

Using ATM LANE with Catalyst and LightStream 1010 Switches

This chapter describes how Asynchronous Transfer Mode (ATM) LAN Emulation (LANE) is used with Catalyst 5000 series and the Catalyst 3000 series switches, and LightStream 1010 switch.

Note The LANE Manager feature allows you to display and configure LANE information on Catalyst 5000 series switches. On Catalyst 3000 series switches, you can only display LANE information; configuration tools are not available. For this reason, the **Create**, **Configure**, **Modify**, and/or **Delete** buttons shown might not appear on Catalyst 3000 series switch LANE Manager screens.

LANE Implementation

LANE service emulates the following LAN-specific characteristics:

- Connectionless services
- Multicast services
- LAN Media Access Control (MAC) driver services

LANE allows an ATM network to be used as a LAN backbone for hubs, bridges, and Ethernet switches such as Catalyst switches. LANE also allows end stations to communicate through a LAN-to-ATM switch with an ATM-attached device, such as a file server, without requiring the traffic to pass through a more complex device such as a router.

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).

An ATM network can support multiple independent ELANs. Participation of an end system in any of the ELANs is independent of its physical location. The end systems can move easily from one ELAN to another, independent of hardware moves.

LANE Hardware Support Requirements

LANE is supported on Catalyst switches containing ATM modules and on Cisco 7000 and 4500 series routers with ATM Interface Processors (AIPs) installed. LANE implementation requires an ATM switch that supports User-Network Interface (UNI) 3.0 and point-to-multipoint signaling, for example, the LightStream 1010 switch.

LANE Components

Up to 256 ELANs can be set up in an ATM switch cloud. An ATM module for the Catalyst 5000 and Catalyst 3000 series switches can participate in up to 64 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, the ATM module in a router or a Catalyst switch can include LECs for multiple ELANs: one LEC for *each* ELAN of which it is a member.

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

Note If the Catalyst 5000 or Catalyst 3000 series switches or LightStream 1010 switch have multiple ATM modules and LECs active for the same ELAN, these switches will not bridge between the ELANs. The switches act as an edge-device on an ATM cloud.

- LANE Server (LES)

The LES provides joining, address resolution, and address registration services to the LECs in its ELAN. The LECs can register destination unicast and multicast MAC addresses with the LES. The LES also handles LANE Address Resolution Protocol (ARP) (LE ARP) requests and responses.

Cisco limits one LES for each 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 for each ELAN.

Note In this document, LES/BUS is a Cisco implementation.

- LANE Configuration Server (LECS)

The LECS contains the database that determines which ELAN a device belongs to (each LECS can have a different 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 for each ATM LANE switch cloud.

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

- ELAN name and ATM address of LES pairs
- LEC MAC address and ELAN name pairs
- LEC ATM template and ELAN name pairs
- Default ELAN name

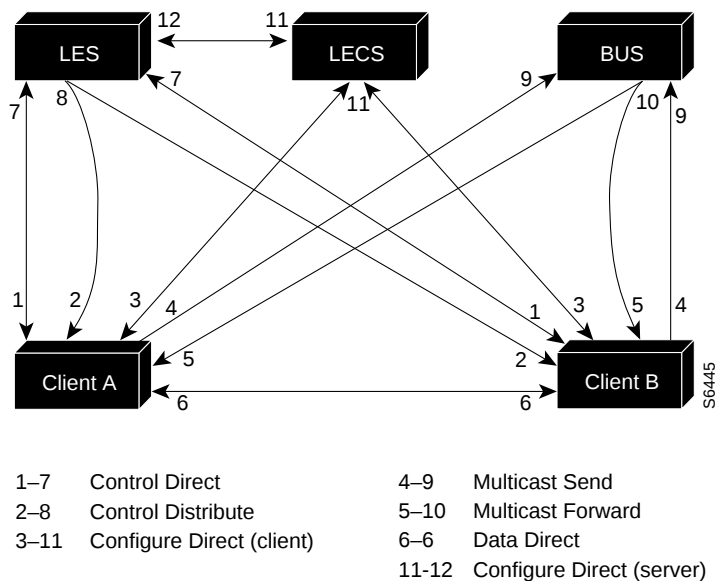
Note ELAN names must be unique on an interface. If two interfaces participate in LANE, the second interface can be in a different switch cloud.

Note The ATM module in the Catalyst 5000 and Catalyst 3000 series switches and the LightStream 1010 switch supports only the LEC function. The Cisco 7000 router with AIP can supply all LANE functions.

LANE Communication

LANE communication is handled by several types of virtual channel connections (VCCs): unidirectional, bidirectional, point-to-point, and point-to-multipoint. Figure E-1 illustrates the various VCC types, including the LECS and the LANE BUS.

Figure E-1 LANE VCC Types



LANE Processes

This section describes the following:

- LEC Joining an ELAN
- Address Resolution
- Multicast Traffic
- Addressing
- VLANs and ELANs
- Typical LANE Scenarios

Note The Catalyst 3000 switch is used in the scenarios, but the information applies also to Catalyst 3200 and Catalyst 3100 switches, Catalyst 5000 series switches, and LightStream 1010 switches.

LEC Joining an ELAN

The following process (illustrated in Figure E-1) normally occurs after an LEC is enabled on the ATM module in a Catalyst 3000 switch:

1 The LEC requests to join an ELAN.

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

The LEC identifies the LECS by checking the database for the following information:

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

2 The LECS identifies the LES.

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

- 3 The LEC tears down the configure direct VCC link.

- 4 The LEC contacts the server for its ELAN.

The LEC sets up a connection to the LES for its ELAN (bidirectional, point-to-point control direct VCC link [link 1-7 in Figure E-1]) to exchange control traffic. After a link is established between an LEC and LES, it remains up.

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

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

- 6 The LES allows or disallows the LEC to join the ELAN.

If allowed, the LES adds the LEC to the unidirectional, point-to-multipoint control distribute VCC link (link 2-8 in Figure E-1) and confirms the join over the bidirectional, point-to-point control direct VCC link (link 1-7 in Figure E-1). If disallowed, the LES rejects the join over the bidirectional, point-to-point control direct VCC link (link 1-7 in Figure E-1).

- 7 The LEC sends LE ARP packets for the broadcast address, which is all 1's (ones).

When the LEC sends these packets for the broadcast address, it returns the ATM address of the BUS. The LEC sets up the multicast send VCC link (link 4-9 in Figure E-1) and the BUS adds the LEC to the multicast forward VCC link (link 5-10 in Figure E-1) to and from the BUS.

Address Resolution

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

- 1 The LEC sends an LE ARP request to the LES for this ELAN (point-to-point control direct VCC link [link 1-7 in Figure E-1]).
- 2 If the MAC address is registered with the server, it returns the corresponding ATM address. Otherwise, the LES forwards the LE ARP request to all LECs on the ELAN (point-to-multipoint control distribute VCC link [link 2-8 in Figure E-1]).
- 3 Any LEC that recognizes the MAC address responds with its ATM address (point-to-point control direct VCC link [link 1-7 in Figure E-1]).
- 4 The LES forwards the response (point-to-multipoint control distribute VCC link [link 2-8 in Figure E-1]).
- 5 The LEC adds the MAC address-ATM address pair to its LE ARP cache.
- 6 The LEC establishes a VCC link to the desired destination and transmits packets to that ATM address (bidirectional, point-to-point Data Direct VCC link [link 6-6 in Figure E-1]).

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

Multicast Traffic

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

- 1 The LEC sends the packet to the BUS (unidirectional, point-to-point multicast send VCC link [link 4-9 in Figure E-1]).

- 2 The BUS forwards (floods) the packet to all LECs (unidirectional, point-to-multipoint multicast forward VCC link [link 5-10 in Figure E-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 address of the destination and source stations. For LANE to have similar functionality, MAC-layer addressing must be supported. Every LEC must have a MAC address. In addition, every LANE component (LES, LEC, BUS, and LECS) must have a unique ATM address.

All LECs on the same interface have different, automatically assigned MAC addresses. These addresses are also used as the end-system identifier (ESI) part of the ATM address (see “LANE ATM Addresses”).

LANE ATM Addresses

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

- 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)
 - DSPFI 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)
- 6-byte ESI
- 1-byte selector field

ILMI Address Registration

The ATM module for the Catalyst 5000 and Catalyst 3000 series switches and the LightStream 1010 switch uses ILMI (Interim Local Management Interface) registration to build an ATM address and to register this address with the ATM switch. To build an ATM address, the Catalyst 5000 and Catalyst 3000 series switches and the LightStream 1010 switch obtain an ATM address prefix from the ATM switch, and combine the prefix with a MAC address and the selector value of 0 (zero). Once the ATM module determines its ATM address, it uses ILMI registration to register this address with the ATM switch.

VLANs and ELANs

On the Catalyst switch, a virtual LAN (VLAN) is a logical group of end stations, independent of physical location, with a common set of requirements. Currently, these switches support a port-centric VLAN configuration. All end stations connected to ports belong to the same VLAN and are assigned to the same VLAN name. The VLAN name is significant only to the Catalyst 5000 and Catalyst 3000 series switches.

Typical LANE Scenarios

In typical LANE cases, one or more Catalyst 5000 and Catalyst 3000 series switches or Cisco 7000 routers are attached to a LightStream 1010 switch. The LightStream 1010 switch provides connectivity to the broader ATM network switch cloud. Each router is configured to support one or more ELANs. One router is configured to perform the LECS functions. Another router is configured to perform the LES and BUS functions for each ELAN. (One router can perform the LES and BUS functions for several ELANs.) Routers and Catalyst 5000 and Catalyst 3000 series switches can act as an LEC for one or more ELANs.

This section describes two scenarios using Cisco 7000 routers, Catalyst 3000 switches, and a Cisco LightStream 1010 switch in single and multiple ELANs.

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

Single ELAN Scenario

In a single ELAN scenario, the LANE components might be assigned to a particular department in a company:

- The router includes the following LANE components:
 - The LECS (one per LANE switch cloud)
 - The LES and BUS for the ELAN with a default name for Manufacturing
- Switch 1 includes an LEC for Manufacturing's ELAN on VLAN 1.
- Switch 2 includes an LEC for Manufacturing's ELAN on VLAN 1.
- Switch 3 includes an LEC for Manufacturing's ELAN on VLAN

Multiple ELAN Scenario

In a multiple ELAN scenario, one ATM switch, two routers, and two Catalyst 3000 series switches are used, but multiple ELANs are configured. Three ELANs are configured on two routers and two Catalyst 3000 series switches for three different departments: Manufacturing, Engineering, and Marketing.

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 Manufacturing's ELAN
 - The LES and BUS functions for Engineering's ELAN
 - An LEC for Manufacturing's ELAN
 - An LEC for Engineering's ELAN
- Router 2 consists of the following LANE components:
 - The LES and BUS for Marketing's ELAN
 - An LEC for Manufacturing's ELAN
 - An LEC for Marketing's ELAN

- Switch 1 contains only the LECs for (VLAN 1) Manufacturing's ELAN and (VLAN 2) Engineering's ELAN.
- Switch 2 contains only the LECs for (VLAN 1) Manufacturing's ELAN and (VLAN 3) Marketing's ELAN.

