANE also runs as an ancillary function of a Cisco workgroup ATM switch. The emulation uses several server functions that operate on the routers.

The ATM LANE system has three servers that are single points of failure. These are the LANE configuration server, the LANE server, and the broadcast-and-unknown server.

Cisco has developed a fault tolerance mechanism known as *simple server redundancy* that eliminates these single points of failure. Although this scheme is proprietary, no new protocol additions have been made to the LANE subsystems.

LANE supports DECnet, Banyan VINES, and XNS.

LANE Servers and Components

A single emulated LAN consists of the following entities: A LANE configuration server, a broadcast-and-unknown server, a LANE server, and LANE clients.

- *LANE configuration server* — A server that assigns individual clients to particular emulated LANs by directing them to the LANE server that corresponds to the emulated LAN. The LANE configuration server maintains a database of LANE client ATM or MAC addresses and their emulated LAN. A LANE configuration server can serve multiple emulated LANs.
- *broadcast-and-unknown server*—A multicast server that floods unknown destination traffic and forwards multicast and broadcast traffic to clients within an emulated LAN. One Cisco broadcast-and-unknown server exists per emulated LAN.
- *LANE server* —A server that provides a registration facility for clients to join the emulated LAN. There is one Cisco LANE server per emulated LAN. The LANE server handles LAN Emulation Address Resolution Protocol (LE ARP) requests and maintains a list of LAN destination MAC addresses.
- *LANE client*—An entity in an endpoint such as a router that performs data forwarding, address resolution, and other control functions for a single endpoint in a single emulated LAN. The LANE client provides a standard LAN service to any higher layers that interfaces to it. A router can have multiple resident LANE clients, each connecting with different emulated LANs. The LANE client registers its MAC and ATM address with the LANE server.

Emulated LAN entities coexist on one or more Cisco routers. On Cisco routers, each LANE server and broadcast-and-unknown server is always a single entity. Other LANE components include ATM switches—any ATM switch that supports the ILMI and signaling. Multiple emulated LANs can coexist on a single ATM network.

Implementation Considerations

The following sections contain information relevant to implementation:

- Network Support
- Hardware Support
- Addressing
- Rules for Assigning Components to Interfaces and Subinterfaces

Network Support

In this release, Cisco supports the following networking features:

- Ethernet-emulated LANs only. This release does not support emulation of Token Ring networks.
- Routing from one emulated LAN to another via IP, IPX, or AppleTalk.
- Bridging between emulated LANs and between emulated LANs and other LANs.
- Simple server redundancy for fault tolerance of all LANE servers.
- DECnet, Banyan VINES, and XNS routed protocols.

Hardware Support

This release of LANE is supported on Cisco 7500 series and Cisco 7000 series routers that contain an ATM Interface Processor (AIP); it requires a Cisco workgroup ATM switch.

Cisco's AIP provides a single ATM network interface Cisco 7000 family of routers. Network interfaces reside on modular interface processors, which provide a direct connection between the high-speed Cisco Extended Bus (CxBus) and the external networks. The maximum number of AIPs that the Cisco 7000 series and Cisco 7500 series each supports depends on the bandwidth configured. The total bandwidth through all the AIPs in the system should be limited to 200 Mbps full duplex—two Transparent Asynchronous Transmitter/Receiver Interface (TAXI) interfaces, or one Synchronous Optical Network (SONET) and one E3, or one SONET and one lightly used SONET, or five E3s.

For a complete description of the Cisco 7000 series and AIP, refer to the *Cisco 7000 Hardware Installation and Maintenance*. For a complete description of the Cisco 7500 series and AIP, refer to the *Cisco 7500 Hardware Installation and Maintenance*. For a complete description of the Cisco 4500 router and AIP, refer to the *Cisco 4500 Hardware Installation and Maintenance*.

Addressing

On a LAN, packets are addressed by the MAC-layer address of the destination and source stations. To provide similar functionality for LANE, MAC-layer addressing must be supported. Every LANE client must have a MAC address. In addition, every LANE component (server, client, broadcast-and-unknown server, and configuration server) must have an ATM address that is different from that of all the other components.

All LANE clients 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)
  - Area field (2 bytes)
- A 6-byte end-system identifier (ESI)
- A 1-byte selector field

Cisco's Method of Automatically Assigning ATM Addresses

Cisco provides the following standard method of constructing and assigning ATM and MAC addresses for use in a LANE configuration server's database. A pool of MAC addresses is assigned to each ATM interface on the router. On the Cisco 7500 series, Cisco 7000 series, and Cisco 4500 routers, the pool contains eight 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 the router; 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 *broadcast-and-unknown serve*r 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 LANE configuration server, 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 router. 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.1007, the ESI part of the ATM addresses is assigned to LANE components as follows:

- Any client gets the ESI 0800.200c.1000.
- Any server gets the ESI 0800.200c.1001.
- The broadcast-and-unknown server gets the ESI 0800.200c.1002.
- The LANE configuration server gets the ESI 0800.200c.1003.

Refer to the "Multiple Emulated LANs with Unrestricted Membership Example" and the "Multiple Emulated LANs with Restricted Membership Example" sections 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 emulated LANs. 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 for address templates of 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 5 indicates how the values of unspecified digits are determined when an ATM address template is used:

Table 5 Values of Unspecified Digits in ATM Address Templates

Unspecified Digits In	Value Is
Prefix (first 13 bytes)	Obtained from ATM switch via Interim Local Management Interface (ILMI)
ESI (next 6 bytes)	Filled with the slot MAC address[1] plus • 0—LANE client • 1—LANE server • 2—LANE broadcast-and-unknown server • 3—Configuration server
Selector field (last 1 byte)	Subinterface number, in the range 0 through 255.

1. The lowest of the pool of MAC addresses assigned to the ATM interface plus a value that indicates the LANE component. For the Cisco 7500, Cisco 7000, and Cisco 4500, the pool has eight MAC addresses.

Rules for Assigning Components to Interfaces and Subinterfaces

The following rules apply to assigning LANE components to the major ATM interface and its subinterfaces in a given router:

- The LANE configuration server always runs on the major interface.

  The assignment of any other component to the major interface is identical to assigning that component to the 0 subinterface.

- The server and the client of the *same* emulated LAN can be configured on the same subinterface in a router.
- Clients of two *different* emulated LANs cannot be configured on the same subinterface in a router.
- Servers of two *different* emulated LANs cannot be configured on the same subinterface in a router.

LANE Configuration Task List

Before you begin to configure LANE, you must decide whether you want to set up one or multiple emulated LANs. If you set up multiple emulated LANs, you must also decide where the servers and clients will be located, and whether to restrict the clients that can belong to each emulated LAN. Bridged emulated LANs are configured just like any other LAN, in terms of commands and outputs. Once you have made those basic decisions, you can proceed to configure LANE.

To configure LANE, complete the tasks in the following sections:

- Create a LANE Plan and Worksheet
- Configure the Prefix on the Switch

- Set Up the Signaling and ILMI PVCs
- Display LANE Default Addresses
- Enter the Configuration Server's ATM Address(es) on the Cisco Switch
- Set Up the Configuration Server's Database

Note For fault tolerance, multiple servers can be assigned to the emulated LAN.

- Enable the Configuration Server

  There can be multiple configuration servers in an ATM cloud.

- Set Up LANE Servers and Clients

  There can be multiple servers on an emulated LAN and/or servers (LANE server/broadcast-and-unknown server) in an ATM cloud.

You can configure some emulated LANs with unrestricted membership and some emulated LANs with restricted membership. You can also configure a default emulated LAN, which must have unrestricted membership.

Once LANE is configured, you can monitor and maintain the components in the participating routers by completing the tasks in the following section:

- Monitor and Maintain the LANE Components

See the "LANE Configuration Examples" section at the end of this chapter.

Create a LANE Plan and Worksheet

It might help you to begin by drawing up a plan and a worksheet for your own LANE scenario, showing the following information and leaving space for noting the ATM address of each of the LANE components on each subinterface of each participating router:

- The router and interface where the LANE configuration server will be located
- The router, interface, and subinterface where the LANE server and broadcast-and-unknown server for each emulated LAN will be located. There can be multiple servers for each emulated LAN for fault-tolerant operation.
- The routers, interfaces, and subinterfaces where the clients for each emulated LAN will be located
- The name of the default emulated LAN (optional)
- The names of the emulated LANs that will have unrestricted membership
- The names of the emulated LANs that will have restricted membership

The last three items in this list are very important; they determine how you set up each emulated LAN in the configuration server's database.

Configure the Prefix on the Switch

Before you configure LANE components on any Cisco 7000 series, Cisco 7500 series, or Cisco 4500 routers, you must configure the Cisco ATM switch with the ATM address prefix to be used by all LANE components in the switch cloud. On the Cisco 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.

To set the ATM address prefix on the Cisco LightStream 1010, complete the following tasks on the Cisco switch, starting in global configuration mode:

Task	Command
Set the local node ID (prefix of the ATM address).	**atm address** {*atm-address* | *prefix***...**}
Exit global configuration mode,	**exit**
Save the configuration values permanently.	**copy running-config startup-config**

To set the ATM address prefix on the Cisco LightStream 100, complete the following tasks on the Cisco switch:

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

On the Cisco switches, 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 the Signaling and ILMI PVCs

You must set up the signaling permanent virtual circuit (PVC) and the PVC that will communicate with the ILMI on the major ATM interface of any router that participates 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 LANE servers 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** *slot*/*port*[1] (for the Cisco 7000 and Cisco 7500) or **interface atm** *number*[1] (for the Cisco 4500)
Step 2	Set up the signaling PVC that sets up and tears down switched virtual circuits (SVCs); the *vpi* and *vci* values are usually set to 0 and 5, respectively.	**atm pvc** *vcd vpi vci* **qsaal**[2]
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**[2]

1. This command is documented in the "Interface Commands" chapter of the *Configuration Fundamentals Command Reference*.
2. This command is documented in the "ATM Commands" chapter of the *Wide-Area Networking Command Reference*.

Display LANE Default Addresses

You can display the LANE default addresses to make configuration easier. Complete this task for each router that participates in LANE. This command displays default addresses for all ATM interfaces present on the router. Write down the displayed addresses on your worksheet.

To display the default LANE addresses, complete the following step, beginning in global configuration mode:

Task	Command
Display the LANE default addresses.	**show lane default-atm-addresses**

Enter the Configuration Server's ATM Address(es) on the Cisco Switch

You must enter the configuration server's ATM address into the Cisco LightStream 100 or Cisco Lightstream 1010 ATM switch and save it permanently, so that the value is not lost when the switch is reset or powered off.

You must specify the full 40-digit ATM address. Use the addresses on your worksheet that you obtained from the previous task.

If you are configuring Simple Server Redundancy Protocol (SSRP), enter the multiple LANE configuration server addresses into the end ATM switches. The switched are used as central locations for the list of LANE configuration server addresses. LANE components connected to the switches obtain the global list of LANE configuration server addresses from the switches.

Depending on which type of switch you are using, perform one of the following tasks:

- Enter the ATM Address(es) on the Cisco LightStream 1010 ATM Switch
- Enter the ATM Address(es) on the Cisco LightStream 100 ATM Switch

Enter the ATM Address(es) on the Cisco LightStream 1010 ATM Switch

On the Cisco LightStream 1010 ATM switch, the configuration server address can be specified for a port or for the entire switch.

To enter the configuration server addresses on the Cisco LightStream 1010 ATM switch for the entire switch, perform the following tasks, beginning in global configuration mode:

Task		Command
Step 1	Specify the LANE configuration server's ATM address for the entire switch. If you are configuring SSRP, include the ATM addresses of all the LANE configuration servers.	**atm lecs-address-default** *address1* [*address2* ...]
Step 2	Exit global configuration mode	**exit**
Step 3	Save the configuration value permanently.	**copy running-config startup-config**

To enter the configuration server addresses on the Cisco LightStream 1010 ATM switch per port, perform the following tasks, beginning in interface configuration mode:

Task		Command
Step 1	Specify the LANE configuration server's ATM address for a port. If you are configuring SSRP, include the ATM addresses of all the LANE configuration servers.	**atm lecs-address** *address1* [*address2* ...]
Step 2	Exit interface configuration mode.	**Ctrl-Z**
Step 3	Save the configuration value permanently.	**copy running-config startup-config**

Enter the ATM Address(es) on the Cisco LightStream 100 ATM Switch

To enter the configuration server's ATM address into the Cisco LightStream 100 ATM switch and save it there permanently, perform the following tasks in privileged command mode:

Task		Command
Step 1	Specify the LANE configuration server's ATM address. If you are configuring SSRP, repeat this command for each configuration server address. The *index* value determines the priority. The highest priority is 0. There can be a maximum of 4 LANE configuration servers.	**set configserver** *index atm-address*
Step 2	Save the configuration value permanently.	**save**

Set Up the Configuration Server's Database

After you have set up all servers, broadcast-and-unknown servers, and clients on all ATM subinterfaces on all 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 emulated LAN, whether or not you set up any other emulated LANs. You can also set up some emulated LANs with restricted membership and others with unrestricted membership.

To set up the database, complete the tasks in the following sections as appropriate for your emulated LAN plan and scenario:

- Set Up the Database for the Default Emulated LAN Only
- Set Up the Database for Unrestricted-Membership Emulated LANs
- Set Up the Database for Restricted-Membership LANs

To set up fault-tolerant operation, see "Configuring Fault-Tolerant Operation," later in this chapter.

Set Up the Database for the Default Emulated LAN Only

When you configure a router as the configuration server for one default emulated LAN, you provide a name for the database, the ATM address of the server for the emulated LAN, and a default name for the emulated LAN. 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 emulated LAN, you do not have to specify where the LANE *clients* are located. That is, when you set up the configuration server's database for a single default emulated LAN, you do not have to provide any database entries that link the ATM addresses of any clients with the emulated LAN name.

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

Task		Commands
Step 1	Create a named database for the LANE configuration server	**lane database** *database-name*
Step 2	In the configuration database, bind the name of the emulated LAN to the ATM address of the LANE server. Repeat this step for each server.	**name** *elan-name* **server-atm-address** *atm-address* **index** *n*
Step 3	In the configuration database, provide a default name for the emulated LAN.	**default-name** *elan-name*
Step 4	Exit from database configuration mode and return to global configuration mode.	**exit**[1]

1. This command is documented in the "Interface Commands" chapter of the *Configuration Fundamentals Command Reference*.

In Step 2, enter the ATM address of the server for the specified emulated LAN, as noted in your worksheet and obtained in the "Display LANE Default Addresses" section. You can have any number of servers per emulated LAN for fault tolerance. Priority is determined by entry order. The first entry has the highest priority unless you override it with the index option.

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

To set up fault-tolerant operation, see "Configuring Fault-Tolerant Operation," later in this chapter.

Set Up the Database for Unrestricted-Membership Emulated LANs

When you set up a database for unrestricted emulated LANs, you create database entries that link the name of each emulated LAN 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 provide any database entries that link the ATM addresses or MAC addresses of any *clients* with the emulated LAN name.

To configure a router as the configuration server for multiple emulated LANs 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.	**lane database** *database-name*
Step 2	In the configuration database, bind the name of the first emulated LAN to the ATM address of the LANE server for that emulated LAN. Repeat this step with the same emulated LAN name but different server ATM addresses to define secondary or backup servers for this emulated LAN.	**name** *elan-name1* **server-atm-address** *atm-address* **index** *n*
Step 3	In the configuration database, bind the name of the second emulated LAN to the ATM address of the LANE server. Repeat this step, providing a different emulated LAN name and an ATM address, for each additional emulated LAN in this switch cloud.	**name** *elan-name2* **server-atm-address** *atm-address* **index** *n*
Step 4	(Optional) Specify a default emulated LAN for LANE clients not explicitly bound to an emulated LAN.	**default name** *elan-name1*
Step 5	Exit from database configuration mode and return to global configuration mode.	**exit**[1]

1. This command is documented in the "Interface Commands" chapter of the *Configuration Fundamentals Command Reference*.

In Steps 2 and 3, enter the ATM address of the server for the specified emulated LAN, as noted in your worksheet and obtained in the "Display LANE Default Addresses" section.

To set up fault-tolerant operation, see "Configuring Fault-Tolerant Operation," later in this chapter.

Set Up the Database for Restricted-Membership LANs

When you set up the database for restricted-membership emulated LANs, you create database entries that link the name of each emulated LAN to the ATM address of its *server*.

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

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

When clients for the same restricted-membership emulated LAN are located in multiple routers, each client's ATM address or MAC address must be linked explicitly with the name of the emulated LAN. As a result, you must configure as many client entries (at Step 5, in the following procedure) as you have clients for emulated LANs in all the routers. Each client will have a different ATM address in the database entries.

To set up the configuration server for emulated LANs with restricted membership, perform the following steps beginning in global configuration mode:

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

1. This command is documented in the "Interface Commands" chapter of the *Configuration Fundamentals Command Reference*.

To set up fault-tolerant operation, see "Configuring Fault-Tolerant Operation," later in this chapter.

Enable the Configuration Server

Once you have created the database entries as appropriate to the type and the membership conditions of the emulated LANs, you can enable the configuration server on the selected ATM interface and router by completing the following steps:

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** *slot/port*[1] (for the Cisco 7000 and Cisco 7500) or **interface atm** *number*[1] (for the Cisco 4500 series)

Task		Command
Step 2	Link the configuration server's database name to the specified major interface, and enable the configuration server.	**lane config database** *database-name*
Step 3	Specify that the configuration server's ATM address will be computed by our automatic method.	**lane config auto-config-atm-address**
Step 4	Exit interface configuration mode.	**exit**[1]
Step 5	Return to EXEC mode.	**Ctrl-Z**

1. This command is documented in the "Interface Commands" chapter of the *Configuration Fundamentals Command Reference*.

Set Up LANE Servers and Clients

For each router that will participate in LANE, set up the necessary servers and clients for each emulated LAN; then display and record the server and client ATM addresses. Be sure to keep track of the router interface where the LANE configuration server will eventually be located.

For only one default emulated LAN, you will have one set of servers to set up: one as a primary server and the rest as backup servers for the same emulated LAN. For multiple emulated LANs, you can set up servers for another emulated LAN on a different subinterface or on the same interface of this router—or you can place the servers on a different router.

When you set up a server and broadcast-and-unknown server on a router, you can combine them with a client on the same subinterface, a client on a different subinterface, or no client at all on the router.

Where you put the clients is important, because any router with clients for multiple emulated LANs can route frames between those emulated LANs.

Set Up the Server, Broadcast-and-Unknown Server, and a Client on a Subinterface

To set up the server, broadcast-and-unknown server, and (optionally) clients for an emulated LAN, perform the following steps beginning in interface configuration mode:

Task		Command
Step 1	Specify the subinterface for the first emulated LAN on this router.	**interface atm** *slot*/*port*.*subinterface-number*[1] (for the Cisco 7000 and Cisco 7500) or **interface atm** *number...*[2] (for the Cisco 4500)
Step 2	Enable a LANE server and a LANE broadcast-and-unknown server for the first emulated LAN.	**lane server-bus ethernet** *elan-name1*
Step 3	(Optional) Enable a LANE client for the first emulated LAN.	**lane client ethernet** [*elan-name1*]
Step 4	Provide a protocol address for the client.	*protocol address mask*[2]

1. This command is documented in the "Interface Commands" chapter of the *Configuration Fundamentals Command Reference*.
2. The command or commands depend on the routing protocol used. See the relevant protocol chapter (IP, IPX, or AppleTalk) in the *Network Protocols Command Reference, Part 1 or Part 2* for the commands to use.

If the emulated LAN 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 LANE configuration server's database when it is set up. However, if you link the client to an emulated LAN in this step, and through some mistake it does not match the database entry linking the client to an emulated LAN, this client will not be allowed to join this emulated LAN or any other.

If you do decide to include the name of the emulated LAN linked to the client in Step 3 and later want to associate that client with a different emulated LAN, make the change in the configuration server's database before you make the change for the client on this subinterface.

Each emulated LAN is a separate subnetwork. In Step 4 make sure that the clients of the same emulated LAN are assigned protocol addresses on the same subnetwork and that clients of different emulated LANs are assigned protocol addresses on different subnetworks.

Set Up Only a Client on a Subinterface

On any given router, you can set up one client for one emulated LAN or multiple clients for multiple emulated LANs. You can set up a client for a given emulated LAN on any routers you choose to participate in that emulated LAN. Any router with clients for multiple emulated LANs can route packets between those emulated LANs.

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 emulated LANs, perform the following steps beginning in interface configuration mode:

Task		Command
Step 1	Specify the subinterface for an emulated LAN on this router.	**interface atm** *slot/port***.***subinterface-number*[1] (Cisco 7000 family) or **interface atm** *number...* [1] (for the Cisco 4500)
Step 2	Provide a protocol address for the client on this subinterface.	*protocol address*[2]
Step 3	Enable a LANE client for the first emulated LAN.	**lane client ethernet** *elan-name1*

1. This command is documented in the "Interface Commands" chapter of the *Configuration Fundamentals Command Reference*.
2. The command or commands depend on the routing protocol used. See the relevant protocol chapter (IP, IPX, or AppleTalk) in the *Network Protocols Command Reference, Part 1 or Part 2* for the commands to use.

Each emulated LAN is a separate subnetwork. In Step 2, make sure that the clients of the same emulated LAN are assigned protocol addresses on the same subnetwork and that clients of different emulated LANs are assigned protocol addresses on different subnetworks.

Configuring Fault-Tolerant Operation

The LANE simple server redundancy feature creates fault tolerance using standard LANE protocols and mechanisms. If a failure occurs on the LANE configuration server or on the LANE server/broadcast-and-unknown server, the emulated LAN can continue to operate using the services of a backup LANE server. This protocol is called the Simple Server Redundancy Protocol (SSRP).

This section describes how to configure simple server redundancy for fault tolerance on an emulated LAN.

Understand Simple Server Redundancy

You can define redundant LANE configuration servers by configuring one or more server addresses—obtained through the Interim Local Management Interface (ILMI)—on the ATM switch. The LANE configuration server turns on server redundancy by adjusting its database to accommodate multiple server ATM addresses for a particular emulated LAN. The additional servers serve as backup servers for that emulated LAN.

For simple LANE service replication or fault tolerance to work, the ATM switch must support multiple LANE server addresses. This mechanism is specified in the LANE standard. The LANE servers establish and maintain a standard control circuit that enables the server redundancy to operate.

LANE simple server redundancy comes ready to operate with Cisco IOS Release 11.2 software. To activate the feature, you add an entry for the hierarchical list of servers that will support the given emulated LAN. All database modifications for the emulated LAN must be identical on all LANE configuration servers.

Older LANE configuration files continue to work with this new software. LANE configurations that network with non-Cisco ATM equipment continue to work, but the non-Cisco ATM equipment cannot participate in the LANE simple server redundancy.

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

With the earlier implementation of LANE, only one LANE configuration server, capable of serving multiple emulated LANS, and only one LANE server/broadcast-and-unknown server per emulated LAN could exist for an ATM switch cloud. The earlier LANE protocol did not allow for multiple LANE servers within an emulated LAN. Therefore, these components represented both single points of failure and potential bottlenecks for LANE service.

LANE simple server redundancy corrects these limitations by allowing backup LANE configuration servers and LANE server/broadcast-and-unknown servers for an emulated LAN. Offered in Cisco IOS Release 11.2 or later, LANE simple server redundancy is enabled when you configure multiple servers for the same emulated LAN.

Note This server redundancy does not overcome other points of failure beyond the router ports: Additional redundancy on the LAN side or in the ATM switch cloud are not a part of the LANE simple server redundancy feature.

This redundancy feature works only with Cisco LANE configuration servers and LANE server/broadcast-and-unknown server combinations. Third-party LANE components continue to interoperate with the LANE configuration server and LANE server/broadcast-and-unknown server function of Cisco routers but cannot take advantage of the redundancy features.

Enable Redundant LANE Configuration Servers

To enable redundant LANE configuration servers, enter the multiple LANE configuration server addresses into the end ATM switches, which are used as central locations where the list of LANE configuration server addresses can be obtained. This allows LANE components connected to the switches to obtain the global list of LANE configuration server addresses.

To enable fault tolerance, you enable multiple, redundant, and standby LANE configuration servers and multiple, redundant, and standby LANE server/broadcast-and-unknown servers.Cisco LANE continues to operate seamlessly with other vendors' LANE components, but fault tolerance is not effective in this situation. To enter the LANE configuration server addresses on the Cisco LightStream 100 ATM switch, perform the following steps:

Task	Command
Enter the multiple LANE configuration server addresses into the end ATM switches. The *index* value determines the priority. Zero is the highest priority. There can be a maximum of 4 LANE configuration server addresses.	**set configserver** *index address*

For the Cisco LightStream 1010 ATM switch, you can enable fault tolerance for the entire switch, or per port. To enable fault tolerance, perform the following steps:

Task		Command
Step 1	Enter the multiple LANE configuration server addresses into the end ATM switch.	**atm lecs-address-default** *addresses*
Step 2	Enter the multiple LANE configuration server addresses into the port on the ATM switch.	**atm lecs-address** *address*

To configure multiple LANE server/broadcast-and-unknown servers for emulated LANs on the routers, perform the following steps:

Task		Command
Step 1	Specify redundant LANE server/broadcast-and-unknown servers, or simple server replication. Enter the command for each LANE server address for the same emulated LAN. The index determines the priority. 0 is the highest priority.	**name** *elan-name* **server-atm-address** *address* **index** *n*
Step 2	Enable a LANE client for the first emulated LAN.	**lane client ethernet** *elan-name1*

Server redundancy guards against the failure of the hardware on which LANE server components are running. This includes all the ATM interface cards in Cisco routers and Catalyst switches. Fault tolerance is not effective for ATM network or switch failures.

For server redundancy to work correctly:

- All the ATM switches must have identical lists of the global LANE configuration server addresses, in the identical priority order.
- The operating LANE configuration servers 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 one place.

Implementation Considerations

- The LightStream 1010 can handle up to 16 LANE configuration server addresses. The LightStream 100 allows a maximum of 4 LANE configuration server addresses.
- There is no limit on the number of LANE servers that can be defined per emulated LAN.
- When a LANE configuration server switchover occurs, no previously joined clients are affected.
- When a LANE server/broadcast-and-unknown server switches over, momentary loss of clients occurs until they are all transferred to the new LANE server/broadcast-and-unknown server.
- LANE configuration servers come up as masters until a higher-level LANE configuration server tells them otherwise. This is automatic and cannot be changed.
- If a higher-priority LANE server comes online, it bumps the current LANE server off on the same emulated LAN. Therefore, there may be some flapping of clients from one LANE server to another after a powerup, depending on the order of the LANE servers coming up. Flapping should settle after the *last* highest-priority LANE server comes up.
- If none of the specified LANE servers are up or connected to the master LANE configuration server and more than one LANE server is defined for an emulated LAN, a configuration request for that specific emulated LAN is rejected by the LANE configuration server.
- Changes made to the list of LANE configuration server addresses on ATM switches may take up to a minute to propagate through the network. Changes made to the configuration database regarding LANE server addresses take effect almost immediately.
- If none of the designated LANE configuration servers are operational or reachable, the ATM Forum-defined well-known LANE configuration server address is used.
- You can override the LANE configuration server address on any subinterface, by using the following commands:
  - **lane auto-config-atm-address**
  - **lane fixed-config-atm-address**
  - **lane config-atm-address**

Caution When an override like this is performed, fault-tolerant operation cannot be guaranteed. To avoid affecting the fault-tolerant operation, do not override any LANE configuration server, LANE server or broadcast-and-unknown server addresses.

- If an underlying ATM network failure occurs, there may be multiple master LANE configuration servers and multiple active LANE servers for the same emulated LAN. This situation creates a “partitioned” network. The clients continue to operate normally, but transmission between different partitions of the network is not possible. When the network break is repaired, the system recovers.

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 emulated LAN, you can display their status. To show LANE information, perform the following tasks in EXEC mode:

Task	Command
Display the global and per-virtual channel connection LANE information for all the LANE components and emulated LANs configured on an interface or any of its subinterfaces.	**show lane** [**interface atm** *slot*/*port*[**.***subinterface-number*] | **name** *elan-name*] [**brief**] (Cisco 7000 family)
Display the global and per-VCC LANE information for the broadcast-and-unknown server configured on any subinterface or emulated LAN.	**show lane bus** [**interface atm** *slot*/*port*[**.***subinterface-number*] | **name** *elan-name*] [**brief**] (Cisco 7000 family)
Display the global and per-VCC LANE information for all LANE clients configured on any subinterface or emulated LAN.	**show lane client** [**interface atm** *slot*/*port*[**.***subinterface-number*] | **name** *elan-name*] [**brief**] (Cisco 7000 family)
Display the global and per-VCC LANE information for the configuration server configured on any interface.	**show lane config** [**interface atm** *slot*[**/***port*] (Cisco 7000 family)
Display the LANE configuration server's database.	**show lane database** [*database-name*]
Display the LANE ARP table of the LANE client configured on the specified subinterface or emulated LAN.	**show lane le-arp** [**interface atm** *slot*/*port*[**.***subinterface-number*] | **name** *elan-name*] (Cisco 7000 family)
Display the global and per-VCC LANE information for the LANE server configured on a specified subinterface or emulated LAN.	**show lane server** [**interface atm** *slot*/*port*[**.***subinterface-number*] | **name** *elan-name*] [**brief**] (Cisco 7000 family)

LANE Configuration Examples

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

- Default Configuration for a Single Emulated LAN
- Default Configuration for a Single Emulated LAN with a Backup LANE configuration server and LANE server Example
- Multiple Emulated LANs with Unrestricted Membership Example
- Multiple Emulated LANs with Restricted Membership Example

All examples use the automatic ATM address assignment method described in the "Cisco's Method of Automatically Assigning ATM Addresses" section earlier in this chapter.

These examples show the LANE configurations, not the process of determining the ATM addresses and entering them.

Default Configuration for a Single Emulated LAN Example

The following example configures four Cisco 7000 routers for one emulated LAN. Router 1 contains the configuration server, the server, the broadcast-and-unknown server, and a client. The remaining routers each contain a client for the emulated LAN. 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 colocated on the router. Membership in this LAN is not restricted.

Router 1

```
lane database example1
name eng server-atm-address 39.0000014155551211.0800.200c.1001.01
default-name eng
interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane config auto-config-atm-address
lane config database example1
interface atm 1/0.1
ip address 172.16.0.1
lane server-bus ethernet eng
lane client ethernet
```

Router 2

```
interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 1/0.1
ip address 172.16.0.3
lane client ethernet
```

Router 3

```
interface atm 2/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 2/0.1
ip address 172.16.0.4
lane client ethernet
```

Router 4

```
interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 1/0.3
ip address 172.16.0.5
lane client ethernet
```

Default Configuration for a Single Emulated LAN with a Backup LANE Configuration Server and LANE Server Example

The following example configures four Cisco 7000 routers for one emulated LAN with fault tolerance. Router 1 contains the configuration server, the server, the broadcast-and-unknown server, and a client. Router 2 contains the backup LANE configuration server and the backup LANE server for this emulated LAN and another client. Routers 3 and 4 contain clients only. 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 colocated on the router. Membership in this LAN is not restricted.

Router 1

```
lane database example1
name eng server-atm-address 39.0000014155551211.0800.200c.1001.01
name eng server-atm-address 39.0000014155551212.0612.200c 2001.01
default-name eng

interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane config auto-config-atm-address
lane config database example1

interface atm 1/0.1
ip address 172.16.0.1
lane server-bus ethernet eng
lane client ethernet
```

Router 2

```
lane database example1_backup
name eng server-atm-address 39.0000014155551211.0800.200c.1001.01
name eng server-atm-address 39.0000014155551212.0612.200c 2001.01 (backup LES)
default-name eng
interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane config auto-config-atm-address
lane config database example1_backup
interface atm 1/0.1
ip address 172.16.0.3
lane server-bus ethernet eng
lane client ethernet
```

Router 3

```
interface atm 2/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi

interface atm 2/0.1
ip address 172.16.0.4
lane client ethernet
```

Router 4

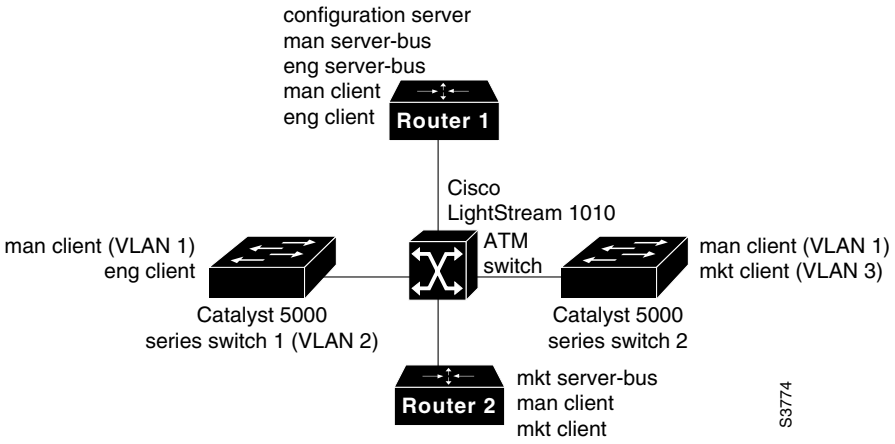
```
interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi

interface atm 1/0.3
ip address 172.16.0.5
lane client ethernet
```

Multiple Emulated LANs with Unrestricted Membership Example

The following example configures the Cisco 7000 router for three emulated LANS for Engineering, Manufacturing, and Marketing, as illustrated in Figure 35. This example does not restrict membership in the emulated LANs.

Figure 35 Multiple Emulated LANs



In this example, shown in Figure 35, Router 1 has the following LANE components:

- The LANE configuration server (there is one configuration server for this group of emulated LANs)
- The LANE server and broadcast-and-unknown server for the emulated LAN for Manufacturing (named *man* in this example)
- The LANE server and broadcast-and-unknown server for the emulated LAN for Engineering (named *eng* in this example)
- A LANE client for the emulated LAN for Manufacturing (*man*)
- A LANE client for the emulated LAN for Engineering (*eng*)

Router 2 has the following LANE components:

- A LANE client for the emulated LAN for Manufacturing (*man*)
- A LANE client for the emulated LAN for Engineering (*eng*)

Switch 1 has the following LANE components:

- A LANE client for the emulated LAN for Manufacturing (*man*)
- A LANE client for the emulated LAN for Marketing (named *mkt* in this example)

Switch 2 has the following LANE components:

- The LANE server and broadcast-and-unknown server for the emulated LAN for Marketing (*mkt*)
- A LANE client for the emulated LAN for Manufacturing (*man*)
- A LANE client for the emulated LAN for Marketing (*mkt*)

For the purposes of this example, the four routers are assigned the following ATM address prefixes and base ESI (the ESI part of the ATM address is derived from the first MAC address of the AIP shown in the example):

Router	ATM Address Prefix	ESI Base
Router 1	39.0000014155551211	0800.200c.1000
Router 2	39.0000014155551211	0800.200c.2000
Router 3	39.0000014155551211	0800.200c.3000
Router 4	39.0000014155551211	0800.200c.4000

Router 1

Router 1 has the configuration server and its database, the server and broadcast-and-unknown server for the Manufacturing emulated LAN, the server and broadcast-and-unknown server for the Engineering emulated LAN, 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 39.0000014155551211.0800.200c.1001.02
name man server-atm-address 39.0000014155551211.0800.200c.1001.01
name mkt server-atm-address 39.0000014155551211.0800.200c.4001.01
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 "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" server, broadcast-and-unknown server,
! and the 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 that the "man" client.
interface atm 1/0.2
ip address 172.16.1.1 255.255.255.0
lane server-bus ethernet eng
lane client ethernet eng
```

Router 2

Router 2 is configured for a client of the Manufacturing emulated LAN and a client of the Engineering emulated LAN. Because the default emulated LAN name is *man*, the first client is linked to that emulated LAN name by default.

```
interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 1/0.1
ip address 172.16.0.2 255.255.255.0
lane client ethernet
interface atm 1/0.2
ip address 172.16.1.2 255.255.255.0
lane client ethernet eng
```

Switch 1

Switch 1 is configured for a client of the Manufacturing emulated LAN and a client of the Marketing emulated LAN. Because the default emulated LAN name is *man*, the first client is linked to that emulated LAN name by default.

```
interface atm 2/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
interface atm 2/0.1
ip address 172.16.0.3 255.255.255.0
lane client ethernet
interface atm 2/0.2
ip address 172.16.2.3 255.255.255.0
lane client ethernet mkt
```

Switch 2

Switch 2 has the server and broadcast-and-unknown server for the Marketing emulated LAN, a client for Marketing, and a client for Manufacturing. Because the default emulated LAN name is *man*, the second client is linked to that emulated LAN name by default. Router 4 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
ip address 172.16.2.4 255.255.255.0
lane server-bus ethernet mkt
lane client ethernet mkt
interface atm 3/0.2
ip address 172.16.0.4 255.255.255.0
lane client ethernet
```

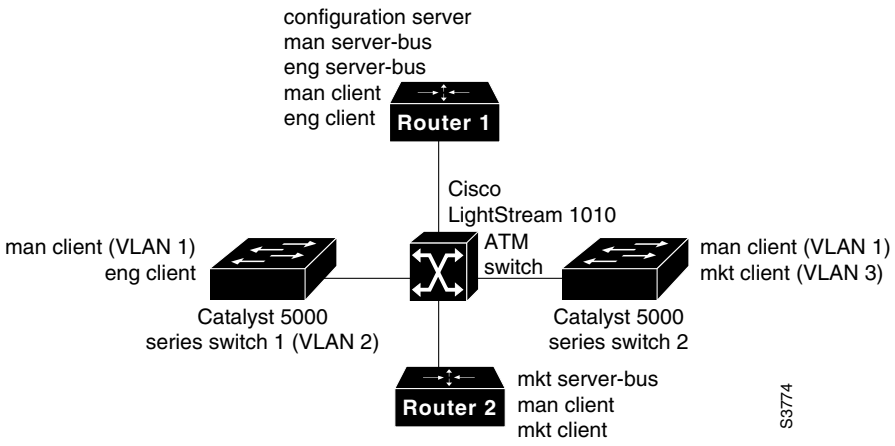
Multiple Emulated LANs with Restricted Membership Example

The following example, illustrated in Figure 36, configures the Cisco 7000 router for three emulated LANS 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 emulated LANs. In this example, the LANE configuration server's database has explicit entries binding the ATM addresses of LANE clients to specified, named emulated LANs. In such cases, the client requests information from the configuration server about which emulated LAN it belongs to; the configuration server checks its database and informs the client which emulated LAN it belongs to.

Figure 36 Multiple Emulated LANs with Restricted Membership



Router 1

Router 1 has the configuration server and its database, the server and broadcast-and-unknown server for the Manufacturing emulated LAN, the server and broadcast-and-unknown server for the Engineering emulated LAN, a client for Manufacturing, and a client for Engineering. It also has explicit database entries binding the ATM addresses of LANE clients to specified, named emulated LANs. 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 39.0000014155551211.0800.200c.1001.02 restricted
name man server-atm-address 39.0000014155551211.0800.200c.1001.01
name mkt server-atm-address 39.0000014155551211.0800.200c.4001.01 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 39.0000014155551211.0800.200c.1000.02 name eng
! The next command binds the client on Router 2's subinterface 2 to the eng ELAN.
client-atm-address 39.0000014155551211.0800.200c.2000.02 name eng
! The next command binds the client on Router 3's subinterface 2 to the mkt ELAN.
client-atm-address 39.0000014155551211.0800.200c.3000.02 name mkt
! The next command binds the client on Router 4's subinterface 1 to the mkt ELAN.
client-atm-address 39.0000014155551211.0800.200c.4000.01 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" server/broadcast-and-unknown server
! and the 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 server-bus ethernet eng
lane client ethernet
```

Router 2

Router 2 is configured for a client of the Manufacturing emulated LAN and a client of the Engineering emulated LAN. Because the default emulated LAN name is *man*, the first client is linked to that emulated LAN name by default.

```
interface atm 1/0
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
! This client is not in the configuration server's database, so it will be
! linked to the "man" ELAN by default.
interface atm 1/0.1
ip address 172.16.0.2 255.255.255.0
lane client ethernet
! A client for the following interface is entered in the configuration
! server's database as linked to the "eng" ELAN.
interface atm 1/0.2
ip address 172.16.1.2 255.255.255.0
lane client ethernet
```

Switch 1

Switch 1 is configured for a client of the Manufacturing emulated LAN and a client of the Marketing emulated LAN. Because the default emulated LAN name is *man*, the first client is linked to that emulated LAN name by default. The second client is listed in the database as linked to the *mkt* emulated LAN.

```
interface atm 2/0
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 2/0.1
ip address 172.16.0.3 255.255.255.0
lane client ethernet
! The second client is explicitly entered in the configuration server's
! database as linked to the "mkt" ELAN.
interface atm 2/0.2
ip address 172.16.2.3 255.255.255.0
lane client ethernet
```

Switch 2

Switch 2 has the server and broadcast-and-unknown server for the Marketing emulated LAN, a client for Marketing, and a client for Manufacturing. The first client is listed in the database as linked to the *mkt* emulated LANs. The second client is not listed in the database, but is linked to the *man* emulated LAN name by default. Router 4 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 les-bus ethernet mkt
lane client ethernet
! 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
```