CISCO SYSTEMS

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Catalyst 3900 Multimode Fiber ATM Expansion Module Configuration Note

December 15, 1997

This document contains instructions for installing and configuring the Catalyst 3900 Token Ring switch Asynchronous Transfer Mode (ATM) expansion module (product number WS-C3900-ATMSC=). For information about configuring and maintaining the Catalyst 3900 switch, refer to the *Catalyst 3900 Token Ring Switch User Guide*. This document is available on the Cisco Connection Documentation CD-ROM or in print.

Sections in this document include the following:

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Package Contents

Along with this document, your package should contain one ATM expansion module. If any item is missing or damaged, contact the place of purchase.

Overview

The ATM expansion module is a single-port expansion module that provides high-speed connectivity between the Catalyst 3900 Token Ring switch and an ATM backbone network. The ATM expansion module has a transmission speed of 155 Mbps over a multimode fiber interface using a duplex SC connector.

The ATM expansion module supports up to 63 emulated LANs and up to 2048 virtual channel connections (VCCs). It has a maximum forwarding rate of 160,000 frames per second (for 64-byte frames) and can support up to 128 concurrent calls and 256 concurrent LAN Emulation-Address Resolution Protocol (LE-ARP) requests.

ATM Expansion Module Highlights

Table 1 provides an overview of the features of the ATM expansion module.

Table 1   ATM Expansion Module Highlights

Feature	Description
Protocol support	ATM Forum LANE over ATM, Version 1.0
Signalling	ATM Forum UNI Version 3.0,Version 3.1, and Version 4.0 (auto-detectable)
Maximum VLANs (emulated LANs)	63 per switch stack
Maximum VCCs	2048 per ATM expansion module (distributed over all active LAN Emulation Clients [LECs])
Maximum bit rate	155 Mbps (SDH STM-1, SONET STS-3 OC-3)
VCC types	As required by the *ATM Forum LAN Emulation over ATM* Version 1.0 specification: • Multicast-send VCC: Configurable as constant bit rate (CBR), variable bit rate (VBR), or unspecified bit rate (UBR) • All other VCCs: UBR
Maximum ATM expansion modules per Catalyst 3900	2
Maximum ATM expansion modules per Catalyst 3900 stack	16
Configuration and management	Console: Catalyst 3900 console provides configuration and monitoring support for the ATM expansion module. This console is accessible via the Catalyst 3900 serial port or Telnet. See the "Configuring the ATM Expansion Module" and "Monitoring the ATM Expansion Module" sections for details. SNMP: Supported MIBs include RFCs 1213, 1493, 1573, and 1695. Traps include link-up and link-down.
Switching	Port-to-port hardware switching without embedded processor intervention. On-board processor is reserved for VCC establishment and maintenance.

Physical Characteristics

Figure 1 shows the ATM expansion module. There are two port status LEDs and two expansion module status LEDs that indicate the operational status of the expansion module and the port.

Figure 1   **ATM Expansion Module**
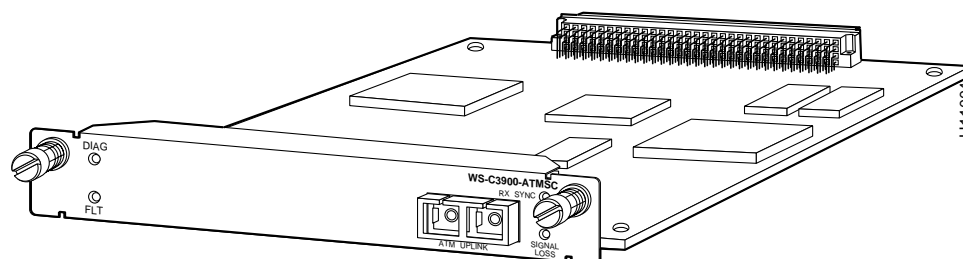
Table 2 describes the module status LEDs and their meanings.

Table 2   **Expansion Module Status LEDs**

Diag (green)	Fault (amber)	Meaning
Off	Off	Expansion module is off.
On	Off	Expansion module is working properly.
Flashing	Flashing	Start up diagnostics are in progress.
On	On	Expansion module failure has occurred.

Table 3 describes the port status LEDs and their meanings.

Table 3   **Port Status LEDs**

Rx Sync (green)	Fault (amber)	Meaning
Off	On	Signal loss.
On	Off	Connection is synchronized.
Flashing	Off	Auto is disabled.
Off	Flashing	Port is disabled
Flashing	Flashing	Loopback test is in progress.

Operating Environment and Physical Dimensions

Table 4 describes the operating environment and physical dimensions of the ATM module.

Table 4   ATM Module Operating Environment and Physical Dimensions

Temperature	50°F to 104°F (10°C to 40°C)
Relative humidity	8% to 80%
Maximum wet-bulb temperature	81°F (27°C)
Electrical power	5 amps at 5 volts DC or 25 watts
Width	6.7 in. (170 mm.)
Depth	8.4 in. (214 mm)
Height	1 in. (25 mm.)

Understanding ATM

ATM is a hardware and software architecture that switches small units of data called *cells*. The latency in a cell switch is very small because of the short cell size. Short cells have a tiny store-and-forward delay. In the absence of port contention and buffering, cells are switched quickly in the hardware. In addition to the low latency, ATM is beneficial to large networks because it:

- Is a multiplexing and switching technology that is designed for flexibility and performance.

- Supports Quality of Service (QOS) options for flexibility and high bandwidth options (up to Gigabits per second) for performance.

- Offers both permanent virtual circuits (PVCs), which allows an engineer to set up static connections, and switched virtual circuits (SVCs), which are automatically set up and torn down when data needs to be transferred.

- Supports environments where applications with different performance requirements need to be executed on the same computer, multiplexer, router, switch and network. The flexibility of ATM means that voice, video, data, and future payloads can be transported.

- Has worldwide support. The ATM Forum, an industry forum made up of many companies (including Cisco), works with formal standards bodies to specify ATM.

ATM Cell

The components of the 53-byte ATM cell are the following:

- Generic flow control. Intended to be used for controlling user access and flow control. This field is used when passing ATM traffic through a user-network (UNI) interface to alleviate short-term overload conditions. A network-to-network (NNI) interface does not use this field for GFC purposes; rather, an NNI uses this field to define a larger VPI value for trunking purposes.

- Virtual path identifier (VPI). Identifies the route (path) to be taken by the ATM cell. In an idle or null cell, the VPI field is set to all zeros. (A cell containing no information in the payload field is either "idle" or "null"). A virtual path connection (VPC) is a group of virtual connections between two points in the network. Each virtual connection may involve several ATM links. VPIs provide a way to bundle ATM traffic being sent to the same destination.

- Virtual channel identifier (VCI). Identifies the circuit or connection number on that path. In an idle or null cell (one containing no payload information), the VCI field is set to all zeros. Other non-zero values in this field are reserved for special purposes. For example, the values VPI=0 and VCI=5 are used exclusively for ATM signalling purposes when requesting an ATM connection. A VCC is a connection between two communicating ATM entities; the connection may consist of a concatenation of many ATM links.

- Payload type identifier (PTI). Indicates the type of data being carried in the payload. The first bit is a 0 if the payload contains user information and is a 1 if it carries connection management information. The second bit indicates if the cell experienced congestion over a path. If the payload is user information, the third bit indicates if the information is from customer premises equipment (CPE).

- Cell loss priority (CLP). 1-bit descriptor in the ATM cell header is set by the ATM adaptation layer (AAL) to indicate the relative importance of a cell. This bit is set to 1 to indicate that a cell can be discarded, if necessary, such as when an ATM switch is experiencing traffic congestion. If a cell should not be discarded, such as when supporting a specified or guaranteed QOS, this bit is set to 0. This bit may also be set by the ATM layer if an ATM connection exceeds the QOS parameters established during connection setup.

- Header error control (HEC). 8-bit cyclic redundancy check (CRC) computed on all fields in an ATM UNI/NNI cell header. The HEC is capable of detecting all single-bit errors and certain multiple-bit errors. This field provides protection against incorrect message delivery caused by addressing errors. However, it provides no error protection for the ATM cell payload proper. The physical layer uses this field for cell delineation functions during data transport.

- Payload. Maximum of 48 bytes. There is no error control for the payload.

PVC

With a PVC, everything is statically configured and no signalling is involved. The PVC is mapped to a network in a subinterface point-to-point configuration. The logical data link layer can use Subnetwork Access Protocol (SNAP) encapsulation (as defined in RFC 1483). This allows multiple protocols to be multiplexed over one PVC. Alternatively, the logical data link layer can use LAN emulation (LANE) Version 1 over PVC.

The PVC is statically mapped at each ATM node. The path of the PVC is identified at each switch by an incoming VCI and VPI and an outgoing VCI and VPI.

SVC

Establishing an ATM SVC involves an agreement between the end nodes and all the switches in between. Each end node has a special signalling channel to the connected switch called the UNI. Switches have a signalling channel between them called the NNI. Cells that arrive on the signalling channel are reassembled into frames in the reliable Service-Specific Connection Oriented Protocol (SSCOP). The signalling information follows the Q.2931 standard.

Establishing an SVC potentially involves signalling between the following:

- Router and a private ATM switch (private UNI)

- Router and a public ATM switch (public UNI)

- Private ATM switch and a public ATM switch (public UNI)

The UNI is defined by the ATM Forum UNI specification.

Interfaces to public ATM networks are identified by an E.164 address. Interfaces to private ATM networks are identified by a network service access point (NSAP) address. These addresses are contained in different fields of the same 20-octet address.

Once an SVC is established, it functions like a PVC. SVCs can be used in point-to-point subinterface configuration or point-to-multipoint nonbroadcast multiaccess (NBMA) configuration.

ATM Adaptation Layers

The purpose of the AAL is to receive the data from the various sources or applications and convert or adapt it to 48-byte segments that will fit into the payload of an ATM cell. Because ATM benefits from its ability to accommodate data from various sources with differing characteristics, the adaptation layer must be flexible.

There are four classes of traffic supported by the adaptation layer:

- Class A is supported by AAL1 and is typically used for servers such as DS1 or DS3 circuit emulation.

- Class B is supported by AAL2 and is typically used for compressed voice and video.

- Class C is supported by AAL3/4 and is used for transmitting VBR traffic and SDMS.

- Class D is supported by AAL5 and also supports VBR traffic but with minimal overhead.

Because ATM is inherently a connection-oriented transport mechanism and because the current applications of ATM are heavily oriented toward LAN traffic, many of the current ATM products, including the Catalyst 3900, support the Class D adaptation layer with AAL5.

Components of an ATM Network

The building blocks of an ATM internetwork may consist of the following:

- Routers with ATM interfaces

- Computers with a native ATM Network Interface Card (NIC)

- LightStream 1010 or other ATM switches

- ATM physical layer, supporting SONET OC-3 with single or multimode fiber, TAXI with multimode fiber, or DS3/E3 with coaxial cable

- LAN switches with ATM interfaces

ATM and VLANs

The ATM expansion module supports up to 63 VLANs (or emulated LANs). Each VLAN corresponds to an emulated LAN. Each association between the ATM expansion module and a VLAN creates a virtual ATM port. A virtual ATM port is the equivalent of an LEC.

Understanding LAN Emulation

LANE makes the ATM network transparent to LAN traffic by mapping connectionless LAN traffic over the connection-oriented ATM network. It uses point-to-multipoint connections to service the connectionless broadcast service that is required by LAN protocols.

Cisco's Token Ring implementation of LANE makes an ATM interface look like one or more Token Ring interfaces; the emulated LAN looks like a ring. Setting up LECs allows the Catalyst 3900 to operate in a LAN environment containing ATM devices, such as Cisco 7000 or 4500 series routers with an ATM interface or ATM port adapter connected to a LightStream 1010 ATM switch.

The Catalyst 3900 supports the LANE standard as defined by the ATM Forum specification *LAN Emulation over ATM Version 1.0,* ATM_FORUM 94-0035. This service emulates the following LAN-specific characteristics:

- Connectionless services

- Multicast services

- LAN Media Access Control (MAC) driver services

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

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

An ATM network can support multiple independent emulated LANs. Membership of an end system in any of the emulated LANs is independent of the physical location of the end system.

Components of LANE

Up to 256 emulated LANs can be set up in an ATM switch cloud. A Catalyst 3900 ATM module can participate in up to 63 of these emulated LANs.

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 emulated LAN. However, a router or a Catalyst 3900 ATM module can include LECs for multiple emulated LANs: one LEC for each emulated LAN of which it is a member.

  If a router has clients for multiple emulated LANs, the router can route traffic between the emulated LANs.

  Note If the Catalyst 3900 has multiple ATM modules and each has a client that active for the same emulated LAN, the Catalyst 3900 will not bridge between the emulated LANs on the different modules. The Catalyst 3900 acts as an edge device on an ATM cloud.

- LANE server (LES)

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

  The current implementation has a limit of one LANE server per emulated LAN.

- LANE broadcast and unknown server (BUS)

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

  One combined LES and BUS is required per emulated LAN.

- LANE configuration server (LECS)

  The LANE configuration server contains the database that determines which emulated LAN a device belongs to (each configuration server can have a different named database). Each LEC contacts the LECS once, when it joins an emulated LAN, to determine which emulated LAN it should join. The LECS returns the ATM address of the LES for that emulated LAN.

  One LECS is required per ATM LANE switch cloud.

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

  — Emulated LAN name, ATM address of LANE server pairs

  — LANE client MAC address, emulated LAN name pairs

  — LANE client ATM template, emulated LAN name pairs

  — Default emulated LAN name

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

- Simple Server Redundancy Protocol (SSRP)

  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.

The Catalyst 3900 ATM module currently supports only the LEC function. A Cisco 7000, Cisco 7200, Cisco 7500, RSP 7000, Cisco 4500, Cisco 4700, or Catalyst 5000 with an ATM Interface Processor (AIP) can supply all LANE functions.

LANE Operation and Communication

Communication among LANE components is typically handled by several types of SVCs. Some SVCs are unidirectional; others are bidirectional. Some are point-to-point and others are point-to-multipoint. Figure 2 illustrates the various types of SVCs.

Figure 2   LANE VCC Types

1–7	Control direct	4–9	Multicast send
2–8	Control distribute	5–10	Multicast forward
3–11	Configure direct (client)	6–6	Data direct
		11–12	Configure direct (server)
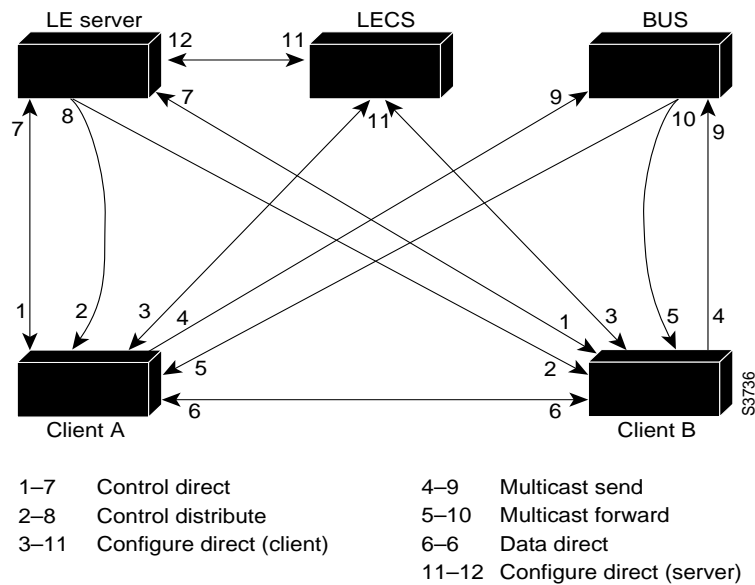
The following section describes various processes that occur, starting with a client requesting to join an emulated LAN.

Join Process

The following process (illustrated in Figure 2) normally occurs after an LEC has been enabled on the ATM module in a Catalyst 3900:

Step 1   The client requests to join an emulated LAN. The client sets up a connection to the LECS to find the ATM address of the LANE server for its emulated LANE. See the bidirectional, point-to-point link (link 1–7 in Figure 2).

An LEC finds the LECS using the following methods in the listed order:

- Locally configured ATM address

- Interim Local Management Interface (ILMI)

- Well-known address defined by the ATM Forum

Step 2   The LECS identifies the LES. Using the same VCC, the LECS returns the ATM address and the name of the LES for the client's emulated LAN.

Step 3   The client tears down the configure direct VCC.

Step 4   The client contacts the server for its LAN. The client sets up a connection to the LES for its emulated LAN (bidirectional, point-to-point control direct VCC [link 1–7 in Figure 2]) to exchange control traffic. Once a Control Direct VCC is established between an LEC and LES, it remains up.

Step 5   The LES verifies that the client is allowed to join the emulated LAN. The server for the emulated LAN sets up a connection to the LECS to verify that the client is allowed to join the emulated LAN (bidirectional, point-to-point server configure VCC [link 11–12 in Figure 2]).

The server's configuration request contains the client's MAC address, its ATM address, and the name of the emulated LAN. The LECS checks its database to determine whether the client can join that LAN; then it uses the same VCC to inform the server whether or not the client is allowed to join.

Step 6   The LES allows or disallows the client to join the emulated LAN. If allowed, the LES adds the LEC to the unidirectional, point-to-multipoint control distribute VCC (link 2–8 in Figure 2) and confirms the join over the bidirectional, point-to-point control direct VCC (link 1–7 in Figure 2). If disallowed, the LES rejects the join over the bidirectional, point-to-point control direct VCC (link 1–7 in Figure 2).

Step 7   The LEC sends LAN emulation address resolution protocol (LE-ARP) packets for the broadcast address, which is all 1s. Sending LE-ARP packets for the broadcast address returns the ATM address of the BUS. Then the client sets up the multicast send VCC (link 4–9 in Figure 2) and the BUS adds the client to the multicast forward VCC (link 5–10 in Figure 2) to and from the broadcast-and-unknown server.

Addressing

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

All LECs on the same interface have a different, automatically assigned MAC address. That MAC address is also used as the end-system identifier part of the ATM address, as explained in the following section.

LANE ATM Addresses

A LANE ATM address has the same syntax as an NSAP rather than E-164. It consists of the following:

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

- A 6-byte end-system identifier (MAC).

- A 1-byte selector field.

ILMI Address Registration

The Catalyst 3900 ATM module uses ILMI registration to build its ATM address and to register this address with the ATM switch. To build its ATM address, the Catalyst 3900 obtains its ATM address prefix from the ATM switch. Then it combines the ATM address prefix with its own MAC address and the selector value. As an alternative, you can hard-code the address. Once the Catalyst ATM module has determined its ATM address, it uses ILMI to register this address with the ATM switch.

Address Resolution

As communication occurs on the emulated LAN, each client dynamically builds a local LE-ARP table. The LE-ARP table maps emulated LAN MAC addresses (Layer 2) to ATM addresses (also Layer 2). A client's LE-ARP table can also have static, preconfigured entries. The LE-ARP table maps MAC addresses to ATM addresses.

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

Step 1   The client sends an LE-ARP request to the LANE server for this emulated LAN (point-to-point control direct VCC [link 1–7 in Figure 2]).

Step 2   If the MAC address is registered with the server, it returns the corresponding ATM address. If not, the LES forwards the LE-ARP request to all clients on the emulated LAN (point-to-multipoint control distribute VCC [link 2–8 in Figure 2]).

Step 3   Any client that recognizes the MAC address responds with its ATM address (point-to-point control direct VCC [link 1–7 in Figure 2]).

Step 4   The LES forwards the response (point-to-multipoint control distribute VCC [link 2–8 in Figure 2]).

Step 5   The client adds the MAC address-ATM address pair to its LE-ARP cache.

Step 6   Now the client can establish a VCC to the desired destination and proceed to transmit packets to that ATM address (bidirectional, point-to-point data direct VCC [link 6–6 in Figure 2]).

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

Traffic Handling

The Catalyst 3900 allows you to define up to 64 traffic profiles. These profiles can be used to define the maximum rates for each traffic type. The traffic profiles are defined on the Traffic Profile Table Setup panel. Refer to "Configuring Traffic Profiles Tables" in the "Configuring the ATM Expansion Module"section for more information.

For each VLAN (or emulated LAN), a traffic profile must be mapped to each DD-VCCs. The process of mapping depends on whether the traffic is incoming or outgoing:

- For incoming calls, the LEC tries to find a traffic profile that best matches the traffic parameters in the call. You can define the maximum discrepancy between the specified parameters and actual values on a per emulated LAN basis on the ELAN Configuration panel. Refer to "Configuring LEC Parameters" section for more information.

- For outgoing calls, you can define up to 10 profiles to use. The destination ATM address is ANDed with the address mask. The resulting ATM address is compared with the ATM address in the mapping table. If there is a match, each defined profile (0 through 9) is used in sequence until a call SETUP is accepted by the destination node. You define the address, address mask, and profiles to be used on the Traffic Profile Mapping panel. Refer to "Configuring Traffic Profile Mapping" in the "Configuring the ATM Expansion Module"section for more information.

Multicast Traffic

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

Step 1 The client sends the packet to the BUS (unidirectional, point-to-point multicast send VCC [link 4–9 in Figure 2]).

Step 2 The BUS forwards (floods) the packet to all clients (unidirectional, point-to-multipoint multicast forward VCC [link 5–10 in Figure 2]).

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

Recommended Environments

This section describes some scenarios for using the Catalyst 3900 with the ATM expansion module. Figure 3 shows how the ATM expansion module can be used to connect Catalyst 3900 switches through an ATM switch.

Figure 3   Connection Over an ATM Backbone
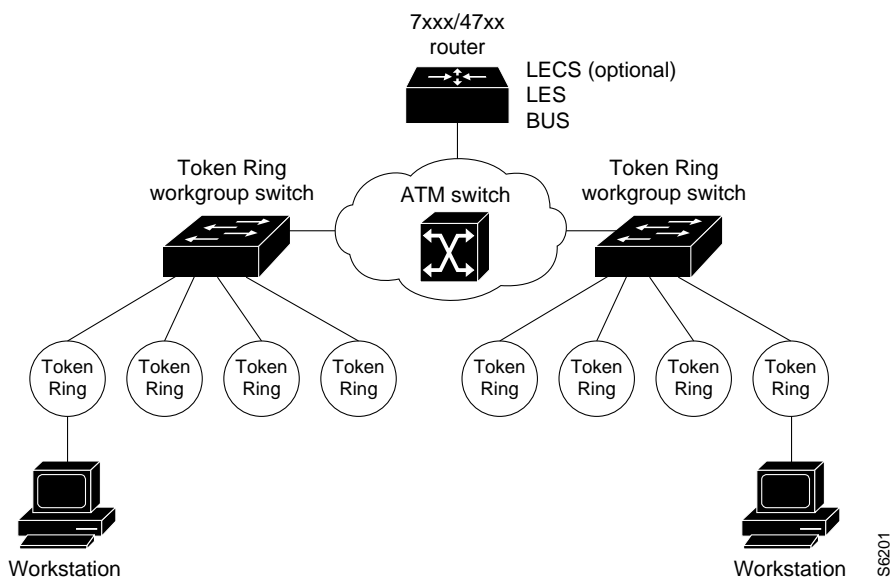
The ATM expansion module is well suited for the following environments:

- ATM backbone for legacy LANs

    A Catalyst 3900 with an ATM expansion module provides a seamless, switched network between legacy LANs communicating over ATM. Therefore, as a first step in migrating from legacy LANs, many users deploy ATM in the backbone or as the WAN technology to connect geographically dispersed legacy LANs.

- LAN-to-ATM interoperability

  A Catalyst 3900 with one or more ATM expansion modules can help protect your legacy LAN investment by providing transparent LAN-to-ATM switching. Therefore, as the next step in a legacy LAN-to-ATM migration, users place high-speed or frequently accessed servers, or both, on the ATM network to take advantage of ATM's scalability. By using LANE over ATM, ATM-based workstations are able to use existing legacy LAN applications with minimal or no upgrade costs for moving to ATM.

Using Multiple ATM Expansion Modules

Because one ATM expansion module can support as many LECs as there are VLANs in a Catalyst 3900, the question arises: Why use two ATM expansion modules?

The first reason is to provide a backup LEC. By enabling two LECs on two different ATM expansion modules to be members of both the same VLAN and the same emulated LAN, the Catalyst 3900's spanning-tree operation will automatically use one LEC for forwarding frames and the other LEC for blocking frames (active standby). For the backup LEC configuration to work, spanning tree *must* be enabled for the related LAN switch domain.

Note The Spanning-Tree Protocol (802.1d or IBM) used depends on whether the bridging mode is configured as source-route bridging (SRB) or source-route transparent (SRT). If the first LEC fails, the second LEC will automatically take over.

The second reason to use two ATM expansion modules is to increase system resources. In some environments the resources associated with a single ATM expansion module (such as a maximum of 2048 VCCs per ATM expansion module and a maximum data rate of 155 Mbps) might affect individual LEC performance. By moving one or more LECs to a second ATM expansion module, you can significantly increase the resources available to each LEC.

Note If the Catalyst 3900 has multiple ATM modules and each has clients active for the same emulated LAN, the Catalyst 3900 will not bridge between the emulated LANs. The Catalyst 3900 acts as an edge device on an ATM cloud.

Planning and Installation Preparations

To use the Catalyst 3900 with an ATM expansion module, you should have the following components in your network:

- ATM switch
- LECS (optional)
- LES
- BUS
- Other LECs

The LECs of an ATM expansion module will join an ATM-based emulated LAN as a proxy LEC supporting the Catalyst 3900's downstream legacy LAN. To prepare the emulated LAN, your ATM switch, LECS, and LES may need to be specially configured to accommodate an ATM expansion module LEC or any new LEC. Refer to the planning and installation guides associated with these other emulated LAN components to determine whether a special configuration is necessary.

Usage Recommendations and Restrictions

Be sure to follow these rules when installing the ATM expansion module:

- Never enable more than one LEC per TrCRF per ATM expansion module.

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

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

  Note   This restriction applies only to enabled LECs. Multiple disabled LECs can be assigned to one TrCRF.

- Never enable more than one LEC per TrBRF per ATM expansion module.

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

  Note   This restriction applies only to enabled LECs. Multiple disabled LECs can be assigned to one TrCRF. This restriction pertains only to the LECs of a single ATM expansion module. LECs on multiple ATM expansion modules can be assigned to the same TrCRF for backup purposes.

Planning the Cabling

The 155-Mbps ATM connection is made using 62.5/125-micron optical fiber, terminated with a subscriber connector. (The subscriber connector is an industry standard connector.) This construction meets the specifications in TIA/EIA/ANSI 568A. The maximum length is 1.24 miles (2 km). Refer the *Catalyst 3900 Token Ring Switch User Guide* for cabling information for other LAN ports.

Installation Considerations

Observe the following notes and cautions when installing an ATM expansion module in the expansion slot of the Catalyst 3900 chassis.

Note   The Catalyst 3900 ATM expansion module requires Release 2.0(1) of the Catalyst 3900 software, which is available via CCO.

Caution   Do not touch the components or connectors on the module. Do not touch cable connector pins when the other end of the cable is plugged in. Damage may result from static discharge.

Caution   During installation, the connector on the ATM expansion module must line up evenly with the connector inside the expansion slot. Misalignment may cause the connector pins to bend. When inserting the module in the expansion slot, be sure that the board is level and that the left and right sides slide evenly into the slot.

Installing the ATM Expansion Module

Follow these steps to install the ATM expansion module:

Step 1   Turn off the base machine. Unplug the power cord. The Catalyst 3900 does not have an on/off switch. To power off the Catalyst 3900, you must disconnect the power cord from the rear of the switch.

Warning Unplug the power cord before you work on a system that does not have an on/off switch.

Caution   This expansion module is *not* hot-pluggable. If you do not unplug the power cord, you might cause severe damage to the expansion module and to the base machine.

Step 2   Remove the plate covering the expansion module slot on the front of the base machine by removing the two thumbscrews holding it in place. Keep the plate and thumbscrews for use in the event that the expansion module is removed.

Step 3   Insert the module on the rails on each side of the expansion module slot (Figure 4) and slide the module back until the connector on the module is seated in the connector at the back of the slot.

When the module is fully seated, the expansion module faceplate will rest against the front of the base machine.

Figure 4   **Inserting an ATM Expansion Module**
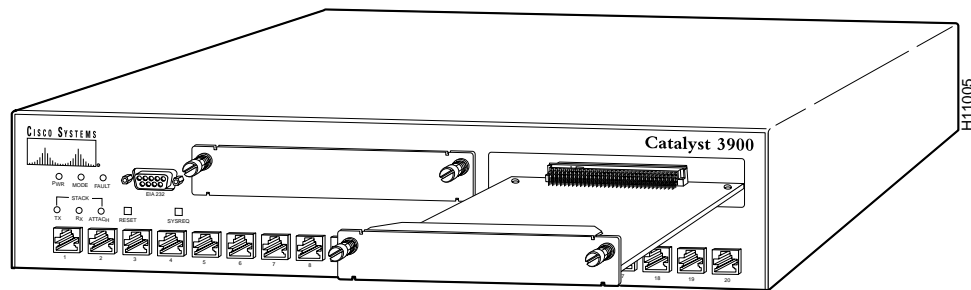
Step 4   Seat the module by pressing the front of the module with your thumbs.

Step 5   Secure the module to the chassis by tightening the thumb screws at the left and right edges of the expansion module's front panel. Do not overtighten the screws.

Step 6   Turn on the power to the switch.

Cabling

Observe the following warnings and notes when cabling an expansion module with fiber-optic cable.

Warning Laser radiation is present when the system is open.

Warning Do not stare into the laser beam.

The ports on the module, and the fiber-optic network to which it is connected, use laser light. Do not stare into a fiber-optic port or into the end of a cable that is connected to a fiber-optic port. To cable your expansion module, do the following:

Step 1   Determine that you have the proper cable.

Step 2   Connect an ATM cable from a switch or network device to the SC duplex ports on the front of the expansion module.

Step 3   Verify that the connection has the proper polarity. Be sure the Tx connector on the ATM module is linked to the Rx connector on the other device, and that the Rx connector on the ATM module is linked to the Tx connector on the other device. (ATM duplex SC connectors are "keyed" to indicate proper polarity, but the polarity of your connector cables may not be clearly marked.)

Testing the Expansion Module

This section provides instructions for verifying operation of the expansion module. See Table 2 and Table 3 for information about the LEDs.

Step 1   Turn on the base Catalyst 3900 by plugging in the power cord. The diagnostics will start.

Step 2   Verify that the base machine diagnostics have successfully completed. This is indicated when the Mode and Fault LEDs are off and the OK LED is on. Diagnostics can take up to 4 minutes to complete. If the base switch does not successfully complete diagnostics, use the troubleshooting procedures in the base machine documentation.

Step 3   Verify that the Fault LED on the expansion module is off. If it is off, continue with the configuration, as described in the "Safety Information" section. If the expansion module Fault LED is on, turn off the base machine, verify that the expansion module has been seated correctly in the slot, and turn on the base machine.

Step 4   If the expansion module Fault LED remains on again, you might need a microcode update. For more information, see the "Downloading the ATM Expansion Module Firmware" section.

Downloading the ATM Expansion Module Firmware

Before you can use your ATM module, you must download the ATM firmware to your switch or stack of switches. You can download the firmware using TFTP or a serial link.

Downloading the ATM Firmware using TFTP

You can use TFTP to download the ATM firmware of the Catalyst 3900. To perform a firmware download via TFTP, the Catalyst 3900 must have access to a TFTP server. Perform the following steps to download the firmware:

Step 1   Copy the binary file C39K_*xyz*.bin to the TFTP server and prepare the TFTP server.

Step 2   If you have not already done so, start a console session as described in the section "Planning for Configuration and Management" in the *Catalyst 3900 Token Ring Switch User Guide*.

Step 3   Select **Download/Upload** on the Main Menu. The Download/Upload panel (Figure 5) is displayed.

Figure 5   Download/Upload Panel


```
                              Download/Upload

                         Serial Link Download...

                         TFTP Download/Upload...




  Return


                         Return to previous menu
```

Step 4   Select **TFTP Download/Upload**. The TFTP Download/Upload panel (Figure 6) is
displayed.

Figure 6   TFTP Download/Upload Panel


```
                         TFTP Download/Upload

        TFTP Server Address              171.69.160.37

        Download VLAN                    trbrf-default

        Main Image Download...

        ATM Firmware Download...

        Configuration Files Download...

        Configuration Files Upload...



  Return


                         Return to previous menu
```
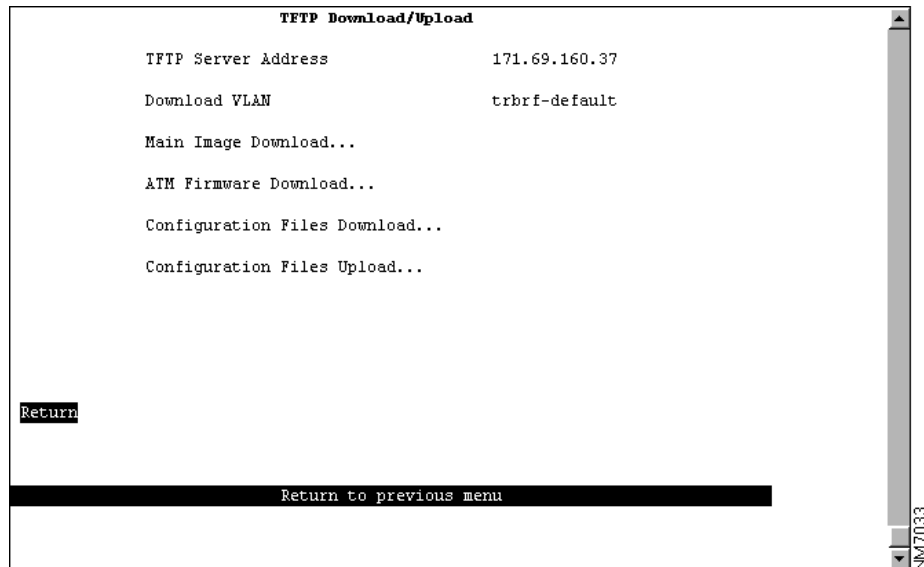
Step 5   Fill in the following fields:

- TFTP Server Address—IP address of the TFTP server.

- Download VLAN—Name of the TrBRF in which the TFTP server resides. The
  default is trbrf-default.

Step 6   Select **ATM Firmware Download**. The ATM Firmware Download panel (Figure 7) is
displayed.

Figure 7   **ATM Firmware Download Panel**

```
                    ATM Firware TFTP Download                              ▲

        ATM Firmware Download Filename      bburns/o2_0_0_28.bin

        Execute ATM Image Network Download




 ┌──────┐
 │Return│
 └──────┘
 ████████████████████████Return to previous menu████████████████████████
                                                                          ▼
```
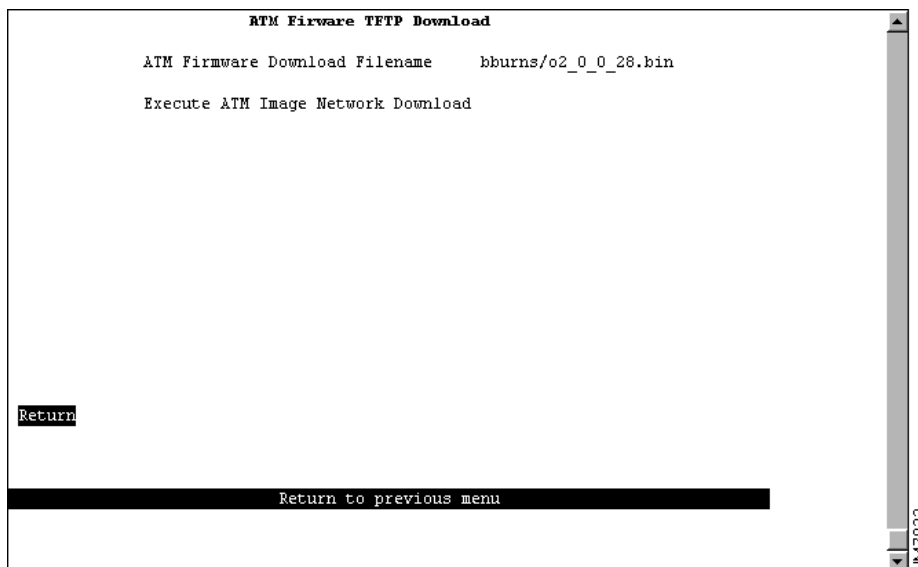
Step 7   Specify the path and filename as it exists on the TFTP server in the ATM Firmware Download Filename field.

Step 8   Select **Execute ATM Image Switch Network Download**.

Step 9   If the Catalyst 3900 is participating in a stack, you will be prompted to specify whether you want to download the new software to a single switch or to the entire stack.

Step 10   Enter **Y** or **N** to confirm the download when the following message is displayed:

```
Please confirm new code download via network (Y or N):
```

Note   Do not interrupt the download while it is writing to Flash memory or the image will be corrupted and need to be reloaded. While the Catalyst 3900 is writing to Flash memory the Mode LED will be blinking.

Step 11   Press **Enter** when you see the message:

```
Download complete - reset switch to activate new software.
Press <Enter> to continue......
```

Step 12   Reset the Catalyst 3900 to activate the new code by selecting Reset on the Main Menu panel or by pressing the Reset button.

Downloading the ATM Firmware using a Serial Link

You can use the serial link to download the ATM firmware of the Catalyst 3900. To perform a firmware download through the serial port, your terminal emulator must support the Xmodem protocol. To download firmware through the serial port, do the following:

Step 1   Insert the upgrade disk in your terminal drive.

Step 2   If you have not already done so, start a console session as described in the "Planning for Configuration and Management" section in the *Catalyst 3900 Token Ring Switch User Guide*.

Step 3   Select **Download/Upload** on the Main Menu. The Download/Upload panel (Figure 5) is displayed.

Step 4   Select **Serial Link Download**. The Serial Link Download panel (Figure 8) is displayed.

Figure 8   Serial Link Download Panel
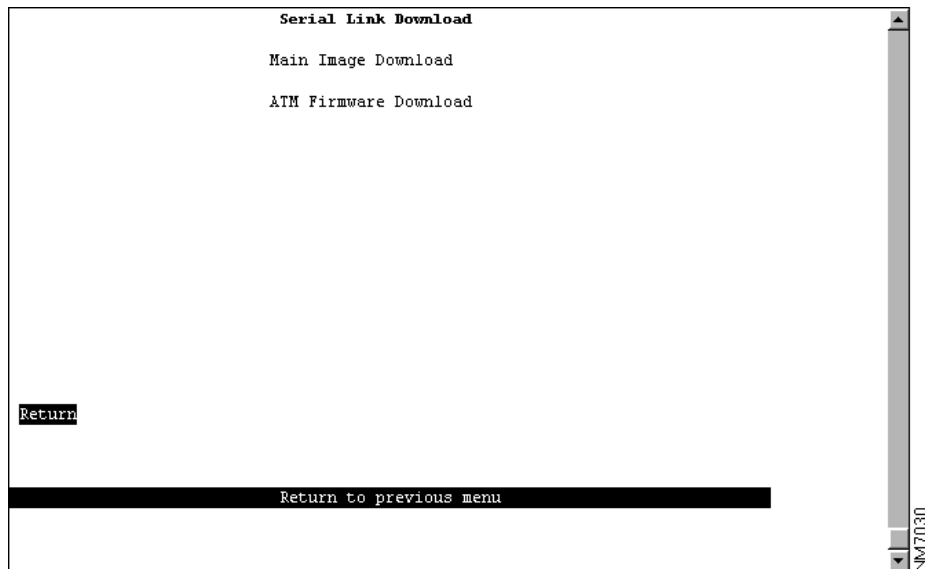
Step 5   Select **ATM Firmware Download**.

Step 6   Confirm the download. The download takes approximately 12 minutes at 9600 baud.

When the download is complete, the following messages appear:

```
Console: Beginning Xmodem download of ATM Firmware image
Console: Waiting for binary file.... Done
Console: Preparing Flash....Done.
Console: Saving ATM Firmware Image into Flash...Done
Please confirm switch reset (Y or N):
```

Step 7   Enter **Y** to confirm the reset. The procedure is complete.

Configuring the ATM Expansion Module

The Catalyst 3900 allows you to configure the ATM expansion module using its menu-driven interface. To access the configuration panels, select **Configuration** from the Main Menu. The Configuration Menu panel (Figure 9) is displayed.

Figure 9   Configuration Menu Panel

```
                          Configuration                              ▲

    Switch Information...              CDP Configuration...

    Module Information...              Switched Port Analyzer...

    VLAN and VTP Configuration...      TokenChannel...

    IP Configuration...               Filters & Port Security...

    SNMP Configuration...             Address Aging...

    Spanning Tree...                  Password...

    Port Configuration...             Console Configuration...



   Return

                       Display the Main Menu
                                                                     ▼
```
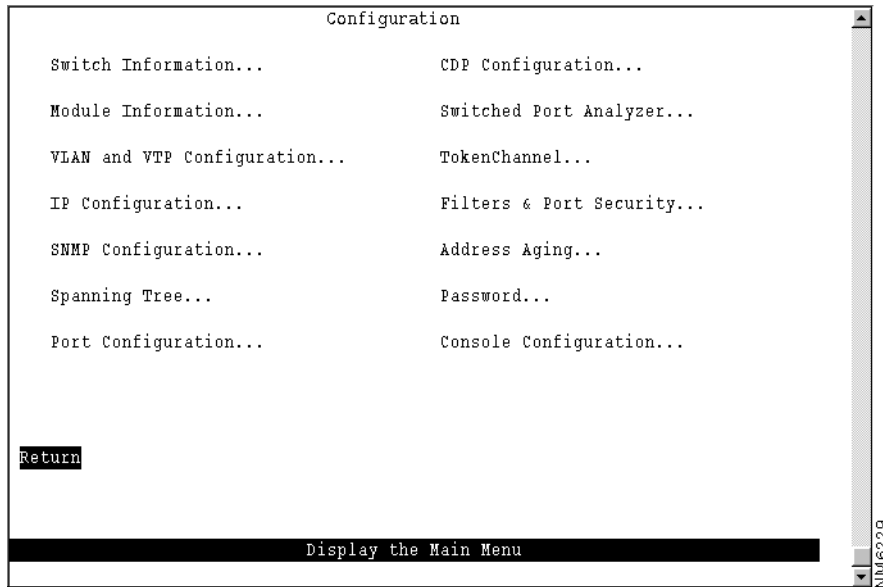
To configure your ATM expansion module, select **Port Configuration** from the Configuration Menu panel. You are prompted to specify the port you want to configure. When you specify a port on an ATM module, the ATM Configuration panel (Figure 10) is displayed. The possible port numbers for the ATM module are 21 (if the module is installed in slot 1) and 25 (if the module is installed in slot 2).

Figure 10   ATM Configuration Panel

```
                    ATM Configuration - Port 21                    ▲

                    Enabled      Yes

                    Status       Up

                    ATM Network Setup...

                    ATM LEC Setup...

                    Traffic Profiles Table...

                    Apply Changes




Return


                      Return to previous menu                      ▼
```

The following information is displayed on this panel:

• Enabled—Indicates whether the ATM port is enabled. Possible values are Yes and No. The default is Yes.

• Status—Current status of the port. Possible values are Down, Going Up, Up, Going Down, and Failing. You cannot change this field.

The following options are displayed on this panel:

• ATM Network Setup—Select this option to define ATM network parameters for the specified port. Refer to the "Configuring ATM Network Parameters" section for more information.

• ATM LEC Setup—Select this option to define parameters for the LEC. Refer to the "Configuring LEC Parameters" section for more information.

• Traffic Profiles Table—Select this option to configure the traffic profiles table. Refer to the "Configuring Traffic Profiles Tables" section for more information.

When you change a parameter on a panel and select Return, the change is saved in NVRAM. The change will not be implemented, however, until you restart the Catalyst 3900 or select **Apply Changes**.

⚠ **Caution**   Selecting **Apply Changes** will cause all emulated LANs to close and could, therefore, disrupt the network.

Configuring ATM Network Parameters

To configure ATM physical-layer network parameters, select **ATM Network Setup** from the ATM Configuration panel. The ATM Network Setup panel (Figure 11) is displayed.

Figure 11   ATM Network Setup Panel
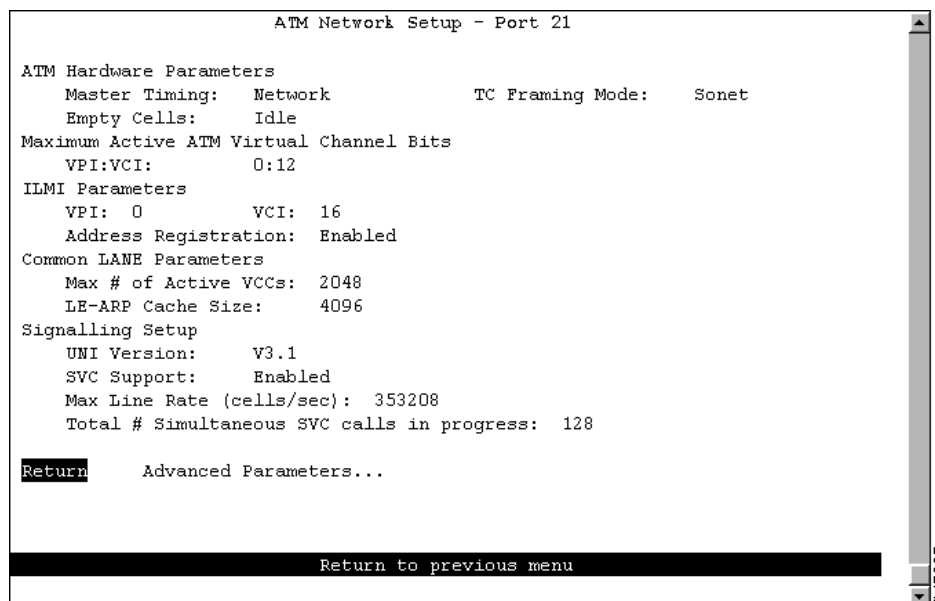
The following information is displayed on this panel:

- ATM Hardware Parameters

    — Master Timing—Source of the transmit timing. Possible values are Local and Network. The default is Network.

    — TC Framing Mode—Transmission convergence framing mode. Possible values are Sonet and SDH. The default is Sonet.

    — Empty Cells—Idle cell generation mode. Possible values are Idle and Unassigned. The default is Idle.

- Maximum Active ATM Virtual Channel Bits

    — VPI:VCI—Maximum active Virtual Path Identifier (VPI) and Virtual Connection Identifier (VCI) bit combination. Possible values are 0:12, 1:11, 2:10. The default is 0:12.

- ILMI Parameters

    — VPI—VPI for the ILMI. Possible values are 0 through 3. The default is 0.

    — VCI—VCI for the ILMI. Possible values are 0 through 4095. The default is 4095.

    — Address Registration—Indicates whether to enable ILMI address registration support. Possible values are Enabled and Disabled. The default is Enabled.

- Common LANE Parameters

  — Max # of Active VCCs—Maximum number of concurrently open Virtual Channel Connections VCCs. Possible values are 10 through 2048. The default is 2048.

  — LE-ARP Cache Size—Size (in bytes) of the LAN Emulation-Address Resolution Protocol (LE-ARP) cache. Possible values are 256 through 4096. The default is 4096.

- Signalling Setup

  — UNI Version—User-Network Interface (UNI) version. Possible values are V3.0, V3.1, and V4.0. The default is V3.1.

  — SVC Support—Indicates whether Switched Virtual Connection (SVC) support is enabled. Possible values are Enabled and Disabled. The default is Enabled.

  — Max Line Rate (cells/sec)—Maximum line rate in cells per second. Possible values are 1 through 353208.

  — Total # Simultaneous SVC calls in progress—Maximum number of SVC calls that can be processed simultaneously. Possible values are 1 through 128. The default is 128.

To	Select	Then
Change the current settings...	The appropriate parameter...	Specify the value.
Configure advanced ATM parameters...	**Advanced Parameters**	Refer to the "Configuring Advanced ATM Parameters" section.
Save your changes...	**Return**	

Configuring Advanced ATM Parameters

To configure advanced ATM parameters, select **Advanced Parameters** on the ATM Network Setup panel. The Advanced Parameters panel (Figure 12) is displayed. We recommend only experienced users configure the parameters listed on this panel. Changing these parameters may impact your network, therefore, use caution when altering the values for these parameters.

Figure 12   Advanced Parameters Panel

```
                    Advanced Parameters - Port 21

SSCOP:   Maximum Receive Window Size:                65535
         Maximum Connection Control States:          4
         Maximum Poll Data States:                   4
         Maximum Number Elements in STAT PDU:        67
         Maximum SDU Size (bytes):                   4096
         Maximum UU Size (bytes):                    4096
         Poll Timer (msec):                          750
         STAT PDU Timeout (sec):                     7
         Keep Alive Timer (sec):                     2
         Idle Timer (sec):                           15
         Connection Control Timer (tenths of sec):   1

Signal Timing Settings (in seconds):
         T301:  180          T309:  10          T316:  120
         T303:  4            T310:  10          T317:  60
         T308:  30           T313:  4           T322:  4

Return




                      Return to previous menu
```

The following information is displayed on this panel:

- SSCOP

    — Maximum Receive Window Size—Maximum size of the SSCOP receive window. Possible values are 1 through 16777215. The default is 65535.

    — Maximum Connection Control States—Maximum number of transmissions of a BGN (establishment), END (release), ER (error recovery), or RS (resynchronization) protocol data unit. Possible values are 1 through 255. The default is 4.

    — Maximum Poll Data States—Maximum number of transmissions between polls. Possible values are 1 through 255. The default is 4.

    — Maximum Number Elements in STAT PDU—Maximum number of list elements placed in a STAT protocol data unit. Possible values are (odd numbers) from 3 through 1023. The default is 67.

    — Maximum SDU Size (bytes)—Maximum size (in bytes) of the SSCOP SAAL service data unit. Possible values are 512 through 16384. The default is 4096.

    — Maximum UU Size (bytes)—Maximum size (in bytes) of the SSCOP user-to-user data unit. Possible values are 512 through 16384. The default is 4096.

    — Poll Timer (msec)—Peer poll time (in milliseconds). Possible values are 1 through 10000. The default is 750.

    — STAT PDU Timeout (sec)—Maximum interval (in seconds) for receiving a STAT protocol data unit. Possible values are 1 through 255. The default is 7.

    — Keep Alive Timer (sec)—Interval (in seconds) at which keep alive messages are sent. Possible values are 1 through 255. The default is 2.

    — Idle Timer (sec)—Period (in seconds) during which no POLL protocol data units are sent. Possible values are 1 through 255. The default is 15.

- — Connection Control Timer (tenths of sec)—Maximum time (in tenths of seconds) to wait for a response during the outgoing link establish, release, resynchronize, and recovery phases. Possible values are 1 through 255. The default is 1.

- Signal Timing Settings (in seconds)

  - — T301—Maximum time (in seconds) to wait for a connect after receiving an alert. Possible values are 1 through 65535. The default is 180.

  - — T303—Maximum time (in seconds) to wait for a network response to a setup request. Possible values are 1 through 255. The default is 4.

  - — T308—Maximum time (in seconds) to wait for a network response to a release request. Possible values are 1 through 255. The default is 30.

  - — T309—Maximum time (in seconds) to wait during a SSCOP connection loss. Possible values are 1 through 255. The default is 10.

  - — T310—Maximum time (in seconds) to wait for a final response after receiving a call proceeding. Possible values are 1 through 255. The default is 10.

  - — T313—Maximum time (in seconds) to wait for a network response to a connect request. Possible values are 1 through 255. The default is 4.

  - — T316—Maximum time (in seconds) to wait for a network response to a restart request. Possible values are 1 through 255. The default is 120.

  - — T317—Maximum time (in seconds) to act on a restart request. Possible values are 1 through 255. The default is 60.

  - — T322—Maximum time (in seconds) to wait for a network response to a status enquiry request. Possible values are 1 through 255. The default is 4.

To	Select	Then
Change the current settings...	The appropriate parameter...	Specify the value.
Save your changes...	**Return**	

Configuring LEC Parameters

Before you can configure parameters for an LEC, you must first assign the module to a TrCRF and TrBRF. Only one TrCRF per TrBRF can contain an ATM port, therefore, you cannot bridge traffic between emulated LANs. For more information about defining TrCRFs and TrBRFs, refer to the "Configuring VLANs and VTP" section of the *Catalyst 3900 Token Ring Switch User Guide*.

To configure LEC parameters, select **ATM LEC Setup** from the Configuration panel. Select the TrCRF to which the module is assigned. The ATM LEC Setup panel (Figure 13) is displayed.

Figure 13   ATM LEC Setup Panel


```
              ATM LEC Setup - Port 21 , crf_02

       Enabled     Yes
       Status      Going Up
       MTU         4472

       Max Explorer Rate (frames/sec)      disabled
       Max Rx Rate Threshold (cells/sec)   16777215
       Max Tx Rate Threshold (cells/sec)   16777215

       Default Traffic Profile             HW Default

       Traffic Profile Mapping...

       LANE Parameters...

       PVC Parameters...

Return


                    Return to previous menu
```
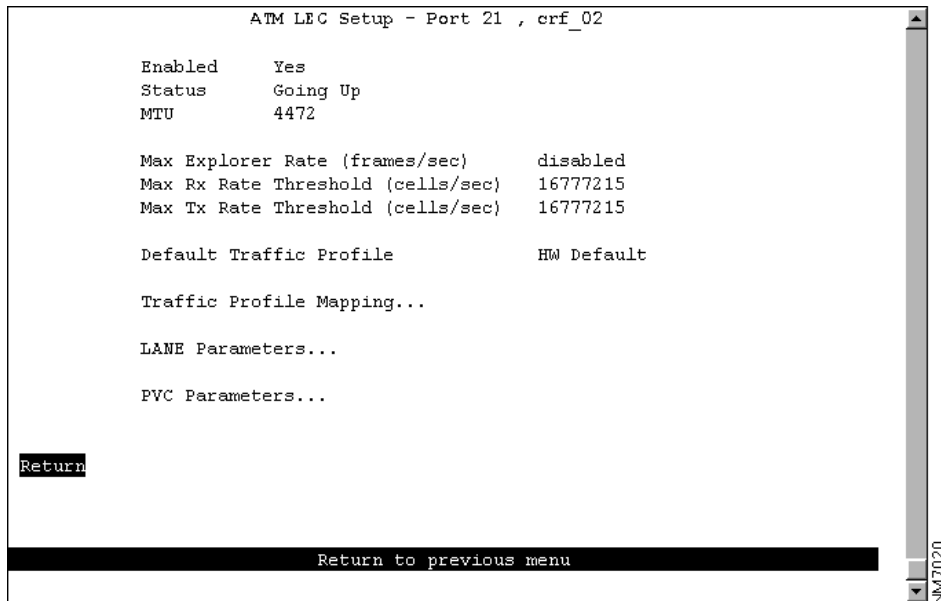
The following information is displayed on this panel:

- Enabled—Administrative status for this LEC. Possible values are Yes and No. The default is Yes.

- Status—Current status of the LEC. Possible values are Disabled, Going Up, Up, Going Admin Down, Admin Down, Failing, Waiting for Module Up, and Forwarding. You cannot change this field.

- MTU—Maximum transmission unit. Possible values are 1500 and 4472. The default is 4472.

- Max Explorer Rate (frames/sec)—Maximum explorer frame-forwarding rate (in frames per second). Possible values are 0 through 5000 and disabled. The default is disabled. If you set this parameter to 0, no explorers are forwarded. To change the value from a numeric value to disabled, select the field and enter a null value (by pressing Enter without specifying any value).

- Max Rx Rate Threshold (cells/sec)—Maximum difference between the requested receive rate and the line rate (in cells per second) beyond which the call is rejected. Possible values are 0 through 16777215. The default is 16777215.

- Max Tx Rate Threshold (cells/sec)—Maximum difference between the requested transmit rate and the closest matching profile (in cells per second) beyond which the call is rejected. Possible values are 0 through 16777215. The default is 16777215.

- Default Traffic Profile—Traffic profile to be used as the default. Possible values are 0 through 63. If you specify a null entry, the hardware default (255) is used.

The following options are displayed on this panel:

- Traffic Profile Mapping—Select this option to map traffic profiles for this emulated LAN. Refer to the "Configuring Traffic Profile Mapping" section for more information.

- LANE Parameters—Select this option to configure LAN emulation parameters for this emulated LAN. Refer to the "Configuring LANE Parameters" section for more information.

- PVC Parameters—Select this option to configure PVCs for this emulated LAN. Refer to the "Configuring PVC Parameters" section for more information.

Configuring Traffic Profile Mapping

To define the list of traffic profiles to be used for mapping outgoing traffic, select **Traffic Profile Mapping** on the ATM LEC Setup panel and specify the map number (0 through 9). The Traffic Profile Mapping panel (Figure 14) is displayed.

Figure 14   Traffic Profile Mapping Panel

```
            Traffic Profile Mapping - Port 21 , crf_02, Map 1          ▲

        Target ATM Address:       00.000000000000000000000000.000000000000.00
        ATM Address Mask:         00.000000000000000000000000.000000000000.00
        VCC Type:                 Any
        Profile 0:                0
        Profile 1:                1
        Profile 2:                2
        Profile 3:                3
        Profile 4:                4
        Profile 5:                5
        Profile 6:                6
        Profile 7:                7
        Profile 8:                8
        Profile 9:                9




  ▄▄▄▄▄▄▄
  Return



                       Return to previous menu
  ▼
```
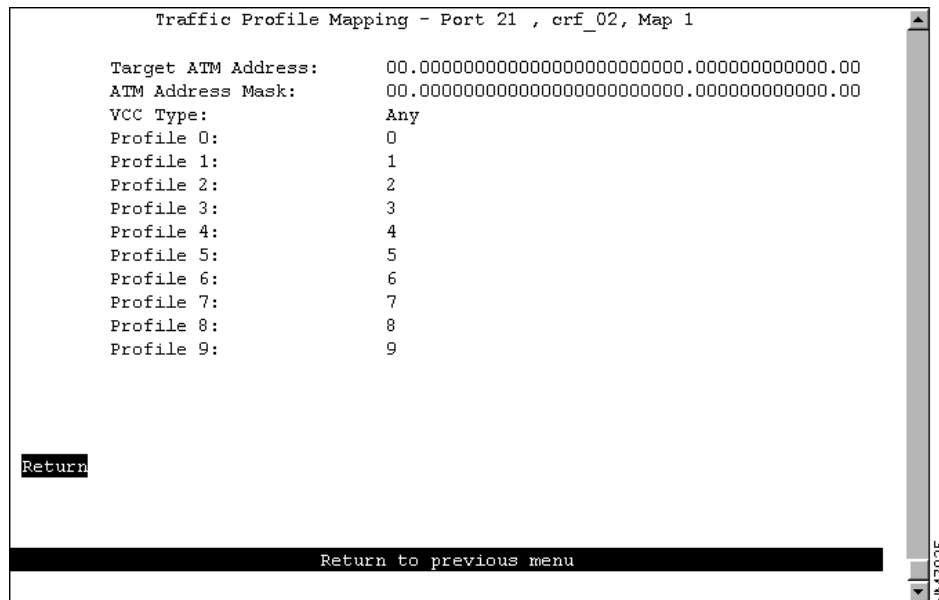
The following information is displayed on this panel:

- Target ATM Address—Destination ATM address to which to apply this traffic profile map.

- ATM Address Mask—Bit mask to be applied to the address before comparing it with the Target ATM Address.

- VCC Type—VCC type to which to apply this traffic profile map. Possible values are Any, Data, Direct, Distribute, Send, and Forward. The default is Any.

- Profile 0 through 9—Indentifier of the entry in the traffic profile table. Possible values are 0 through 63. The default for each profile is 0 through 9 respectively.

To	Select	Then
Change the current settings...	The appropriate parameter...	Specify the value.
Save your changes...	**Return**	

Configuring LANE Parameters

To configure LANE parameters for this LEC, select **LANE Parameters** on the ATM LEC Setup panel. The LANE Parameters panel (Figure 15) is displayed.

Figure 15   **LANE Parameters Panel**

```
                    LANE Parameters - Port 21 , crf_02

LANE ATM Address:        Automatic
LAN Emulation Server (LES) Address:
                        Automatic
LAN Emulation Configuration Server (LECS):
     VPI: 0  VCI: 17    Address: 00.00000000000000000000000000.000000000000.00
LAN Emulation Client:
     ELAN Name:                      crf_02
     Guaranteed # of VCCs:           5
     Guaranteed # of LE-ARP Entries: 5
     Max Unknown Frame Count:        1
     Max Unknown Frame Time (sec):   1
     Max Retry Count:                1
     Connection Complete Timer:      4
     Control Timeout (sec):    120   VCC Timeout (sec):          1200
     Aging Timeout (sec):      300   FLUSH Timeout (sec):        4
     Forward Delay Time (sec): 15    Expected ARP Resp time (sec): 1

Return



                      Return to previous menu

```

The following information is displayed on this panel:

- LANE ATM Address—Indicates whether the ATM address for this emulated LAN is assigned manually or automatically. Possible values are Manual and Automatic. The default is Automatic. If the address is assigned manually, this field also displays the address.

- LAN Emulation Server (LES) Address—Indicates whether the ATM address of the LES is obtained automatically or manually. If you select Manual, you must specify the ATM address of the LES. If the LES address is specified, then the LECS information is not needed.

- LAN Emulation Configuration Server (LECS)

  — VPI—VPI of the LECS to which this emulated LAN connects. Possible values are 0 through 3. The default is 0.

  — VCI—VCI of the LECS to which this emulated LAN connects. Possible values are 0 through 4095. The default is 17.

  — Address—ATM address of the LECS.

- LAN Emulation Client

  — ELAN Name—Name of the preferred emulated LAN to join.

  — Guaranteed # of VCCs—Guaranteed number of VCCs. Possible values are 5 through 2048. The default is 5.

  — Guaranteed # of LE-ARP Entries—Guaranteed number of LE-ARP entries. Possible values are 2 through 4096. The default is 2.

  — Max Unknown Frame Count—Maximum number of frames that can be sent to a unicast MAC address within the Max Unknown Frame Time. Possible values are 1 through 10. The default is 1.

  — Max Unknown Frame Time (sec)—Time (in seconds) during which the Max Unknown Frame Count is measured. Possible values are 1 through 60. The default is 1.

  — Max Retry Count—Maximum number of LE-ARP retries for a given destination. Possible values are 0 through 2. The default is 1.
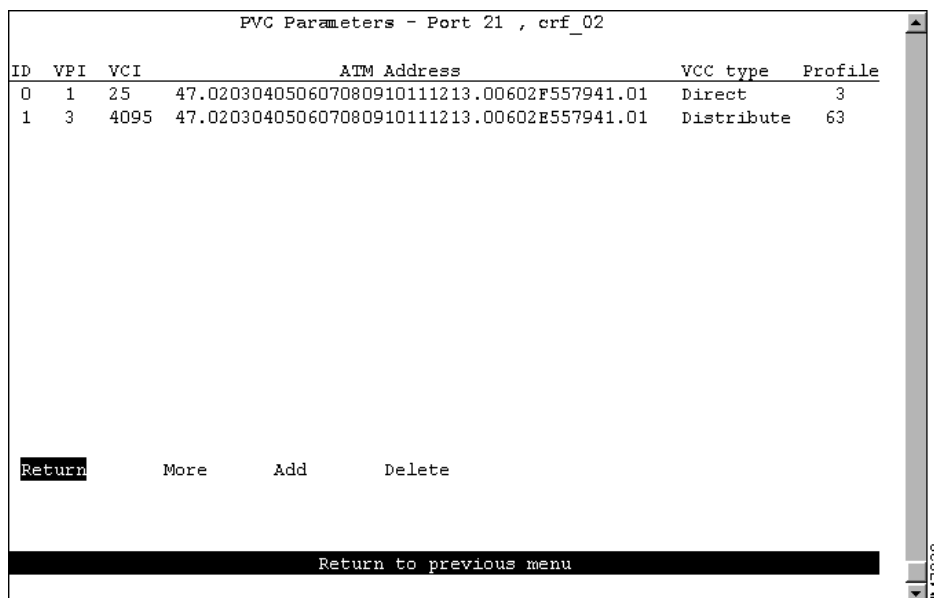
— Connection Complete Timer—Length of time (in seconds) in which the LEC expects data or a READY_IND message from a calling party. Possible values are 1 through 10. The default is 4.

— Control Timeout (sec)—Amount of time (in seconds) before most request/response frames are timed out. Possible values are 10 through 300. The default is 120.

— VCC Timeout (sec)—Length of time (in seconds) after which the LEC will release a VCC if the VCC has not been used to transmit or receive any frames. Possible values are 10 through 1200. The default is 1200.

— Aging Timeout (sec)—Maximum time (in seconds) between LE-ARP verifications for a DD-VCC. Possible values are 10 through 300. The default is 300.

— FLUSH Timeout (sec)—FLUSH protocol time period. Possible values are 1 through 4. The default is 4.

— Forward Delay Time (sec)—Maximum time (in seconds) that a remote destination table entry may keep a DD-VCC without LE-ARP verification. Possible values are 0 through 30. The default is 15.

— Expected ARP Response time (sec)—Maximum time (in seconds) the LEC will wait for a flush response after sending a flush request. If this value is exceeded, the LEC will take recovery action. Possible values are 1 through 30. The default is 1.

To	Select	Then
Change the current settings...	The appropriate parameter...	Specify the value.
Save your changes...	**Return**	

Configuring PVC Parameters

To configure the PVCs to be assigned to this LEC, select **PVC Parameters** on the ATM LEC Setup panel. The PVC Parameters panel (Figure 16) is displayed.

Figure 16   PVC Parameters Panel

```
                    PVC Parameters - Port 21 , crf_02

ID  VPI  VCI               ATM Address                 VCC type   Profile
0    1   25    47.02030405060708091011213.00602F557941.01   Direct        3
1    3   4095  47.02030405060708091011213.00602E557941.01   Distribute   63










    Return        More      Add       Delete



                      Return to previous menu
```

The following information is displayed on this panel:

- ID—Identifier of the PVC entry.

- VPI—VPI of this PVC. Possible values are 0 through 3.

- VCI—VCI of this PVC. Possible values are 0 through 4095.

- ATM Address—ATM address of this PVC.

- VCC Type—Type of VCC connection to this PVC. Possible values are Data, Direct, Distribute, Send, and Forward.

- Profile—Traffic profile (from the traffic profile table) to be used. Possible values are 0 through 63.

To	Select	Then
Add a PVC...	**Add**	Specify the VPI, VCI, ATM address, VCC type, and profile.
Delete a PVC...	**Delete**	
Save your changes...	**Return**	

Configuring Traffic Profiles Tables

To configure the traffic profile table, select **Traffic Profiles Table** on the ATM Configuration panel. The Traffic Profiles Table panel (Figure 17) is displayed.

Figure 17   Traffic Profile Table Panel

```
                 Traffic Profiles Table - Port 21                    ▲

  Pr   Traffic Type        QOS      Peak Rate    Sustained Rate   Max Burst Size
  0    BestEffort          None      353208          N/A             N/A
  1    BestEffort          None      235849          N/A             N/A
  2    BestEffort          None       96000          N/A             N/A
  3    BestEffort          None       81056          N/A             N/A
  4    BestEffort          None       59259          N/A             N/A
  5    BestEffort          None       23585          N/A             N/A
  6    BestEffort          None        2358          N/A             N/A
  7    BestEffort          None        1208          N/A             N/A
  8    BestEffort          None         604          N/A             N/A
  9    BestEffort          None         353          N/A             N/A




  Return        More       Add     Change      Delete



                         Return to previous menu                       ▼
```

The following information is displayed on this panel:

- Pr—Identifier of the profile in the table. Possible values are 0 through 63.

- Traffic Type—Possible values are NoClpNoScr (no cell loss priority/no sustained cell rate),
  NoClpScr (no cell loss priority/sustained cell rate), ClpNo-TaggingScr (cell loss priority/no
  tagging sustained cell rate) ClpTaggingScr (cell loss priority/ tagging sustained cell rate), and
  BestEffort. The default is BestEffort.

  Normally, traffic profiles used with LAN Emulation, Classical IP, or Multiprotocol Encapsulation
  over ATM are of type BestEffort (or UBR). For this type of traffic profile, the network does not
  guarantee any specific bandwidth.

  For a BestEffort traffic profile, the Peak Rate is the only valid parameter. The Peak Rate
  parameter can be used to limit the maximum transmission rate that the adapter will use to avoid
  congestion if the device at the other end of the connection is a slower device.

- QOS—Quality of Service. Possible values are Class 1, Class 2, Class 3, Class 4, and None. The
  default is None.

- Peak Rate—Maximum rate (in kilobits per second) at which a virtual circuit can transmit.
  Possible values are 353 through 353208.

- Sustained Rate—Average rate (in kilobits per second) at which a virtual circuit can transmit.
  Possible values are 353 through 353208 and N/A. This parameter is not applicable if the Traffic
  Type is BestEffort.

- Max Burst Size—Maximum number of ATM cells the virtual circuit can transmit to the network
  at the peak rate of the PVC. Possible values are 0 through 356 and N/A. This parameter is not
 applicable if the Traffic Type is BestEffort.

To	Select	Then
Add an entry	**Add**	Specify the profile identifier, traffic type, QOS, peak rate, sustained rate, and maximum burst size.
Change the current settings...	**Change**	Specify the profile identifier, traffic type, QOS, peak rate, sustained rate, and maximum burst size.
Remove an entry	**Delete**	Specify the profile identifier.
Save your changes...	**Return**	

Configuring SPAN for ATM

You can use the Switched Port Analyzer (SPAN) function to perform active monitoring of your ATM module. An active port monitor allows you to monitor traffic using a customer-supplied monitoring device, such as an RMON probe, or a trace tool, such as a Network General Sniffer. The trace tool monitors only the LLC traffic that is switched by the monitored port. The MAC frames are not monitored.

To configure a SPAN port, select **Switched Port Analyzer** on the Configuration Menu. The Switched Port Analyzer panel (Figure 18) is displayed.

Figure 18   Switched Port Analyzer Panel
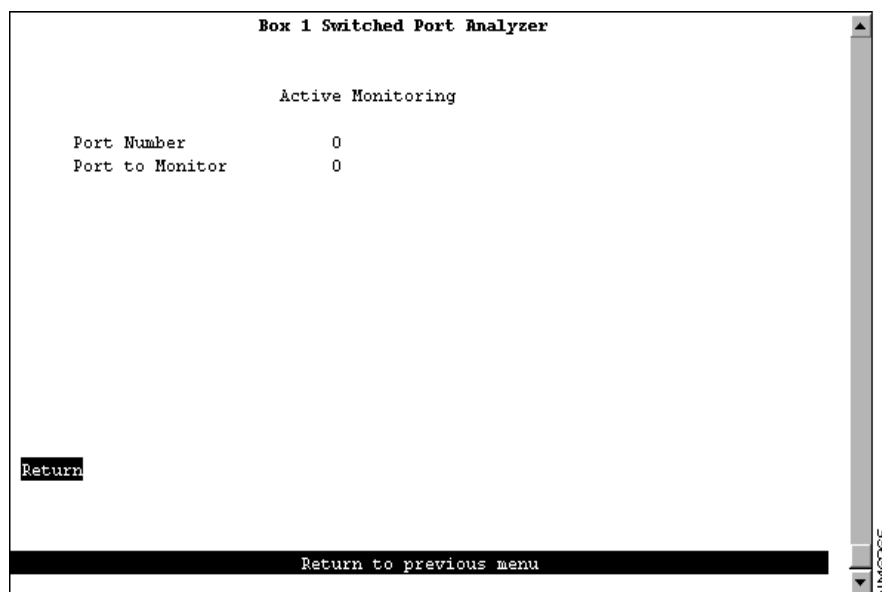
The following information is displayed on this panel:

- Active Monitoring

    — Port Number—Port to which the network analyzer or RMON probe will be attached. Possible values are 0 through 28. You cannot, however, specify an ATM port.

    — Port To Monitor—Port that will be monitored. Possible values are 0 through 28. If you specify an ATM port, you will be prompted to select the TrCRF that you want to monitor.

- Passive Monitoring

  You cannot perform passive monitoring on or with an ATM port.

To	Select	Then
Change the current settings…	The appropriate parameter…	Specify the value.
Disable the SPAN port…	**Port to Monitor**	Specify 0.
Save your changes…	**Return**	

Monitoring the ATM Expansion Module

The Catalyst 3900 provides status and statistical information for several aspects of the ATM expansion module. To access the status and statistical information, select **Statistics** on the Main Menu. The Statistics panel (Figure 19) is displayed.

Figure 19   **Statistics Panel**
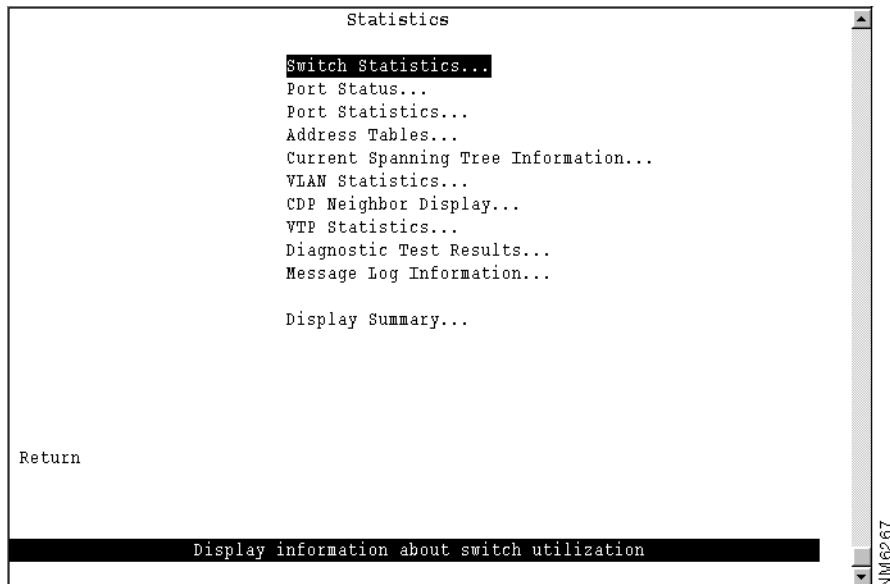
The Port Status and Port Statistics options have been modified to provide information about the ATM expansion module.

Viewing Port Status

To view status information about the virtual ATM ports, select **Port Status** on the Statistics panel. The Port Status panel (Figure 20) is displayed.

Figure 20   Port Status Panel

```
                        Port Status

Port TrCRF            TrBRF           Enabled Ins Spd  Oper Mode    Fwd Mode
  16 trcrf-default    trbrf-default     Yes   No
  17 trcrf-default    trbrf-default     Yes   No
  18 trcrf-default    trbrf-default     Yes   No
  19 trcrf-default    trbrf-default     Yes   No
  20 trcrf-default    trbrf-default     Yes   No
  21 trcrf-default    trbrf-default   Going Up 155  ATM ELAN     Store-Fwd
  21 crf_02           brf_03          Going Up 155  ATM ELAN     Store-Fwd
  21 crf_04           brf_05          Going Up 155  ATM ELAN     Store-Fwd
  21 crf_06           brf_07          Going Up 155  ATM ELAN     Store-Fwd
  21 crf_08           brf_09          Going Up 155  ATM ELAN     Store-Fwd
  21 crf_10           brf_11          Going Up 155  ATM ELAN     Store-Fwd




Return      More



                     Return to previous menu
```
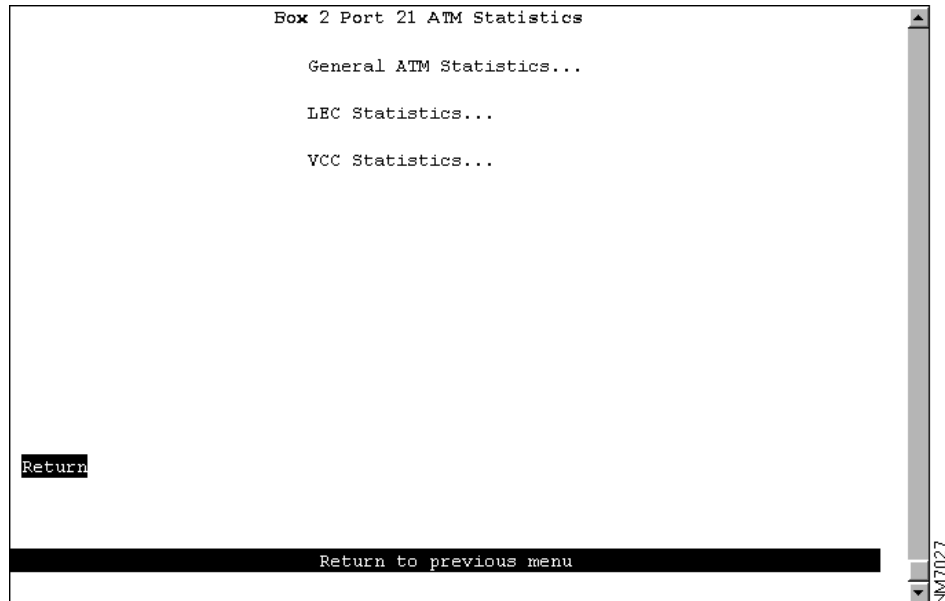
The following information is displayed on this panel:

- Port—Port number. For an ATM port, there is an entry for each virtual ATM port, or LEC, defined.

- TrCRF—Name of the TrCRF to which this port belongs. The panel shows only the first 16 characters of the name. For an ATM port, this is the name of the TrCRF to which the LEC belongs.

- TrBRF—Name of the TrBRF to which this port belongs. The panel shows only the first 16 characters of the name.

- Enabled—Indicates whether the port is enabled. For ports on the LEC, the possible values are Disabled, Going Up, Up, Going Admin Down, Admin Down, Failing, Waiting for Module Up, and Forwarding.

- Ins—Indicates whether the port is inserted into the ring. Possible values are Yes and No.

- Spd—Speed of the port in megabits per second. For ports on the ATM module, the only possible value is 155.

- Oper Mode—Operating mode of the port. For ports on the ATM module, the only possible value is ATM ELAN.

- Fwd Mode—Forwarding mode of the port. For ports on the ATM module, the only possible value is Store-Fwd.

You cannot change any information on this panel.

Viewing Port Statistics

To access statistics about the virtual ATM ports, select **Port Statistics** on the Statistics Menu panel and specify the port identifier of the ATM port. The Port *x* ATM Statistics panel (Figure 21) is displayed.
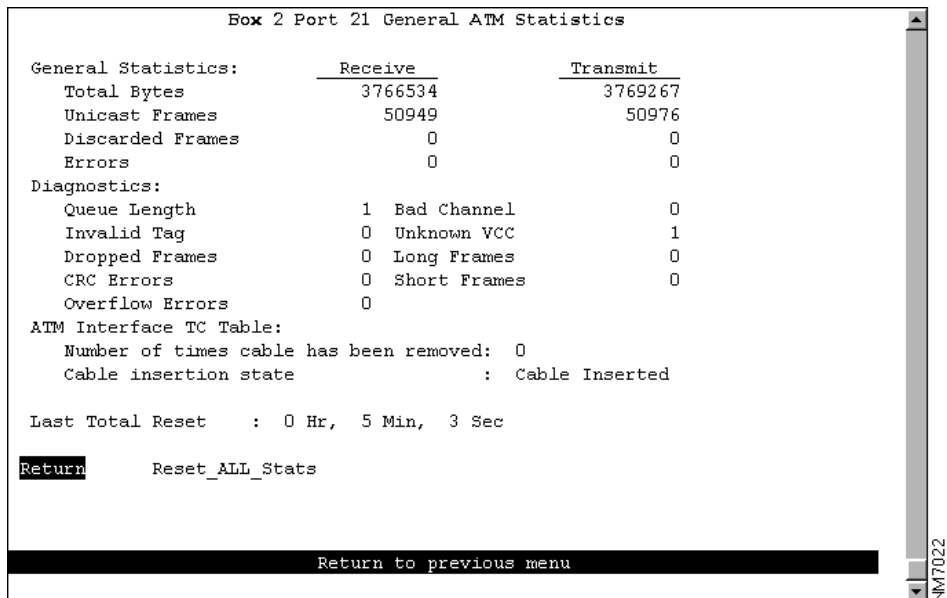
Figure 21   Port x ATM Statistics Panel


```
                    Box 2 Port 21 ATM Statistics

                      General ATM Statistics...

                      LEC Statistics...

                      VCC Statistics...




Return

                      Return to previous menu
```

The following options are displayed on this panel:

- General ATM Statistics—Select this option to display statistical counters for the inbound and outbound traffic. Refer to the "Viewing General ATM Statistics" section for more information.

- LEC Statistics—Select this option to access statistical information about an LEC. Refer to the "Viewing LEC Statistics" section for more information.

- VCC Statistics—Select this option to display statistical counters for the VCC. Refer to the "Viewing VCC Statistics" section for more information.

Viewing General ATM Statistics

To view general ATM statistical information, select **General ATM Statistics** on the Port *x* ATM Statistics panel. The Port x General ATM Statistics panel (Figure 22) is displayed.

Figure 22   Port x General ATM Statistics Panel

```
                   Box 2 Port 21 General ATM Statistics

   General Statistics:          Receive              Transmit
       Total Bytes              3766534               3769267
       Unicast Frames             50949                 50976
       Discarded Frames               0                     0
       Errors                         0                     0
   Diagnostics:
       Queue Length           1  Bad Channel          0
       Invalid Tag            0  Unknown VCC          1
       Dropped Frames         0  Long Frames          0
       CRC Errors             0  Short Frames         0
       Overflow Errors        0
   ATM Interface TC Table:
       Number of times cable has been removed:  0
       Cable insertion state                 :  Cable Inserted

   Last Total Reset   :  0 Hr,  5 Min,  3 Sec

   Return       Reset_ALL_Stats



                       Return to previous menu
```

The following information is displayed on this panel:
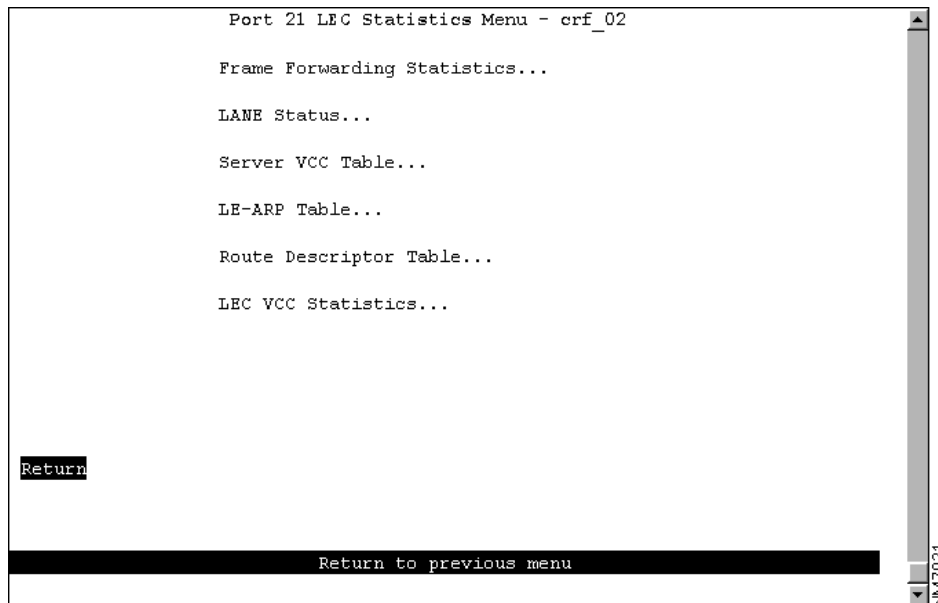
- General Statistics

    — Total Bytes Receive—Number of bytes received.

    — Total Bytes Transmit—Number of bytes transmitted.

    — Unicast Frames Receive—Number of unicast frames received.

    — Unicast Frames Transmit—Number of unicast frames transmitted.

    — Discarded Frames Receive—Number of received frames that were subsequently discarded.

    — Discarded Frames Transmit—Number of frames discarded from the transmit queue.

    — Errors Receive—Number of frames received that contained errors.

    — Errors Transmit—Number of frames transmitted that contained errors.

- Diagnostics

    — Queue Length—Number of PDU's currently queued for transmission on ATM.

    — Bad Channel—Number of packets received on the AXIS bus with a channel number that is not currently associated with an open VCC.

    — Invalid Tag—Number of packets received on the AXIS bus with an invalid tag type.

    — Unknown VCC—Number of AAL-5 frames received from ATM on a VCC that is not currently open.

    — Dropped Frames—Number of frames dropped.

    — Long Frames—Number of frames received that were longer than the MTU.

    — CRC Errors—Number of frames received that contained a CRC error.

    — Short Frames—Number of frames received that were too short.

    — Overflow Errors—Number of buffer overflow errors.

- ATM Interface TC Table

    — Number of times cable has been removed—Number of times the cable has been removed since the statistics were last reset.

    — Cable insertion state—Indicates whether the cable is inserted or has been removed.

- Last Total Reset—Time (in hours, minutes, and seconds) since the ATM module statistics were last reset.

Viewing LEC Statistics

To view statistical information about the LEC, select **LEC Statistics** on the Port *x* ATM Statistics panel. The Port *x* LEC Statistics Menu panel (Figure 23) is displayed.

Figure 23   Port x LEC Statistics Panel


```
                    Port 21 LEC Statistics Menu - crf_02

              Frame Forwarding Statistics...

              LANE Status...

              Server VCC Table...

              LE-ARP Table...

              Route Descriptor Table...

              LEC VCC Statistics...




 Return


                        Return to previous menu
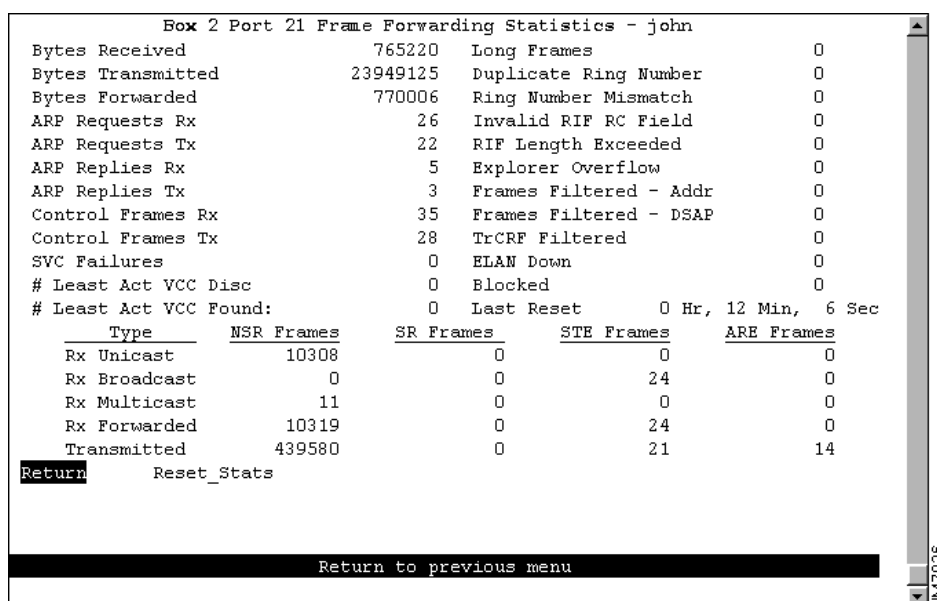```

The following options are displayed on this panel:

- Frame Forwarding Statistics—Select this option to display forwarding statistics about received and transmitted frames. Refer to the "Viewing Frame Forwarding Statistics" section for more information.

- LANE Status—Select this option to display the status of the elements of this emulated LAN. Refer to the "Viewing LANE Status" section for more information.

- Server VCC Table—Select this option to display the server VCC table. Refer to the "Viewing the Server VCC Table" section for more information.

- LE-ARP Table—Select this option to display the LE-ARP table. Refer to the "Viewing the LE-ARP Table" section for more information.

- Route Descriptor Table—Select this option to display the LE-ARP route descriptor table. Refer to the "Viewing the LE-ARP Route Descriptor Table" section for more information.

- LEC VCC Statistics—Select this option to display VCC statistics for this LEC. Refer to the "Viewing the LEC VCC Statistics" section for more information.

| To | Select |
|---|---|
| Reset the emulated LAN statistics to 0... | **Reset ELAN Statistics** |

### Viewing Frame Forwarding Statistics

To view forwarding statistics about frames received and transmitted on this port, select **Frame Forwarding Statistics** on the Port *x* LEC Statistics Menu panel. The Frame Forwarding Statistics panel (Figure 24) is displayed.

**Figure 24      Frame Forwarding Statistics Panel**

```
            Box 2 Port 21 Frame Forwarding Statistics - john
  Bytes Received              765220   Long Frames                    0
  Bytes Transmitted         23949125   Duplicate Ring Number          0
  Bytes Forwarded             770006   Ring Number Mismatch           0
  ARP Requests Rx                 26   Invalid RIF RC Field           0
  ARP Requests Tx                 22   RIF Length Exceeded            0
  ARP Replies Rx                   5   Explorer Overflow              0
  ARP Replies Tx                   3   Frames Filtered - Addr         0
  Control Frames Rx               35   Frames Filtered - DSAP         0
  Control Frames Tx               28   TrCRF Filtered                 0
  SVC Failures                     0   ELAN Down                      0
  # Least Act VCC Disc             0   Blocked                        0
  # Least Act VCC Found:           0   Last Reset      0 Hr, 12 Min,  6 Sec
       Type        NSR Frames    SR Frames      STE Frames     ARE Frames
     Rx Unicast         10308            0              0              0
     Rx Broadcast           0            0             24              0
     Rx Multicast          11            0              0              0
     Rx Forwarded       10319            0             24              0
     Transmitted       439580            0             21             14
  Return      Reset_Stats


                        Return to previous menu
```

The following information is displayed on this panel:

- Bytes Received—Total number of bytes received on this port.

- Bytes Transmitted—Total number of bytes transmitted on this port.

- Bytes Forwarded—Total number of bytes received on this port and forwarded by the Catalyst 3900 hardware or processor.

- ARP Requests Rx—Number of ARP requests received.

- ARP Requests Tx—Number of ARP requests sent.

- ARP Replies Rx—Number of ARP replies received.

- ARP Replies Tx—Number of ARP replies sent.

- Control Frames Rx—Number of control frames received.

- Control Frames Tx—Number of control frames sent.

- SVC Failures—Number of SVC failures detected.

- # Least Act VCC Disc—Number of times the VCC table has been full and the least active VCC has been disconnected.

- # Least Active VCC Found—Number of times the VCC table has been full and no least active VCC could be found.

- Long Frames—Number of frames received that exceed the maximum frame-length limit of 4540 bytes.

- Duplicate Ring Number—Number of frames received that contained a duplicate ring number.

- Ring Number Mismatch—Number of frames received that did not correctly include the port's ring number.

- Invalid RIF RC Field—Number of frames received that contained an illegal Routing Control field.

- RIF Length Exceeded—Number of frames received that contained a RIF that was too long.

- Explorer Overflow—Number of explorer frames dropped because the maximum explorer-forwarding rate was exceeded (as specified on the ELAN Configuration panel described in the "Configuring LEC Parameters" section).

- Frames Filtered - Addr—Number of frames filtered by the MAC address filters.

- Frames Filtered - DSAP—Number of frames filtered by the protocol filters.

- TrCRF Filtered—Number of frames that were filtered at the TrCRF level.

- ELAN Down—Number of times frames could not be transmitted because the emulated LAN was down.

- Blocked—Number of times frames could not be transmitted because this port was blocked.

- Last Reset—Time (in hours, minutes, and seconds) since the emulated LAN statistics for this port were last reset.

- Rx Unicast

  — NSR Frames—Number of non-source-routed, unicast frames received on this port.

  — SR Frames—Number of source-routed, unicast frames received on this port.

  — STE Frames—Number of unicast spanning- tree explorer frames received on this port.

  — ARE Frames—Number of unicast all-routes explorer frames received on this port.

- Rx Broadcast

  — NSR Frames—Number of non-source-routed, broadcast frames received on this port.

  — SR Frames—Number of source-routed, broadcast frames received on this port.

  — STE Frames—Number of broadcast spanning-tree explorer frames received on this port.

  — ARE Frames—Number of broadcast all-routes explorer frames received on this port.

- Rx Multicast

  — NSR Frames—Number of non-source-routed, multicast frames received on this port.

  — SR Frames—Number of source-routed, multicast frames received on this port.

  — STE Frames—Number of multicast spanning-tree explorer frames received on this port.

  — ARE Frames—Number of multicast all-routes explorer frames received on this port.
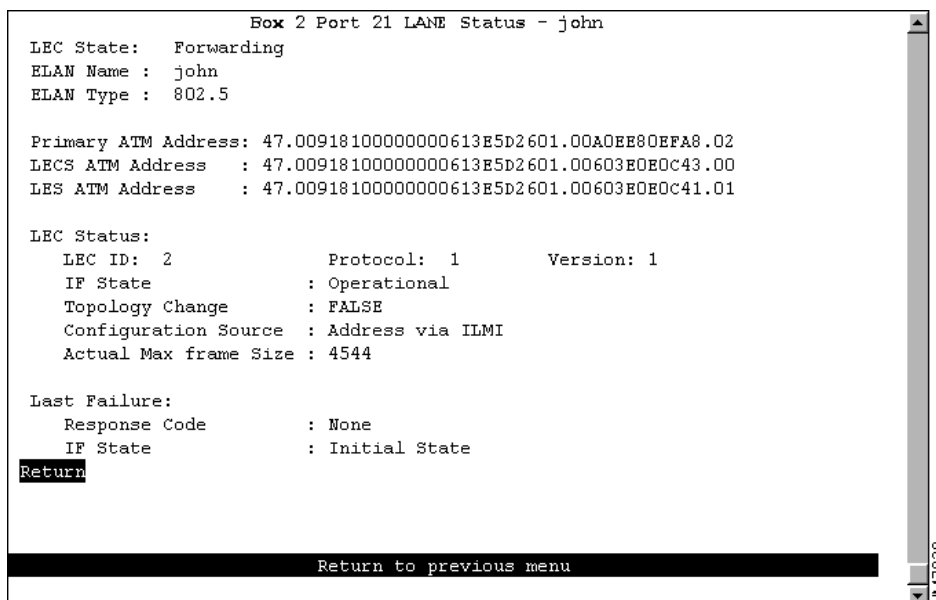
- Rx Forwarded

    — NSR Frames—Number of non-source-routed frames received on this port and forwarded by the Catalyst 3900 hardware or processor.

    — SR Frames—Number of source-routed frames received on this port and forwarded by the Catalyst 3900 hardware or processor.

    — STE Frames—Number of spanning-tree explorer frames received on this port and forwarded by the Catalyst 3900 hardware or processor.

    — ARE Frames—Number of all-routes explorer frames received on this port and forwarded by the Catalyst 3900 hardware or processor.

- Transmitted

    — NSR Frames—Number of non-source-routed frames transmitted by this port.

    — SR Frames—Number of source-routed frames transmitted by this port.

    — STE Frames—Number of spanning-tree explorer frames transmitted by this port.

    — ARE Frames—Number of all-routes explorer frames transmitted by this port.

To	Select
Reset the emulated LAN statistics for this port to 0...	**Reset_Stats**

Viewing LANE Status

To view the status of the elements of this LEC, select **LANE Status** on the Port *x* LEC Statistics Menu panel. The Port *x* LANE Status panel (Figure 25) is displayed.

Figure 25   Port x LANE Status Panel


```
                    Box 2 Port 21 LANE Status - john
  LEC State:   Forwarding
  ELAN Name :  john
  ELAN Type :  802.5

  Primary ATM Address: 47.00918100000000613E5D2601.00A0EE80EFA8.02
  LECS ATM Address   : 47.00918100000000613E5D2601.00603E0E0C43.00
  LES ATM Address    : 47.00918100000000613E5D2601.00603E0E0C41.01

  LEC Status:
     LEC ID:  2             Protocol:  1        Version: 1
     IF State              : Operational
     Topology Change       : FALSE
     Configuration Source  : Address via ILMI
     Actual Max frame Size : 4544

  Last Failure:
     Response Code         : None
     IF State              : Initial State
  Return


                      Return to previous menu
```

The following information is displayed on this panel:

- LEC State—Current state of the emulated LAN. Possible values are Disabled, Going Up, Up, Going Admin Down, Admin Down, Failing, Waiting for Module Up, and Forwarding.

- ELAN Name—Name of the emulated LAN that the LEC joins to provide connection to the ATM network. The name is automatically provided when the LEC connects with the emulated LAN.

- ELAN Type—Type of LAN to which the LEC belongs. Possible values are unspecified, .3 (for 802.3), and .5 (for 802.5).

- Primary ATM Address—Primary ATM address of the LEC.

- LECS ATM Address—ATM Address of the LECS that is assigned to the LEC.

- LES ATM Address—ATM address of the LES that is assigned to the LEC. This address is determined when the LEC starts.

- LEC Status

  — LEC ID—Virtual ATM Port LEC ID.

  — Protocol—LANE protocol.

  — Version—Version number of LANE protocol.

  — IF State—Status of the interface. Possible values are Initial State, LECS Connect, Configure, Join, Initial Registration, Bus Connect, Operational.

  — Topology Change—Indicates whether a topology change has occurred. Possible values are TRUE and FALSE.

  — Configuration Source—Source from which the LEC obtained its configuration. Possible values are Address via ILMI, Used Well Known Address, Used LEC PVC, and Did Not use LECS.

  — Actual Max Frame Size—Actual maximum frame size used. The maximum frame size is the MTU minus the header. Possible values are 1516, 4544, 9234, and 18190.

- Last Failure

  — Response Code—Response code of the last failure. Possible values are None, Time-Out, Undefined error, Version Not Supported, Invalid Request Parameters, Duplicate LAN Destination, Duplicate ATM Address, Insufficient Resources, Access Denied, Invalid Requestor ID, Invalid LAN Destination, Invalid ATM Address, No Configuration, LE Configure Error, and Insufficient Information.

  — IF State—State of the interface at the last failure. Possible values are Initial State, LECS Connect, Configure, Join, Initial Registration, Bus Connect, and Operational.

Viewing the Server VCC Table

To view the server VCC table, select **Server VCC Table** on the Port *x* LEC Statistics Menu panel. The Port *x* Server VCC Table panel (Figure 26) is displayed.

Figure 26   Port x Server VCC Table Panel
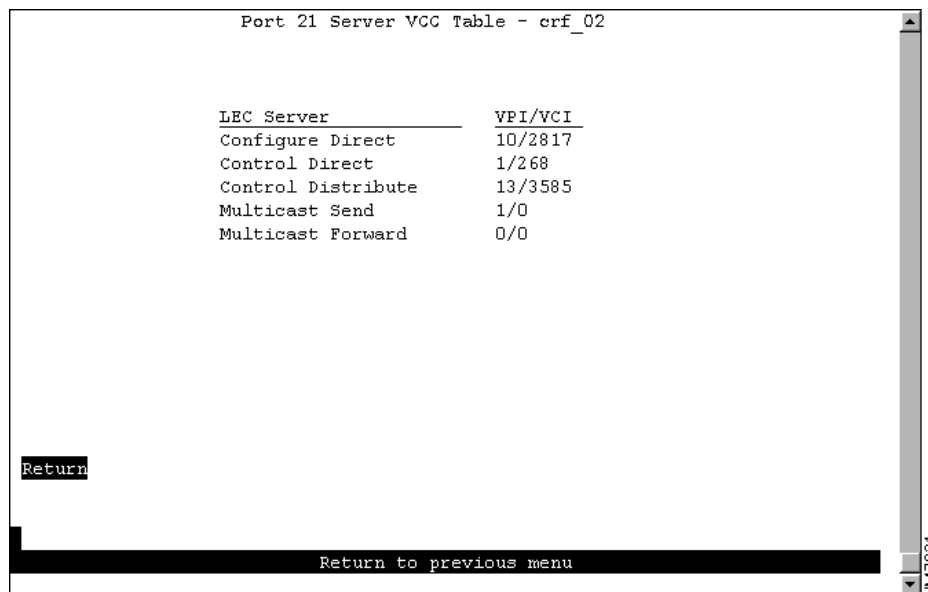
The following information is displayed on this panel:

- Configure Direct—VPI/VCI of the configure direct server.

- Control Direct—VPI/VCI of the control direct server.

- Control Distribute—VPI/VCI of the control distribute server.

- Multicast Send—VPI/VCI of the multicast send server.

- Multicast Forward—VPI/VCI of the multicast forward server.

Viewing the LE-ARP Table

To view the LE-ARP table, select **LE-ARP Table** on the Port *x* LEC Statistics Menu panel. The Port *x* LE-ARP Table panel (Figure 27) is displayed.

Figure 27   Port x LE-ARP Table Panel

```
                    Box 2 Port 21 LE-ARP Table - john                         ▲

   MAC Address                    ATM Address                 Rem   Entry Type
  00067C:703002    47.00918100000000613E5D2601.00603E0E0C40.01  No    Data











 Return      More



                        Return to previous menu
                                                                              ▼
```

The following information is displayed on this panel:

- MAC Address—MAC address.

- ATM Address—Corresponding ATM address.

- Rem—Indicates whether the address is remote. Possible values are Yes and No.

- Entry Type—How the entry was learned. Possible values are Learned Via Control, Learned Via Data, Static Volatile, Static Non-volatile, and Other.

Viewing the LE-ARP Route Descriptor Table

To view the LE-ARP route descriptor table, select **Route Descriptor Table** on the Port *x* LEC Statistics Menu panel. The Port *x* Route Descriptor Table panel (Figure 28) is displayed.

Figure 28   Port x Route Descriptor Table Panel

```
              Port 21 Route Descriptor Table - crf_02

   Bridge  Segment              ATM Address              Entry Type




   Return      More




                       Return to previous menu
```
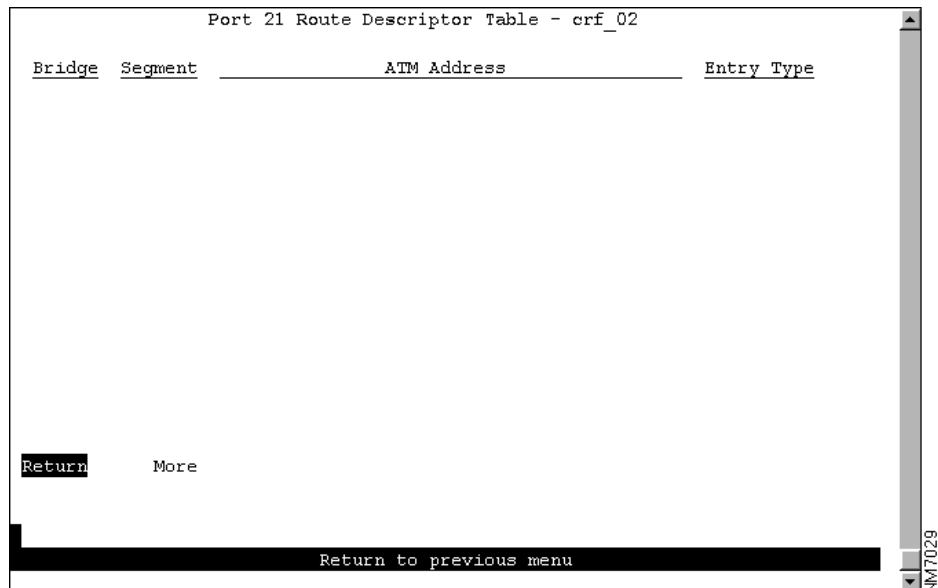
The following information is displayed on this panel:

- Bridge—Number of the bridge through which the ATM address is accessed. Possible values are 1 through 15.

- Segment—Ring number of the segment through which the ATM address is accessed. Possible values are 0 through 4095.

- ATM Address—ATM address.

- Entry Type—Indicates how the entry was learned. Possible values are Learned Via Control, Learned Via Data, Static Volatile, Static Non-volatile, and Other.

Viewing the LEC VCC Statistics

To view VCC statistics for this LEC, select **LEC VCC Statistics** on the Port *x* LEC Statistics Menu panel. The Port *x* LEC VCC Statistics panel (Figure 29) is displayed.

Figure 29   Port x LEC VCC Statistics Panel

```
              Box 2 Port 21 LEC VCC Statistics - john

    VPI/VCI   Usage   Tx Frames    Tx Bytes    Rx Frames    Rx Bytes
    0/32      DDirec      10304      762496        10306      762564
    0/33      CDirec         17        1836            1         108
    0/34      CDist           0           0           20        2160
    0/35      M-Send     429114    23174156            0           0
    0/36      M-Forw          0           0       296569    16019618
```

```
Return      More
```

```
                      Return to previous menu
```

The following information is displayed on this panel:

- VPI/VCI—VPI and VCI that make up each VCC in this emulated LAN.

- Usage—Indicates how the VCC is used. Possible values are Config, CDirec, CDist, M-Send, M-Forward, and DD.

- Tx Frames—Number of frames transmitted through this VCC.

- Tx Bytes—Number of bytes transmitted through this VCC.

- Rx Frames—Number of frames received through this VCC.

- Rx Bytes—Number of frames transmitted through this VCC.

Viewing VCC Statistics

To view statistical information about the VCCs associated with this port, select **VCC Statistics** on the Port *x* ATM Statistics panel. The Port *x* ATM VCC Statistics panel (Figure 30) is displayed.

Figure 30   Port x ATM VCC Statistics Panel

```
                  Box 2 Port 21 ATM VCC Statistics

                       VPI:  0  VCI:  5
Usage          : SSCOP

ATM Address    : 00.000000000000000000000000.000000000000.00
Creation Method:  System
Transmit Traffic Descriptor:
   Type : Best Effort
   Peak Rate: 353208
   QOS  : None         Frame Discard: No   Service Category:  UBR

AAL5 Statistics:
   CRC Errors        :             0
   SAR Timeouts      :             0
   Oversized SDUs    :             0
   Frames Transmitted:           104    Bytes Transmitted:        1452
   Frames Received   :           107    Bytes Received   :        1556
      Last Total Reset:  0 Hr,  5 Min, 22 Sec
Return      More


                    Return to previous menu
```

The following information is displayed on this panel:

- VPI—VPI associated with this VCC. Possible values are 0 through 3.

- VCI—VCI associated with this VCC. Possible values are 0 through 4095.

- Usage—Indicates how this VCC is used. Possible values are SSCOP, ILMI, OAM, LANE Config, LANE Control Direct, LANE Control Distribute, LANE Multicast Send, LANE Multicast Forward, and LANE Data Direct.

- Instance—Associated Virtual ATM Port number, which is also to TrCRF number.

- MAC Address—MAC address associated with this VCC.

- ATM Address—ATM address associated with this VCC.

- Creation Method—Indicates how the VCC was created. Possible values are System, PVC, Incoming Point-Point SVC, Outgoing Point-Point SVC, Incoming Point-Multipoint SVC, Outgoing Point-Multipoint SVC.

- Transmit Traffic Descriptor

    — Type—Traffic type. Possible values are atmfNoClpNoScr, atmfNoClpScr, atmfClpNo-TaggingScr, atmfClpTaggingScr, and BestEffort.

    — QOS—Quality of service. Possible values are Class 1, Class 2, Class 3, Class 4, and None.

    — Frame Discard—Whether to allow the switch to discard all complete AAL5 frames if any single cells are lost from an AAL5 frame. Possible values are Yes and No.

    — Service Category—Service category of the traffic. Possible values are other, cbr, rtVbr, nrtVbr, abr, and ubr.

- AAL5 Statistics

    — CRC Errors—Number of frames with CRC errors.

    — SAR Timeouts—Number of times the segment and reassembly unit timed out.

    — Oversized SDUs—Number of SSCOP SAAL service data units that exceeded the maximum specified size.

    — Frames Transmitted—Number of frames transmitted.

    — Bytes Transmitted—Number of bytes transmitted.

    — Frames Received—Number of frames received.

    — Bytes Received—Number of bytes received.

- Last Total Reset—Time (in hours, minutes, and seconds) since the port was last reset.

Safety Information

This section contains information about working safely with electrical equipment, safety information about the module LEDs, translations of any safety warnings that appear in this document, and electronic emission notices.

Safety with Electricity

Warning Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the objects to the terminals.

The Catalyst 3900 does not have an on/off switch. To power off the Catalyst 3900, you must disconnect the power cord from the rear of the switch.

Warning Unplug the power cord before you work on a system that does not have an on/off switch.

Follow these guidelines when working with equipment powered by electricity:

- Locate the emergency power-off switch for the room in which you are working.

- Before working on the equipment, unplug the power cord.

- Disconnect all power before doing the following:

    — Installing or removing a chassis

    — Performing a hardware upgrade

- Do not work alone when potentially hazardous conditions exist.

- Never assume that power has been disconnected from a circuit. Always check.

- Look carefully for possible hazards in your work area, such as moist floors, ungrounded power extension cables, and missing safety ground wires.

- If an electrical accident occurs, proceed as follows:

    — Use caution.

    — Unplug the power cord.

    — If possible send another person to get medical aid. Otherwise, assess the victim's condition and then call for help.

    — Determine if the victim needs rescue breathing or external cardiac compressions, then take appropriate action.

Preventing Electrostatic Discharge Damage

Electrostatic discharge can damage or impair electrical circuitry. It occurs when electronic components are handled improperly. Always follow electrostatic discharge prevention procedures when removing or replacing components. Ensure that the chassis is electrically connected to earth ground using an electrostatic discharge mat or a ground wire. Wear an electrostatic discharge-preventive wrist strap, ensuring that it makes good skin contact and is connected to an unpainted surface on the chassis frame. If no wrist strap is available, ground yourself by touching the metal part of the chassis while handling a component.

LED Safety Information

The Multimode fiber ATM module contains LEDs. The expansion module is classified as a Class 1 LED product and is certified to conform to the requirements of EN60825-1:1994 and IEC825-1:1993.

Class 1 laser products are not considered hazardous. The 4-port fiber Token Ring module has embedded Class 3a LED assemblies operating at a nominal wavelength of 850 nanometers and a maximum potential output power of 1.25 milliwatts. The design of the 4-port fiber Token Ring module incorporates engineering features including current limiting, which ensures that there is no human access to LED radiation greater than Class 1 under any set of operating, maintenance, or service conditions, including a single fault.

There are fewer than 0.442 milliwatts propagating in the link or in any portion of the module. Therefore, according to IEC825-2:1993, Hazard Level 1 prevails in all parts of the system.

The LEDs are located on the front face of the module.

Translated Safety Warnings

Safety warnings appear throughout this publication in procedures that, if performed incorrectly, may harm you. A warning symbol precedes each warning statement.

Warning Means *danger.* You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.

Waarschuwing Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen. Voor vertalingen van de waarschuwingen die in deze publicatie verschijnen, kunt u het document *Regulatory Compliance and Safety Information* (Informatie over naleving van veiligheids- en andere voorschriften) raadplegen dat bij dit toestel is ingesloten.

Varoitus Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista. Tässä julkaisussa esiintyvien varoitusten käännökset löydät laitteen mukana olevasta *Regulatory Compliance and Safety Information* -kirjasesta (määräysten noudattaminen ja tietoa turvallisuudesta).

Attention Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions d'avertissements figurant dans cette publication, consultez le document *Regulatory Compliance and Safety Information* (Conformité aux règlements et consignes de sécurité) qui accompagne cet appareil.

Warnung Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt. Übersetzungen der in dieser Veröffentlichung enthaltenen Warnhinweise finden Sie im Dokument *Regulatory Compliance and Safety Information* (Informationen zu behördlichen Vorschriften und Sicherheit), das zusammen mit diesem Gerät geliefert wurde.

Avvertenza Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti. La traduzione delle avvertenze riportate in questa pubblicazione si trova nel documento *Regulatory Compliance and Safety Information* (Conformità alle norme e informazioni sulla sicurezza) che accompagna questo dispositivo.

Advarsel Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker. Hvis du vil se oversettelser av de advarslene som finnes i denne publikasjonen, kan du se i dokumentet *Regulatory Compliance and Safety Information* (Overholdelse av forskrifter og sikkerhetsinformasjon) som ble levert med denne enheten.

Aviso Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes. Para ver as traduções dos avisos que constam desta publicação, consulte o documento *Regulatory Compliance and Safety Information* (Informação de Segurança e Disposições Reguladoras) que acompanha este dispositivo.

¡Advertencia! Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes. Para ver una traducción de las advertencias que aparecen en esta publicación, consultar el documento titulado *Regulatory Compliance and Safety Information* (Información sobre seguridad y conformidad con las disposiciones reglamentarias) que se acompaña con este dispositivo.

Varning! Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador. Se förklaringar av de varningar som förkommer i denna publikation i dokumentet *Regulatory Compliance and Safety Information* (Efterrättelse av föreskrifter och säkerhetsinformation), vilket medföljer denna anordning.

Jewelry Removal Warning

Warning Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.

Waarschuwing Alvorens aan apparatuur te werken die met elektrische leidingen is verbonden, sieraden (inclusief ringen, kettingen en horloges) verwijderen. Metalen voorwerpen worden warm wanneer ze met stroom en aarde zijn verbonden, en kunnen ernstige brandwonden veroorzaken of het metalen voorwerp aan de aansluitklemmen lassen.

Varoitus Ennen kuin työskentelet voimavirtajohtoihin kytkettyjen laitteiden parissa, ota pois kaikki korut (sormukset, kaulakorut ja kellot mukaan lukien). Metalliesineet kuumenevat, kun ne ovat yhteydessä sähkövirran ja maan kanssa, ja ne voivat aiheuttaa vakavia palovammoja tai hitsata metalliesineet kiinni liitäntänapoihin.

Attention Avant d'accéder à cet équipement connecté aux lignes électriques, ôter tout bijou (anneaux, colliers et montres compris). Lorsqu'ils sont branchés à l'alimentation et reliés à la terre, les objets métalliques chauffent, ce qui peut provoquer des blessures graves ou souder l'objet métallique aux bornes.

Warnung Vor der Arbeit an Geräten, die an das Netz angeschlossen sind, jeglichen Schmuck (einschließlich Ringe, Ketten und Uhren) abnehmen. Metallgegenstände erhitzen sich, wenn sie an das Netz und die Erde angeschlossen werden, und können schwere Verbrennungen verursachen oder an die Anschlußklemmen angeschweißt werden.

Avvertenza Prima di intervenire su apparecchiature collegate alle linee di alimentazione, togliersi qualsiasi monile (inclusi anelli, collane, braccialetti ed orologi). Gli oggetti metallici si riscaldano quando sono collegati tra punti di alimentazione e massa: possono causare ustioni gravi oppure il metallo può saldarsi ai terminali.

Advarsel Fjern alle smykker (inkludert ringer, halskjeder og klokker) før du skal arbeide på utstyr som er koblet til kraftledninger. Metallgjenstander som er koblet til kraftledninger og jord blir svært varme og kan forårsake alvorlige brannskader eller smelte fast til polene.

Aviso Antes de trabalhar em equipamento que esteja ligado a linhas de corrente, retire todas as jóias que estiver a usar (incluindo anéis, fios e relógios). Os objectos metálicos aquecerão em contacto com a corrente e em contacto com a ligação à terra, podendo causar queimaduras graves ou ficarem soldados aos terminais.

¡Advertencia! Antes de operar sobre equipos conectados a líneas de alimentación, quitarse las joyas (incluidos anillos, collares y relojes). Los objetos de metal se calientan cuando se conectan a la alimentación y a tierra, lo que puede ocasionar quemaduras graves o que los objetos metálicos queden soldados a los bornes.

Varning! Tag av alla smycken (inklusive ringar, halsband och armbandsur) innan du arbetar på utrustning som är kopplad till kraftledningar. Metallobjekt hettas upp när de kopplas ihop med ström och jord och kan förorsaka allvarliga brännskador; metallobjekt kan också sammansvetsas med kontakterna.

No On/Off Switch Warning

Warning   Unplug the power cord before you work on a system that does not have an on/off switch.

Waarschuwing   Voordat u aan een systeem werkt dat geen aan/uit schakelaar heeft, dient u de stekker van het netsnoer uit het stopcontact te halen.

Varoitus   Ennen kuin teet mitään sellaiselle järjestelmälle, jossa ei ole kaksiasentokytkintä, kytke irti virtajohto.

Attention   Avant de travailler sur un système non équipé d'un commutateur marche-arrêt, débrancher le cordon d'alimentation.

Warnung   Bevor Sie an einem System ohne Ein/Aus-Schalter arbeiten, ziehen Sie das Netzkabel heraus.

Avvertenza   Prima di lavorare su un sistema che non è dotato di un interruttore on/off, scollegare il cavo di alimentazione.

Advarsel   Før det skal utføres arbeid på et system som ikke har en av/på-bryter, skal strømledningen trekkes ut.

Aviso   Antes de começar a trabalhar num sistema que não possua um interruptor ON/OFF, desligue o cabo de alimentação.

¡Advertencia!   Antes de trabajar sobre cualquier sistema que carezca de interruptor de Encendido/Apagado (ON/OFF), desenchufar el cable de alimentación.

Varning!   Dra ur nätsladden innan du utför arbete på ett system utan strömbrytare.

Laser Radiation Warning

Warning   Laser radiation is present when the system is open.

Waarschuwing Laserstraling wanneer geopend.

Varoitus Lasersäteitä aukkojen ollessa avoinna.

Attention Production d'un rayonnement laser en position ouverte.

Warnung Laserstrahlung in geöffnetem Zustand

Avvertenza Emette radiazioni laser quando è aperto.

Advarsel Laserstråling er til stede når enheten er åpen.

Aviso Radiação laser presente quando aberto.

¡Advertencia! Radiación láser cuando está abierto.

Varning! Rikta inte blicken in mot strålen.

Laser Beam Exposure Warning

Warning   Do not stare into the laser beam.

Waarschuwing Niet in de straal staren.

Varoitus Älä katso säteeseen.

Attention Ne pas fixer le faisceau des yeux.

Warnung Nicht direkt in den Strahl blicken.

Avvertenza Non fissare il raggio con gli occhi.

Advarsel Stirr ikke på strålen.

Aviso Não olhe fixamente para o raio.

¡Advertencia! No mirar fijamente el haz.

Varning! Laserstrålning när enheten är öppen.

Electronic Emission Notices

This section contains statements pertaining to compliance with electronic emission regulations.

Federal Communications Commission (FCC) Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

Industry Canada Class B Emission Compliance Statement

This Class B digital apparatus meets the requirements of the Canadian Interference-Causing Equipment Regulations.

Avis De Conformite Aux Normes D'industrie Canada

Cet appareil numerique de la classe B respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

European Union (EU) Statement

This product is in conformity with the protection requirements of EU Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. This company cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-Cisco option cards.

This product has been tested and found to comply with the limits for Class B Information Technology Equipment according to CISPR 22 / European Standard EN 55022. The limits for Class B equipment were derived for typical residential environments to provide reasonable protection against interference with licensed communication devices.

Japanese Voluntary Control Council for Interference (VCCI) Statement

This is a Class B product based on the standard of the Voluntary Control Council for Interference from Information Technology Equipment (VCCI). If this is used near a radio or television receiver in a domestic environment, it may cause radio interference. Install and use the equipment according to the instruction manual.

Obtaining Service and Support

For service and support for a product purchased from a reseller, contact the reseller. Resellers offer a wide variety of Cisco service and support programs, which are described in the section "Service and Support" in the information packet that shipped with your product.

Note If you purchased your product from a reseller, you can access Cisco Connection Online (CCO) as a guest. CCO is Cisco Systems' primary, real-time support channel. Your reseller offers programs that include direct access to CCO's services.

For service and support for a product purchased directly from Cisco, use CCO.

Cisco Connection Online

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

Available 24 hours a day, 7 days a week, CCO provides a wealth of standard and value-added services to Cisco's customers and business partners. CCO services include product information, product documentation, software updates, release notes, technical tips, the Bug Navigator, configuration notes, brochures, descriptions of service offerings, and download access to public and authorized files.

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

You can access CCO in the following ways:

- WWW: http://www.cisco.com

- WWW: http://www-europe.cisco.com

- WWW: http://www-china.cisco.com

- Telnet: cco.cisco.com

- Modem: From North America, 408 526-8070; from Europe, 33 1 64 46 40 82. Use the following terminal settings: VT100 emulation; databits: 8; parity: none; stop bits: 1; and connection rates up to 28.8 kbps.

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

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

Ordering Documentation

Documentation for Cisco products is available in three forms: in a CD-ROM package, printed books, and on the World Wide Web. You have the option of subscribing to the CD ROM package through an update service. Or you can order printed documentation at an additional cost. Refer to the information packet included with the router for detailed ordering information. You can also access Cisco documentation on the World Wide Web URL http://www.cisco.com.