



# Configuring Token Ring LAN Emulation

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This chapter describes how to configure Token Ring LAN emulation (LANE) on the Catalyst 5000 platform. This feature is supported on the following Catalyst 5000 series ATM modules:

- ATM Dual PHY OC-12 modules (WS-X5161 and WS-X5162)
- ATM Dual OC-3 modules (WS-5167 and WS-X5168)

Support for the Token Ring LANE feature was first introduced in Cisco IOS Release 12.0(7)T.



Note

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Beginning with Cisco IOS Release 11.3, all commands supported on the Cisco 7500 series routers are also supported on the Cisco 7000 series.

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For a complete description of the Token Ring LANE commands in this chapter, refer to the “Token Ring LANE Commands” chapter of the *Cisco IOS Switching Services Command Reference*. To locate documentation of other commands that appear in this chapter, use the command reference master index or search online. This chapter contains the following sections:

- Token Ring LANE on ATM
- Network Support
- Restrictions
- Prerequisites
- Token Ring LANE Configuration Tasks
- Token Ring LANE Configuration Example

## Token Ring LANE on ATM

LANE bridges LAN traffic across an ATM network. The Catalyst 5000 Series Token Ring LANE feature emulates an IEEE 802.5 Token Ring LAN using ATM technology. LANE is transparent to upper-layer protocols and applications. No changes are required to existing upper-layer protocols and applications. With Token Ring LANE, Token Ring packets are encapsulated in the appropriate ATM cells and sent across the ATM network. When the packets reach the other side of the ATM network, they are de-encapsulated.

## Benefits of Token Ring LANE

ATM is a cell-switching and multiplexing technology that combines the benefits of circuit switching (constant transmission delay and guaranteed capacity) with those of packet switching (flexibility and efficiency for intermittent traffic). Like X.25 and Frame Relay, ATM defines the interface between the user equipment (such as workstations and routers) and the network (referred to as the User-Network Interface [UNI]).

Token Ring LANE allows Token Ring LAN users to take advantage of ATM's benefits without modifying end-station hardware or software. ATM uses connection-oriented service with point-to-point signaling or multicast signaling between source and destination devices. However, Token Ring LANs use connectionless service. Messages are broadcast to all devices on the network. With Token Ring LANE, routers and switches emulate the connectionless service of a Token Ring LAN for the end stations.

By using Token Ring LANE, you can scale your networks to larger sizes while preserving your investment in LAN technology.



### Note

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This release of the Catalyst 5000 series Token Ring LANE software includes only Token Ring LANE. The Catalyst 5000 series Token Ring LANE software does not support Ethernet LANE or RFC 1483 permanent virtual connections (PVCs).

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## Components

LANE defines emulated LANs (ELANs). An ELAN consists of the following components:

- LANE client (LEC)

A 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 switch or a Catalyst ATM module can include LECs for multiple ELANs; there is one LEC for each ELAN of which it is a member.

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

- LANE server (LES)

The LES is the control center for an ELAN. It provides joining, address resolution, and address registration services to the LECs in that ELAN. LECs can register destination unicast and multicast media access control (MAC) address with the LES. The LES also handles LANE Address Resolution Protocol (LE\_ARP) requests and responses and maintains a list of route descriptors that is used to support source-route bridging (SRB) over ELANs. The route descriptors are used to determine the ATM address of the next hop in the frame's routing information field (RIF).

There is one LES per ELAN.

- LANE broadcast and unknown server (BUS)

The BUS floods unknown destination traffic and forwards multicast and broadcast traffic to LECs within an ELAN.

One combined LES and BUS is required for each ELAN.

- 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 contacts the LECS once 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, ATM address of LES pairs
- ELAN name and the ring number of the ELAN (local-seg-id)
- LEC MAC address, ELAN name pairs
- LEC ATM template, ELAN name pairs
- Default ELAN name



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

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The server assigns individual LECs to particular ELANs by directing them to the LES for the ELAN. The LECS maintains a database of LEC and server ATM or MAC addresses and their ELANs. A LECS can serve multiple ELANs.

- Fast Simple Server Redundancy Protocol (FSSRP)

Token Ring LANE relies on three servers: LECS, LES, and BUS. If any one of these servers fails, the ELAN cannot fully function.

Cisco has developed a fault tolerant mechanism known as Simple Server Redundancy Protocol (SSRP) that eliminates these single points of failure. While there is only one LES per ELAN, SSRP allows you to configure redundant servers. You can configure servers to act as backup servers that become active if a master server fails. The priority levels for the servers determine which servers have precedence.

FSSRP is an enhancement to the SSRP. With FSSRP, LECs no longer need to go down whenever there is a change in the master LES. This uninterrupted service is achieved by connecting the LECs simultaneously to more than one LES/BUS (up to four) so that if the master LES goes down, the backup LESs are immediately available. With the basic SSRP, the LEC has to go down and completely recycle before coming back up. This operation is accomplished by keeping the control connections open to all of the active LESs and BUSs in the ELAN. Although this method uses more virtual circuits (VCs), the main benefits are the transparency and speed in the switchover.



**Note**

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ELAN components coexist on one or more Cisco routers or Catalyst switches that contain an ATM module. On Cisco routers or Catalyst switches the LES and the BUS are combined into a single entity.

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## Network Support

The Token Ring LANE on the Catalyst 5000 series ATM module feature supports the following networking features:

- LAN switching between ELANs and between a Token Ring ELAN and a legacy LAN
- Two-port and multi-port SRB between ELANs and between ELANs and a Token Ring LAN
- SRB, source-route transparent bridging (SRT), and source-route switching

The Cisco implementation of LAN emulation over IEEE 802.5 uses existing terminology and configuration options for Token Rings and provides for the IEEE 802.5 transport of Token Ring frames across an ATM switching fabric.

## Restrictions

Before you implement Token Ring LANE, be aware of the following restrictions:



### Caution

While VLAN Trunking Protocol (VTP) Version 2 must be enabled on a Catalyst 5000 for Token Ring to function, do not use VTP to distribute VLAN configuration information between the switches. Configure the switches to operate in VTP transparent mode and manually configure the VLANs on each switch.

- If you plan to run both Ethernet and Token Ring LANE, the Ethernet LANE software and the Token Ring LANE software must be run on separate ATM modules.
- All ATM switches have identical lists of the global LECS addresses with the identical priorities.
- Ensure that the spanning-tree port cost and priority for the ATM port are configured so that the ATM port is the preferred path (the lowest port cost with the highest priority).
- Only one LEC can be defined for each subinterface. Up to 256 subinterfaces per ATM module can be configured.
- Do not create more than one LEC for each Token Ring Bridge Relay Function (TrBRF) in each ATM module.

While you can have only one LEC for each TrBRF in each module, you can have more than one module installed. These additional modules allow you to have more than one LEC per TrBRF, which means the module can participate in more than one ELAN. The ELANs, however, cannot be parallel or the Spanning-Tree Protocol will block one of the connections.



### Note

Configuring more than one LEC for a TrBRF on a single ATM module will adversely affect frame forwarding.

- Do not configure parallel ELANs within a TrBRF (parallel ELANs are those ELANs that form a loop between switches).
- Do not create more than one LEC for each Token Ring Concentrator Relay Function (TrCRF) per ATM module.
- Ensure that all-routes explorer (ARE) reduction is enabled (using the **set tokenring reduction enable** command) on the Token Ring module.

- The number of LESs that can be defined per ELAN is unlimited; however, only one LES per ELAN can be active at a time.
- When a LECS switchover occurs, no previously joined clients are affected.
- In a LES/BUS switchover, there is a momentary loss of clients until all clients are transferred to the new LES/BUS.
- LECSs automatically come up as masters until a higher-level LECS takes priority.
- Using FSSRP, you can configure redundant LES/BUSs and LECSs to reduce the possibility of a server failure resulting in loss of communication on the LANE network. With redundant LES/BUSs and LECSs, LANE components can switch automatically to the backup LES/BUS or LECS if the primary server fails. For specific information on how to configure FSSRP, refer to the “Configuring Fast SSRP for Redundant LANE Services” section on page 291.



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**Note** FSSRP works only with LECS and LES/BUS combinations on Cisco devices. Third-party LANE components interoperate with the LECS and LES/BUS functions of Cisco devices but cannot take advantage of the redundancy features. Additionally, FSSRP-unaware LECs on Cisco equipment cannot take advantage of FSSRP LES/BUS redundancy.

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- When a higher-priority LES comes online, it bumps the current LES off the same ELAN. For a short time after power on, some clients might change from one LES to another, depending upon the order of the LESs coming up.
- If no LES/BUS pair is up or connected to the master LECS, and more than one LES/BUS is defined for an ELAN, the LECS rejects any configuration request for that specific ELAN.
- Changes made to the list of LECS addresses on ATM switches can take up to 1 minute to propagate through the network. Changes made to the LECS database regarding LES addresses take effect almost immediately.
- If no LECS is operational or reachable, the “well-known” LECS address defined by the ATM Forum is used.
- The LECS to be used can be overridden on any subinterface by entering the following command:

```
lane config-atm address atm-address template
```



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

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- In an underlying ATM network failure, there can be multiple master LECSs and multiple active LES/BUSs for the same ELAN, resulting in a partitioned network. Clients continue to operate normally, but transmission between partitions of the network is not possible. The system recovers when the network break is repaired.

## Prerequisites

Token Ring LANE requires that the Catalyst 5000 series switch contain one of the following ATM modules running ATM software Release 4.9b or later:

- ATM Dual PHY OC-12 (WS-X5161 and WS-X5162)
- ATM Dual PHY OC-3 (WS-X5167 and WS-X5168)

These ATM modules provide an ATM network interface for the Catalyst 5000 series switch. Network interfaces reside on modular interface processors, which provide a direct connection between the high-speed synergy backplane and the external networks. The maximum number of ATM modules that the switch supports depends on the bandwidth configured.

The Catalyst 5000 series Token Ring LANE software also requires the Catalyst 5000 series supervisor engine software Release 4.3(1a) or later and one of the following switches:

- Cisco LightStream 1010 with Cisco IOS Release 12.0(1)W5 or later (recommended)
- Any ATM switch with UNI 3.0/3.1 and Interim Local Management Interface (ILMI) support for communicating the LECS address

**Note**

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If you plan to run both Ethernet and Token Ring LANE, the Ethernet LANE software and the Token Ring LANE software must be run on separate ATM modules.

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## Token Ring LANE Configuration Tasks

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

- Opening a Session from the Switch to the ATM Module
- Creating a LANE Plan and Worksheet
- Configuring the ATM Module from the Terminal
- Configuring the ATM Module from NVRAM
- Configuring the Prefix on the LightStream 1010 Switch
- Setting Up the Signalling PVC
- Displaying LANE Default Addresses
- Entering the LECS ATM Address on the LightStream 1010 Switch
- Configuring the LECS Database
- Binding the LECS to the ATM Interface
- Setting Up a LES/BUS and a LEC
- Configuring Redundant LANE Services
- Verifying the LANE Setup
- Monitoring and Maintaining LANE Components

**Note**

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There can be multiple LECSs in an ATM cloud.

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Before configuring Token Ring LANE, you must first open a session with the ATM module in the Catalyst 5000 series switch by entering the **session** command from the supervisor **Console>** prompt. After opening the session, you see the **ATM>** prompt. You only have direct access to the ATM module with which you have established a session.

**Note**

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The ATM module uses a subset of the Cisco IOS software. Generally, the Cisco IOS software works the same on the ATM module as it does on routers. After configuring the ATM module, you are ready to implement LANE.

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## Opening a Session from the Switch to the ATM Module

Use the **session** *mod\_num* command to open a session to the ATM module from the Catalyst 5000 family switch in which the module is installed.

This example shows how to session to an ATM module installed in slot 5 of the Catalyst 5000 switch:

```
Console> (enable) session 5
Trying ATM-5...
Connected to ATM-5.
Escape character is '^'.
```

ATM>

After opening the session, you see the **ATM>** prompt. You then have direct access only to the ATM module with which you have established a session.

**Note**

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The ATM module uses a subset of Cisco IOS software. Generally, Cisco IOS software works the same on the ATM module as it does on routers.

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To configure the ATM module, you must use the ATM configuration mode in the Cisco IOS software. To enter global configuration mode, enter the **configure EXEC** command at the privileged EXEC prompt (**ATM#**). You see the following message, which asks you to specify the terminal, the NVRAM, or a file stored on a network server as the source of configuration commands:

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

If you specify terminal, the run-time configuration is used. You can then save the run-time configuration into the NVRAM. If you specify memory, the run-time configuration is updated from the NVRAM. If you specify network, the run-time configuration is updated from a file in a server on the network.

**Note**

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You cannot configure from the network.

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

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

## Creating a LANE Plan and Worksheet

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

Before implementing Token Ring LANE, 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 to note the ATM address of each LANE component on each subinterface for each participating switch:

- Catalyst 5000 series switch interface where the LECS will be located.
- Catalyst 5000 series switch interface and subinterface where the LES/BUS for each ELAN will be located. For fault-tolerant operation, there can be multiple servers on each ELAN.
- Catalyst 5000 series switch ATM modules, subinterfaces, and VLANs where the LECs for each ELAN will be located.
- Name of the default ELAN (optional). The default Token Ring ELAN is the same as the default TrCRF (1003). You can use the default Token Ring ELAN (trcrf-default) or configure a new one.
- Names of the ELANs that will have unrestricted membership.
- Names of the ELANs that will have restricted membership.
- Local segment ID for the ELAN. The local segment ID must be identical to the ring number of the TrCRF.



### Note

The last three items in the list above are important because they determine how you set up each ELAN in the LECS database.

## Default LANE Configuration

Table 25 shows the default LANE configuration.

**Table 25** *Default LANE Configuration*

Feature	Default Value
LANE components	No LECS database is configured. No LES/BUS is configured. No LECs are configured.
PVCs	ILMI and signaling PVCs are set up.
Preferred PHY (Dual PHY modules only)	PHY A
Output throttling	Disabled
ILMI keepalives	Disabled
UNI version	Autonegotiate (reverts to UNI 3.0 if autonegotiation fails)
VTP	Disabled

## Configuring the ATM Module from the Terminal

To configure the ATM module from the terminal, use the following commands beginning in privileged EXEC mode:

	Command	Purpose
Step 1	ATM# <b>configure terminal</b>	Selects the terminal option and enters global configuration mode.
Step 2	Refer to the appropriate tasks in this document for more information about specific commands.	Enter the necessary configuration commands.
Step 3	ATM(config-if)# <b>Ctrl-Z</b>	Exits global configuration mode.
Step 4	ATM(config)# <b>write memory</b>	Saves the configuration file modifications to NVRAM.

In the following example, the ATM module is configured from the terminal. The **interface atm 0** command designates that the ATM interface 0 is to be configured. The **lane client tokenring** command links TrCRF 10 to the ELAN named trcrf-10. The **Ctrl-Z** command quits configuration mode. The **write memory** command loads the configuration changes into NVRAM on the ATM module.

```
ATM# configure terminal
ATM (config)# interface atm 0
ATM (config-subif)# lane client tokenring 10 trcrf-10
ATM (config-subif)# Ctrl-Z
ATM# write memory
```

NVRAM stores the current configuration information in text format as configuration commands, recording only nondefault settings. The ATM module software performs a memory checksum to guard against corrupted data.

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

## Configuring the ATM Module from NVRAM

Configure the ATM module from NVRAM by reexecuting the configuration commands in privileged EXEC mode:

Command	Purpose
ATM(config)# <b>configure memory</b>	Configures the ATM module from NVRAM.

## Configuring the Prefix on the LightStream 1010 Switch

Before you configure LANE components on a Catalyst 5000 series switch ATM module, you must configure the Cisco LightStream 1010 switch with the ATM address prefix to be used by all LANE components in the switch cloud.

To set the ATM address prefix, use the following commands on the Cisco LightStream 1010 switch, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# <b>atm address</b> { <i>atm_address</i>   <i>prefix...</i> }	Sets the local node ID (prefix of the ATM address).
Step 2	Switch(config)# <b>exit</b>	Exits global configuration mode.
Step 3	Switch# <b>copy running-config startup-config</b>	Saves the configuration values permanently.



**Note** On the Cisco LightStream 1010, 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. LANE prefixes must start with 39 or 47.



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

To display the current prefix on the Cisco LightStream 1010 switch, use the **show network** command.

## Setting Up the Signalling PVC

You must set up the signalling PVC and the PVC that will communicate with the ILMI on the major ATM interface of any Catalyst 5000 series switch 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 LESSs and clients on several of its subinterfaces.

To set up these PVCs, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	ATM(config)# <b>interface atm</b> <i>slot/port</i>	Specifies the major ATM interface and enters interface configuration mode.
Step 2	ATM(config)# <b>atm pvc</b> <i>vcd vpi vci qsaal</i>	Establishes the signaling PVC that sets up and tears down switched virtual circuits (SVCs); the <i>vpi</i> and <i>vci</i> values are usually set to 0 and 5, respectively. The <i>vcd</i> is the virtual channel descriptor.
Step 3	ATM(config)# <b>atm pvc</b> <i>vcd vpi vci ilmi</i>	Sets up a PVC to communicate with the ILMI; the <i>vpi</i> and <i>vci</i> values are usually set to 0 and 16, respectively.

## Displaying LANE Default Addresses

You can display the LANE default addresses to make configuration easier. Complete this task for each Catalyst 5000 series switch ATM interface that participates in LANE. The **show lane default-atm-address** command displays default addresses for all ATM interfaces present on the switch. Write down the displayed addresses on your LANE worksheet.

To display the default LANE addresses, use the following commands beginning in global configuration mode:

Command	Purpose
ATM# <b>show lane default-atm-addresses</b> [interface atm number [.subinterface-number]]	Displays the LANE default addresses.

## Entering the LECS ATM Address on the LightStream 1010 Switch

You must enter the LECS ATM address into each ATM switch (such as a LightStream 1010 ATM switch) connected to an ATM module in your LANE network and save the address permanently so that the value will not be lost when the switch is reset or powered off. Programming the LECS addresses allows the LESs and LECs to determine the LECS addresses dynamically through ILMI.

To enter a LECS ATM address into a LightStream 1010 switch and save it there permanently, complete the following tasks on the LightStream 1010 switch, beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# <b>atm lecs-address-default address1</b> [address2...]	Specifies the LECS's ATM address for the entire switch. Use the addresses from your LANE worksheet and specify the full 40-digit ATM address.
Step 2	Router(config)# <b>exit</b>	Exits global configuration mode.
Step 3	Switch# <b>copy running-config startup-config</b>	Saves the configuration value permanently.

## Configuring the LECS Database

The LECS database contains LANE configuration information, including ELAN name-to-LES/BUS ATM address mappings, LEC address-to-ELAN name mappings, and the name of the default ELAN, if specified. You must configure at least one LECS database in the LANE network.

When configuring the LECS database, remember the following:

- You can configure redundant LECSs. Redundant LECSs should be configured on different devices in the LANE network. If you configure more than one LECS, make sure that all databases with the same name are identical.
- You can specify one default ELAN in the database. The LECS assigns any client that does not request a specific ELAN to the default ELAN.
- ELANs are either restricted or unrestricted. The LECS assigns a client to an unrestricted ELAN if the client specifies that particular ELAN in its configuration. However, the LECS only assigns a client to a restricted ELAN if the client is specified in the LECS's database as belonging to that ELAN. The default ELAN should have unrestricted membership.

- If you are configuring fault tolerance, you can have any number of servers per ELAN. Priority is determined by entry order; the first entry has the highest priority unless you override it with the `index` option.

When setting up the LECS database remember that the following are requirements when configuring LECs:

- VLAN name must match the ELAN name
- Ring number defined when configuring the VLAN must match the local segment ID

The `set vlan` command assumes that any ring number you enter is in hexadecimal. Therefore, 12 is stored as the hexadecimal value 0x12. The `name elan_name local-seg-id segment_number` command assumes that any value you enter for the `local-seg-id` is in decimal unless you enter it explicitly in hexadecimal. For example, to define a TrCRF with a ring number of 12 you could enter `set vlan 12 name crf12 type trcrf ring 12 parent 100` or `set vlan 12 name crf12 type trcrf ring 0x12 parent 100`.

When defining a corresponding LEC, you could enter `name crf12 local-seg-id 0x12` or `name crf12 local-seg-id 18` because 18 is the decimal equivalent of 0x12.

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

- Setting Up the Database for the Default ELAN
- Setting Up the Database for Unrestricted-Membership ELANs
- Setting Up the Database for Restricted-Membership ELANs

## Setting Up the Database for the Default ELAN

When you configure a Catalyst 5000 series switch ATM module as the LECS for one default ELAN, you need to provide the following information:

- A name for the database
- The ATM address of the LES for the ELAN
- A default name for the ELAN.

In addition, you indicate that the LECS's ATM address is to be computed automatically.

The default ELAN cannot be a restricted-membership ELAN. You do not need to specify the ATM or MAC addresses of the LECs for the default ELAN.

On the Dual PHY ATM modules, you must configure redundant LES/BUS/LECS, one for each PHY.

When you configure a database with only a default unrestricted ELAN, you do not have to specify where the LECs are located. That is, when you set up the LECS's database for a single default ELAN, you do not have to provide any database entries that link the ATM addresses of any clients with the ELAN name. All of the clients are automatically assigned to a default ELAN.

To set up the LECS for a default ELAN, use the following commands in global configuration mode:

	Command	Purpose
Step 1	<code>ATM(config)# lane database database-name</code>	Enters database configuration mode for the LANE database that you specify.
Step 2	<code>ATM(lane-config-database)# name elan-name server-atm-address atm-address [index n]</code>	Binds the name of the ELAN to the ATM address of the LES in the configuration database.  The index determines the priority. The highest priority is 0.  Enter the ATM address of the server for the specified ELAN, as noted in your LANE worksheet and obtained in the “Displaying LANE Default Addresses” section on page 279. You can have any number of servers per ELAN for fault tolerance. Priority is determined by entry order. The first entry has the highest priority unless you override it with the index number.
Step 3	<code>ATM(lane-config-database)# name elan-name local-seg-id segment-number</code>	Assigns a segment number to the emulated Token Ring LAN in the configuration database.  The segment number you specify for <b>local-seg-id</b> must remain the same for each entry you add and it must also be identical to the ring number of the TrCRF. The <b>set vlan</b> command assumes that any ring number you enter is in hexadecimal. The <b>name elan-name local-seg-id segment-number</b> command assumes that any value you enter for the <b>local-seg-id</b> is in decimal unless you enter it explicitly in hexadecimal.
Step 4	<code>ATM(lane-config-database)# default-name elan-name</code>	Provides a default name for the ELAN in the configuration database.  If you are setting up only a default ELAN, the <i>elan-name</i> value in Step 2 and Step 3 is the same as the default ELAN name you provide in Step 4.
Step 5	<code>ATM(lane-config-database)# exit</code>	Exits from database configuration mode and returns to global configuration mode.



#### Note

After you configure the LECS database, you must bind the LECS database to the major ATM interface (ATM0) on the ATM module. For information on how to bind the database to the interface, see the Binding the LECS to the ATM Interface section later on in this chapter.

## Setting Up the Database for Unrestricted-Membership ELANs

When you configure unrestricted-membership ELANs in the LECS database, you create database entries that link the name of each ELAN to the ATM address of its LES/BUS.

However, you may choose *not* to specify where the LECs are located. That is, when you set up the LECS'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. The LECS assigns the clients to the ELANs specified in the client's configurations.



### Note

In the steps listed in the task table, enter the ATM address of the server for the specified ELAN, as noted in your LANE worksheet and obtained in the Displaying LANE Default Addresses section earlier in this chapter.

To configure unrestricted-membership ELANs in the LECS database, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	<code>ATM(config)# lane database database-name</code>	Enters database configuration mode for the LANE database that you specify.
Step 2	<code>ATM(lane-config-database)# name elan-name1 server-atm-address atm-address [index n]</code>	Binds the name of the first ELAN to the ATM address of the LES/BUS for that ELAN in the configuration database.  The index determines the priority. The highest priority is 0.
Step 3	<code>ATM(lane-config-database)# name elan-name2 server-atm-address atm-address [index n]</code>	Binds the name of the second ELAN to the ATM address of the LES/BUS in the configuration database.  The index determines the priority. The highest priority is 0.  Repeat this step, providing a different ELAN name and ATM address for each additional ELAN in this switch cloud.
Step 4	<code>ATM(lane-config-database)# name elan-name1 local-seg-id segment-number</code>	Assigns a segment number to the first emulated Token Ring LAN in the configuration database.  The segment number you specify for <b>local-seg-id</b> must be identical to the ring number of the TrCRF. The <b>set vlan</b> command assumes that any ring number you enter is in hexadecimal. The <b>name elan-name local-seg-id segment-number</b> command assumes that any value you enter for the <b>local-seg-id</b> is in decimal unless you enter it explicitly in hexadecimal.

	Command	Purpose
Step 5	ATM(lane-config-database)# <b>name</b> <i>elan-name2</i> <b>local-seg-id</b> <i>segment-number</i>	Assigns a segment number to the second emulated Token Ring LAN in the configuration database.  The segment number you specify for <b>local-seg-id</b> must be identical to the ring number of the TrCRF. The <b>set vlan</b> command assumes that any ring number you enter is in hexadecimal. The <b>name</b> <i>elan-name</i> <b>local-seg-id</b> <i>segment-number</i> command assumes that any value you enter for the <b>local-seg-id</b> is in decimal unless you enter it explicitly in hexadecimal.  Repeat this step, providing a different ELAN name and segment number for each additional source-route bridged ELAN in this switch cloud.
Step 6	ATM(lane-config-database)# <b>default-name</b> <i>elan-name</i>	(Optional) Specifies a default ELAN for LECs not explicitly bound to an ELAN.
Step 7	ATM(lane-config-database)# <b>exit</b>	Exits database configuration mode and returns to global configuration mode.

## Setting Up the Database for Restricted-Membership ELANs

When you configure restricted-membership ELANs in the LECS database, you create database entries that link the name of each ELAN to the ATM address of its LES/BUS.

Unlike unrestricted-membership, you must *also* 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 which clients are allowed to join the ELAN. When a client requests to join an ELAN, the LECS consults its database and then assigns the client to the ELAN specified in the LECS's database.

When clients for the same restricted-membership ELAN are located in multiple switch ATM interfaces, 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 as you have clients for ELANs in all the switch ATM interfaces. Each client will have a different ATM address in the database entries.

To configure restricted-membership ELANs in the LECS database, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	ATM(config)# <b>lane database</b> <i>database-name</i>	Enters database configuration mode for the LANE database that you specify.
Step 2	ATM(lane-config-database)# <b>name</b> <i>elan-name1</i> <b>server-atm-address</b> <i>atm-address</i> <b>restricted</b> [ <b>index</b> <i>n</i> ]	Binds the name of the first ELAN to the ATM address of the LES/BUS for that ELAN in the configuration database.  If you are configuring SSRP, repeat this step with the same ELAN name but with different server ATM addresses for each additional server for the same ELAN. The index determines the priority. The highest priority is 0.

	Command	Purpose
Step 3	ATM(lane-config-database)# <b>name</b> <i>elan-name2</i> <b>server-atm-address</b> <i>atm-address</i> <b>restricted</b> [ <b>index</b> <i>n</i> ]	<p>Binds the name of the second ELAN to the ATM address of the LES/BUS in the configuration database.</p> <p>The index determines the priority. The highest priority is 0.</p> <p>Repeat this step, providing a different name and a different ATM address, for each additional ELAN.</p>
Step 4	ATM(lane-config-database)# <b>name</b> <i>elan-name1</i> <b>local-seg-id</b> <i>segment-number</i>	<p>Assigns a segment number to the first emulated Token Ring LAN in the configuration database.</p> <p>The segment number you specify for <b>local-seg-id</b> must be identical to the ring number of the TrCRF. The <b>set vlan</b> command assumes that any ring number you enter is in hexadecimal. The <b>name elan-name local-seg-id segment-number</b> command assumes that any value you enter for the <b>local-seg-id</b> is in decimal unless you enter it explicitly in hexadecimal.</p>
Step 5	ATM(lane-config-database)# <b>name</b> <i>elan-name2</i> <b>local-seg-id</b> <i>segment-number</i>	<p>Assigns a segment number to the second emulated Token Ring LAN in the configuration database.</p> <p>The segment number you specify for <b>local-seg-id</b> must be identical to the ring number of the TrCRF. The <b>set vlan</b> command assumes that any ring number you enter is in hexadecimal. The <b>name elan-name local-seg-id segment-number</b> command assumes that any value you enter for the <b>local-seg-id</b> is in decimal unless you enter it explicitly in hexadecimal.</p> <p>Repeat this step, providing a different ELAN name and segment number for each additional source-route bridged ELAN in this switch cloud.</p>
Step 6	ATM(lane-config-database)# <b>client-atm-address</b> <i>atm-address-template</i> <b>name</b> <i>elan-name</i>	<p>Adds a database entry associating a specific client's ATM address with a specific restricted-membership ELAN.</p> <p>Repeat this step for each of the clients of each of the restricted-membership ELANs on the switch cloud, in each case specifying that client's ATM address and the name of the ELAN with which it is linked.</p>
Step 7	ATM(lane-config-database)# <b>exit</b>	Exits from database configuration mode and returns to global configuration mode.

## Binding the LECS to the ATM Interface

Once you have created the database entries as appropriate to the type and the membership conditions of the ELANs, you can enable the LECS on the selected ATM interface and switch by using the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	ATM(config)# <b>interface atm</b> <i>number</i>	If you are not currently configuring the interface, specifies the major ATM interface where the LECS is located and enters interface configuration mode.
Step 2	ATM(config-if)# <b>lane config auto-config-atm-address</b>	Specifies that the LECS's ATM address will be computed by the automatic method.
Step 3	ATM(config-if)# <b>lane config database</b> <i>database-name</i>	Binds the LECS's database name to the specified major interface, and enables the LECS.
Step 4	ATM(config-if)# <b>exit</b>	Exits interface configuration mode.
Step 5	ATM# <b>copy running-config startup-config</b>	Saves the configuration.

## Setting Up a LES/BUS and a LEC

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

If you are going to have only one default ELAN, you only need to set up one server. 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 switch, or you can place it on a different switch.

When you set up a server and BUS on a switch, you can combine them with a client on the same subinterface, a client on a different subinterface, or no client at all on the switch.

Depending on where your clients and servers are located, perform one of the following tasks for each LANE subinterface:

- Setting Up the LES/BUS for an ELAN
- Setting Up a LEC for an ELAN

### Setting Up the LES/BUS for an ELAN

To set up the LES/BUS for an ELAN, use the following commands beginning in global configuration mode.

	Command	Purpose
Step 1	ATM(config)# <b>interface atm</b> <i>number</i> [ <i>.subinterface-number</i> ]	Specifies the subinterface for the first ELAN on this switch and enters interface configuration mode.
Step 2	ATM(config-if)# <b>lane server-bus tokenring</b> <i>elan-name1</i>	Enables a LES/BUS for the first ELAN on the subinterface (you cannot configure more than one LES/BUS per subinterface).

	Command	Purpose
Step 3	Repeat Steps 1 and 2 for all LES/BUSs you want to configure on the ATM module.	
Step 4	ATM(config-if)# <b>exit</b>	Exits interface configuration mode.
Step 5	ATM# <b>copy running-config startup-config</b>	Saves the configuration.

If the ELAN specified in Step 2 is intended to have *restricted membership* in the LECS database, carefully consider whether or not 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.

If you do decide to include the name of the ELAN linked to the client in Step 2 and later want to associate that client with a different ELAN, make the change in the LECS's database before you make the change for the client on this subinterface.

## Setting Up a LEC for an ELAN

This section describes the following tasks for setting up a LEC:

- Guidelines for Setting up a LEC
- Creating a Token Ring VLAN
- Setting up the Token Ring VLAN on a LEC

### Guidelines for Setting up a LEC

The Catalyst 5000 series Token Ring LANE requires the following software:

- Catalyst 5000 series supervisor engine software Release 4.3(1a) and later
- ATM software Release 4.9(b) and later
- VTP Version 2



#### Note

While VTP version 2 must be enabled on a Catalyst 5000 for Token Ring to function, do not use VTP to distribute VLAN configuration information between the switches. Configure the switches to operate in VTP transparent mode and manually configure the VLANs on each switch.

When you set up a LEC, follow these rules and recommendations:

- Make sure you properly configure the LECS and LES/BUS using the ATM module command-line interface (CLI) for each VLAN before creating a LEC. VTP does not set up the LECS or LES/BUS.
- In the **set vlan** command, the *vlan\_num* argument represents the VLAN number to configure, and the *vlan\_name* argument is the name of the VLAN.

- The VLAN name must match the ELAN name and the ring number must match the local segment ID.

The **set vlan** command assumes that any ring number you enter is in hexadecimal. Therefore, 0x12 or 12 is stored as the hexadecimal value 0x12. The **name elan\_name local-seg-id segment\_number** command assumes that any value you enter for the **local-seg-id** is in decimal unless you enter it explicitly in hexadecimal. For example, to define a TrCRF with a ring number of 12 you could enter **set vlan 12 name crf12 type trcrf ring 12 parent 100** or **set vlan 12 name crf12 type trcrf ring 0x12 parent 100**.

When defining a corresponding LEC, you could enter **name crf12 local-seg-id 0x12** or **name crf12 local-seg-id 18** because 18 is the decimal equivalent of 0x12.

- Before you can create a LEC, the TrBRF and TrCRF to which it will be associated must exist.
- Do not create more than one LEC for each TrBRF per ATM module.

While you can have only one LEC per TrBRF per module, you can have more than one module installed. This allows you to have more than one LEC per TrBRF, which means the switch can participate in more than one ELAN. The ELANs, however, cannot be parallel or the Spanning-Tree Protocol will block one of the connections.



**Note** Configuring more than one LEC for a TrBRF on a single ATM module will adversely affect frame forwarding.

- Ensure that all-routes explorer (ARE) reduction is enabled (using the **set tokenring reduction enable** command) on the Token Ring module.
- Do *not* configure parallel ELANs within a TrBRF (parallel ELANs are those ELANs that form a loop between switches).
- Do not create more than one LEC for each TrCRF per ATM module.

A TrCRF can include only one enabled LEC from any ATM module.

An ATM module LEC is assigned to a TrCRF to provide connectivity to the ATM network. In this sense, an ATM module is a logical port within the TrCRF. When assigning enabled LECs to TrCRFs, the enabled LECs of any one ATM expansion module should each be assigned to different TrCRFs.

- You can change all ELAN names with the exception of VLANs 1, 1003, or 1005 whose ELAN names must remain **default**, **trcrf-default**, and **trbrf-default**, respectively. You cannot override the ELAN name for VLAN 1, 1003, or 1005 by using the **name elan\_name** parameter. You can assign all other VLANs any name.

When you enter the **set vlan vlan\_num [name vlan\_name]** command in transparent mode and do not specify the optional **name elan\_name**, the software uses the names in Table 26 by default.

**Table 26** Default VLAN ELAN Names

VLAN Number	VLAN Name
1	default
2...1002	VLAN0002 through VLAN1002
1003	trcrf-default
1004	VLAN1004
1005	trbrf-default

If you currently have a different ELAN name for VLAN 1 or VLAN 1003, you must change the ELAN name to default (for VLAN 1) or trcrf-default (for VLAN 1003) in the LECS database. The following example shows an LECS database configuration that specifies **marktng** as the ELAN name for VLAN 1003:

```
lane database test
name marktng server-atm-address 47.0091810000000061705B8301.00400B020011.01
!
interface ATM0
no ip address
no ip route-cache
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane config auto-config-atm-address
lane config database test
!
interface ATM0.1 multipoint
no ip route-cache
lane server-bus tokenring marktng
lane client tokenring 1003 marktng
```

You must change the ELAN name for VLAN 1003 from marktng to trcrf-default in the second and last lines of the display, as follows:

```
lane database test
name default server-atm-address 47.0091810000000061705B8301.00400B020011.01
!
interface ATM0
no ip address
no ip route-cache
atm pvc 1 0 5 qsaal
atm pvc 2 0 16 ilmi
lane config auto-config-atm-address
lane config database test
!
interface ATM0.1 multipoint
no ip route-cache
lane server-bus tokenring default
lane client tokenring 1003 trcrf-default
```

## Creating a Token Ring VLAN

With Token Ring, to successfully route packets between ELANs, you can only set up one LEC for each TrBRF on an ATM module. For multiple ELANs with the same TrBRF to route packets, they must be configured on either separate ATM modules or connected via an external device.

If the TrBRF and TrCRF for which you are creating a LEC do not already exist, create the Token Ring VLANs by using the following commands beginning in privileged mode:

	Command	Purpose
Step 1	Console> (enable) <b>set vlan</b> <i>vlan_num</i> [ <b>name</b> <i>name</i> ] <b>type</b> <b>trbrf</b> [ <b>state</b> { <b>active</b>   <b>suspend</b> }] [ <b>mtu</b> <i>mtu</i> ] <b>bridge</b> <i>bridge_number</i> [ <b>stp</b> { <b>ieee</b>   <b>ibm</b>   <b>auto</b> }]	From the supervisor module, defines the TrBRF that you will associate to TrCRF as a parent
Step 2	Console> (enable) <b>set vlan</b> <i>vlan_num</i> [ <b>name</b> <i>name</i> ] <b>type</b> <b>trcrf</b> [ <b>state</b> { <b>active</b>   <b>suspend</b> }] [ <b>mtu</b> <i>mtu</i> ] <b>ring</b> <i>ring_number</i> <b>parent</b> <i>vlan_num</i> [ <b>mode</b> { <b>srt</b>   <b>srb</b> }] [ <b>backupcrf</b> { <b>off</b>   <b>on</b> }] [ <b>aremaxhop</b> <i>hopcount</i> ] [ <b>stemaxhop</b> <i>hopcount</i> ]	From the supervisor module, defines the TrCRF for which you are creating a LEC.

## Setting up the Token Ring VLAN on a LEC

To set up the LEC for the Token Ring VLAN and corresponding ELAN, use the following commands on the ATM module beginning in global configuration mode:

	Command	Purpose
Step 1	<code>ATM(config)# interface atm number[.subinterface-number]</code>	Specifies the subinterface for an ELAN on this switch and enters interface configuration mode.
Step 2	<code>ATM(config-if)# lane client tokenring vlan_id [elan-name]</code>	Creates a LEC for the first ELAN and specifies the VLAN number and the ELAN name to which to bind the LEC.
Step 3	<code>ATM(config-if)# exit</code>	Exits configuration mode.
Step 4	<code>ATM(config)# copy running-config startup-config</code>	Saves the configuration.

## Configuring Redundant LANE Services

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

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

LANE LES/BUS and LECS redundancy corrects these limitations by allowing you to configure redundant LES/BUSs so that the LECs in an ELAN can automatically switch to a backup LES if the primary LES fails. The priority of the LES/BUS pairs is established by the order in which they are entered in the LECS database. LANE LES/BUS and LECS redundancy is always enabled. You can use this redundancy feature by configuring multiple servers.

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

The following servers are single points of failure in the ATM LANE system:

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

LES/BUS and LECS redundancy eliminates these single points of failure.

## Enabling Redundant LECSs

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



### Note

To configure LES/BUS and LECS redundancy, you must enable multiple, redundant, and standby LECSs and multiple, redundant, and standby LES/BUSs. The LES/BUS and LEC redundancy configuration procedure guards against failure on hardware on which LANE components are running, including all Catalyst 5000 series switches. The configuration procedure is not effective for ATM network switch failures.

To enable LES/BUS and LEC redundancy, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	Switch(config)# <b>atm lecs-address</b> <i>address</i>	Allows you to enter the multiple LECS addresses on the ATM switch.
Step 2	ATM(config)# <b>name elan-name server-atm-address</b> <b>les-address</b> [ <i>index n</i> ]	Specifies redundant LES/BUSs on the ATM module. Enter the command for each LES address on the ELAN. The index determines the priority; 0 is the highest priority.

## Enabling ILMI Keepalive Timeout

If enabled, ILMI sends keepalive messages on an ongoing basis on the active physical (PHY) to the switch, and the switch responds. If the response is not obtained for the last four polls, the ILMI timer times out and the Dual PHY changes from active PHY to backup PHY. This feature is useful only if the two PHYs are connected to two different switches.

By default, this feature is disabled. To enable it, start a session to the ATM module (using the **session** command), and then enter the following commands:

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

These commands enable the transmission of ILMI keepalive messages and set the time between ILMI keepalive messages to 4 seconds.

## Using UNI 3.1 Signaling Support

The ATM LANE Dual PHY module supports backward compatibility with ATM switches for UNI version 3.1. On startup, ILMI negotiates between UNI versions 3.0 and 3.1, which requires no configuration. If the ILMI link autodetermination is successfully enabled on the interface, the router or switch accepts the UNI version returned by ILMI. If the ILMI link autodetermination is unsuccessful or if ILMI is disabled, the UNI version defaults to 3.0. You can override the version number by entering the **atm uni-version** command. If ILMI is enabled when you enter the **no** version of the command, the UNI version is set to the version returned by ILMI and the link autodetermination is successful. Otherwise, the version reverts to 3.0. Enter the **no atm uni-version** command to override the UNI version.



Note

Each ELAN is a separate subnetwork.

## Configuring Fast SSRP for Redundant LANE Services

With Fast Simple Server Redundancy Protocol (FSSRP), you can configure redundant LES/BUS pairs for each ELAN. With FSSRP, which differs from the previously implemented Simple Server Redundancy Protocol (SSRP), all configured LESs of an ELAN are active which means FSSRP-aware redundant LES/BUS pairs can accept join requests from any FSSRP-aware client.

LECs that are FSSRP aware have virtual circuits established to every single LES/BUS in the ELAN. Because virtual circuit connections already exist between all LECs and LES/BUS pairs in the ELAN, the LECs can switch over to another LES/BUS pair without any noticeable delay should a failure occur.

When you configure more than one LES/BUS pair for an ELAN, one LES/BUS takes precedence over others based on the order in which they are entered into the LECS database.



Note

Redundant LES/BUS pairs for a single ELAN should be configured on different ATM LANE modules in the LANE network for maximum fault tolerance.

Configuring redundant LES/BUS pairs for an ELAN is a two-part process:

- You must first configure the redundant LES/BUS pairs on subinterfaces for that ELAN.
- You must then enter the ATM addresses of the redundant LES/BUS pairs into the LECS database for the ELAN.

To configure the LES/BUS pairs, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	ATM# <b>configure terminal</b>	Enters global configuration mode.
Step 2	ATM (config)# <b>interface atm0</b>	Specifies the major interface and enters subinterface configuration mode.
Step 3	ATM (config-subif)# <b>lane fssrp</b>	Enables FSSRP on the major interface
Step 4	ATM (config-subif)# <b>interface atm 0. subinterface-number</b>	Specifies the subinterface for the first ELAN.

	Command	Purpose
Step 5	ATM (config-subif)# <b>lane server-bus tokenring</b> <i>elan-name</i>	Enables the LES/BUS for an ELAN on the subinterface (you cannot configure more than one LES/BUS per subinterface).
	Repeat Steps 2 and 3 for all LES/BUSs you want to configure on this ATM module.	
Step 6	ATM (config-subif)# <b>Ctrl-Z</b>	Exits subinterface configuration mode.
Step 7	ATM# <b>show lane server</b>	Verifies the LES/BUS configuration.

**Note**

The LES/BUSs are not fully operational until one or more LECs are configured and the LECS database is configured and bound to the ATM module interface.

This example shows how to specify the LES/BUS for an ELAN and verify the configuration:

```
ATM#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
ATM(config)#interface atm0.1
ATM(config-subif)#lane server-bus tokenring default
ATM(config-subif)#interface atm0.2
ATM(config-subif)#lane server-bus tokenring Eng_ELAN
ATM(config-subif)#^Z
ATM#show lane server
LE Server ATM0.1 ELAN name: default Admin: up State: operational
type: tokenring Max Frame Size: 4472
ATM address: 47.00918100000000E04FACB401.00100DAACC41.01
LECS used: 47.00790000000000000000000000.00A03E000001.00 NOT yet connected

LE Server ATM0.2 ELAN name: Eng_ELAN Admin: up State: operational
type: tokenring Max Frame Size: 4472
ATM address: 47.00918100000000E04FACB401.00100DAACC41.02
LECS used: 47.00790000000000000000000000.00A03E000001.00 NOT yet connected
```

To add the redundant LES/BUS pairs to the LECS, use the following commands beginning in privileged EXEC configuration mode:

	Command	Purpose
Step 1	ATM# <b>show lane server</b>	Displays the ATM address of the LES/BUS for the ELAN.
Step 2	ATM# <b>configure terminal</b>	Enters global configuration mode.
Step 3	ATM (config)# <b>lane database</b> <i>database-name</i>	Enters database configuration mode, specifying a LANE database name.
Step 4	ATM (lane-config-database)# <b>name</b> <i>elan-name</i> <b>server-atm-address</b> <i>atm-address</i>	Binds the name of the ELAN to the ATM addresses of the LES/BUS pairs in the order you want the services to fail over.
Step 5	ATM (lane-config-database)# <b>default-name</b> <i>elan-name</i>	In the configuration database, provides a default name of the ELAN.
Step 6	ATM (lane-config-database)# <b>Ctrl-Z</b>	Exits from database configuration mode.
Step 7	ATM# <b>show lane database</b>	Displays the LECS database configuration so that you can verify your changes.

This example shows how to display the ATM address of the LES/BUS of the default ELAN, how to configure the LECS database for the default ELAN, and how to verify the configuration:

```

ATM#show lane server
LE Server ATM0.1  ELAN name: default  Admin: up  State: operational
type: ethernet           Max Frame Size: 1516
ATM address: 47.00918100000000E04FACB401.00100DAACC41.01
LECS used: 47.0079000000000000000000000000.00A03E000001.00 NOT yet connected

ATM#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ATM(config)#lane database LANE_Backbone
ATM(lane-config-database)#name default server-atm-address
47.00918100000000E04FACB401.00100DAACC41.01
ATM(lane-config-database)#default-name default
ATM(lane-config-database)#^Z
ATM#show lane database

LANE Config Server database table 'LANE_Backbone'
default elan: default
elan 'default': un-restricted
server 47.00918100000000E04FACB401.00100DAACC41.01 (prio 0)

```

## Verifying the LANE Setup

Once you have set up the LECs on the subinterfaces of an ATM module, you can display their ATM addresses by using the following command in privileged EXEC mode:

Command	Purpose
Router# <b>show lane</b>	Displays the LES, BUS, and LEC ATM addresses.

The command output shows all the subinterfaces configured for LANE. For each subinterface, the command displays and labels the ATM addresses that belong to the LES, BUS, and the LEC.

When you look at each ATM address, check the following items:

- The prefix is the one you set up on the switch.
- The end-system identifier 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 (converted to hexadecimal).

Enter the **show lane** command on each Catalyst 5000 series switch to verify the LANE setup before you set up the LECs on the next Catalyst 5000 series switch. Print the display or make a note of these ATM addresses so that you can use it when you set up the LECS database. At this point in the configuration process, the LECs are not normally operational.

## Monitoring and Maintaining LANE Components

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

Command	Purpose
Router# <b>show lane</b> [interface atm 0 [subinterface-number]   name elan-name] [brief]	Displays the global and per-VCC LANE information for all the LANE components and ELANs configured on an interface or any of its subinterfaces.
Router# <b>show lane bus</b> [interface atm 0 [subinterface-number]   name elan-name] [brief]	Displays the global and per-VCC LANE information for the BUS configured on any subinterface or ELAN.
Router# <b>show lane client</b> [interface atm 0 [subinterface-number]   name elan-name] [brief]	Displays the global and per-VCC LANE information for all LECs configured on any subinterface or ELAN.
Router# <b>show lane config</b> [interface atm 0]	Displays the global and per-VCC LANE information for the LECS configured on any interface.
Router# <b>show lane database</b> [database-name]	Displays the LECS database.
Router# <b>show lane le-arp</b> [interface atm 0 [subinterface-number]   name elan-name]	Displays the LANE Address Resolution Protocol (ARP) table of the LECs configured on the specified subinterface or ELAN.
Router# <b>show lane server</b> [interface atm 0 [subinterface-number]   name elan-name] [brief]	Displays the global and per-VCC LANE information for the LES configured on a specified subinterface or ELAN.



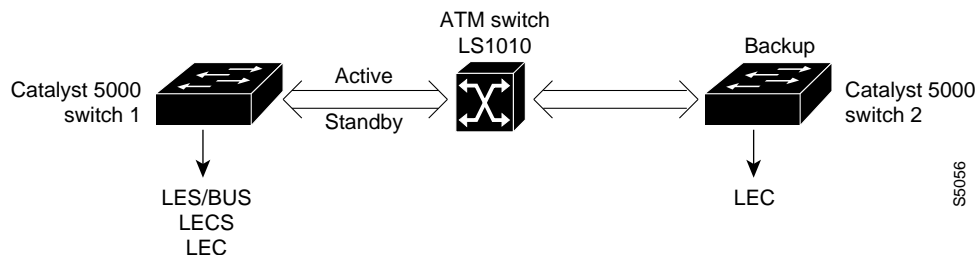
### Note

For descriptions of the output displayed by the commands listed above, see the description of the command documented in the *Cisco IOS Switching Services Command Reference*.

## Token Ring LANE Configuration Example

This section provides a configuration example composed of two Catalyst 5000 series switches and a LightStream 1010 ATM switch as illustrated in Figure 55.

**Figure 55** LES/BUS and LECS Configuration



## Example Assumptions

For the example in Figure 55 the following assumptions apply:

- Catalyst 5000 series switches with the ATM modules installed are running ATM software Release 4.9b and later.
- Catalyst 5000 series switch 1 runs the LES/BUS and LECS on interface **atm0** and the LEC on interface **atm0.1**.
- Catalyst 5000 series switch 2 runs LEC on interface **atm0.1**.
- The ATM module is installed in slot 4 of both Catalyst 5000 series switches.
- You can change the ELAN name by entering the **set vlan vlan\_num [name vlan\_name]** command.
- The ELAN on the switches is essentially a new TrCRF. The ELAN name is crf112 and the VLAN ID is 112.
- The parent TrBRF to the TrCRF 112 is brf400 (VLAN ID 400).

## Configuring the TrCRF Example

To define the TrCRF, complete the following tasks:

**Step 1** At the enable prompt, enter:

```
Console> (enable) set vlan 112 name crf112 type trcrf ring 112 parent 400 mode srb
```

**Step 2** To verify the configuration of the new VLAN, enter the **show vlan** command.

The output indicates that crf112 has been added and that brf400 is its parent.

```
Console> (enable) show vlan 112
VLAN Name                               Status      Mod/Ports, Vlans
-----
112   crf112                                active

VLAN Type  SAID      MTU    Parent RingNo BrdgNo  Stp   BrdgMode Trans1 Trans2
-----
112   trcrf  100112    4472   400    0x112   -     -     srb      0      0

VLAN AREHops STEHops Backup CRF
-----
112   7         7         off

Console> (enable)
```

## Configuring the LES/BUS and the LEC Example

To configure the LES/BUS and LEC, complete the following tasks:

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



**Note** The LightStream 1010 ATM switch provides a default prefix.

- Step 2** Start a session to the ATM module by entering the **session 4** command. You see the following display:

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

- Step 3** Obtain the addresses of the LES and LES/BUS for later use by entering the **enable** command (to enable configuration mode) and the **show lane default-atm-addresses** command at the ATM prompt. You see the following display:

```
ATM> enable
ATM#
ATM# show lane default-atm-addresses interface atm0

interface ATM0:
LANE Client:      47.0091810000000061705b7701.00400BFF0010.**
LANE Server:     47.0091810000000061705b7701.00400BFF0011.**
LANE Bus:        47.0091810000000061705b7701.00400BFF0012.**
LANE Config Server: 47.0091810000000061705b7701.00400BFF0013.00
ATM#
```



**Note** The two asterisks (\*\*) represent the subinterface number byte in hexadecimal.

- Step 4** Using the LECS address obtained in Step 3, set the address of the default LECS in the LightStream 1010 switch by entering the **configure terminal** and **atm lecs-address-default** commands on the console of the LightStream 1010 switch. You see the following display:

```
Switch> enable
Switch#
Switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)# atm lecs-address-default 47.0091810000000061705b7701.00400BFF0013.00 1
Switch(config)# end
Switch#
```

The commands shown in this step configure the address of the LECS in the switch. The LECS ATM NSAP address is 47.0091810000000061705b7701.00400BFF0013.00. The sequence number of this LECS address, which is 1, means it is the first LECS in this switch.

- Step 5** Save the configuration to NVRAM by entering the **write memory** command, as follows:

```
ATM# write memory
```

- Step 6** Start a LES/BUS pair on Catalyst 5000 series switch 1 by entering the **interface atm0** and the **lane server-bus tokenring** commands in global configuration mode. On the console of Catalyst 5000 series switch 1, enter the following commands:

```
ATM# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
ATM(config)# interface atm0
ATM(config-subif)# lane server-bus tokenring crf112
ATM(config-subif)# end
ATM#
```

The commands shown in this step start a LES/BUS pair and assign the ATM 0 interface to crf112. The ELAN name is **crf112**, and the interface on which this LES/BUS pair is configured is **atm0**. The ELAN name must be the same as the VLAN name assigned to the TrCRF.

**Step 7** Save the configuration in NVRAM entering the **write memory** command, as follows:

```
ATM# write memory
```

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

Enter the LES address obtained in Step 3 and replace the \*\* with the subinterface number of the interface on which the LES/BUS is to be configured. In this example, that number is 00. Enter the **lane database database\_name**, the **name elan\_name server-atm-address atm\_address** command, the **name elan\_name local-seg-id segment\_number**, and the **default-name elan\_name** commands at the ATM prompt. You see the following display:

```
ATM# config terminal
Enter configuration commands, one per line. End with CNTL/Z.
ATM(config)# lane database test
ATM(lane-config-database)# name trcf-default server-atm-address
                               47.009181000000061705b7701.00400BFF0011.00
ATM (lane-config-database) name crf112 local-seg-id 0x112
ATM(lane-config-database)# default-name crf112
ATM(lane-config-database)# exit
ATM#
```

The commands shown in this step create the LECS database. The database name is *test*. The ELAN name is **crf112**. The ELAN segment number is 112. The LES ATM NSAP address is 47.009181000000061705b7701.00400BFF0011.00.




---

**Note** The segment number you specify for **local-seg-id** argument must be identical to the ring number of the TrCRF. The **set vlan** command assumes that any ring number you enter is in hexadecimal. The **name elan-name local-seg-id segment-number** command assumes that any value you enter for the **local-seg-id** argument is in decimal unless you enter it explicitly in hexadecimal.

---

**Step 9** Save the configuration in NVRAM by entering the **write memory** command, as follows:

```
ATM# write memory
```

**Step 10** Start and bind the LECS on the Catalyst 5000 series switch 1 by entering the **interface atm0**, the **lane config database database\_name**, and the **lane config auto-config-atm-address** commands at the ATM prompt. You see the following display:

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

The commands shown in this step start the LECS. The database to use is *test*. The interface on which the LECS is configured is *atm0*.

**Step 11** Save the configuration in NVRAM by entering the **write memory** command, as follows:

```
ATM# write memory
```

- Step 12** Start the LEC on the Catalyst 5000 series switches 1 and 2 by entering the **interface atm0.1** command and the **lane client tokenring 112 crf112** command in configuration mode on the consoles of switches 1 and 2. The interface on which the LEC is configured is *atm0.1*. The ELAN name is default, and it is configured to emulate Token Ring. You see the following display:

```
ATM# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
ATM(config)# interface atm0.1
ATM(config-subif)# lane client tokenring 112 crf112
ATM(config-subif)# end
ATM#
```

- Step 13** Save the configuration in NVRAM by entering the **write memory** command, as follows:

```
ATM# write memory
```

---