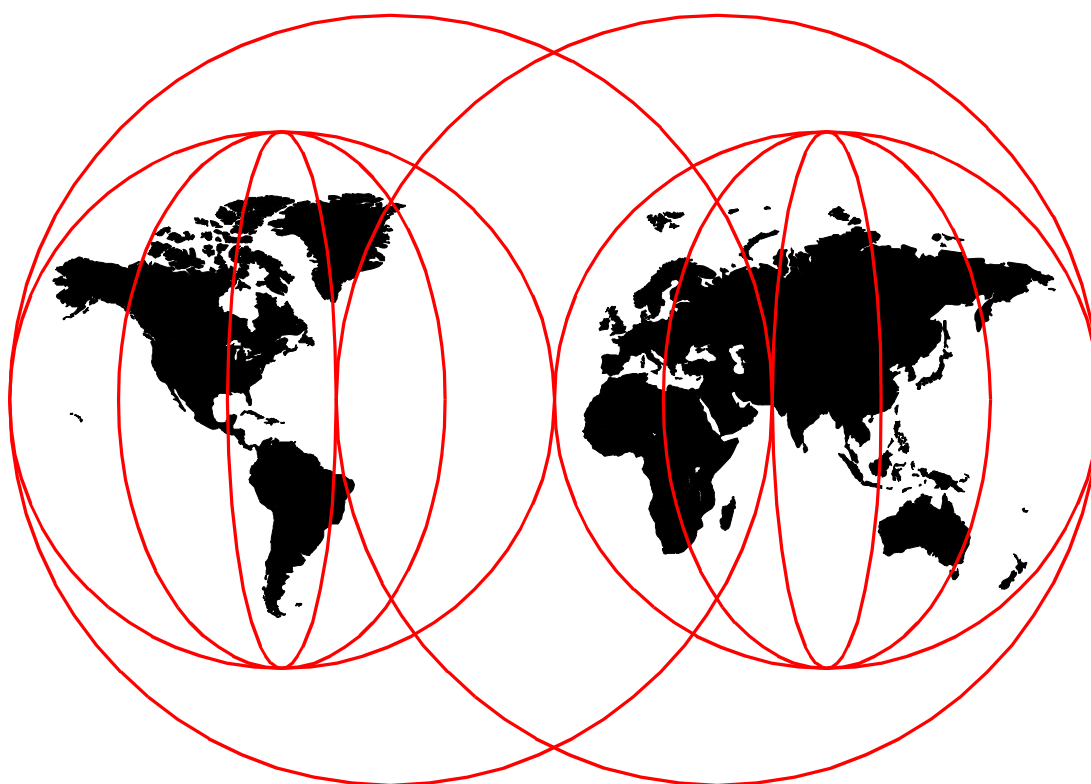


ATM Configuration Examples

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International Technical Support Organization

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ATM Configuration Examples

December 1999

Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix B, "Special Notices" on page 457.

Second Edition (November 1999)

This edition applies to IBM ATM networking products.

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Preface

In this redbook we describe the steps involved in connecting various devices, such as ATM switches, LAN switches with ATM uplinks, and servers and workstations, to an ATM network, including which ATM adapters and configurations should be used.

This book will help technical networking specialists to implement ATM networks by showing practical examples of the implementations of and ideas behind the latest levels of code.

These configurations could be used as a guide for installing these devices into ATM environments. The ATM network described is simple and was put together to show the various connectivity options.

This book should be used as a reference on how to configure each specific ATM device, what commands are used, and what parameters are needed. It should not be used as an ATM design guide.

The Team That Wrote This Redbook

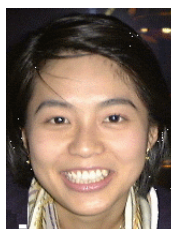
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Part 1. Overview

Chapter 1. ATM Overview

This chapter provides basic concepts of ATM Forum-Compliant (FC) LAN Emulation and Classical IP.

1.1 Need for LAN Emulation

The primary benefit of LAN Emulation (LANE) or Emulated LANs (ELANs) is to allow Ethernet and token-ring networks to interface with ATM networks, thus utilizing the high-speed ATM links while still protecting the existing software and hardware investment. LANE is implemented within the data link control layer, which is below the device driver interface of endstations; hence the application programming interface is unchanged, thus protecting the software investment. The hardware investment is protected by means of bridging between LAN and ATM environments (enabling utilization of the existing adapters/wiring).

1.2 Emulated LAN Components

A typical ELAN consists of one or more LAN Emulation Clients (LECs), the LAN Emulation Configuration Server (LECS), the LAN Emulation Server (LES), and Broadcast and Unknown Server (LES/BUS). The LES, BUS, and LECS are collectively known as the LE Service Components. Each ELAN has a dedicated LES and BUS. The LECs get the address of the LES/BUS from the LECS or alternatively, may be preconfigured with their LES/BUS address; however, using LECS is preferred for address assignments to reduce administration overhead.

Figure 1 shows a physical and logical view of a simple LAN Emulation network consisting of two ELANs:

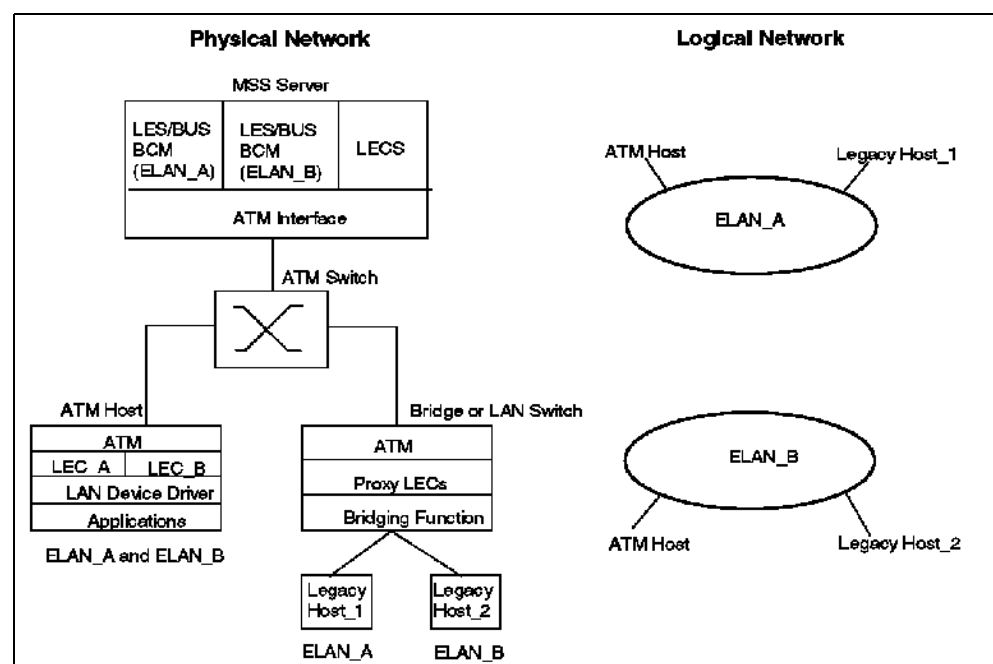


Figure 1. Physical and Logical Views of a Simple LAN Emulation Network

Ethernet/IEEE802.3 and Token-Ring/IEEE802.5 can be emulated, but all endstations of an ELAN should be of the same type. The function that bridges between legacy LAN segments and ELANs is called a Proxy LEC.

Before going into LAN Emulation in more detail, the basics of ATM addressing and functions of the Interim Local Management Interface (ILMI) will be reviewed as they relate to LAN Emulation.

1.3 ATM Addresses

ATM uses 20-byte hierarchical addressing. The first 13 bytes of an ATM address are called the network prefix. End systems obtain the network prefix component of their addresses from their adjacent ATM switch. The next six bytes of the address are called the end system identifier (ESI). The final byte is called the selector. End systems form their addresses by appending their ESI and selector to the network prefix provided by the ATM switch. The selector is only significant within the end system; it is not used to route calls within the ATM network, but is used within end systems to uniquely identify called/calling parties.

The network prefix and ESI components of ATM addresses must register with an ATM switch before calls can be placed or received. If the address is not unique (that is, if it duplicates an address already registered with the switch), the switch will reject the registration. One way to guarantee a unique ATM address is to use the burned-in (universally administered) IEEE MAC address as the ESI.

1.3.1 ATM Addresses of LAN Emulation Components

In general, ATM addresses must be unique among LAN Emulation components. The only exception is a LES and BUS serving the same ELAN. They may share an ATM address, as is the case for the MSS server. LAN Emulation components are configured for a particular ATM interface. The user may decide to use the burned-in MAC address as the ESI portion of the component's ATM address or select one of the locally administered ESIs defined for the ATM interface. Multiple LE components may share the same ESI if they have unique selector bytes. By default, the configuration interface assigns each LE component a unique selector byte value for the configured ESI; however, the user may override this assignment and explicitly configure a particular selector byte value.

An ATM interface parameter determines the number of selectors per ESI reserved for explicit assignment. The remainder are available for dynamic assignment by the ATM interface at run time. LE components only use the selectors reserved for explicit assignment; by default, 200 of the 256 possible selectors per ESI are reserved for explicit assignment. Run-time selector assignment is beneficial when the user does not need to control the assigned selector; Classical IP clients are an example of this.

While ATM addresses must be unique among LE components, LE components may use the same ATM addresses as non-LE components such as Classical IP clients and servers.

1.4 Overview of ILMI Functions

The Interim Local Management Interface (ILMI) defines a set of SNMP-based procedures used to manage the user-to-network interface (UNI) between an ATM end system and an ATM switch. The following three ILMI functions are particularly relevant to LAN Emulation:

1. ATM address registration
2. Dynamic determination of the UNI version being run on the switch
3. Acquisition of the LECS ATM address(es)

ILMI is the method of choice for locating the LECS. The ILMI MIB at the ATM switch includes a list of LECS ATM addresses that may be retrieved by the LECs. It is useful to have the LECS ATM address(es) configured at the ATM switches only, and not at the LECs. There are fewer switches than LECs.

1.5 LAN Emulation Components

An emulated LAN is comprised of the following components:

- One LAN Emulation configuration server (LECS)
- One LAN Emulation server (LES)
- One broadcast and unknown server (BUS)
- LAN Emulation clients (LECs), such as user workstations, bridges and routers.

Users connect to the ELAN via the LEC, which requests services through the LAN Emulation User-to-Network Interface (LUNI). The three components (LES, LECS, and BUS) may be distributed over different physical systems or may be grouped together in one system, but logically they are distinct functions. The LAN Emulation services may be implemented in ATM intermediate systems (for example, switches such as the 8260 and 8285) as part of the ATM network, or in one or more ATM end systems, such as the MSS for the transport of control and data traffic.

1.5.1 LE Configuration Server (LECS) Overview

The LECS assigns the individual LECs to the different ELANs that can exist in the ATM network. During initialization, a LEC requests the ATM address of the LES for the ELAN to which it should be connected. LECs are not required to use a LECS; a LES's ATM address may be configured (that is, system-defined) in the LEC.

Using a LECS to assign LECs to the different ELANs allows for central configuration and administration of multiple ELANs in an ATM network. The LECS could make its decision to assign a LES, for example, based on a client's ATM or MAC address according to a defined policy, or simply based on a system-defined database.

To take advantage of an MSS server's flexibility in creating policy-based ELANs, it is recommended that a LEC be configured to use the LECS to obtain the ATM address of the LES, where possible.

1.5.2 LAN Emulation Server (LES)

The basic function of the LE server is to provide directory and address resolution services to the LECs of the emulated LAN. Each emulated LAN must have an LE server. An LE client registers the LAN address(es) it represents with the LE server. When an LE client wants to establish a direct connection with a destination LEC, it gets the destination's MAC address from the higher layer protocols and has to send a request to the LE server for the destination ATM address.

The LES will either respond directly (if the destination client has registered that address) or forward the request to other clients to find the destination.

An emulated token-ring LAN cannot have members that are emulating an Ethernet LAN (and vice versa). Thus, an instance of a LES is dedicated to a single type of LAN Emulation.

The problems of translational bridging between different LAN types is not addressed in the ATM Forum's LAN Emulation; however, the MSS will perform translational bridging between Ethernet and token-ring for NetBIOS and SNA protocols.

The LES may be physically internal to the ATM network or provided in an external device, but logically it is always an external function that simply uses the services provided by ATM to do its job.

1.5.3 Broadcast and Unknown Server (BUS)

The BUS has two main functions:

- Distribute multicast and broadcast frames to all LECs in the ELAN.
- Forward unicast frames to the appropriate destination.

The BUS is required because legacy applications on Ethernet and token-ring rely on broadcasts to find their partners. Since ATM is a point-to-point connection, BUS service is required to resolve broadcasts on the ATM network. To avoid creating a bottleneck at the BUS, the rate at which a LEC can send unicast frames to the BUS is limited.

1.5.4 LAN Emulation Client (LEC)

Each workstation connecting to the ELAN has to implement the LE layer (also called LE entity), which performs data forwarding and control functions such as address resolution, establishment of the various VCCs, etc. The LE layer functions could be implemented completely in software, in hardware on a specialized LAN Emulation ATM adapter, or in a combination of both. The layered structure of the LEC is shown in Figure 2 on page 7.

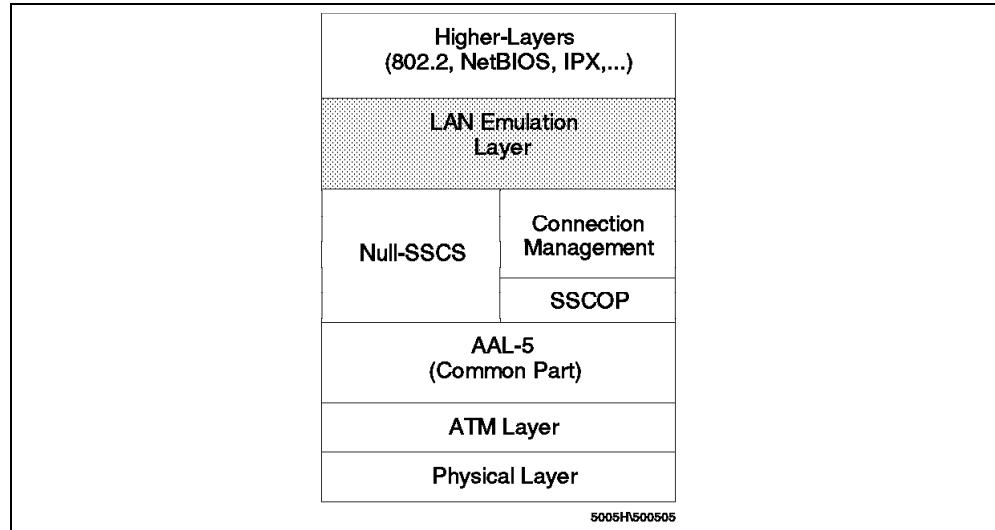


Figure 2. LAN Emulation Client Functional Layers

The LE layer provides the interface to existing higher-layer protocol support (such as IPX, IEEE 802.2 LLC, NetBIOS, etc.) and emulates the MAC-level interface of a real shared-media LAN (802.3/Ethernet or token-ring). This means that no changes are needed in existing LAN application software to use ATM services. The LE layer implements the LUNI interface when communicating with other entities in the emulated LAN.

The primary function of the LE layer is to transfer LAN frames (arriving from higher layers) to their destination.

A separate instance of the LE layer is needed in each workstation for each different LAN or type of LAN to be supported. For example, if both token-ring and Ethernet LAN types are to be emulated within a single station, then two LE layers are required. In fact, they will probably just be different threads within the same copy of the same code but they are logically separate LE layers. Separate LE layers would also be used if one workstation needed to be part of two different ELANs both emulating the same LAN type (for example, token-ring). Each separate LE layer needs to have a different MAC address and must be attached to its own LE server, but it can share the same physical ATM connection (adapter).

1.5.5 LAN Emulation VC Connections

Data transfer in the LE system (consisting of control messages and encapsulated LAN frames) uses a number of different ATM VCCs as illustrated in Figure 3 on page 8.

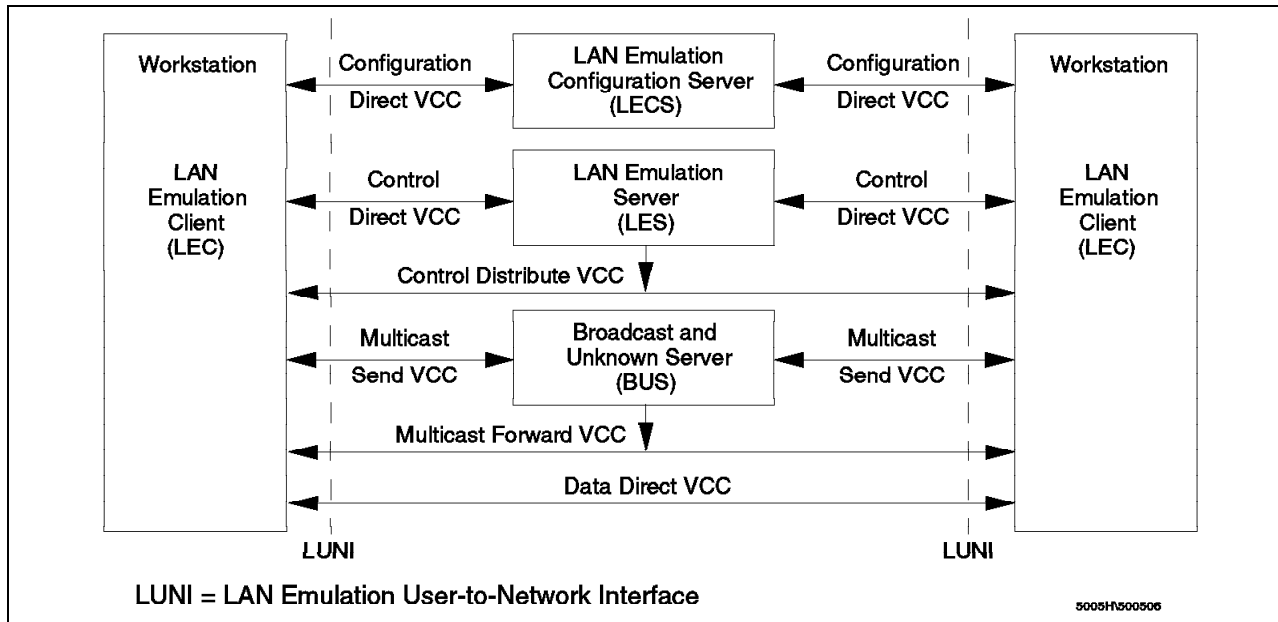


Figure 3. LAN Emulation Components

1.5.5.1 Configuration and Control Connections

Control VCCs connect a LEC to the LECS and the LES, but they are never used for user data traffic. These connections may be permanent or switched and are established when a LEC connects to the ELAN.

Configuration Direct VCC

A bidirectional, point-to-point configuration direct VCC may be established between a LEC and the LECS to obtain configuration information (for example, the LES's ATM address).

Control Direct VCC

A bidirectional, point-to-point control direct VCC must be established (and kept active) between each LEC and the LES. This is used for the exchange of control traffic (for example, address resolution) between the LEC and the LES.

Control Distribute VCC

The LES may optionally establish a unidirectional control distribute VCC to distribute control information (for example, query for an unregistered MAC address) to all LECs connected to the ELAN. This can be a point-to-point VCC to each LEC. If the ATM supports point-to-multipoint connections, then the LES might instead establish one point-to-multipoint VCC to all LECs. (The clients will be added or deleted as leaves on this point-to-multipoint tree as they enter or leave the ELAN.)

1.5.5.2 Data Connections

Data connections are direct VCCs from one LEC to another LEC and to the BUS. They are used to carry user data traffic and never carry control traffic (except for a flush message for cleanup).

Data Direct VCC

For unicast data transfer between end systems, data direct VCCs are set up through ATM signaling as bidirectional, point-to-point connections once the LEC has received the destination's ATM address from the LES.

The LEC will send its first frame to the LES/BUS. The LES/BUS will resolve the destination LEC's ATM address and send the destination address to the originating LEC. The originating LEC will now set up a data direct VCC to the destination LEC and send the data on that newly created VCC.

Data direct VCCs stay in place until one of the partner LECs decides to end the connection based on installation options defining relevant timeouts, etc.

Multicast Send VCC

During initialization, a LEC has to establish a bidirectional, point-to-point multicast send VCC to the BUS (the BUS's ATM address is provided to the LEC by the LES) and must keep this VCC alive while connected to the ELAN. This VCC is used by the LEC to send broadcast and multicast data frames.

Multicast Forward VCC

When a LEC establishes its multicast send VCC to the BUS, the BUS learns about the new member of the ELAN. The BUS then will initiate signaling for the unidirectional multicast forward VCC to the LEC. This VCC can be either point-to-point or point-to-multipoint.

(A point-to-multipoint VCC is more effective for multicast operations.)

1.5.6 LE Service Operation

In operation, the LAN Emulation service performs the following functions:

Initialization

During initialization, the LEC discovers its own ATM address from the ATM switch, which is needed for the client to set up direct VCCs. It obtains the LES's ATM address from the LECS and establishes the control VCCs with the LES and the BUS. The BUS address is provided to the LEC by the LES.

Address Registration

Clients use this function to provide address information to the LES. A client must either register all LAN destinations for which it is responsible, or join as a proxy. The LAN destinations may also be unregistered as the state of the clients changes. A LES may respond to address resolution requests if LECs register their LAN destinations (MAC addresses, or for source-routing IEEE 802.5 LANs only, route descriptors) with the LES.

Address Resolution

This is the method used by an ATM client to associate a LAN destination with the ATM address of another client or the BUS. Address resolution allows clients to set up data direct VCCs to carry cells. This function includes mechanisms for learning the ATM address of a target station, mapping the MAC address to an ATM address, storing the mapping in a table, and managing the table.

For the LES, this function provides the means to support the use of direct VCCs by endstations. This includes a mechanism for mapping the MAC address of an end system to its ATM address, storing the information, and providing it to a requesting endstation.

Connection Management

In SVC environments, the LEC, the LES, and the BUS set up connections between each other using UNI signaling.

Data Transfer

To transmit a frame, the sending LE layer must do the following:

- Decide on which of its VCCs (to destination LEC or BUS) a frame is to be transmitted.
- Encapsulate the frame using AAL-5.

It must also decide when to establish and release data direct VCCs. To do this, it may need to access the LES for address resolution purposes.

1.5.6.1 Operation in Real Systems

In many practical LAN networks, ATM LAN Emulation is going to work very well. While LANs allow any-to-any data transport, typical LAN users connect to very few servers (such as communication servers, file servers, and print servers) at one time.

In this situation, the LE architecture described above can be extremely effective. After a short time, workstations will have established VCCs with all of the servers that they usually communicate with. Data transfer is then direct and very efficient. Timeouts can be set so that the switched VCCs are maintained during normal session usage.

Further details and an explanation of ATM Forum LAN Emulation is available in the ATM Forum Technical Committee's LAN Emulation Over ATM technical specification.

1.5.7 LAN Emulation Summary

LAN Emulation provides a relatively efficient means of transporting existing LAN-based applications across an ATM network, providing them with the benefits of high-speed switched connections and scalability. A LAN Emulation system consists of the following basic components:

1. LAN Emulation Clients (LECs), which reside on endstations or proxy-bridges/switches. These provide the interface between traditional LAN traffic based on frames, and the ATM cell-based network.
2. A LAN Emulation Server (LES), which provides ATM-to-MAC address resolution.
3. A Broadcast and Unknown Server (BUS), which forwards all broadcast traffic to the LE clients.
4. A LAN Emulation Configuration Server (LECS), which assigns LES/BUS addresses to attaching LE clients. The LECS is optional, but if available, provides a central administration point for the assignment of policy-based ELANs.

1.6 Classical IP (CIP) Overview

Classical IP is a standardized solution by IETF for sending IP traffic over an ATM interface. With Classical IP the ATM infrastructure is made transparent to IP.

1.6.1 Classical IP Benefits

One of the main benefits of using CIP is being able to utilize the high-speed link provided by ATM. In addition, CIP requires fewer framing bytes than, for example, LANs that contain source and destination MAC addresses; thus, less bandwidth is used for overhead bytes and more for data. Also, CIP requires no broadcast traffic for the resolution of the ARP frames. The ARP frames are only processed by the ARP server and the endstations exchanging information, while other stations on the subnet are not affected. Nonbroadcast traffic on a shared Ethernet or token-ring medium precludes other stations from using the media for discrete amounts of time. In CIP, independent channels are established between the hosts having the conversation.

In CIP, logically related stations are grouped together in a Logical IP Subnet (LIS), which eases the adds, deletes, moves, etc., using the ARP server.

While all members of a LIS should support the Classical IP model, the MS server can route between subnets that are CIP based and subnets that are LANE based.

Finally, the investments in a CIP solution are protected. The IETF work on IP over ATM, such as distributed ARP servers, Next Hop Resolution Protocol (NHRP), Multicast Address Resolution Service (MARS), resource ReSerVation protocol (RSVP), and other work that is being defined by the IETF, will provide continual growth in functionality and performance.

1.6.2 Classical IP Components

The Logical IP Subnet (LIS) has the same properties of a normal IP network whether running over Ethernet, token-ring or frame relay. However, because ATM is a Non-Broadcast Multiple Access (NBMA) network, the existing broadcast method for resolving addresses cannot be performed. ARP servers and ARP clients were developed to solve this problem. Within the CIP model, there are two forms of requests/replies: ATMARP requests/replies, and InATMARP requests/replies. InATMARP is used to determine the IP and ATM addresses of the entity at the other end of a VCC. ATMARP is used to request the ATM address associated with a specific IP address.

Each LIS has an ARP server. The server maintains the translation of IP addresses to ATM addresses. The server allows clients to register by accepting incoming VCCs and querying the clients for the appropriate mapping information (that is, IP and ATM addresses of the client) using InATMARP requests. The ARP server also responds to ATMARP requests for ATM addresses corresponding to IP addresses specified by the client. Finally, the ARP server updates its tables through aging ARP entries and managing incoming VCCs.

The ARP client is the entity that always places calls. A client, as it initializes, places a call to the ARP server, and through the exchange of InATMARP requests/replies, registers with the ARP server. When a client has traffic to transmit to another client on the LIS, it sends an ARP request, containing the target IP address to the ARP server. The server either sends back a reply that

includes the target ATM address or a NAK (if no information is available). The client then uses this ATM address to place a call to the target client. IP datagrams then traverse this VCC.

1.6.3 Timeouts and Refresh

Both clients and servers age their ARP table entries. Once the timer expires, these ARP entries are deleted. If traffic is flowing while an ARP entry gets aged out, that traffic will cease until a new ARP entry gets created. To avoid an interruption in service, MSS server provides an automatic refresh option. This option allows the MSS client to transmit either an ARP to the ARP server or an InARP to the target client before the ARP entry expires. If the target replies, then the timer of the ARP entry is reset. If the target does not, then the entry is deleted. The ARP server automatically sends out an InATMARP message before aging an entry out of its table. The MSS CIP clients and ARP servers have a default aging period of five minutes and 20 minutes, respectively. These times are configurable for each LIS.

1.6.4 IP Addresses and CIP Components

IP addresses are key to IP routing. When configuring the MSS server, the act of adding an IP address to the ATM interface automatically creates a CIP client. The user must then specify whether MSS is to act as the ARP server for the LIS. Thus, an MSS ARP server never exists without a paired client. The MSS server supports up to 32 LISs per ATM interface.

Creation of an IP address on the MSS server implies packet forwarding behavior. The MSS server forwards packets between subnets even if no routing protocol (for example, OSPF) is configured. Furthermore, if a packet is sent to the MSS server but the destination is not on the same subnet as the source, the MSS server sends an ICMP redirect message to the originator, and forwards the packet to the proper host.

1.6.5 ATM Addresses of CIP Components

In general, ATM addresses must be unique among CIP components; however, on the MSS server, client/server pairs share an ATM address. The ESI and selector portions of a CIP component's ATM address may be configured automatically or generated at run time. The ESI defaults to the MAC address burned into the ATM interface hardware and, similar to LAN Emulation, the user may override the default by explicitly selecting one of the locally administered ESIs defined for the ATM interface. If only a client is being created, then explicitly configuring the ESI is not recommended; however, if a client/server pair is being created, then at least the selector should be specified in order to provide the server with a fixed address (that can be configured at all the clients on the LIS).

1.6.6 CIP Channel Connections

Two types of connections are supported by CIP: Switched Virtual Circuits (SVCs), and Permanent Virtual Circuits (PVCs).

1.6.6.1 SVCs

SVCs require a signaling protocol to establish connections. SVCs may be generated automatically through the address resolution and call setup process of Classical IP, or they may be explicitly configured. Automatic SVCs are brought up

and torn down by the ARP subsystem as required for sending IP traffic. A configured SVC is brought up during initialization and kept up indefinitely.

1.6.6.2 PVCs

PVCs do not require a signaling protocol, but do require configuration in both the ATM network and end systems. PVCs and configured SVCs do not require an ARP server. That is, a LIS can consist of hosts that are interconnected only by configured information. However, this is useful only in small networks as the amount of manual configuration can quickly become prohibitive in large networks. The attribute for both control channels (connections from client to server) and data channels (connections from one client to another) may be customized to specific user needs, for example, Quality of Service. Characteristics can be specified on a LIS basis by configuring VCC traffic parameters such as peak and sustained rates.

For more information on ATM connections, refer to *Internetworking over ATM: An Introduction*, SG24-4699.

1.7 LAN Emulation Version 2

LAN Emulation Version 2 is an enhancement to the original LAN emulation standard and was released in July 1997. Some of the enhancements with LANE V2 are:

- It allows LECs on different ELANs in the same box to use the same VCCs thus reducing the VCC requirement.
- Multiprotocol over ATM (MPOA) is supported. It allows MPOA servers and clients to discover each other on an ELAN.
- Enhanced quality of service support for LAN emulation data direct VCCs. Applications can now access the QoS characteristics of the ATM network.

A full description of the new and updated LANE functions can be found in the redbook *MSS Release 2.1, Including the MSS Client and Domain Client*, SG24-5231.

1.8 MPOA

MPOA Multiprotocol over ATM is an ATM forum standard for the virtual router model defined for ATM networks. It provides unprecedented scalability and flexibility by emulating the functions of the traditional router in a network. MPOA separates the logical functions of route calculation and data forwarding and splits them between MPOA servers and clients. It is based on standard networking technologies such as bridging, LAN emulation and next hop resolution protocol (NHRP). It enables direct VCC connections across the ATM network between MPOA clients bypassing the routers.

The MPOA servers perform the route calculation function, address management and topology discovery. They then provide this information to MPOA clients. They are also seen as the routing engines from outside the MPOA segment. They keep connections with traditional routers that run traditional routing protocols such as RIP and OSPF.

The MPOA clients are the incoming and outgoing points of the virtual router. They monitor the data forwarded to the MPS router. The ingress MPOA client (the entry point) recognizes when the data rate has exceeded a predetermined level and starts the process to establish a shortcut to the egress (the exit point) MPOA client. The MPOA server does the route calculation and provides this to the MPOA clients. The MPOA clients then establish the shortcut.

A detailed description of how MPOA works can be found in the *MSS Release 2.1, Including the MSS Client and Domain Client*, SG24-5231.

Chapter 2. Hardware Overview

ATM solutions provide high speed, multimedia, uninterrupted transmission, and enhanced bandwidth cost control. For more information, refer to <http://www.networking.ibm.com>.

As part of IBM's ATM strategy, there are campus products available to enable ATM backbones, switch-based ATM workgroups, and coexistence with current devices and applications.

This chapter gives a short introduction to the switch family of products, including ATM, LAN and WAN switches, an ATM LAN bridge and routers that can be directly connected to an ATM network.

In addition, this chapter contains information on the IBM 8210 (MSS) and its functionality and how servers and endstations can be attached to an ATM network.

2.1 ATM Switches

The heart of an ATM campus backbone is provided by one or more high-speed ATM switches. IBM has four ATM capable switches:

- 8260 Multiprotocol Hub
- 8265 Nways ATM Switch
- 8285 ATM Workgroup Switch
- 8274 Nways RouteSwitch

2.1.1 IBM 8260 Nways Multiprotocol Switching Hub

The 8260 supports the direct attachment of your servers and workstations and connects to other switches, giving scalability to any campus network. The 8260 provides support for Ethernet, token-ring and FDDI LANs, as well as ATM.

Designed for multiworkgroup and campus backbone applications, the 8260 delivers the functions you need to build high-speed ATM networks while you continue to connect existing Ethernet, token-ring and FDDI networks.

With more than 70 modules available, the 8260 combines the functions of a shared-media, modular, intelligent hub with LAN and ATM switches in a single unit, providing a smooth migration path from today's to tomorrow's networks. The 8260 accepts a wide range of Ethernet, token-ring, FDDI, ATM and unique features such as MPEG-2 video distribution modules and can also accept any module from IBM's midrange 8250 Multiprotocol Intelligent Hub.

The 8260 offers the following functions:

- Ethernet, token-ring and FDDI connectivity
 - Up to 8 Ethernet, 17 token-ring or 4 FDDI networks in a single hub.
 - Up to 612 managed Ethernet ports in the 17-slot hub, with up to 128 independent workgroup segments using port-switching.

- Up to 340 managed token-ring ports in the 17-slot hub, with up to 176 independent segments using port-switching.
- Port-bank and module-switching for dynamic network reconfiguration to adjust to changing loads or to move users between networks without rewiring or expensive trips to the wiring closet.
- RMON support using the T-MAC and E-MAC daughter cards.
- RMON2 support using the HTMAC or HEMAC cards.
- High-Capacity LAN Switching
 - Up to 204 switched 10 Mbps Ethernet ports or 68 Fast Ethernet ports with full switching.
 - High-aggregate LAN switching through a packet channel running at over 2 Gbps.
 - Embedded RMON2 monitoring.
 - LAN-to-ATM switching.
- ATM for Workgroups
 - Separate switch and concentrator modules provide the ability to simultaneously support multiple speeds and balance between workgroup and backbone configuration.
 - Up to 168 25 Mbps ports, 56 100 Mbps ports or 42 155 Mbps ports for a wide range of configuration options including 622 Mbps links.
 - Ability to support both conventional LANs and ATM in the same device is less expensive and less complex than multiple-device alternatives.
 - ATM LAN Ethernet and token-ring switches with full-duplex operation and adaptive cut-through switching.
 - Video distribution over ATM.
 - Integrated multiprotocol switched server module with advanced LANE functions.
- Extensive Management
 - Distributed management system uses plug-in daughter cards to monitor network operations instead of separate management modules.
 - Daughter cards are independent monitoring agents, with their own processors and memory.
 - Daughter cards are switchable from network to network to allow monitoring of multiple LAN segments from a single access point.
 - Supports hub management and LAN configuration from a PC, a terminal or an SNMP manager.

For more technical details refer to *8260 Multiprotocol Intelligent Switching Hub*, GG24-4370 and *IBM 8260 as A Campus ATM Switch*, SG24-5003.

2.1.2 8265 Nways ATM Switch Model 17S

The 8265 is a world class ATM switch with a unique architecture that combines the strengths of single stage switching and distributed buffer pools with ATM traffic management. In addition to the support of all ATM Class of Services (CBR, VBR, ABR and UBR), the 8265 provides advanced traffic management functions,

such as traffic shaping at the VP level, statistics at the connection level, traffic policing, or port mirroring. The 8265 also has one of the most sophisticated ATM Forum-compliant PNNI implementations in the industry, in addition to the high level of ATM signaling performance and robustness. The 8265 was built using the IBM 8260 chassis and ATM-proven architecture, and therefore it leverages on the technology that was developed and deployed during the past years providing a performance increase. The 8265 provides a backward compatibility mode for 8260 ATM modules. The 8265 brings the following capabilities:

- Up to 12.8 Gbps full duplex aggregate throughput
- A new 25 Gbps ATM backplane
- Up to 56 OC3 or 14 OC12 port capacity (nonblocking)
- All ATM quality of services

8265 contains the following components:

- 17-slot chassis with the ATM backplane
- Control point/switch module
- 4-port OC3 (155 Mbps) multimode fiber module
- 1 port OC3 (155 Mbps) flexible module that can host up to four individual OC3 (155 Mbps) I/O cards (SMF, UTP/STP, MMF)
- 1-port OC12 (622 Mbps) MMF and SMF
- The 8265 also supports all the 8260 modules in its compatibility slots (slots 1, 3, 5 and 7) using CPSW F/C 6501. This facility is not available with CPSW2 F/C 6502.

8265 Microcode

- Version 3 microcode brings the PNNI capability with a single level of peer group (node 0).
- Version 4 microcode provides the next level of PNNI peer group hierarchy. (node 1). This version of microcode is available in two forms: PNNI and IISP. There is also an enhanced Web server improved serviceability with the new ATM Ping command and integration of two LES/BUS pairs.

New CP/SW module (F/C 6502)

- A new CP/SW is also available now that has a faster processor (MPC860 50 MHz) and increased memory (64 MB DRAM) bringing increased performance.
- Has a built-in power controller and does not need the RCTL (F/C 8000) in slot 18. This can be disabled if the customer wants to use two RCTL cards for redundancy with only one CPSW2.

A new Version 4 chassis

WAN connectivity is available using the WAN 2.5 module. This card allows the following feature cards to be installed on it:

- 4-port ATM E1/T1/J1
- 1-port ATM E3/T3
- 1-port ATM "full" SONET/SDH

An ESCON channel attachment card for direct connection to the Sys/390.

The table below illustrates some of the restrictions with the new CPSW2 and Version 4 chassis. This CPSW is designed to operate with native 8265 modules in a Version 4 chassis.

Table 1. IBM 8260 and 8265 Chassis/Backplane Compatibility

	17S chassis: previous level (EC P/N 13J8689)	17S chassis release 4.0 (EC P/N 26L0112)
CP/SW (F/C 6501)	8260 modules in slots 1,3,5,7 <hr/> 8265 modules in slots 1 through 8 and 12 through 17	8260 modules in slots 1,3,5,7 <hr/> 8265 modules in slots 1 through 8 and 12 through 17
CP/SW 2 (F/C 6502)	8260 modules not supported <hr/> 8265 modules in slots 1 through 8 and 13 through 17	8260 modules not supported <hr/> 8265 modules in slots 1 through 8 and 12 through 17

The CPSW2 contains an internal power controller. Two CPSW2s provide the same backup capability as two previous RCTL cards. If you wish you can disable the power controller function on the CPSW2 and use the RCTL cards instead. This way you could have one CPSW installed and redundant power using two RCTL cards.

2.1.3 8285 Nways ATM Workgroup Switch

The IBM 8285 Nways ATM Workgroup Switch is a low-end ATM Workgroup Switch.

The IBM 8285 Nways ATM Workgroup Switch comprises two desktop or rack-mountable units:

- Base unit
- An optional expansion unit feature

The ATM Workgroup Switch Base Unit is a self-contained ATM switch and control point unit with 12 ATM ports (25.6 Mbps) and a slot for one of the optional 155 Mbps ATM I/O card features:

- Multimode fiber (FC 5500)
- Single-mode fiber (FC 5501)

The 155 Mbps I/O card can be linked to:

- A local server (such as an ATM-enabled RS/6000)
- An ATM network consisting of other ATM Workgroup Switches
- Other vendor products that are compliant with ATM Forum specifications for 155 Mbps links.

The expansion unit feature provides three slots to add IBM 8260 ATM modules that can provide up to 36 additional ATM ports. The ATM modules that are currently available include:

- ATM media modules (25, 100, and 155 Mbps)
- ATM LAN bridge modules

The slots are interconnected by the same type of ATM backplane found in the 8260 hub, and ports on ATM modules in the expansion unit can be switched to any other port in either the base unit or the expansion unit. The 8285 is a good entry-level product for customers who want to explore the possibilities of ATM. The 8285 inherits the powerful and well-proven architecture of the 8260 ATM hub, such as the Software Control Point Switch-on-a-Chip traffic management technologies common to the entire IBM ATM switch family.

2.1.4 8274 Nways ATM RouteSwitch

The IBM 8274 Nways LAN RouteSwitch provides an immediate performance boost or gives assistance to begin migrating to ATM (or both at once) by using a scalable, hot-swappable, modular approach. The Nways 8274 LAN RouteSwitch combines an innovative hardware architecture with a sophisticated feature set, inexpensive enough to use as a basic network building block. It provides you with the unique combination of LAN switching and ATM switching to the desktop and to the backbone.

With the 13.2 Gbps ATM cell switching backplane available in selected models, they currently include the Models W33, W53 and W93. In addition to selecting one of the models above, certain feature codes are required in order to perform ATM switching. Requirements include an MPM-II with 16 MB memory or an MPM-1G or MPM-1GW an FCSM (Frame to Cell Switching Module) and a CSM (Cell Switching Module). Also required is the Nways RouteSwitch Software Program at the minimum level of Version 3 Release 0.

Otherwise, model GRS supports the 22 Gbps ATM cell switching backplane. It requires MPX with 32 MB of DRAM and 8 MB of flash memory. It also requires Nways RouteSwitch Software Program-GbE Version 3 Release 4 or later.

2.2 8210 Nways Multiprotocol Switched Services (MSS) Server

The IBM 8210 Nways Multiprotocol Switched Services (MSS) Server is an IBM-developed technology, that implements multiprotocol, distributed routing in switched networks. There are three types of MSS servers:

- Stand-alone IBM 8210
- MSS Server as a blade for the IBM 8260
- MSS Server as a blade for the IBM 8265

The stand-alone IBM 8210 has two slots for 155 Mbps ATM adapters, one of which can be chosen for FDDI connection. Two versions of the 155 Mbps adapter are available:

- One for single-mode fiber
- One for multimode fiber

The 8210 blade supports a single ATM interface and is connected to the ATM network via the 8260/8265 backplane.

2.2.1 MSS Server - Hardware

1. MSS Server 8210-001 and 2-slot MSS Server module for 8260

Released with software version MSS Release 1.0

- 100 MHz PowerPC 603e
- 32 MB DRAM (upgradeable to 64 MB)
- 12 MB flush
- PCMCIA removable hard drive
- PCMCIA modem slot

2. MSS Server 8210-002 and 1-slot MSS Server module for 8260/8265

Released with software version MSS Release 2.0

- 166 MHz 603EV PowerPC processor
- 64 MB EDO DRAM
- 20 MB PCMCIA flash card
- 10 Mbps Ethernet attachment
 - Serial port, modem and Ethernet port can be used for management
- Built-in 1 MB flash to store firmware
- Built-in 1.6 GB IDE hard drive

3. MSS Server 8210-003 and 1-slot MSS Server 3.0 Module for 8265 features

Released with software version MSS Release 2.2

- 233 MHz PowerPC 740
- 64 MB EDO DRAM
- PCMCIA flash card
- PCMCIA modem card
- 10 Mbps Ethernet attachment
 - Serial port, modem and Ethernet port can be used for management

2.2.2 MSS Server Software Release 1.1

The MSS Server Release 1.1 contains four basic functions:

- LAN Emulation
- Classical IP
- Routing
- Bridging

For a more detailed explanation of these functions, please see *Understanding and Using the MSS Release 1.1 and 2.0*, SG24-2115.

Release 1.1 of the MSS Server contains these additional functions:

Super VLAN

Super VLAN is a collection of emulated LANs that allows you to build large ATM networks. A client on any of the emulated LANs can establish a direct link, a datadirect VCC, to any other client on the Super VLAN. In essence, the Super VLAN is emulating a standard VLAN, except that the LAN Emulation Server (LES) function is distributed throughout the ATM network. Reliability and performance of the LE services increase with the number of service entities. Resource utilization becomes less centralized, allowing for a much larger Super VLAN than a standard ELAN. Two additional functions are added to complete the function. Bridging BroadCast Manager (BBCM), and Dynamic Protocol VLANs (D-PVLAN) are added to control broadcast traffic, that would otherwise limit the effectiveness of a large emulated LAN. BBCM, like BroadCast Manager in a single emulated LAN, resolves layer-3 broadcasts into a layer-2 unicast frame. D-PVLAN on the other hand, keeps track of what protocols and what subnets are on each of the LES domains. When BBCM is unable to resolve a broadcast, D-PVLAN forwards only to those segments that would be interested. D-PVLAN partitions the Super VLAN into protocol-specific VLANs.

Virtual ATM interfaces

Virtual ATM interfaces can actually improve performance in large, complicated networks and will aid multicast routing protocols, such as OSPF. Currently only 32 protocol addresses can be configured on any physical interface. This function eliminates this limitation. When more protocol interfaces are needed on a physical interface, additional virtual interfaces can be defined on the physical interface. To the protocol support in the MSS Server, a virtual ATM interface looks just like an additional adapter and 32 addresses can be assigned to each virtual interface.

BUS performance

In LAN emulation, BUS performance determines the ability of ATM to forward frames for which a data direct VCC has not been established. Release 1.1 increases the number of frames forwarded to over 100000 packets per second in the standard BUS configuration.

FDDI-to-ATM connection

Release 1.1 also adds support for FDDI that allows you to route IP, IPX and AppleTalk traffic between FDDI and ATM networks. Four types of FDDI adapters allow customers to use copper and optical fiber cables as well as the support of single and dual FDDI rings.

QoS

One of the advantages of ATM is the ability to negotiate QoS. Release 1.1 provides the ability to define a QoS level for a LAN Emulation Client (LEC), an emulated LAN or an ATM interface. Customers can take advantage of this function now and know that IBM will provide compliance when the standard is finalized.

NHRP

Release 1.1 also provides one of the main functions of the expected Multiprotocol over ATM (MPOA) standard, NHRP. This function allows

NHRP clients to set up a data direct VCC and forward IP data frames without traversing intermediate routers.

Enhanced routing and bridging

Release 1.1 provides routing support for AppleTalk and bridging support for RFC 1483 bridge format frames.

Redundant ARP server

In Release 1.0 two MSS servers could act as redundant ARP servers. But, it was not possible to designate which one was primary and which was secondary. Nor was it possible to switch back from the secondary to the primary when the primary returned online. Release 1.1 adds control that allows you to configure which MSS server will act as the Primary ARP server, and which will act as the Secondary ARP server. If both MSS servers are active, the primary server will always be the one to service incoming calls.

Improved redundant default IP gateway

This function allows endstations with manually configured default gateway IP addresses to continue passing traffic to other subnets after their primary gateway goes down. Without a backup gateway an endstation with a manually configured default gateway address is unable to send packets to other subnets until either the gateway comes up or the user changes the default gateway address. For more information on Release 1.1 functions, please see *Understanding and Using MSS Release 1.1 and 2.0*, SG24-2115.

2.2.3 MSS Server Software Release 2.0

The following functions were added to the base and MSS 1.1 versions in October 1997:

1. APPN routing
2. Distributed ARP server
3. RFC 1577+ client
4. RFC 1483 bridging using SVC
5. Routing enhancements
 - IP enhancements
 - IPX enhancements
 - Banyan Vines routing
6. ELAN enhancements
7. ATM interface enhancements (VCC multiplexing)
8. SR-TB duplicate MAC address support
9. Classical IP MIB
10. Dynamic reconfiguration (new interfaces)
11. Dynamic (selective) linking and loading (DLL)
12. MSS-specific functions
 - Zero-hop routing server

Note: Enables zero-hop (IP) routing for legacy LAN devices

- Multicast Address Resolution (RFC 2022)

2.2.4 MSS Server Software Release 2.0.1

The functions supported with the December 1997 release included:

1. Bridging enhancements
 - SuperELAN Bridging (TB/SRB)
 - Multiple SuperELANs Running Separate Bridge Instances
 - Bridge Broadcast Management (BBCM) Enhancements
 - Dynamic Protocol Filtering (DPF) Enhancements
 - MAC Address VLANs
 - Sliding Window VLANs
 - Display VLAN Membership by MAC Address

2.2.5 MSS Server Software Release 2.1

The functions supported with the June 1998 release included:

1. ELAN enhancements
 - LECS Access Controls
 - Enhanced QoS Support for ELANs
 - LANE V2 (LUNI V2)
 - BCM IPX Server Farm Detection
2. Classical IP enhancements
 - IP Multicast over ATM (MARS Client/Server, MCS)
 - Peer ARP-Server Redundancy
3. Routing enhancements
 - APPN and Banyan Vines routing on FDDI
 - APPN - Enterprise Extender (HPR over IP)
 - IP - MPOA Server (beta)
4. Data Link Switching (DLSw)
5. Bridging enhancements
 - Dynamic Protocol Filtering (DPF) Enhancements
 - Port-based VLANs
 - IP Multicast VLANs
 - FDDI TB Bridging
 - Requires new FDDI Adapter

2.2.6 MSS Server Software Release 2.2

The functions supported with the March 1999 release included:

1. Performance enhancements

2. Network performance enhancements
 - Broadcast Unknown Server (BUS) Filters
 - Broadcast Unknown Server (BUS) Policing
3. LANE redundancy enhancements
 - LES/BUS peer redundancy
 - LECS database synchronization
 - Persist data direct VCCs
4. MPOA enhancements
 - MPOA server/client for IPX
 - MPOA server/client MIB
5. Additional dynamic reconfiguration
6. Dynamic RFC 1483 PVC/SVC
7. Non-zero VPI
8. CPU performance monitor

2.3 8281 Nways ATM LAN Bridge

The IBM 8281 ATM LAN Bridge is a multiport bridge, which can be used to provide connectivity between workstations attached to legacy LANs (such as token-ring and Ethernet) and workstations attached to ATM, using FC LAN Emulation. It can also provide connectivity between LAN-attached stations using the emulated LAN over ATM as the backbone.

The IBM 8281 comes either as a stand-alone bridge with:

- Two Ethernet (V.2 or IEEE 802.3) or token-ring (IEEE 802.5) ports (base)
- Two additional Ethernet (V.2 or IEEE 802.3) or token-ring (IEEE 802.5) ports (option)
- An ATM connection at 100 Mbps full-duplex (option)

Or as a blade for the IBM 8260 with:

- Four Ethernet (V.2 or IEEE 802.3) or token-ring (IEEE 802.5) ports
- A connection to the ATM network via the 8260 backplane

The following are the highlights of the IBM 8281 ATM LAN bridge:

Bridging for token-ring or Ethernet

You can configure the LAN interface ports as either all Ethernet ports or all token-ring ports. You can start with either two or four LAN ports. The LAN ports provide RJ-45 connectors that can be used for either Ethernet or token-ring. As a bridge, the 8281 provides efficient transmission from token-ring to token-ring or from Ethernet to Ethernet. The bridge provides source-route bridging for token-ring and transparent bridging for Ethernet. It enables you to set filters to control the traffic flow. In addition, the LAN ports can function in either full-duplex or half-duplex mode.

A gateway to ATM

You can add the ATM connection to the bridge whenever you need it. The 8281 connects to ATM with an optional, 100 Mbps multimode fiber interface. An ATM Forum-compliant standard, LAN Emulation, lets LAN workstations communicate with ATM workstations.

Access to the ATM backbone

Using the bridge as a gateway, you can connect either Ethernet or token-ring LANs to other LANs of the same type over a high-capacity, ATM backbone. You can add the backbone to your network without changing any of your existing software applications or hardware on the LANs.

Standards-based link to higher capacity networks

The 8281 interoperates with a wide range of other devices. It is fully compliant with Ethernet V2, IEEE 802.3 (Ethernet), IEEE 802.5 (token-ring), and the ATM Forum LAN Emulation over ATM: Version 1.0 Specification. The 8281 can be managed by an SNMP manager. The Configuration Utility Program provides a graphical interface for configuration and utility functions, such as microcode upgrade. This program and the 8281 SNMP agent can be accessed through an EIA 232 serial interface with a DB-25 connector on the front panel.

2.4 LAN Switches

The IBM LAN Switch family includes several products.

The IBM 8271 and the 8272 provide LAN switching to traditional Ethernet and token-ring LAN environments.

The IBM 8273 provides powerful, transparent Ethernet switching at wire speed, while at the same time providing extensive VLAN support. The IBM 8274 extends the 8273 architecture with a chassis design that allows for several media type blades to be inserted. These blade types can be token-ring, Ethernet, fast Ethernet, FDDI, and ATM.

2.4.1 8271 Nways Ethernet LAN Switch

The IBM 8271 Nways Ethernet LAN Switches provide LAN switching technology to an Ethernet environment. The 8271 employs cut-through switching technology that provides the benefits of dedicated-media, high-speed switching to serve emerging, high-demand desktop applications. However, should your operating environment demand more error isolation between segments, the 8271 can be configured to alternate automatically between cut-through and store-and-forward switching based on user-specified thresholds. This IBM-patented technique is called adaptive cut-through mode.

The models available are:

- Stand-alone IBM 8271 Model 001
- Stand-alone IBM 8271 Model 108
- Stand-alone IBM 8271 Model 216
- Stand-alone IBM 8271 Model 524
- Stand-alone IBM 8271 Model 612

- Stand-alone IBM 8271 Model 624
- Stand-alone IBM 8271 Model 712
- Stand-alone IBM 8271 Model E12/E24
- Stand-alone IBM 8271 Model F12/F24
- IBM 8271 module for the IBM 8260 (2-slot version)
- IBM 8271 module for the IBM 8260 (3-slot version)

Model Highlights 8271-001

- Transports Ethernet frames among up to eight Ethernet LAN segments, each connected to one 10Base-T port on the IBM 8271. A single AUI port is also provided, for use instead of one 10Base-2, 10Base-5 or fiber segment backbone.
- Supports both shared and dedicated LAN segments on any of the ports.
- Bandwidth to a single LAN station on a dedicated LAN segment can be doubled from 10 Mbps to 20 Mbps by using the full-duplex capabilities of the 8271 and full-duplex Ethernet adapters.
- Provides multiport, transparent connection between ports (transparent switching).
- The virtual switch capability of the 8271 allows a single physical switch to be divided into multiple switching domains (virtual switches).

Model Highlights 8271-108

- Provides all features described for Model 001
- Provides an EtherProbe network monitor port to monitor all switch network traffic.
- Can be configured to block the forwarding of small, incomplete frames or runts using runt-free mode, thus enhancing network operations.
- EtherPiping provides the capability for two 8271s to communicate by connecting together up to four full-duplex Ethernet ports.
- Includes one Universal Feature Slot that supports optional Universal Feature Cards for additional connectivity.

Model Highlights 8271-216

- Includes all the features described for Model 108
- Provides 16 fixed Ethernet ports as well as two Universal Feature Slots.

Model Highlights 2-slot version 8271-module

- Includes all the features described for Model 108
- Provides eight fixed Ethernet ports as well as two Universal Feature Slots.

Model Highlights 3-slot version 8271-module

- Includes all the features described for Model 108
- Provides 16 fixed Ethernet ports as well as four Universal Feature Slots.

Universal Feature Cards (UFCs)

Each Universal Feature Slot supports one optional Universal Feature Card, such as:

- One-port FDDI 100 Mbps SAS UTP
- One-port FDDI 100 Mbps SAS fiber
- One-port FDDI 100 Mbps DAS fiber
- One-port ATM (155 Mbps SONET) multimode fiber
- One-port 100Base-TX UTP-5
- One-port 100Base-FX multimode fiber
- Four-port 10Base-T
- Three-port 10Base-FL multimode fiber

FDDI 100 Mbps UFCs

These UFCs provide additional 100 Mbps uplink alternatives, allow interconnection of IBM 8271 Nways LAN Switches through dual-attachment concentrators (DACs) or stations (DAS) to an FDDI backbone and provide bridge access from the Ethernet ports to high-speed stations on the FDDI backbone. They are compatible with industry and international FDDI standards (ISO 9314/ANSI X3T9.5) and support FDDI station management (SMT 7.3). They perform IP fragmentation (RFC 1188) and have an SNMP agent that supports MIB II (RFC 1213) and the FDDI MIB (RFC 1512). Another application is high-speed connectivity between LAN switches and servers. For redundancy the DAS UFC supports dual-homing.

ATM 155 Mbps multimode (MMF) fiber UFC

As new applications require more and more bandwidth in the backbone, the one-port, 155 Mbps ATM UFC, with its fully ATM Forum-compliant SONET interface, can switch data to an industry-standard ATM backbone switch such as the IBM 8260 Nways Multiprotocol Switching Hub, over multimode optical fiber cables to get to another switch or file server. The ATM UFC will support ATM Forum-compliant LAN Emulation (LANE) that will let you run all of your applications without any change to your software.

The ATM 155 Mbps multimode fiber UFC, supported in the IBM 8271 LAN Switch and the 8271 LAN Switch Module for the 8260, switches Ethernet and Fast Ethernet frames between LAN segments connected to the LAN switch and an ATM network. The UFC provides an industry-standard LAN Emulation Client (LEC) that is fully compliant with ATM Forum specifications. The UFC also allows LAN traffic to be switched between LAN workstations or segments attached to a LAN switch and other devices with compatible ATM LANE applications. The ATM UFC provides one ATM interface that complies with UNI 3.0 and 3.1 ATM Forum specifications. It's designed with an SC connector for attachment over multimode fiber media.

100Base-TX UFC and 100Base-FX UFC

These UFCs provide additional, 100 Mbps Ethernet ports for the 8271 that can be configured similarly to the fixed 10Base-T, RJ-45 ports. Connect these UFC ports to a shared, 100 Mbps Ethernet segment via a compatible 100 Mbps repeater for a half-duplex connection, or

directly to a dedicated, compatible 100 Mbps Ethernet adapter, such as the IBM 100/10 PCI Ethernet Adapter, for full-duplex communication.

Fully compliant with IEEE 802.3u specifications, the 100Base-TX UFC supports connections via unshielded twisted-pair, UTP-5 cabling. The 100Base-FX UFC supports connections via multimode fiber media. You can connect each of these UFC ports to another 8271 or high-speed server using a dedicated, full-duplex 100 Mbps connection. You can also include UFC ports in any virtual switch, which you can then configure with address filters. You cannot mix UFC ports with fixed 10Base-T ports to form a multilink EtherPipe connection to another 8271. But you can include the 100Base ports in any virtual switch that you can then configure with address filters. You cannot configure the EtherProbe port on the 8271 Model 108 to monitor the 100Base-TX or the 100Base-FX UFC port.

4-Port 10Base-T UFC and 3-Port 10Base-FL UFC

These UFCs provide additional 10 Mbps Ethernet ports that you can configure identically to the fixed Ethernet ports. Each or all of these UFC ports can be configured (in combination with any of the fixed ports) to be used in multilink EtherPipe connections and configured to be included in virtual switches. These UFC ports support address filters, BootP, TFTP, Telnet or SNMP sessions and can be monitored by the EtherProbe port.

The 4-port 10Base-T UFC provides four 10Base-T MDI-X ports with RJ-45 connectors. Any of these four UFC ports can be configured similarly to any of the fixed 10Base-T ports to provide either shared (half-duplex), 10 Mbps Ethernet connections or dedicated (full-duplex), 20 Mbps connections.

The 3-port 10Base-FL UFC provides three 10Base-FL multimode fiber connections via ST connectors. Any of these three UFC ports can be configured similarly to any of the fixed 10Base-T ports to provide either shared (half-duplex), 10 Mbps Ethernet connections or dedicated (full-duplex), 20 Mbps connections at distances up to 2 km (6600 ft). Shared connections are established by connecting a port on the UFC to a port on a compatible Ethernet repeater or hub such as the IBM 8224 Ethernet Stackable Hub or the 8260 Nways Multiprotocol Switching Hub. Dedicated connections are established by connecting these ports directly to a compatible Ethernet adapter.

Models 524, 612, 624 and 712 are based on higher performance Application Specific Integrated Circuits (ASICs). In addition, the new uplink modules offered on the new 8271 models are not interchangeable with earlier 8271 models and vice versa. Each of the new models can be configured to support a variety of backbone and server link options, including Fast Ethernet 100Base-TX, Ethernet 100Base-FX, and Asynchronous Transfer Mode (ATM). Each model provides full-duplex transmission on selected ports to increase performance and throughput.

Model highlights 8271-524

- 24 10Base-T ports
- 1 100Base-TX (uplink) port

- Full-duplex capability on all ports

Model highlights 8271-612

- 12 10Base-T ports
- 1 100Base-TX (uplink) port
- Full-duplex capability on all ports

Model highlights 8271-624

- 24 10Base-T ports
- 1 100Base-TX (uplink) port
- Full-duplex capability on all ports

Model highlights 8271-712

- 12 10/100Base-TX auto-sensing ports
- Full-duplex capability on all ports

Optional features

- 100Base-TX uplink module
- 100Base-FX uplink module
- ATM uplink module

Models E12/E24 and F12/F24 support most current technologies including Gigabit Ethernet and ATM. E and F models can be interconnected to form a stack that offers excellent performance, switch density and management features.

Model highlights 8271-E12/E24

- 1 Gbps internal backbone
- 12/24 10Base-T ports
- Two 10/100Base-TX ports
- 1 Gbps matrix port for stacking
- 1 expansion slot for uplink modules

Model highlights 8271-F12/F24

- 2.1 Gbps internal backbone
- 12/24 10/100Base-T ports
- Two 10/100Base-TX ports
- 1 Gbps matrix port for stacking
- 1 expansion slot for uplink modules

Optional features

- Fast Ethernet fiber module
- 1000Base-SX uplink module
- ATM uplink

All models

- Control software in firmware (microcode)
- Built-in RS-232 port for local console
- Built-in 100-120/200-240 VAC, auto-ranging power supply
- High-performance Application Specific Integrated Circuits (ASICs)
- Intelligent flow management, to minimize packet loss under heavy network loads
- V24 management port (9-way male D-type) for local and remote out-of-band management
- Cut-through (default), fragment-free, and lower latency in cut-through mode
- Store-and-forward function
- Simple Network Management Protocol (SNMP) management, running over Unacknowledged Datagram Protocol/Internet Protocol (UDP/IP) and I Packet eXchange (IPX) protocol
- WEB based management for E12/24 and F12/24
- Local management: RS-232 port, VT100 screens, and Telnet (up to three sessions)

2.4.2 8272 Nways Token-Ring LAN Switch

The IBM 8272 Nways Token-Ring LAN Switches provide LAN switching technology for a token-ring environment. The 8272 employs cut-through switching technology that provides the benefits of dedicated-media, high-speed switching to serve emerging, high-demand desktop applications. This switching technique delivers extremely low latency or delay. However, should your operating environment demand more error isolation between segments, the 8272 can be configured to alternate automatically between cut-through and store-and-forward switching based on user-specified thresholds. This IBM-patented technique is called adaptive cut-through mode.

There are four models available:

- Stand-alone IBM 8272 Model 108
- Stand-alone IBM 8272 Model 216
- IBM 8272 module for the IBM 8260 (2-slot version)
- IBM 8272 module for the IBM 8260 (3-slot version)

Model highlights 8272-108

- Transports token-ring frames among up to eight shared or dedicated token-ring LAN segments using twisted-pair media (UTP/STP) using RJ-45 connectors, operating at 4 or 16 Mbps.
- Can double the bandwidth available to a single LAN station on a dedicated LAN segment from the usual 16 Mbps to 32 Mbps by using native full-duplex capabilities and full-duplex adapters.
- Includes one Universal Feature slot, that supports optional Universal Feature Cards for additional connectivity.
- Automatic configuration to the optimum operating level.
- Full-duplex (bidirectional) communication.

- Token-piping, provides the capability for two 8272s to communicate by connecting together up to four full-duplex token-ring ports.
- Source-route switching and internal source-route bridging in source-routing environments.
- The virtual switch capability of the 8272 allows a single physical switch to be divided into multiple switching domains (virtual switches).
- Alternates automatically between cut-through and store-and-forward switching based on user-specified thresholds (adaptive cut-through token-ring switching).

Model highlights 8272-216

- Includes all features of the Model 108.
- Provides 16 fixed token-ring ports as well as two Universal Feature Slots.

Model highlights 2-slot version 8272 module

- Includes all features of the Model 108.
- Provides eight fixed token-ring ports as well as two Universal Feature Slots.

Model highlights 3-slot version 8272 module

- Includes all features of the Model 108.
- Provides eight fixed token-ring ports as well as four Universal Feature Slots.

Universal Feature Cards (UFCs)

Each Universal Feature Slot supports one optional Universal Feature Card, such as:

- One-port FDDI 100 Mbps SAS UTP
- One-port FDDI 100 Mbps SAS fiber
- One-port FDDI 100 Mbps DAS fiber
- One-port ATM (155 Mbps SONET) multimode fiber
- Four-port token-ring UTP/STP
- Two-port token-ring fiber

FDDI 100 Mbps UFCs

These UFCs provide additional, 100 Mbps uplink alternatives, allow connection of IBM 8270 and 8272 Nways token-ring LAN switches through dual-attachment concentrators (DACs) or stations (DAS) to an FDDI backbone and provide bridge access from the token-ring ports to high-speed stations on the FDDI backbone. They are compatible with industry and international FDDI standards (ISO 9314/ANSI X3T9.5) and support FDDI station management (SMT 7.3). They have an SNMP agent that supports MIB II (RFC 1213) and the FDDI MIB (RFC 1512). Another application is high-speed connectivity between LAN switches and servers. For redundancy the DAS UFC supports dual-homing.

ATM 155 Mbps Multimode Fiber UFC

As new applications require more and more bandwidth in the backbone, the one-port, 155 Mbps ATM UFC, with its fully ATM

Forum-compliant SONET interface, can switch data to an industry-standard ATM backbone switch such as the IBM 8260 Nways Multiprotocol Switching Hub, over multimode optical fiber cables. The ATM UFC will support ATM Forum-compliant LAN Emulation (LANE) that will let you run all of your applications without any change to your software. The LAN Switch Module for the 8260 switches token-ring frames between the LAN segments connected to the LAN switch and an ATM network. The UFC provides an industry-standard LAN Emulation Client (LEC) that is fully compliant with ATM Forum specifications. It also allows LAN traffic to be switched between LAN workstations or segments attached to a LAN switch and other devices with compatible ATM LANE applications.

The ATM UFC provides one ATM interface that complies with UNI 3.0 and 3.1 ATM Forum specifications. It is designed with an SC connector for attachment over multimode fiber media.

4-Port Token-Ring UTP/STP UFC

These UFCs provide additional token-ring ports, increasing the maximum number of ports per switch. These ports can be configured similarly to the fixed token-ring ports. Each or all of these UFC ports can be configured (in combination with any of the fixed ports) to be used in multilink TokenPipe connections and to be included in virtual switches. These UFC ports will support address filters, BootP, TFTP and Telnet or SNMP sessions. The 4-port UFC provides four token-ring ports that support token-ring, twisted-pair (UTP/STP) media via RJ-45 connectors. You can configure any of these ports to provide either shared (half-duplex), 4 or 16 Mbps token-ring connections or dedicated (full-duplex), 32 Mbps connections.

2-port Token-Ring Fiber UFC

The 2-port token-ring fiber UFC provides two token-ring, multimode fiber connections via ST connectors. Similar in capability to the 8272's token-ring UTP/STP ports, each port on this UFC is a switch port that can be connected to one of the following LAN components:

- A shared token-ring segment via a fiber RI/RO port on a token-ring concentrator or hub that forms the segment. Token-ring segments with 8272s connected in this manner will utilize both the backup ring path as well as the main ring path. Consequently the redundant path is in use and not available for ring recovery.
- A token-ring fiber port on another 8272.

2.4.3 8270 Nways Token-Ring Switch

The IBM 8270 Nways Token-Ring Switch is a modular high-speed switch solution. It has the same features and functionality as the IBM 8272. The IBM 8270 Model 800 is a chassis with one power supply and the token-ring processor card and 8270 Model 600 has one power supply and a built-in processor. The 8270 has no fixed ports and offers six (Model 600) or eight (Model 800) UFC slots.

With the 8270 you can build larger switched networks with a larger number of high-speed uplinks. To help ensure continuous operation, you may install an optional redundant power supply.

Versatility means you can configure the modular LAN switch for any of the following functions:

- Add between four and 31 ports to your network configuration, more ports per switch than any other model.
- Install uplink UFCs to connect native protocols to high-speed links such as ATM or the 8265 Nways Multiprotocol Switching Hub.

The following models are available:

- Model 600
 - six slots
 - Built-in processor
- Model 800
 - eight slots
 - Token-Ring Processor card
 - Redundant power supply (optional)

The UFCs include the following:

- Two-port token-ring/enhanced fiber
- Four-port token-ring/enhanced UTP/STP
- One-port ATM token-ring II MMF
- MSS client MMF
- MSS client SMF
- MSS domain client

2-Port Token-Ring/Enhanced Fiber

Provides two token-ring, multimode fiber connections via ST connectors. Each port is a switch port that can be connected to a shared token-ring segment via a fiber RI or RO port on a token-ring concentrator or hub that forms the segment, or connected to a token-ring fiber port on another switch.

4-Port Token-Ring/Enhanced UTP/STP

Provides four token-ring ports that support twisted-pair (UTP/STP) media via RJ-45 connectors. Any of these ports can be configured to provide either shared (half-duplex), 4 or 16 Mbps token-ring connections or dedicated (full-duplex), 32 Mbps connections.

These two UFCs, designed specifically for the 8270 for token-ring, provide the same functions and features as the four-port token-ring UTP/STP UFC and the two-port token-ring fiber UFC provided for the 8272.

1-Port ATM Token-Ring II MMF

With a fully ATM Forum-compliant SONET interface, the UFC can switch data to another server or to an industry-standard ATM backbone switch, such as an IBM 8265 Nways Multiprotocol Switching Hub. Supports ATM Forum-compliant LAN Emulation so you can run applications without any change to your software.

MSS Client MMF

MSS client provides layer-2 and layer-3 forwarding. Layer-2 forwarding is accomplished by hardware while layer-3 is done by software. So MSS client improves the utilization of the ATM backbone and reduces the MSS server load. MSS client MMF supports multimode fiber via SC connectors. UFCs for MMF and SMF each occupy two slots in an 8270. All other UFCs occupy one slot each.

MSS Client SMF

Provides single-mode fiber (SMF) via SC connectors. The function is the same as MSS client MMF.

MSS Domain Client

MSS domain client provides layer-2 and layer-3 forwarding. It has logical LAN interfaces, but it does not have a physical ATM interface. The main difference between the MSS domain client and the MSS Client is the lack of an ATM interface on the domain client. No cabling required.

Notes

- The MSS client and MSS domain client should be placed in a slot number lower than the token-ring UFCs.
- The MSS domain client has no ATM port, but it can coexist with ATM UFC.
- The combined number of MSS client UFCs, MSS domain client UFCs and ATM UFCs in a single switch must not be greater than two.

2.4.4 8273 Ethernet RouteSwitch

The IBM 8273 Nways Ethernet RouteSwitch is the most powerful, versatile LAN switch of its size. The IBM 8273 uses advanced hardware architecture to provide high-speed switching between a fixed number of Ethernet ports and two uplinks for high-speed server and backbone access. It supports very large numbers of hubs and segments throughout your network by connecting multiple 8273s together over FDDI, CDDI, 100Base-TX, 100Base-FX or ATM backbone links.

It provides powerful, transparent switching at wire speed with automatic any-to-any translation, internal IP and IPX routing, comprehensive LAN-to-ATM internetworking, LAN Emulation, multiprotocol encapsulation over ATM and Classical IP over ATM, as well as shared Ethernet networking over shared LANs, FDDI, ATM and WAN networks and RMON. Available in two models, this switch is an ideal midrange solution.

The following models are available:

- Model 10E
 - 12 Ethernet 10Base-T
 - two slots for uplink modules
- Model 10U
 - eight universal slots for any mix of Ethernet adapter boards

- two slots for uplink modules

The following uplink modules are available:

- To servers:
 - 100Base-TX
 - CDDI
 - 155 Mbps ATM (OC3)
- To backbones:
 - 100Base-FX
 - FDDI DAS
 - 155 Mbps ATM (OC3)
- To WANs:
 - Frame Relay WAN
 - WAN ATM (DS3 or E3)

The IBM 8273 Ethernet RouteSwitch provides powerful, inexpensive, transparent switching at wire speed with any-to-any translation including:

- Ethernet-to-Ethernet
- Ethernet-to-FDDI
- Ethernet-to-CDDI
- Ethernet-to-ATM
- Fast Ethernet-to-ATM
- Ethernet-to-Fast Ethernet
- Fast Ethernet-to-FDDI
- Ethernet-to-WAN Frame Relay

2.4.5 8274 Nways LAN RouteSwitch

The IBM 8274 switch has an intelligent hardware design that supports high data rates and a sophisticated feature set. The 8274 offers a unique, dual quality of providing powerful and complete LAN switching with ATM speed for the desktop and the backbone. It integrates a comprehensive, flexible, virtual LAN (VLAN) architecture.

There are four models available:

- IBM 8274 Model W33
- IBM 8274 Model W53
- IBM 8274 Model W93
- IBM 8274 Model GRS

Model highlights 8274-W33,W53,W93

- The 8274-Wx3 can be configured with one or two management processor Modules (MPM). The 3-slot 8274 supports one or two switching modules, the 5-slot 8274 supports up to three switching modules, and the 9-slot 8274

supports up to eight switching modules, according to the number of MPMs. The additional MPMs can be used for redundancy requirements.

- The 8274-Wx3 serves as a powerful platform for a broad range of switching module options that support Ethernet, Fast Ethernet, Gigabit Ethernet, token-ring, FDDI and ATM on twisted-pair, coaxial and optical fiber cabling at wire speed with automatic any-to-any translation.
- Most of the modules provide the capacity for 13.2 Gbps cell matrix for frame-to-cell and cell-to-cell switching with the ATM interfaces. Ethernet, token-ring and FDDI can all be switched within the same unit and can be switched directly to ATM interfaces.

Model highlights 8274-GRS

- The 8274-GRS can be configured with one or two new management processor modules (MPX). This 9-slot 8274 supports up to eight switching modules, according to the number of MPXs. The additional MPX can be used for redundancy requirements.
- The 8274-GRS supports Ethernet, Fast Ethernet, Gigabit Ethernet, token-ring and ATM.
- The MPX and associated switching modules all connect through the 22 Gbps switching fabric in the 8274-GRS chassis.

The 8274 includes a broad range of model types and switching modules, that make the 8274 uniquely versatile. All 8274 models provide:

- Policy-based VLANs
- IP and IPX routing
- FDDI trunking (Only 8374-Wx3)
- ATM private and switched virtual circuits
- ATM LAN Emulation
- Multiprotocol encapsulation over ATM
- Classical IP over ATM
- Graphical network management on a broad set of standard management platforms

Each model offers a management bus you can use to configure, diagnose and manage all system elements. They also contain architecture for taking full advantage of frame-to-frame and frame-to-cell switching, which means a high-speed pipeline bus that uses hardware-controlled switching to keep throughput high and latency low.

The 8274 also has dual, redundant, hot-swappable power supplies, redundant management processors, redundant cooling fans and a temperature alarm, that make it highly reliable. Its software and configuration are stored in nonvolatile flash memory.

The 8274 supports ASCII (DEC VT100) console management, software and configuration downloads over the network, a powerful protocol toolkit (FTP, SLIP, Telnet, Zmodem), port mirroring and RMON.

2.4.6 8277 Nways Ethernet RouteSwitch

IBM 8277 uses advanced hardware architecture to provide high-speed switching between a fixed number of Ethernet ports, and an uplink for high-speed server and backbone access. It supports a very large number of hubs and segments throughout your network by connecting multiple 8277s together over 100Base-TX, 100Base-FX or ATM backbone links.

Available in one model called the 524, this 8277 is ideal for small-to-mid-size solutions. The 8277-BPS (Backup Power Supply) provides backup power for the 8277-524 in the event of a failure of the primary power supply in the 8277.

The 8277-524 supports the 24 10/100 auto-sensing ports and one optional expansion slot. The following modules are available for it:

- 1-port ATM uplink
- 1-port ATM uplink with Redundant Ports
- 2-port 100Base-FX
- 2-port 100Base-TX

The 8277 provides:

- Policy-based VLANs
- IP and IPX routing
- ATM private and switched virtual circuits
- ATM LAN Emulation
- Multiprotocol Encapsulation over ATM
- Classical IP over ATM
- Next Hop Resolution Protocol (NHRP)
- Remote Network Monitoring (RMON)
- Graphical network management on a broad set of standard management platforms

2.4.7 8371 Multilayer Ethernet Switch

The 8371 is a flexible, high-performance and cost-effective product designed to meet the growing needs of Ethernet workgroups through its advanced nonblocking switch architecture, layer-3 switching capabilities, and IP routing capability.

There are three models available:

- Stand-alone IBM 8371 Model A16
- IBM 8371 10/100 Base-TX module for IBM 8265 (2-slot)
- IBM 8371 100 Base-FX module for IBM 8265 (2-slot)

Model highlights of the stand-alone A16

- It provides 16-port 10/100Base-TX auto-sensing.
- It supports two optional feature slots that can be filled with the following expansion cards:
 - 2-port 155 Mbps MMF expansion card

- 8-port 10/100Base-TX expansion card
- 8-port 100Base-FX MMF expansion card
- A maximum of one 2-port 155 Mbps ATM module can be used with each 8371-A16. The 2-port 155 Mbps ATM port can provide load-sharing and redundant links to the ATM network.

Model highlights of the 10/100 Base-TX and 100 Base-FX modules for IBM 8265

- They provide 16-port 10/100Base-TX auto-sensing or 16-port 100 Base-FX with 622 Mbps attachment to the 8265 backplane.
- They support one optional feature slot that can be filled with the following expansion cards:
 - 8-port 10/100Base-TX expansion card
 - 8-port 100Base-FX MMF expansion card

In conjunction with the MSS server in the ATM network, the 8371 provides local, wirespeed IP and IPX routing between Fast Ethernet ports on the same module and MPOA virtual one-hop routing over the ATM backbone network.

The 8371 provides:

- Self-learning IP routing
- MultiProtocol over ATM (MPOA) client for IP and IPX
- LAN Emulation client (LANE 1.0 and LANE 2.0)
- Protocol-based VLANs for IP, IPX and NetBIOS
- RMON

The 8371 supports ASCII (DEC VT100) console management, Web-based management, software and configuration downloads over the network.

2.5 Wide Area Switches

The wide area switches listed in this section are for documentation purposes. These devices are listed in this redbook because they are capable of attaching to an ATM network. No specific configurations will be included for these device types.

2.5.1 2230 Nways ATM Switch

The IBM 2230 Nways ATM Switch is a scalable switch designed for quality of service (QoS) and high performance (internal switch port speed of 640 Mbps) across all ATM operations. This switch supports a mixture of data, video and voice traffic, allowing you to efficiently share network resources.

The IBM 2230 Nways ATM switch provides:

- High-performance, multiservice, ATM switching
- A nonblocking, scalable switch fabric
- Speed of up to 640 Mbps for a total capacity of 2.5 or 5 Gbps

For more information on the IBM 2230 Nways ATM switch please refer to *IBM Nways 2219, 2225, 2230 WAN Switches: Services and Technology*, SG24-4777.

2.5.2 2220 Nways BroadBand Switch

The IBM 2220 Nways BroadBand Switch is a family of networking products. The 2220 is a fast-packet and ATM cell switch based on IBM's Networking BroadBand Services (NBBS) architecture. This architecture was designed specifically to meet the challenges of broadband, multiservice transport networks. The Nways Switch family brings the following advantages to broadband backbone transport networks: ease of network migration through support of existing and new equipment, existing and new wide area links, and a modular scalable hardware architecture and switch design; integration of applications with different quality-of-service (QOS) requirements (voice, video, data and image) into a consolidated network and guaranteeing the QOS while maximizing link utilization; bandwidth optimization through unique algorithms for reservation and traffic policing schemes; and continuous network availability through a distributed architecture, redundancy, and nondisruptive system operations features.

For more information on the IBM 2220 Nways switch please refer to *Installing and Implementing 2220 Networks*, SG24-2589.

2.5.3 2225 Nways MultiService Switch

The IBM 2225 Nways MultiService Switch is a flexible, cost-effective multiservice WAN platform based on ATM cell switching for interworking with frame relay, SMDS, and ISDN. The 2225 uses a full implementation of interworking standards to let different technologies at either end of a connection communicate seamlessly.

For more information on the IBM 2225 Nways Multiservice Switch, please refer to *IBM Nways 2219, 2225, 2230 WAN Switches: Services and Technology*, SG24-4777.

2.6 IBM 2210 Nways Multiprotocol Router

The IBM 2210 Nways Multiprotocol Router provides the practicality of a low-cost, entry node with the power and versatility of a full-function, multiprotocol bridge/router. The IBM 2210 provides cost-effective connectivity for small workgroups or remote offices requiring interoperability in any size network. By offering a choice of configuration options, these models can satisfy a wide range of connectivity requirements.

IBM 2210 Nways Multiprotocol Router provides:

- Full SNMP management
- APPN support
- Comprehensive DLSw support for SNA and NetBIOS
- Multiprotocol support (IP, IPX, AppleTalk, Banyan Vines, DECNet, OSI)
- Support for all major network types including frame relay, ISDN, leased line services, X.25, and V.25bis connections
- ATM workgroup connections to the WAN via the new 2210 25 Mbps ATM adapter

For more information on the 2210, please refer to *IBM 2210 Nways Multiprotocol Routing Network*, SG24-4446.

2.7 IBM 2216 Multiaccess Connector

For improved access to business-critical SNA and IP host applications, plus campus and LAN connections, the IBM 2216 is the box of choice, considering its connectivity options. Whether devices accessing the host are connected with leased lines, frame relay, ISDN, ATM, X.25, or LANs, the 2216 Multiaccess Connector Model 400 can connect you.

IBM 2216 Multiaccess Connector provides:

- Access to SNA and TCP/IP host applications from LANs, WANs, and ATM
- ATM
 - LAN Emulation
 - Classical IP - RFC 1577
 - IPX - RFC 1483
 - PVC and SVC
 - Interim Local Management Interface (ILMI)
- The IBM's Multiprotocol Access Services software, guaranteeing compatibility with 2210 and campus MSS solutions, and providing a rich set of additional multiprotocol functions
- Multiprotocol services software for 2210 and MSS compatibility
- Industry-leading price/performance for ESCON host application access
- APPN and IP routing from the channel to any other 2216 interface
- DLUR and BAN/BNN support in APPN to connect downstream SNA devices to VTAM SNA applications
- Full range of IP routing support including filtering and routing algorithms
- Data Link Switching (DLSw) to connect downstream SNA devices to VTAM SNA applications
- ESCON Channel Support

For more information on the 2216, please refer to *IBM Nways 2216 Multiaccess Connector Description and Configuration Scenarios - Volume 1*, SG24-4957.

2.8 ATM Workstation Adapters

This section examines the ATM adapters, IBM TURBOWAYS ATM adapters as well as the Interphase ATM adapters, used to build ATM networks compliant with FC LAN Emulation or Classical IP (RFC 1577) networks. For more information on these adapters go to <http://www.networking.ibm.com>.

The IBM family of TURBOWAYS ATM adapters consists of the following:

2.8.1 TURBOWAYS 25 Mbps ATM Adapter

The TURBOWAYS 25 ATM adapters are an affordable way to bring high-bandwidth ATM connectivity to the desktop, with adapters available for ISA, Micro Channel, Sbus, and PCI computers.

And by including Forum-compliant LAN Emulation and Classical IP with the adapters, they are cost-effective upgrades to your existing Ethernet or token-ring infrastructure, providing a 25 Mbps, full-duplex connection to the ATM network.

The adapters use low-cost, unshielded twisted-pair (UTP) cable, category 3, 4, or 5, or shielded twisted-pair (STP) cable for distances up to 100 meters (328 feet), also capitalizing on the wiring already installed.

It is available for the following bus platforms:

- ISA
- PCI
- Micro Channel
- SBus

The adapters support the following standards:

- ATM Forum UNI Specifications V3.0 and 3.1 for switched virtual circuits
- AAL-5 adaptation layer interface
- NDIS 2.01 network device interface specification (not for SBus)
- PVC support (SBus only)

2.8.2 TURBOWAYS 100 Mbps ATM Adapter

The TURBOWAYS 100 ATM adapter operates at a speed of 100 Mbps full-duplex over multimode fiber. This adapter, designed for use in RISC System/6000 or personal computers with Micro Channel architecture, offers high-performance throughput for applications that require high bandwidth.

The adapter uses an onboard i960 processor and a specialized ATM chip set to minimize access to the host processor and increase performance. The adapter supports up to 1024 virtual circuits.

This adapter is only available for Micro Channel bus platforms.

The adapters support the following standards:

- ATM Forum UNI Specification V3.0 for SVCs (including PVC)
- AAL-5 adaptation layer interface
- Open data link interface
- NetWare device driver specification (PS/2 only)

2.8.3 TURBOWAYS 155 Mbps ATM Adapter

The TURBOWAYS 155 ATM adapter is a high-performance adapter that provides dedicated bandwidth of 155 Mbps over multimode fiber or copper wiring, offering higher throughput than is available with current LAN technology. Through the use of an onboard processor and the specialized chip set, access to the host processor is minimized, resulting in increased performance for your ATM client or server. Also included is SNMP subagent support for TCP/IP network management compatibility.

The TURBOWAYS 155 adapter is available for Micro Channel and Sbus platforms, with the following cabling systems:

- Multimode fiber
- UTP5
- STP (Micro Channel only)

The adapters support the following standards:

- ATM Forum UNI Specification V3.0 AAL-5 adaptation layer interface
- Open data link interface
- NetWare device driver specification
- OC/3

2.8.4 Interphase Adapters

IBM is also offering complementary products by Interphase Corporation to round out its ATM adapter family. The Interphase adapters use either multimode fiber or UTP category 5 wiring. There are three adapters, available for PCI-bus, EISA-bus, and GIO-bus computers:

- 5515 PCI adapters
- 4915 GIO adapters
- 4815 EISA adapters

All three support ATM Forum-compliant LAN Emulation and Classical IP.

The PCI and EISA Interphase adapters support NetWare, Windows NT Version 3.5 (and higher), and the GIO adapter supports IRIX Version 5.3. All three adapters support symmetrical multiprocessors (SMPs), as well as the following standards:

- ATM Forum UNI Specification V3.0 and V3.1 for SVCs (including PVC)
- AAL-5 adaptation layer interface
- Open data link interface
- NetWare device driver specification
- OC/3

2.9 Adapters for Various Operating Systems

The following section shows which ATM adapters and drivers are available for the different operating systems.

2.9.1 OS/2

This table shows for which ATM adapters the OS/2 drivers are available. It also shows which protocols are enabled and the environment under which these protocols run:

Table 2. OS/2 2.11 or higher

ATM Adapter	Protocols Enabled	Environment
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP
TURBOWAYS 100 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 155 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP

2.9.2 Windows NT

This table shows for which ATM adapters the Windows NT drivers are available. It also shows which protocols are enabled and the environment under which these protocols run:

Table 3. Windows NT 3.5 or higher

ATM Adapter	Protocols Enabled	Environment
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP
TURBOWAYS 100 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP
TURBOWAYS 100 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation	IBM LAN Emulation FC LAN Emulation
TURBOWAYS 155 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation	IBM LAN Emulation FC LAN Emulation
Interphase 155 Mbps ATM 5515 PCI	NetBIOS SNA IPX TCP/IP	FC LAN Emulation Classical IP SMP
Interphase 155 Mbps ATM 4815 EISA	NetBIOS SNA IPX TCP/IP	FC LAN Emulation Classical IP SMP

2.9.3 Windows 95

This table shows for which ATM adapters the Windows 95 drivers are available. It also shows which protocols are enabled and the environment under which these protocols run:

Table 4. Windows 95

ATM Adapter	Protocols Enabled	Environment
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP

2.9.4 DOS/Windows V3.11

This table shows for which ATM adapters the DOS and Windows drivers are available. It also shows which protocols are enabled and the environment under which these protocols run:

Table 5. MS-DOS 6.2 or PC-DOS 6.3 or higher

ATM Adapter	Protocols Enabled	Environment
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP

Table 6. Windows V3.11

ATM Adapter	Protocols Enabled	Environment
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP

2.9.5 AIX

This table shows for which ATM adapters the AIX drivers are available. It also shows which protocols are enabled and the environment under which these protocols run:

Table 7. AIX 3.2.5, AIX 4.1.4 and AIX 4.2

ATM Adapter	Protocols Enabled	Environment
TURBOWAYS100 ATM MCA	TCP/IP	FC LAN Emulation (AIX 4.2.1 only) Classical IP
TURBOWAYS 155 ATM MCA	TCP/IP	FC LAN Emulation (AIX 4.2.1 only) Classical IP
Interphase 155 Mbps ATM 5515 PCI	TCP/IP	FC LAN Emulation Classical IP

2.9.6 Novell NetWare

This table shows for which ATM adapters the NetWare drivers are available. It also shows which protocols are enabled and the environment under which these protocols run:

Table 8. NetWare

ATM Adapter	Protocols Enabled	Environment
TURBOWAYS100 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation	IBM LAN Emulation FC LAN Emulation
TURBOWAYS 155 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation	IBM LAN Emulation FC LAN Emulation
Interphase 155 Mbps ATM 5515 PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation	FC LAN Emulation SMP
Interphase 155 Mbps ATM 4815 EISA	NetBIOS SNA IPX TCP/IP through LAN Emulation	FC LAN Emulation SMP

2.9.7 OS/400

This table shows for which ATM adapters the OS/400 drivers are available. It also shows which protocols are enabled and the environment under which these protocols run. (To support the ATM adapter, the AS/400 needs communication controller such as AS/400 feature number 2809 or 2810)

Table 9. OS/400 4.2

ATM Adapter	Protocols Enabled	Environment
AS/400 Feature number #2811 (25 Mbps UTP-3 Adapter) #2812 (45 Mbps DS-3 Adapter) #2815 (155 Mbps UTP-5 Adapter) #2816 (155 Mbps MMF Adapter) #2818 (155 Mbps SMF Adapter) #2819 (34 Mbps E3 Adapter)	TCP/IP APPC/APPN	IBM LAN Emulation FC LAN Emulation

2.9.8 OS/390

S/390 delivers a multipurpose and integrated open systems network interface called OSA-2. In addition to Ethernet, token-ring and FDDI adapters, the S/390 Open Systems Adapter feature has two ATM adapters, multimode and single mode:

- FC 5204 is a one-port 155 Mbps MMF-ATM adapter
- FC 5205 is a one-port 155 Mbps SMF-ATM adapter

The number of OSA-2 ATM adapters that an individual S/390 can support varies depending on the model of S/390. Each adapter provides one physical port for a fiber connection to an ATM switch such as the IBM 8265. Each adapter provides up to two ATM Forum compliant user-to-network interfaces (UNIs), specification V3.0 or V3.1 for attachment to either token-ring or Ethernet emulated LANs. These two logical ports can be configured to be two Ethernet ELANs, two token-ring or one of each. Each interface is configured independently and can support TCP/IP and SNA/APPN protocols or both. For more technical details refer to *S/390 I/O Connectivity Handbook*, SG24-5444 or *OSA-2 Implementation Guide for OS/390*, SG24-4470.

Part 2. Pre-PNNI

Chapter 3. An Example of a Pre-PNNI ATM Environment

This section presents the network topology for both physical and logical definitions for a sample ATM network showing the ATM communication devices that will deliver the LAN Emulation and Classical IP services.

3.1 Physical Hardware Inventory

The following hardware inventory represents the communication devices used for our ATM network. (See Chapter 2, "Hardware Overview" on page 15 for a functional overview of the hardware.)

- 8210 Model 001 x (2)
 - 2 x 155 Mbps ATM ports (each box)
- 8260 Nways Multiprotocol Switching Hub
 - Model A17
 - 2 x 3-port 155 Mbps switch module
 - 4-port 100 Mbps switch module
 - ATM switch/control point module (CPSW)
 - Token-ring access module
 - DMM
- 8271 Nways Ethernet LAN Switch
 - Model 108
 - 8 x 10Base-T ports (copper)
 - 1 x 155 Mbps ATM port (SONET) UFC
- 8272 Nways Token-Ring LAN Switch
 - Model 108
 - Eight token-ring ports (copper)
 - 1 x 155 Mbps ATM port (SONET) UFC
- 8274 Nways LAN RouteSwitch
 - Model 513
 - 12 x 10Base-T ports (copper)
 - 1 x 155 Mbps ATM switching module (two ports)
- 8281 Nways ATM LAN Bridge
 - 1 x 100 Mbps ATM port (multimode fiber)
 - Two LAN ports (Ethernet/token-ring)
- 8285 Nways ATM Workgroup Switch
 - Base chassis
 - 12 x 25 Mbps ATM ports
 - 1 x 155 Mbps ATM port (multimode fiber)
- ATM adapters

- Turboways 25 Mbps
- Turboways 100 Mbps
- Turboways 155 Mbps

3.2 Physical Topology

A view of the physical network topology is shown in Figure 4. The view shows the core of the ATM network, which is comprised of two 8260s and an 8285. In addition to the ATM switches a number of edge and ATM devices are shown such as the 8272. The diagram also shows the IP addresses used in the configuration of the network.

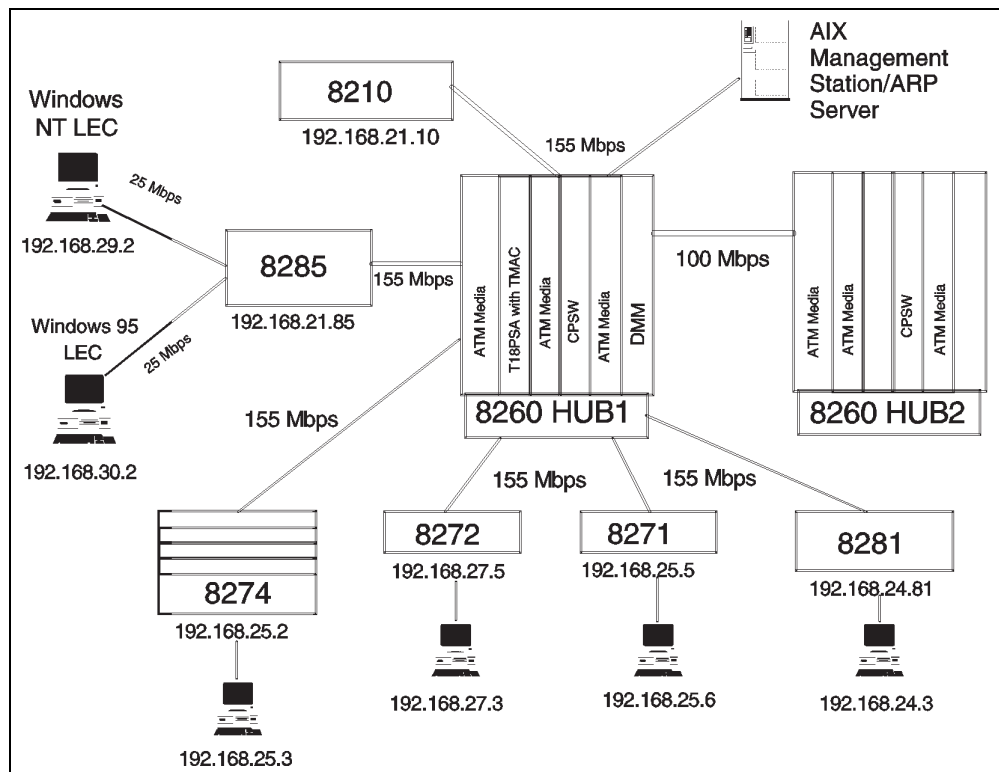


Figure 4. Physical Network Topology

The network will be built by first describing the steps necessary to interconnect the ATM switches followed by the ATM clients, bridges, and switches. ATM switch configuration examples of SSI and NNI connection will also be shown.

3.3 Logical Topology

A view of the logical network topology is shown in Figure 5 on page 53. This view shows the final network that will be created. It shows that four ATM ELANs will be created on the MSS along with a Logical IP Subnet (LIS). In addition, the figure shows the two ELANs that will be created on the 8285. Various clients and endstations will be configured to join these logical ELANs and LIS areas.

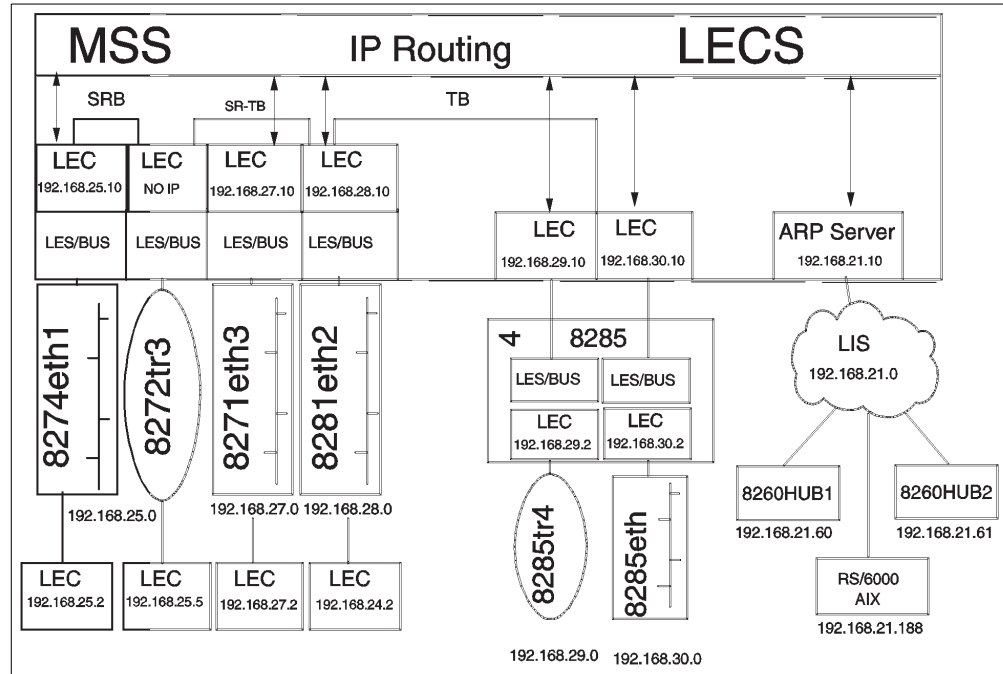


Figure 5. Logical Network Topology

The ATM services enabled in the environment are as follows:

- Classical IP has been shown by creating a LIS (Logical IP Subnet) that is routed via the MSS.
 - The LIS is used by CIP clients with 192.168.21.0 (class C mask) addresses.
 - Each CIP client will configure a default gateway of 192.168.21.10. The 192.168.21.10 addresses represent the virtual router arm of the MSS.
- An ARP server function has been provided for the LIS.
 - The MSS is providing the ARP server function for the 192.168.21.0 subnet.
 - The RS/6000 is providing an alternative ARP server function.
- IP routing is enabled for each LEC defined in the MSS.
 - Transparent bridging will allow the IP traffic across ELANs 8274eth1 and 8281eth3.
 - Traffic will be routed via the MSS to the appropriate destination (ELAN or LIS).
- Translational bridging will be configured for connecting ELANs 8281eth2 and 8285tr4 for non-IP traffic.

3.4 Configuring the ATM Backbone

The network diagram in Figure 4 on page 52, shows that the ATM backbone consists of two IBM 8260 ATM switches and one IBM 8285 Workgroup Switch. A Classical IP (CIP) server (an RS/6000) is attached via 100 Mbps to one of the switches. It provides ARP server function for the logical IP subnet (LIS). Every device is in the same LIS, 192.168.21.0.

Communication between ATM switches can be achieved via SSI, NNI or PNNI protocols. This chapter shows examples of SSI and NNI configurations. The management station communicates over a UNI connection to the 8260_HUB1.

Initially, the IBM 8260s, 8260_HUB1 and 8260_HUB2, are in the same cluster and connect via SSI. Next, the two 8260s are configured as two separate clusters using NNI communication. Then an IBM 8285 is added to one of the clusters and connected via SSI. At the end of this chapter, the IBM 8210 MSS is added to provide the ARP server function for this LIS.

3.5 Configuring IBM 8260s as ATM Backbone (SSI)

In this section, we create an ATM backbone consisting of two 8260s in one cluster connected via SSI. Figure 6 illustrates the physical network layout:

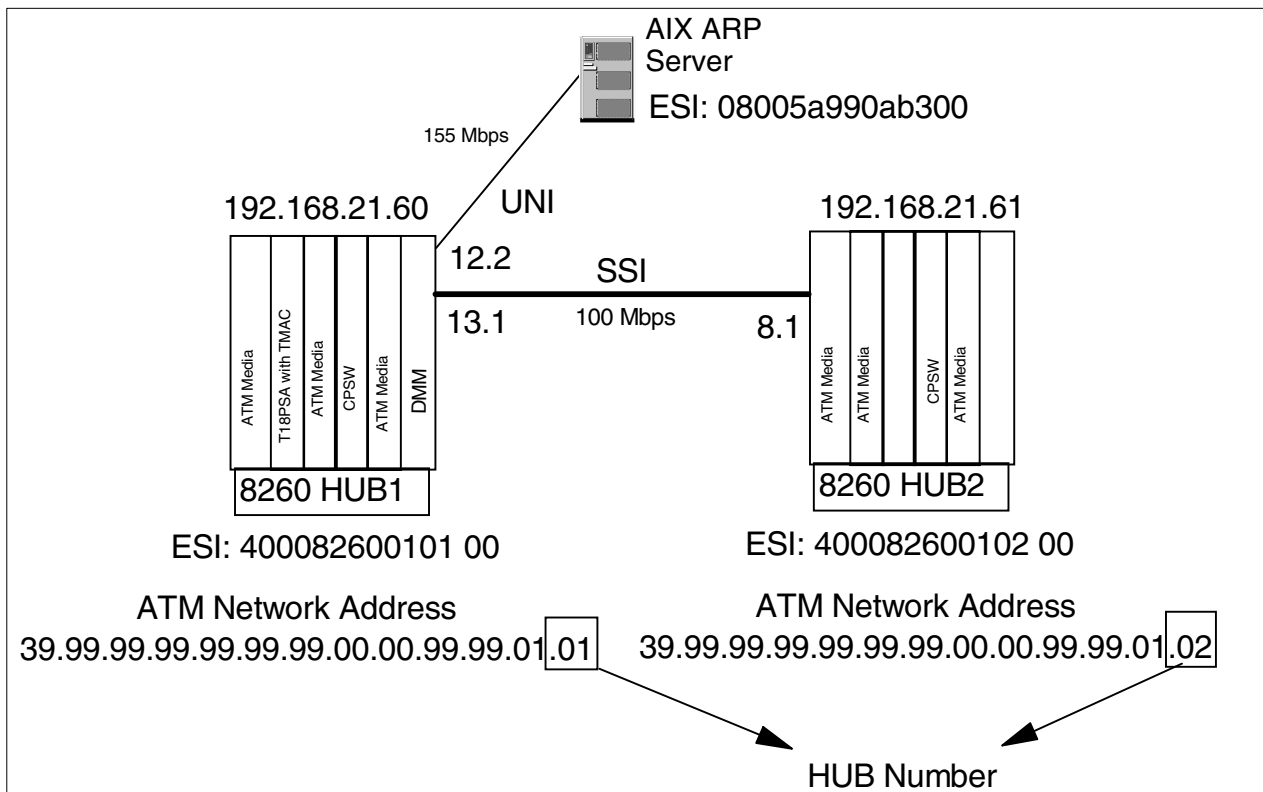


Figure 6. Physical View - ATM Backbone Using SSI

In an SSI configuration, the first 11 bytes of the ATM prefix must be the same for both switches. The 12th byte represents the ATM cluster number (ACN) and must be the same for each switch, because they are part of the same cluster. The 13th byte represents the hub number (HN) and must be unique within the cluster.

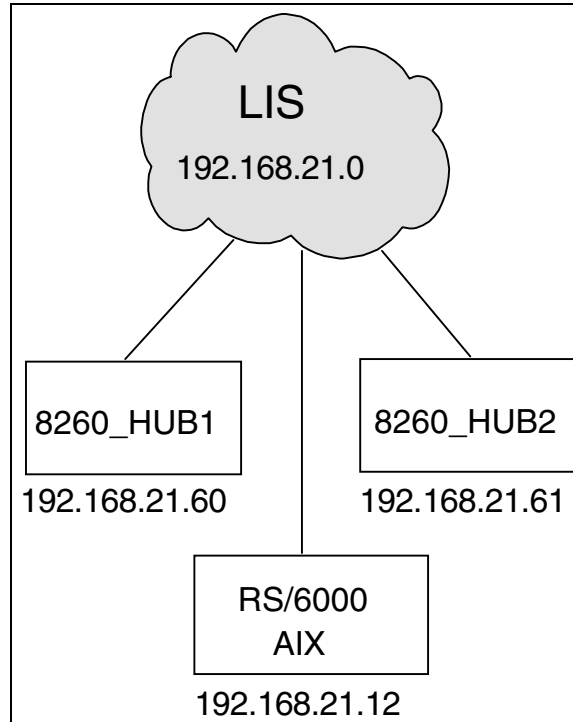


Figure 7. Logical View of the Classical IP Subnet

The 8260s are identified as `8260_HUB1` and `8260_HUB2`. The command prompts for each hub are modified to easily identify them. This is done by issuing the `set device name` command and then entering the device name.

3.5.1 Configuring IBM 8260_HUB1 for SSI Connection

The ATM network is created by configuring an ATM address for the 8260. The cluster number will be `01` and the hub number `01`. The command shown in Figure 8 is used to set the ATM address:

```

8260_HUB1> set device atm_address
Enter ATM address : 39.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.01.01.00

This call will reset the ATM subsystem.

Are you sure ? (Y/N) Y
  
```

Figure 8. Setting the ATM Address on HUB1

This command resets the ATM subsystem, so be sure that you have issued the `save all` command beforehand to save any changes.

To provide IP connectivity between the switches, the ARP server and the ATM IP addresses need to be configured. Figure 9 on page 56 shows how we configure the ARP server and the ATM IP address of the switch.

```

8260_HUB1> set device arp_server 1
Enter ATM address : 39.99.99.99.99.99.00.00.99.99.01.01.08.00.5a.99.0a.b3.00
ATM Address set

8260_HUB1> set device ip_address 2
Enter network: atm
Enter parameter : 192.168.21.60
Enter subnet mask: ff.ff.ff.00
IP address and mask set

```

Figure 9. Setting the ARP Server and IP Addresses on HUB1

Notes:

- 1 The 13-byte ATM prefix 39.99.99.99.99.99.00.00.99.99.01.01 matches this 8260's ATM 13-byte address. This is because the AIX device is connected to this ATM cluster and will acquire its ATM prefix from 8260_HUB1. The ESI and the Selector byte must be obtained from the ARP server configuration on the AIX machine before being able to configure this parameter.
- 2 IP address assigned to this ATM switch.

The ATM port that the ARP server is connected to is configured for UNI. Using the `set module` and `set port` command sets, as shown in Figure 10, the module is changed from `isolated` to `connected`, and the port is enabled for UNI. The ARP server is physically connected to the switch and the status changes to `UP-OKAY`

```

8260_HUB1> set module 12 connected
Module set
8260_HUB1> set port 12.2 enable uni
Port set
8260_HUB1> show port 12.2 verbose

```

Type	Mode	Status

12.02:	UNI enabled	UP-OKAY
Signalling Version	:	with IIMI
Flow Control	:	Off
Connector	:	MIC
Media	:	fiber
Port speed	:	100000 kbps
Remote device is active		
IX status	:	IX OK

Figure 10. Setting Port Parameters for UNI Connection on HUB1

To display the ATM ESI addresses of devices connected to the switch, we issue the command `show atm_esi` as shown in Figure 11 on page 57.

```

8260_HUB1> show atm_esi
Enter module: all
Port   ATM_ESI           Type
-----
12.02  08.00.5A.99.0A.B3 dynamic

```

Figure 11. Displaying the Connected ATM ESI Entries on HUB1

The ATM_ESI value of 08.00.5A.99.0A.B3 represents the management station connected to port 12.2. This value matches the ESI portion of the ARP server ATM address in Figure 9.

The 8260_HUB1 port 13.1 is connected to the 8260_HUB2 port 8.1. The command shown in Figure 12 is used to set port 13.1 for an SSI connection with a speed of 100 Mbps:

```

8260_HUB1> set module 13 connected
Module set

8260_HUB1> set port 13.1 enable ssi 100000
Port set

8260_HUB1> show port 13.1 verbose

      Type  Mode      Status
-----
13.01: SSI enabled  UP-NOT IN SERVICE

SSI Bandwidth      : 100000 kbps
Connector          : MIC
Media              : fiber
Port speed         : 100000 kbps
Remote device is active
IX status          : IX KO

```

Figure 12. Setting Port Parameters for SSI Connection on HUB1

Figure 12 shows the port is up, but not in service because the 8260_HUB2 port is not configured yet.

The configuration of 8260_HUB1 is now complete. The device information can be displayed by issuing the `show device` command as shown in Figure 13 on page 58.

```

8260_HUB1> show device
8260 ATM Control Point and Switch Module
Name : 8260_HUB1
Location :
For assistance contact :
Manufacture id: vime
Part Number: 58g9605 EC Level: c38846
Boot EEPROM version: v.1.2.0
Flash EEPROM version: v.2.0.4
Flash EEPROM backup version: v.2.0.4
Last Restart : 06:45:18 Mon 30 Sep 96 (Restart Count: 1)

A-CPSW
-----
ATM address: 39.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.01.01.00 1

> Subnet atm: Up
IP address: 192.168.21.60 2
Subnet mask: FF.FF.FF.00

Default Gateway :
-----
IP address: 0.0.0.0 3

ARP Server:
-----
ATM address: 39.99.99.99.99.99.00.00.99.99.01.01.08.00.5A.99.0A.B3.00 4

Diagnostics: ENABLED
8260_HUB1>

```

Figure 13. Displaying 8260_HUB1 Device Information

Notes:

- 1 Displays the ATM address of this ATM subsystem.
- 2 Displays the IP address and subnet for this ATM subsystem.
- 3 A default gateway is not defined because there is only one LIS at this time, thus no need for a default gateway at this point.
- 4 Displays the ATM address of the ARP server.

3.5.2 Configuring IBM 8260_HUB2 (SSI)

Next added is the 8260_HUB2. The ATM address is set by issuing the command `set device atm_address` as shown in Figure 14. The cluster number is set to 01, matching the cluster number value configured in 8260_HUB1. The hub number is set to 02, being unique within the cluster.

```

8260_HUB2> set device atm_address
Enter ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.60.01.02.00

This call will reset the ATM subsystem.
Are you sure ? (Y/N) Y

```

Figure 14. Setting the ATM Address on HUB2

To provide IP connectivity between the switches, the ARP server address and the ATM IP address are required. Figure 15 on page 59 shows how we configured the ARP server address and the ATM IP address:

```
8260_HUB2> set device arp_server 1
Enter ATM address : 39.99.99.99.99.99.00.00.99.99.01.01.08.00.5a.99.0a.b3.00
ATM Address set

8260_HUB2> set device ip_address 2
Enter network: atm
Enter parameter : 192.168.21.61
Enter subnet mask: ff.ff.ff.00

IP address and mask set
```

Figure 15. Setting the ARP Server and IP Address for HUB2

Notes:

- 1 The ARP server ATM address must be the same value configured in 8260_HUB1.
- 2 The IP address is unique within the logical IP subnet.

In Figure 16, port 8.1 is configured as an SSI connection at 100 Mbps. This port is used to connect to 8260_HUB1.

```
8260_HUB2> set module 8 connected
Module set

8260_HUB2> set port 8.1 enable ssi 100000
Port set

8260_HUB2> show port 8.1 verbose

      Type  Mode      Status
-----
8.01: SSI enabled UP-OKAY

SSI Bandwidth      : 100000 kbps
Connector          : MIC
Media              : fiber
Port speed         : 100000 kbps
Remote device is active
IX status          : IX OK
```

Figure 16. Setting the Port Parameters for SSI Connection on HUB2

The status of this port is UP-OKAY, because both ports, on the 8260_HUB1 and 8260_HUB2, are configured and enabled for a 100 Mbps SSI connection.

To verify connectivity from 8260_HUB2 across the ATM backbone to the 8260_HUB1 and the ARP server, a ping command is issued from the prompt.

```

8260_HUB2> ping 192.168.21.60 ❶
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.60: 1 packets sent, 1 received
Ping 192.168.21.60: 2 packets sent, 2 received

8260_HUB2>
8260_HUB2> ping 192.168.21.12 ❷
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.12: 1 packets sent, 1 received
Ping 192.168.21.12: 2 packets sent, 2 received

```

Figure 17. Verifying IP Connectivity

Notes:

- ❶ Test connectivity to 8260_HUB1.
- ❷ Test connectivity to the AIX management station (ARP server).

The `show device` command in Figure 18 is used to display the device information:

```

8260_HUB2> show device
8260 ATM Control Point and Switch Module
Name : 8260_HUB2
Location :
For assistance contact :

Manufacture id: VIME
Part Number: 58G9605 EC Level: C38846
Boot EEPROM version: v.1.2.0
Flash EEPROM version: v.2.0.4
Flash EEPROM backup version: v.2.0.4
Last Restart : 15:51:21 Tue 12 Aug 97 (Restart Count: 2)

A-CPSW
-----
ATM address: 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.60.01.02.00 ❶

> Subnet atm: Up
IP address: 192.168.21.61 ❷
Subnet mask: FF.FF.FF.00

Default Gateway :
-----
IP address: 0.0.0.0 ❸

ARP Server:
-----
ATM address: 39.99.99.99.99.99.00.00.99.99.01.01.08.00.5A.99.0A.B3.00 ❹

Diagnostics: ENABLED

```

Figure 18. Displaying Device Information on HUB2

Notes:

- ❶ Displays the ATM address of this ATM subsystem.
- ❷ Displays the IP address and subnet for this ATM subsystem.
- ❸ A default gateway is not defined because there is only one LIS at this time, thus no need for a default gateway at this point.

- 4 Displays the ATM address of the ARP server.

3.6 Configuring IBM 8260s as ATM Backbone (NNI Connection)

In 3.5, “Configuring IBM 8260s as ATM Backbone (SSI)” on page 54, a simple ATM backbone comprised of two 8260 ATM switches communicating via SSI protocol was illustrated.

Next we changed the SSI connection to an NNI connection. Each switch will be part of a separate cluster as identified by the ATM addresses shown in Figure 19. This figure represents the physical network topology.

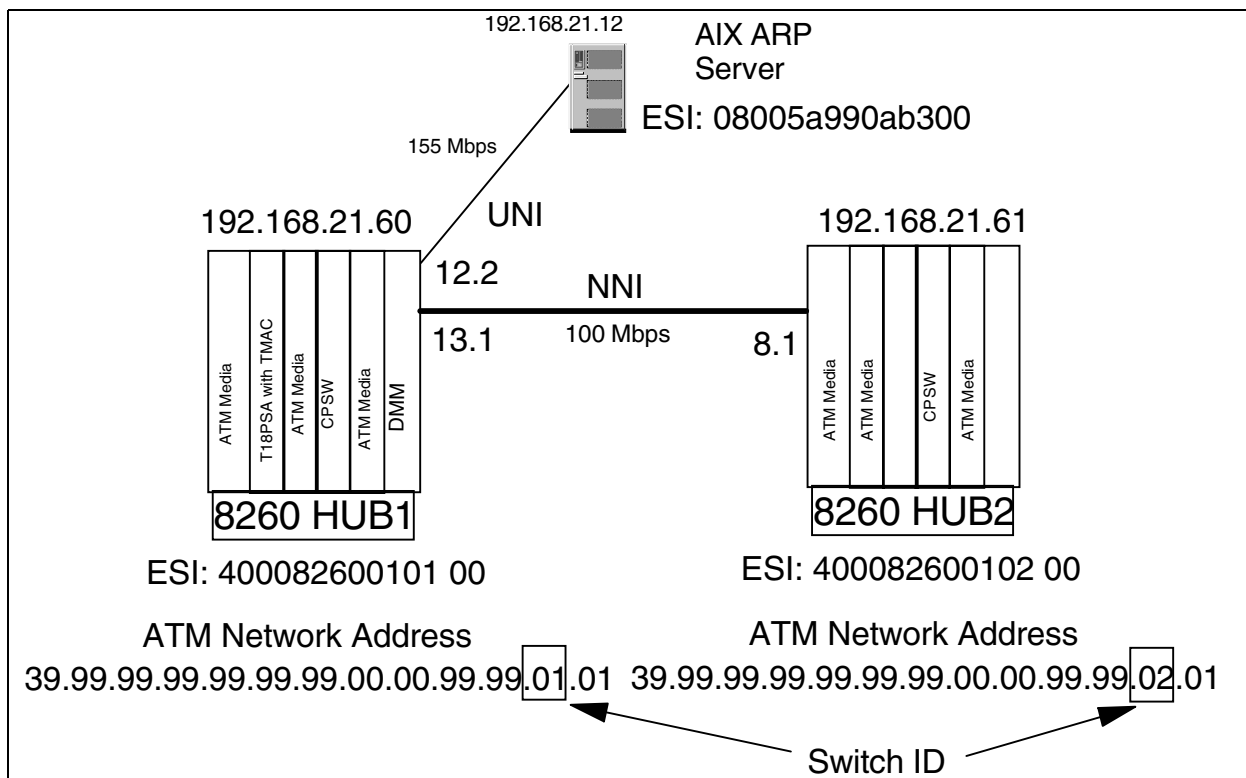


Figure 19. Physical View - ATM Backbone Using NNI

To configure a connection between the ATM switches, you must:

1. Configure the ATM ports that are providing the connection between the two clusters, as NNI ports.
2. Configure a *logical link* over the NNI connection for each ATM switch.
3. Configure the appropriate ATM addresses.

3.6.1 Configuring IBM 8260_HUB1 (NNI)

The following figures illustrate how to configure NNI on 8260_HUB1 port 13.1:

```
8260_HUB1> set port 13.1 disable 1
Port set

8260_HUB1> set port 13.1 enable nni 2
Port set
```

Figure 20. Configuring the Port for NNI on HUB1

Notes:

- 1 If the port to be configured for NNI is already configured as either UNI or SSI, then you must disable the port first. Otherwise the `set port 13.1 enable nni` command will be rejected.
- 2 Defines slot 13, port 1 as an NNI port.

To show the status of the port use the following command:

```
8260_HUB2> show port 13.1 verbose

Type  Mode      Status
-----
13.01: NNI enabled UP-OKEY 1

Connector      : MIC
Media           : fiber
Port speed     : 100000 kbps
Remote device is active
IX status      : IX OK
Logical links indexes: none. 2
```

Figure 21. Displaying the Port Configuration on HUB1

Notes:

- 1 NNI is enabled.
- 2 Indicates that no logical links have been configured.

The command in Figure 22 is used to configure a logical link connection. A logical link must be established at both switches.

```
8260_HUB1> set logical_link 13.1
Enter Virtual Path Identifier: 3 1
Enter ATM Cluster Network: 02 2
Enter parameter: network_side 3
Enter signalling type: 3.1 4
Enter traffic type: any 5
Enter bandwidth in kbps: 85 6
Logical link set
```

Figure 22. Creating the Logical Link on HUB1

Notes:

- 1 Virtual Path Identifier (VPI) is used to identify the logical link. The value is from 0-15, and 3 is selected. You must assign the same VPI at each end of the logical link. If you assign more than one logical link for a port, you must assign a different VPI for each logical link.

- 2 ATM Cluster Network (ACN) - When connecting two ATM clusters in the same subnetwork, this is the cluster number of the remote boundary ATM switch. In this case, 02 represents 8260_HUB2.
- 3 Role - This parameter defines the Q.2931 role that is assumed by the boundary ATM switching subsystems. *Network_side* means that the 8260 assigns ATM labels for this logical link; *user_side* means that the 8260 does not assign labels. Note that one side must always be configured as the *network_side* and the other side as the *user_side*. This 8260 is configured as *network_side*.
- 4 UNI version - This parameter defines the version of the UNI signaling protocol (3.0 or 3.1) used on this logical link. This parameter must match both ends of the link; 3.1 is configured.
- 5 Traffic type - This parameter allows you to define the type of connections supported by the NNI link using this logical link; *any* connection is selected.
- 6 Bandwidth - The maximum bandwidth (in kbps) available is 85% of the port speed, which is 85 for our 100 Mbps port.

In Figure 23 the logical links are displayed. It is important to understand that although the status appears as *UP*, it only represents this end of the link. The 8260_HUB2 switch has not been configured yet.

```
8260_HUB1> show logical_link
Port Vpi Acn Side Mode Sig Traf Bwidth Status Index
-----
13.01 3 02 netw enab 3.1 ANY 85000 UP 1
49 entries empty
```

Figure 23. Displaying the Logical Link on HUB1

3.6.2 Configuring IBM 8260_HUB2 (NNI)

To complete the topology, the 8260_HUB2 is configured for NNI as follows:

1. Configure the ATM address as a separate cluster (02).
2. Configure the port for NNI.
3. Create a logical link over the NNI connection.

A new cluster, 02, is created in the network by configuring the 8260_HUB2 ATM address, as shown in Figure 24.

```
8260_HUB2> set device atm_address
Enter ATM address : 39.99.99.99.99.99.00.00.99.99.02.01.40.00.82.60.02.01.00
This call will reset the ATM subsystem. 1
Are you sure ? (Y/N) Y
```

Figure 24. Configure the ATM Address on HUB2

Note:

- 1 The cluster number (12th byte) is set to 02, representing cluster 02. The hub number (13th byte) is 01.

```

8260_HUB2> set port 8.1 disable 1
Port set
8260_HUB2> set port 8.1 enable nni 2
Port set
8260_HUB2> show port 8.1 verbose

```

Type	Mode	Status

8.01:	NNI enabled	UP-OKEY

```

Connector          : MIC
Media              : fiber
Port speed         : 100000 kbps
Remote device is active
IX status          : IX OK
Logical links indexes: none.

```

Figure 25. Configuring the Port for NNI on HUB2

Notes:

- 1** If the port to be configured for NNI is already configured as either UNI or SSI, then you must disable the port first. Otherwise, the `set port 8.1 enable nni` command will be rejected.
- 2** Defines slot 8, port 1 as an NNI port.

The commands shown in Figure 26, are used to configure and show the logical link configuration:

```

8260_HUB2> set logical_link 8.1

Enter Virtual Path Identifier: 3 1
Enter ATM Cluster Network: 01 2
Enter parameter: user_side 3
Enter signalling type: 3.1 4
Enter traffic type: any 5
Enter bandwidth in kbps: 85000 5
Logical link set

8260_HUB2> show logical_link

```

Port	Vpi	Acn	Side	Mode	Sig	Traf	Bwidth	Status	Index

8.01	3	01	user	enab	3.1	ANY	85000	UP	1

```

49 entries empty

```

Figure 26. Creating the Logical Link on HUB2

Notes:

- 1** This value of 3 matches the VPI value configured on 8260_HUB1.
- 2** Enter the number of the adjoining cluster, in this case, 01.
- 3** Each end of the logical link must be different. 8260_HUB1 was set to `network_side`, so this end is set to `user_side`.
- 4** Signalling type must match the value configured for 8260_HUB1, 3.1.

- 5 These parameters allow you to define the type of connections supported by the NNI link using this logical link and the bandwidth allocation. We allow any connection and 85 Mbps.

To verify connectivity from 8260_HUB2 across the ATM NNI backbone to the 8260_HUB1 and the AIX management station, a ping command is issued from the command prompt:

```
8260_HUB2> ping 192.168.21.60 1
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.60: 1 packets sent, 1 received
Ping 192.168.21.60: 2 packets sent, 2 received

8260_HUB2> ping 192.168.21.12 2
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.12: 1 packets sent, 1 received
Ping 192.168.21.12: 2 packets sent, 2 received
```

Figure 27. Verifying IP Connectivity

Notes:

- 1** Test connectivity to 8260_HUB1.
- 2** Test connectivity to the AIX management station (ARP server).

3.7 Adding an IBM 8285 to the ATM Backbone

In this section, the IBM 8285 is added to the existing ATM backbone, consisting of two IBM 8260s in two different clusters. The 8285 is added to cluster 01 and connected via its 155 Mbps port to one of 8260_HUB1's 155 Mbps ports.

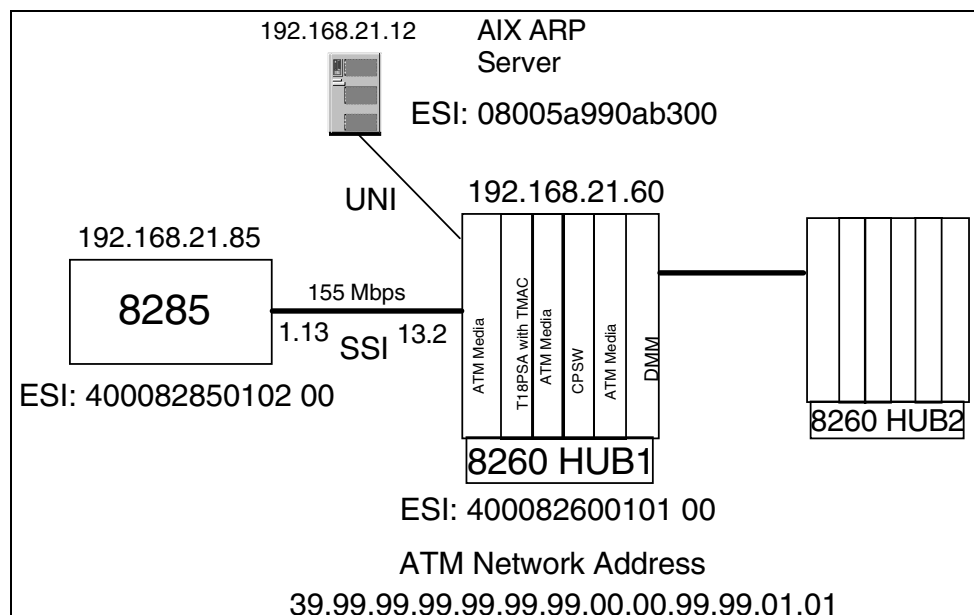


Figure 28. Physical View of the 8285 Connection

To configure the 8285 into cluster 01 an SSI connection will be used; therefore, the ATM network address portion will be the same as 8260HUB1 and the 8285 will be assigned an ESI of 400082850102 with a selector byte value of 00.

Figure 29 shows the logical representation for the 8285 connection using a Classical IP network along with the devices previously added:

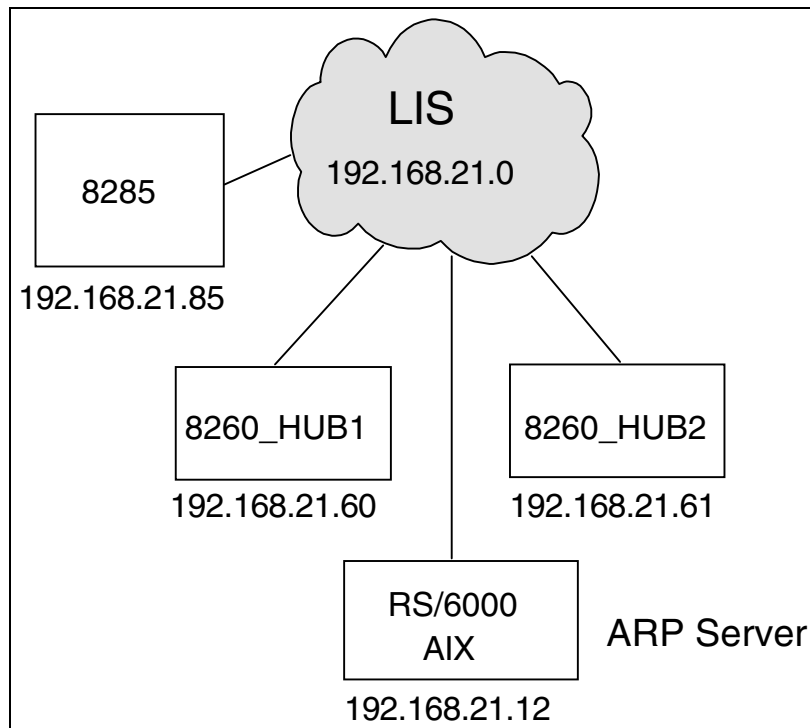


Figure 29. Logical View of the 8285 Classical IP Configuration

3.7.1 Connecting the 8285 to the 8260 via SSI

The 8285 is added to the existing ATM network cluster 01, by assigning an ATM address. The cluster number will be the same as for the 8260_HUB1, 01. The hub number must be unique within the cluster, and will be set to 02. The following figures illustrate the configuration of the 8285. The ATM address is set by issuing the command shown in Figure 30.

```

8285> set device atm_address
Enter ATM address : 39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00

This call will reset the ATM subsystem.
Are you sure ? (Y/N) Y
  
```

Figure 30. Setting the ATM Address on the 8285

To provide IP connectivity to the 8260s, the ARP server address and the ATM network IP address are configured. To set the ATM ARP server and ATM network IP address, we use the following commands:

```

8285> set device arp_server 1
Enter ATM address : 39.99.99.99.99.99.00.00.99.99.01.01.08.00.5a.99.0a.b3.00
ATM Address set

8285> set device ip_address 2
Enter network: atm
Enter parameter : 192.168.21.85
Enter subnet mask: ff.ff.ff.00
IP address and mask set

```

Figure 31. Setting the ARP Server and IP Addresses on the 8285

Notes:

- 1 The ARP server ATM address must be the same value configured in 8260_HUB1 and 8260_HUB2.
- 2 The IP address is unique within the logical IP subnet.

We configure port 1.13 for an SSI connection with 100 Mbps allocation as shown in Figure 32. This port is used to connect to the 8260_HUB1. The port on the 8260_HUB1 is already configured for a 100 Mbps SSI connection.

```

8285> set port 1.13 enable ssi 100000
Port set

8285> show port 1.13 verbose

      Type  Mode      Status
-----
1.13: SSI enabled UP-OKAY

SSI Bandwidth      : 100000 kbps
Connector          : MIC
Media              : fiber
Port speed         : 100000 kbps
Remote device is active
IX status          : IX OK

```

Figure 32. Setting Port Parameters for SSI Connection on the 8285

The status of this port is UP-OKAY, because both ports, on the 8260_HUB1 and 8285, are configured and enabled for a 100 Mbps SSI connection. The status of the port on the 8260_HUB1 is also UP-OKAY.

To verify connectivity from the 8285 across the ATM backbone to 8260_HUB1, 8260_HUB2 and the ARP server, a ping command is issued from the prompt.

```
8285> ping 192.168.21.60 ❶
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.60: 1 packets sent, 1 received
Ping 192.168.21.60: 2 packets sent, 2 received

8285> ping 192.168.21.61 ❷
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.60: 1 packets sent, 1 received
Ping 192.168.21.60: 2 packets sent, 2 received

8285> ping 192.168.21.12 ❸
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.12: 1 packets sent, 1 received
Ping 192.168.21.12: 2 packets sent, 2 received
```

Figure 33. Verifying IP Connectivity from the 8285

Notes:

- ❶ Test connectivity to 8260_HUB1 from 8285.
- ❷ Test connectivity to 8260_HUB2 from 8285.
- ❸ Test connectivity to the ARP server from 8285.

The command in Figure 34 on page 69 is used to display the 8285 device information.


```

8285> show device

8285 Nways ATM Workgroup Switch
Name : 8285
Location :

For assistance contact :

Manufacture id: VIM
Part Number: 51H4119 EC Level: E59245
Serial Number: 4343
Boot EEPROM version: v.1.3.0
Flash EEPROM version: v.1.3.0
Flash EEPROM backup version: v.1.3.0
Last Restart : 10:34:09 Mon 8 Sep 97 (Restart Count: 5)

A-8285
-----
ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00

> Subnet atm: Up
IP address: 192.168.21.85. Subnet mask: FF.FF.FF.00
*
*
*
Default Gateway : OK
-----
IP address: 0.0.0.0 1

ARP Server:
-----
ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.01.08.00.5a.99.0a.b3.00

Dynamic RAM size is 8 MB. Migration: off. Diagnostics: enabled.
8285>

```

Figure 34. Displaying Device Information on the 8285

Note:

1 A default gateway is not defined because there is only one LIS at this time.

3.8 Adding the IBM 8210 MSS to the ATM Backbone

The IBM 8210 is added to the backbone. In the first step, the 8210 will be configured to provide the ARP server function for the LIS, replacing the AIX management station. Later the MSS will be configured to provide LES/BUS, routing and bridging functionality for our ELANS. This section shows the MSS's base configuration, as well as configuring the MSS as an ARP server for the 192.168.21.0 LIS.

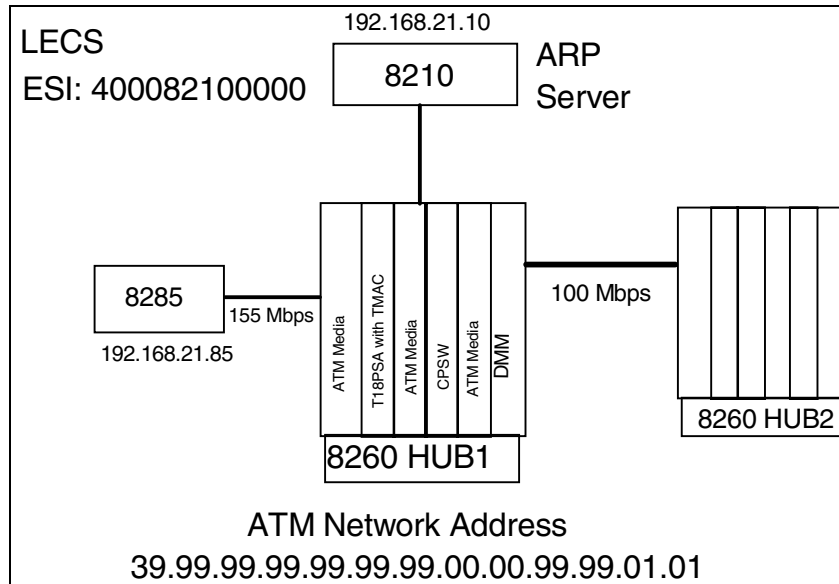


Figure 35. Physical View of the 8210 Connection

There are three ways to configure an MSS:

- Multiprotocol Switched Services Configuration Program

The MSS Configuration Program is used to create configurations for the MSS. It operates under Windows 3.1, Windows 95, Windows NT, OS/2 and AIX. It provides the following:

- Retrieves the active configuration from the MSS (not OS/2).
- Creates configurations without any connection to the MSS.
- Stores and organizes configurations in database files on hard disk.
- Creates ASCII or binary configuration files.
- Requires SNMP connectivity to send configurations to the MSS.

- Any Web browser

You can access the MSS configuration via a SLIP connection or in-band network connection using a Web browser.

- Any terminal program

You can access the MSS command line configuration via a serial connection using a terminal program.

The base and ARP server configuration is done via the command-line configuration using a terminal program. The active configuration is then downloaded from the MSS. Any further configuration will be done with the MSS Configuration Program.

3.8.1 MSS Base Configuration

Using a terminal program and command-line interface, the IP and SNMP parameters are configured. The settings for the terminal program are:

- 8, none, 1
- VT100 emulation

- 19200 bps

Starting with an unconfigured MSS, the following screens show the base configuration:

```
Config (only)>list device
Ifc 0   CHARM ATM                               Slot: 1  Port: 11
Config (only)>net 0 2
ATM user configuration
ATM Config>interface 2
ATM interface configuration
ATM Interface Config>add esi
ESI in 00.00.00.00.00.00 form []? 40.00.82.10.00.00 3
ATM Interface Config>list esi

      ESI          Enabled
-----
40.00.82.10.00.00  YES
ATM Interface Config>set uni
UNI version [3.0, 3.1, AUTO, NONE] []? auto 4
ATM Interface Config>list config

                        ATM Configuration

Interface (net) number =    0
Maximum VCC data rate Mbps =    155
Maximum frame size      = 9234
Maximum number of callers = 209
Maximum number of calls = 1024
Maximum number of parties to a multipoint call = 512
Maximum number of Selectors that can be configured = 200
UNI Version = AUTO
Packet trace = OFF
ATM Network ID =    0
ATM Interface Config>exit
ATM Config>exit
Config (only)>
```

Figure 36. Interface Configuration

Notes:

- 1** Before any configuration is done the `list device` command shows you which interfaces are installed.
- 2** To configure the ATM interface, `network 0` is entered and then `interface`.
- 3** This command is used to configure a user-defined ESI, here, 40.00.82.10.00.00.
- 4** The default for the UNI version is 3.0, and the interface is set to `AUTO`.

This is the base interface configuration. All other parameters can be left at their default values.

The IP configuration for the ATM interface is shown in Figure 37 on page 72.

```

Config (only)>protocol ip
Internet protocol user configuration
IP config>add address
Which net is this address for [0]? 0
New address [0.0.0.0]? 192.168.21.10
Address mask [255.255.255.0]?
IP config>list all
Interface addresses
IP addresses for each interface:
    intf 0   192.168.21.10   255.255.255.0   Local wire broadcast, fill 1

Routing

Protocols
BOOTP forwarding: disabled
IP Time-to-live: 0
Source Routing: enabled
Echo Reply: enabled
Directed broadcasts: enabled
ARP subnet routing: disabled
ARP network routing: disabled
Per-packet-multipath: disabled
OSPF: disabled
BGP: disabled
RIP: disabled

IP config>exit
Config (only)>

```

Figure 37. IP Configuration

An IP address is added for the ATM interface. For the ARP server, the IP address is 192.168.21.10.

To allow network management stations and the MSS Configuration Program access, the SNMP parameters must be configured. The SNMP configuration is shown in Figure 38 on page 73.

```

Config (only)>protocol snmp
SNMP user configuration
SNMP Config>add community 1
Community name []? public
Community added successfully
SNMP Config>set community access write_read_trap 2
Community name []? public
Access set successfully
SNMP Config>add address 3
Community name []? public
IP Address [0.0.0.0]? 192.168.21.12
IP Mask [255.255.255.255]? 255.255.255.255
Address added successfully
SNMP Config>enable trap all 4
Community name []? public
Trap(s) enabled successfully
SNMP Config>list all

SNMP is enabled
Trap UDP port: 162
SRAM write is enabled

```

Community Name	Access
public	Read, Write, Trap

Community Name	IP Address	IP Mask
public	192.168.21.12	255.255.255.255

Community Name	Enabled Traps
public	Cold Restart, Warm Restart, Link Down, Link Up, Authentication Failure, EGP Neighbor Loss, Enterprise Specific

Community Name	View
public	All

There are no views

```

SNMP Config>exit
Config (only)>

```

Figure 38. SNMP Configuration

Notes:

- 1 This is where you add your community name.
- 2 This is where you define the access to the community.
- 3 This is where you define the IP address and subnet mask.
- 4 This is where you enable the traps.

3.8.2 ARP Server Configuration

To provide IP connectivity CIP must be configured on the MSS. The MSS is also able to provide ARP server functionality. The ARP server is configured for the 192.168.21.0 IP subnet. Figure 39 shows the ARP server configuration.

```
Config (only)>protocol arp
ARP user configuration
ARP config>add atm-arp-client-configuration
Interface Number [0]?
Protocol [IP]?
Client IP Address [0.0.0.0]? 192.168.21.10
This client is also a server? [No]: y
Refresh timeout (in minutes) [20]?
Enable auto-refresh? [Yes]:
Refresh by InAtmArp? [Yes]:
  ( 1) Use burned in ESI
  ( 2) 400082100000
Select ESI [1]? 2
Use internally assigned selector? [Yes]: n
Selector Only, Range 00..FF [00]?
Validate PCR for best effort VCCs? [No]:
Maximum Reserved Bandwidth for incoming VCCs (Kbps) [0]?
Use Best Effort Service for Control VCCs? [Yes]:
Peak Cell Rate of outbound control VCCs (Kbps) [0]?
Sustained Cell Rate of outbound control VCCs (Kbps) [0]?
Use Best Effort Service for Data VCCs? [Yes]:
Peak Cell Rate of outbound Data VCCs (Kbps) [0]?
Sustained Cell Rate of outbound Data VCCs (Kbps) [0]?
Max SDU size (bytes) [9188]?
ARP config>list atm

ATM Arp Clients:
-----
If: 0 Prot: 0 Addr: 192.168.21.10 ESI: 40.00.82.10.00.00 Sel: 00
Server: yes Refresh T/O: 20 AutoRefr: yes By InArp: yes Validate PCR: no
Use Best Effort: yes/yes (Control/Data) Max B/W(kbps): 0
Cell Rate(kbps): Peak: 0/ 0 Sustained: 0/ 0
Max SDU(bytes): 9188
ARP config>exit
```

Figure 39. ARP Server Configuration

Most of the parameters are left at their default values; however, the ESI is changed from Use burned-in ESI to the ESI defined before, 400082100000, and the selector byte is set from internally assigned to the first available 00.

The base and ARP server configuration is complete. Reload the MSS to make this configuration the active configuration. The command to reload the MSS is shown in Figure 40.

```
Config (only)>reload
Are you sure you want to reload the gateway? (Yes or [No]): y
The configuration has been changed, save it? (Yes or [No]): y
Config Save: Using bank A and config number 2
```

Figure 40. Reloading the MSS with the New Configuration

3.8.3 Setting the ESI Using the MSS Configuration Program

After the MSS is reloaded and the configuration is active, the configuration is downloaded to the MSS Configuration Program on the AIX network management station.

To download the configuration from the MSS, select **Configure...Communications...Single Router** in the Navigation Window of the MSS Configuration Program. You will see the Communicate... screen.

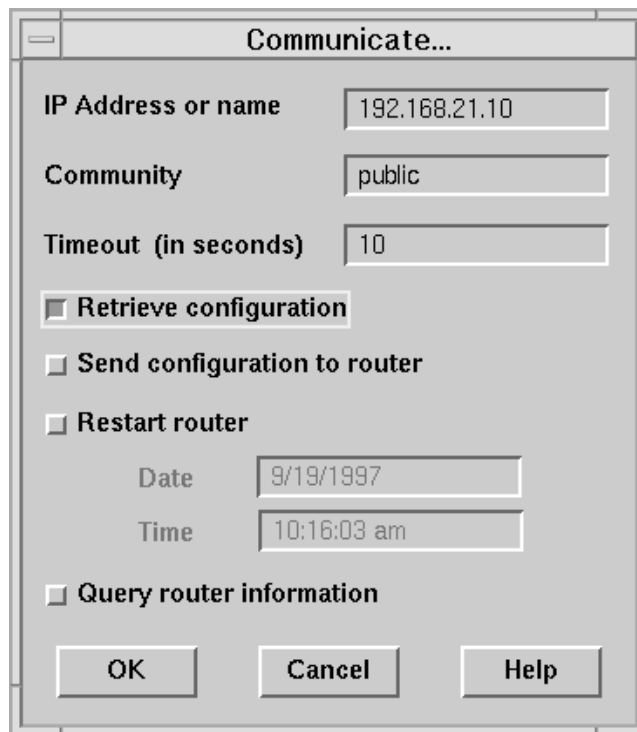


Figure 41. Retrieving the MSS Configuration

On this panel enter the **IP Address or name** of the MSS, here 192.168.21.10, and the **Community**, here public. Then select the **Retrieve configuration** button and select **OK**. The active configuration of the MSS will be downloaded.

Figure 42 on page 76 through Figure 49 on page 80 show the results of our initial configuration.

The Navigation Window shown in Figure 42 on page 76, allows selection of configuration parameters that can be viewed or modified.

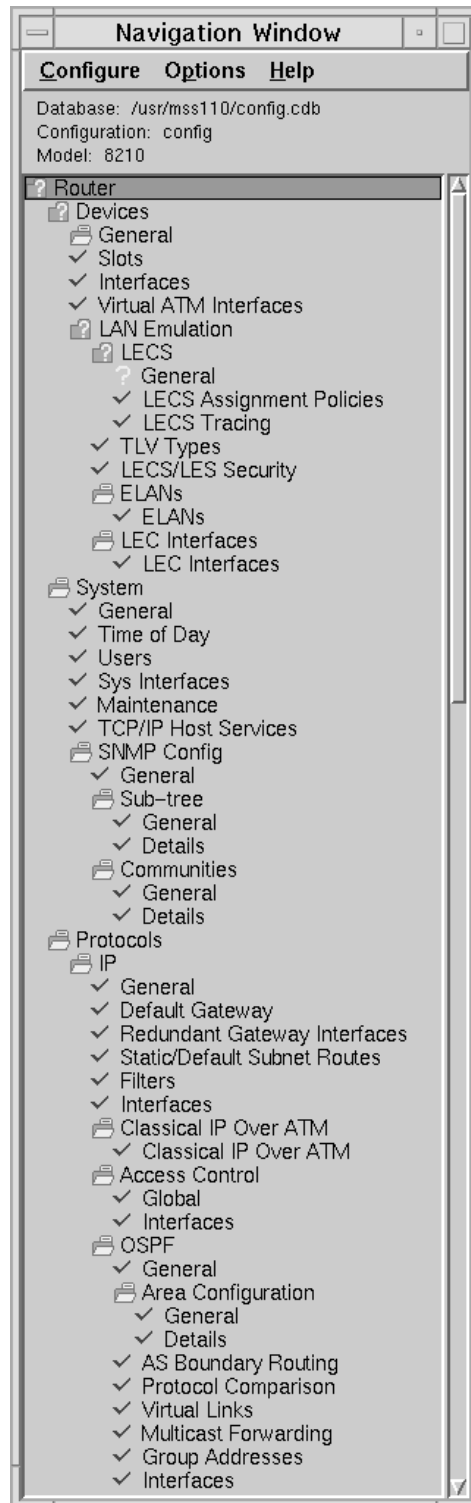


Figure 42. The Navigation Window of the MSS Configuration Program

The screen in Figure 43 on page 77 shows the adapters installed in the MSS. But it is also the first configuration you have to do, when you perform an out-of-band configuration, so the Configuration program knows how many and what adapters you have installed.

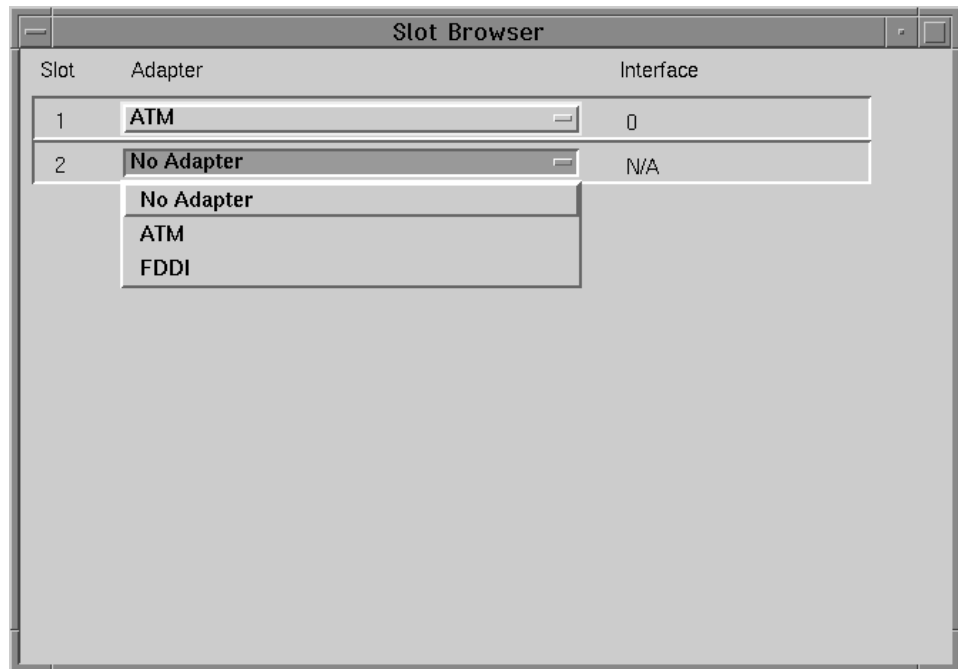


Figure 43. The Slot Browser Window

The following panels show the interface configuration of the ATM port. In Figure 44 you can see and configure the General parameters for each ATM interface. You can also enable or disable an installed interface.

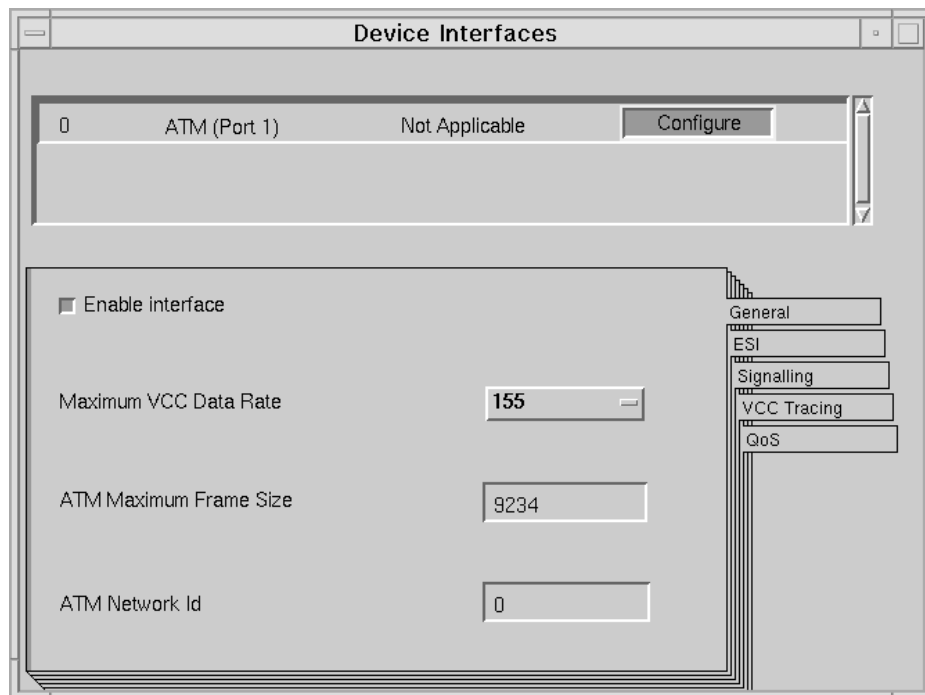


Figure 44. The Device Interfaces Window - General Parameters

The panel in Figure 45 on page 78 allows you to enable and configure Locally Administered ESIs.

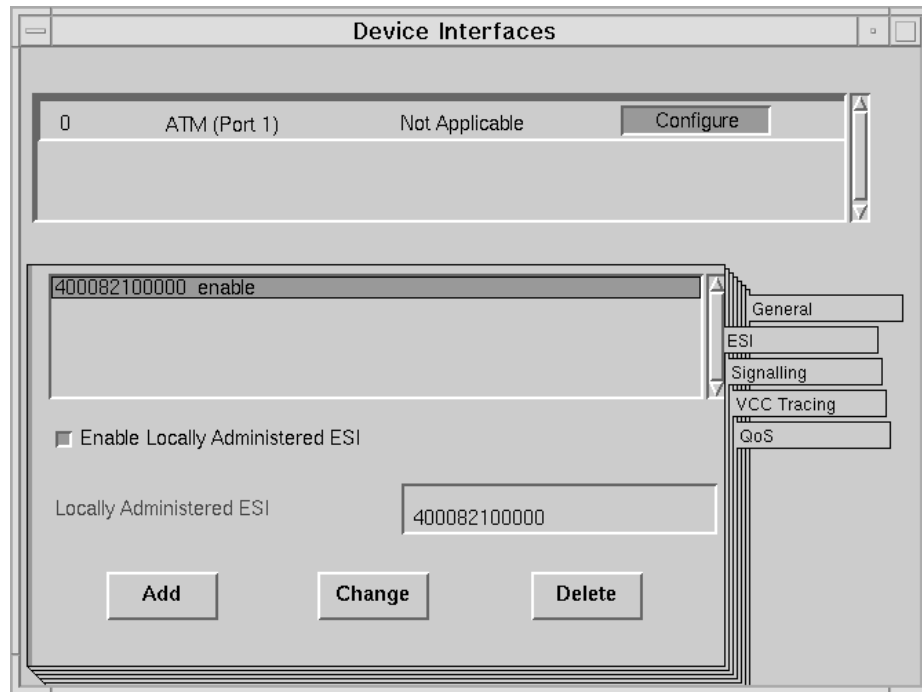


Figure 45. The Device Interfaces Window - ESI Parameters

To set the signaling protocol to the value you want, select the **Signalling** tab and the panel shown in Figure 46 appears:

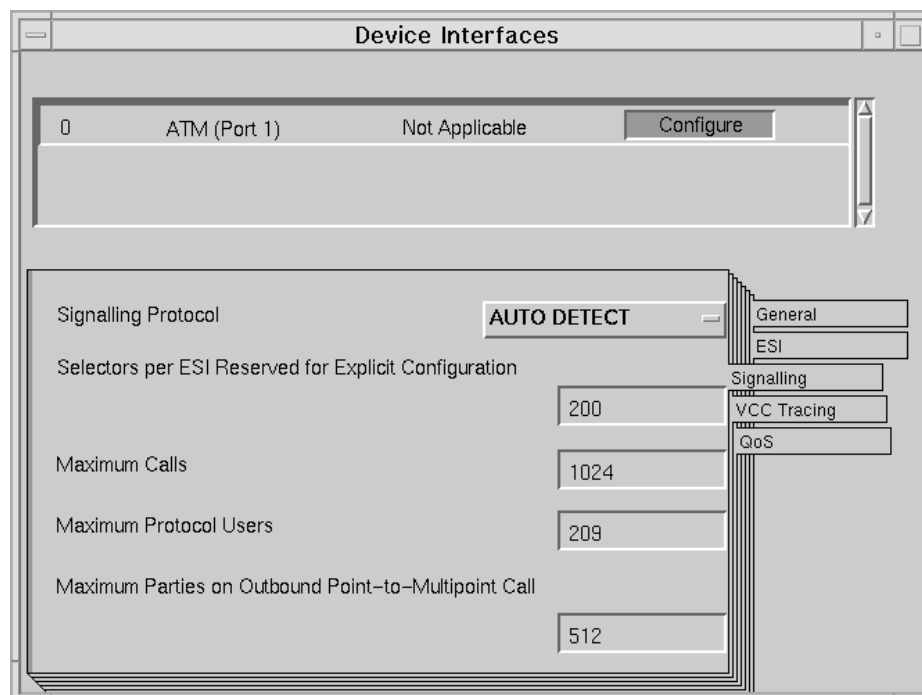


Figure 46. The Device Interfaces Window - Signaling Parameters

You can assign IP addresses to each interface. (See Figure 47 on page 79.)

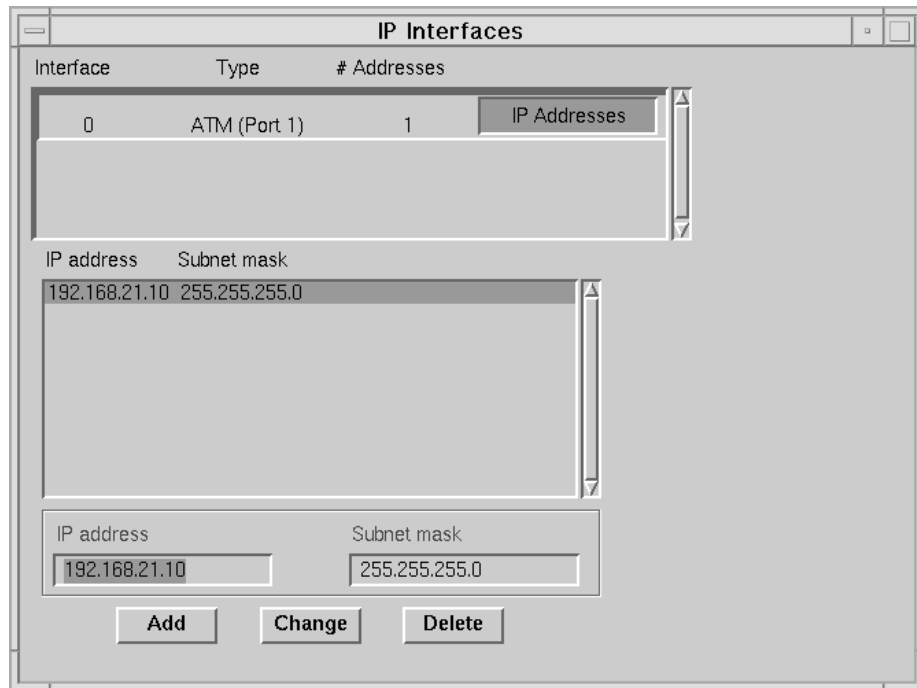


Figure 47. The IP Interfaces Window

To configure the MSS for CIP select **Classical IP over ATM** under Protocol in the Navigation Window. On the panel shown in Figure 48 you can set the ARP server address for the client you are creating or click the **Client is also an ARP Server** button.

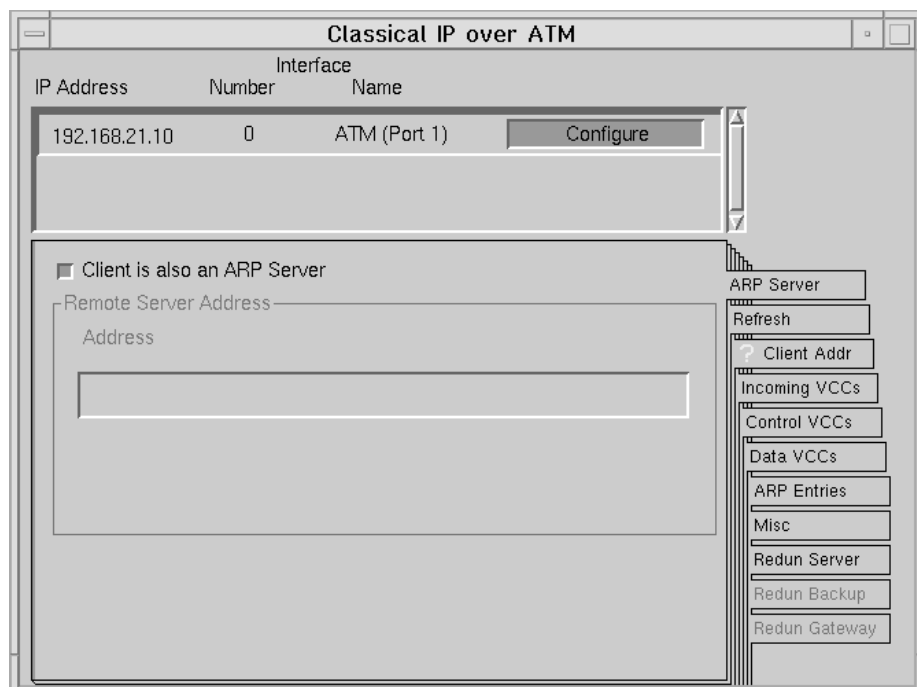


Figure 48. The CIP over ATM Window - ARP Server Address

To select the ESI and selector byte for the client/server, select the **Client Addr** tab as shown in Figure 49.

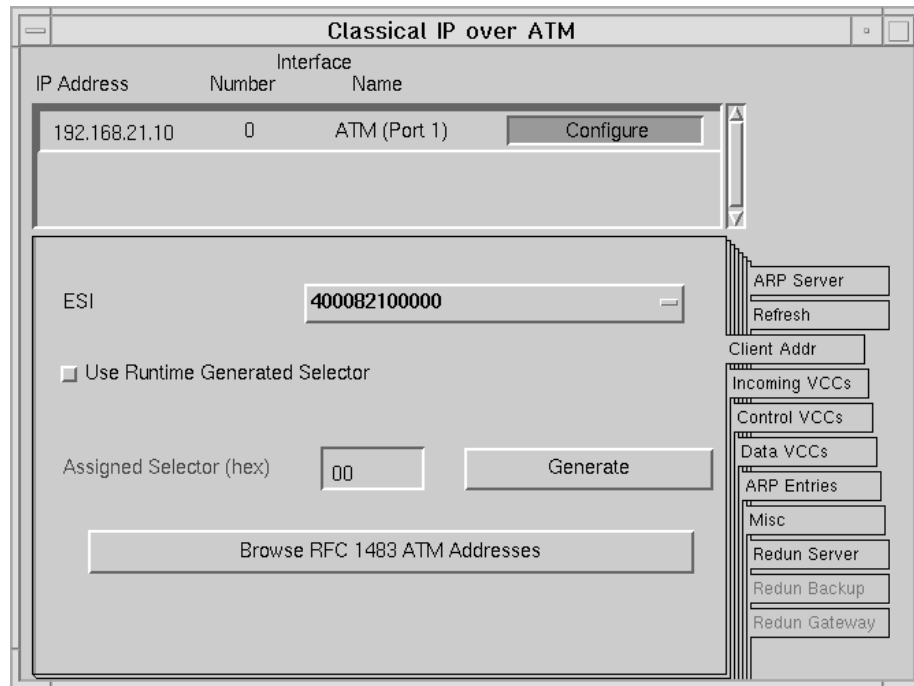


Figure 49. The CIP over ATM Window - Client Address Parameters

By completing the previous steps we have set the ATM ESI to a locally administered address. This will make the setup of future clients much easier by referencing a known address rather than having to remember a burned-in address.

Chapter 4. ATM Proxy Clients Configuration Examples

As shown in the network design documented in Figure 4 on page 52, Proxy LAN Emulation clients will be added to the ATM backbone. A proxy LEC is located in network devices like LAN switches and ATM LAN bridges to provide connectivity from legacy LANs to the emulated LAN or between legacy LANs over the ATM backbone.

This chapter will show how to add an 8274, 8281, 8272 and an 8271 to the ATM backbone, create an ELAN for each of the devices and connect these ELANs via routing and/or bridging. We create both token-ring and Ethernet ELANs and describe how to configure these ELANs on the MSS, with the MSS Configuration Program, and how to configure the LEC on each network device.

The next section will begin by creating a LECS instance on the MSS, followed by configuring the ATM switches to support the Well Known Address (WKA).

4.1 Configuring LECS Support

Any ATM LEC can be configured in one of four ways to locate its LES ATM address to join the appropriate ELAN:

1. Directly configure the LES ATM address.
2. Request from a LECS by hardcoding the LECS address.
3. Request from a LECS by using the WKA.
4. Utilize ILMI to acquire the LECS ATM address.

In the following configurations, the various options will be explored. For example, the 8274 is configured to use the ATM Forum-compliant Well Known Address of 4700790000000000000000000000A03E0, whereas the 8281 is configured directly with the ATM address of the LES. Each LEC will support one or more of these options. The method selected depends on which options are supported on a given machine.

4.1.1 Configuring the LECS Instance on the MSS

The LECS function is provided by the MSS. Once configured and enabled, the LECS of the MSS knows the ATM addresses of each LES/BUS function created on the MSS and the appropriate ELAN. You can define various policies for how to assign a LES address to a specific LEC. To configure and enable the LECS function on the MSS select **General** under **LAN Emulation...LECS** in the Navigation Window of the MSS Configuration Program.

Figure 50. Configuring the General LECS Parameters

Figure 50 shows the LECS General configuration window. Make sure the Create LECS Instance and Enable LECS buttons are marked. LECS ATM Device is the ATM device on which the LECS should be created. We have only installed one adapter, so 0 is selected. More options would be available if more devices were installed. Then you configure the LECS End System Identifier and Selector:

- LECS ESI

The options include, Use Burned-In Address or any locally administered ESI defined in the Interface Configuration; we entered a locally administered address of **400082100000**.

- LECS Selector (hex)

Create by clicking **Generate** to select the next available selector for this address; here 00 is assigned.

All other parameters can be left at their default values.

The next step is to create LECS assignment policies, which are used as criteria to assign a LEC to an ELAN and to the associated LES. We configure the assignment policy by selecting **LECS Assignment Policies** under **LAN Emulation...LECS** in the Navigation Window of the MSS Configuration Program.

Priority	Policy	Status
10	By ELAN Name	enable

☐ Enable Policy
 Policy Type: By ELAN Name
 Policy Priority: 10

Add Change Delete

Figure 51. Configuring LECS

Six assignment policies can be created with equal or different priorities. The assignment policies are:

- By ATM address
- By MAC address
- By Route descriptor
- By LAN type
- By Max. Frame Size
- By ELAN name

Each assignment policy has an associated priority. Lower numbers indicate higher priority. Policies with equal priority are considered at the same time and are ANDed together.

Select the Policy from the drop-down window and accept the default priority (10) or assign your own priority by typing it in the Priority field. The example shows By ELAN Name, which was selected using the default priority.

After this the LECS configuration is done. Upload the configuration file and reload the MSS.

4.1.2 Configuring the ATM Switches to Support Well Known Address

For the following configuration examples all ATM backbone switches, the 8260_HUB1, 8260_HUB2 and 8285 must be configured to translate the well known address to the ATM address of the LECS in the last step. Figure 52 shows

how to configure the LECS address to be substituted for the WKA on the 8260_HUB1.

```
8260_HUB1> set lan_emul configuration_server active_wka
Enter ATM address : 39.99.99.99.99.99.00.00.99.99.01.01.40.00.82.10.00.00.00
Entry set.

8260_HUB1> show lan_emul configuration_server
Index          ATM address
-----
1 WKA active 39.99.99.99.99.99.00.00.99.99.01.01.40.00.82.10.00.00.00
```

Figure 52. Setting LECS ATM Address

This configuration is the same for the 8260_HUB2 and 8285 and must be done for both of them, to provide WKA support for every device connected to any ATM backbone switch in our network.

4.2 Configuring ELANs on the IBM 8285

The IBM 8285 Control Point can provide ATM Forum-compliant LAN Emulation server (LES/BUS) and client (LEC) functions. To enable these functions on the 8285, it is necessary to configure and enable LAN Emulation.

It supports up to two LES/BUSes simultaneously with any combination of ELAN types. In addition, it supports both TR and ETH LECs simultaneously, but you cannot define two LECs with the same ELAN type.

The base configuration of the IBM 8285 has already been done in 3.7, “Adding an IBM 8285 to the ATM Backbone” on page 65. This section will only describe how to configure and start the LES/BUS and LEC functions on an IBM 8285.

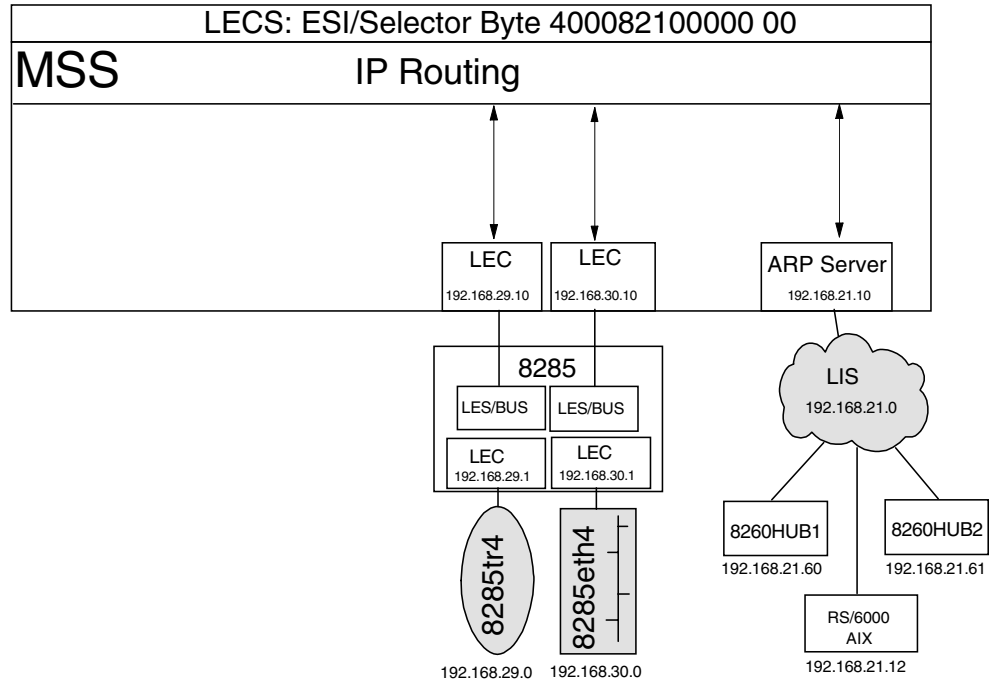


Figure 53. Logical ELAN Configuration for the 8285

One token-ring and one Ethernet ELAN will be created on the 8285, 8285tr4 and 8285eth4. Figure 54 on page 85 shows how to configure and start the LES/BUS function on the IBM 8285:

```
8285> set lan_emul server 1 start eth 64 1
Enter emulated LAN name: 8285eth4 2

Starting server. 3

8285> set lan_emul server 2 start tr 64 4544 4
Enter emulated LAN name: 8285tr4 5

Starting server. 6
```

Figure 54. Configuring and Starting a LES/BUS Function

- 1** This command is used to configure and start the LES/BUS. You can configure the following parameters:
 - Server ID
 - Specify the designated LES/BUS identifier to issue the command. The valid options are 1 or 2.
 - Start/Stop
 - Start or stop the designated LES/BUS. When the command is to stop the server, the following parameters are not needed.
 - ELAN type
 - Specify the ELAN type of the designated LES/BUS. The valid options are ETH (Ethernet LANE) or TR (token-ring LANE). When the ELAN type of the

LES/BUS is Ethernet, it always supports both Ethernet types, 802.3 and DIX/Ethernet V2; you cannot make it support only one type.

- Maximum number of clients
 - Specify the maximum number of LECs supported by the designated LES/BUS. The maximum number is 128 and is the sum of both LES/BUSes when two LES/BUSes are configured.
 - Maximum SDU size
 - Specify the maximum AAL-5 service data unit (SDU) size supported by the designated LES/BUS. The SDU is the information part of an AAL-5 protocol data unit (PDU). The possible values are 1516, 4544, 9234 and 18190 (default, 1516) regardless of the ELAN type.
 - Here we configured an Ethernet ELAN, so we started Server number 1 as an Ethernet (eth) LES/BUS with a maximum of 64 clients and default SDU size.
- 2 This ELAN name is 8285eth4.
 - 3 The integrated LES/BUS #1 is started.
 - 4 This command is used to configure and start the integrated LES/BUS. Here we configured a token-ring ELAN, so we started server number 2 as a token-ring (tr) LES/BUS with a maximum of 64 clients and 4544 as the maximum SDU size, the default for token-ring ELANs.
 - 5 This ELAN name is 8285tr4.
 - 6 The integrated LES/BUS #2 is started.

To provide an additional node management interface and to test if the LES/BUS is functional, we configure and start one integrated LEC for each ELAN. The following screen shows how to do this:

```
8285> set device lan_emulation_client eth no_lecs_with_les: 1
Enter address : 39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02
Some parameters are missing. Client state unchanged. 2
8285> set device lan_emulation_client eth ip_address: 3
ip_address: 192.168.30.1
subnet_mask: ff.ff.ff.00
Some parameters are missing. Client state unchanged.
8285> set device lan_emulation_client eth mac_address: 4
mac_address: 400082850001
Client starting. 5
8285> set device lan_emulation_client eth eth_type:DIX 6
Client starting. 7
```

Figure 55. Configuring and Starting a LEC on the 8285

The `set device lan_emulation_client` command has several parameters to configure the LEC. The main parameter is the ELAN type of the LEC, either token-ring (tr) or Ethernet (eth). You have to use this parameter every time to configure the right LEC. In the following, we refer to the command-line screen to explain the additional parameters.

- 1 You can either decide to configure the LEC to go directly to the LES/BUS (`no_lecs_with_les`) or obtain the LES/BUS address from a LECS (`no_les_with`

lecs). Then you have to type in the LES/BUS's or LECS's ATM address. Here we chose `no_lecs_with_les` and configured the ATM address of the integrated LES/BUS.

- 2 The LEC in the IBM 8285 doesn't start until you define the necessary parameters and this message is displayed. But the parameters you define are reflected.
- 3 To assign an IP address to this LEC we specify `ip_address` in the command line and enter the IP address and subnet mask when prompted, here `192.168.30.1` and `255.255.255.0`.
- 4 To specify a locally administered MAC address (LAA) for the LEC, specify `mac_address` in the command line to enter the LAA, here `400082850001`.
- 5 The LEC in the IBM 8285 starts automatically.
- 6 You may change the Ethernet type of the LEC in the IBM 8285 because the default is 802.3 and many devices use DIX as the default.
- 7 The integrated Ethernet LAN Emulation client is started.

The default gateway is not defined because the MSS is not configured to join the 8285 ELANs. But the LECs configured on the MSS will become the default gateways for the integrated LECs. You configure the default gateway for each LEC by issuing the `set device lan_emulation_client` command for the `tr` and `eth` LEC with the parameter `default_gateway` on the command line and then entering the default gateway IP address, here `192.168.29.10` (`tr`) and `192.168.30.10` (`eth`)

Figure 56 on page 88 shows the command used to check the status of the LES/BUS, the number of clients that joined, and the LECs.

```

8285> show lan_emul servers 1

----- LAN Emulation Server 1 -----
Status           : Running. 1
LAN type         : Ethernet.
Actual ELAN name  : "8285eth4".
Desired ELAN name : "8285eth4".
Actual max frame size : 1516.
Desired max frame size: 1516.
ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02
Max number of clients : 64.
Current number of operational clients : 1. 2
Local : 39.99.99.99.99.99.00.00.99.99.01.02
40.00.82.85.01.02.00 (port 0.0) OPERATIONAL NonProxy 3
8285>
8285> show lan_emul servers 2

----- LAN Emulation Server 2 -----
Status           : Running. 1
LAN type         : Token Ring.
Actual ELAN name  : "8285tr4".
Desired ELAN name : "8285tr4".
Actual max frame size : 4544.
Desired max frame size: 4544.
ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.03
Max number of clients : 64.
Current number of operational clients : 1. 2
Local : 39.99.99.99.99.99.00.00.99.99.01.02
40.00.82.85.01.02.01 (port 0.0) OPERATIONAL NonProxy 3
8285>

```

Figure 56. The Console Screen to Check the LANE Registration

This screen shows:

- 1 The integrated LES/BUS is running and operational.
- 2 The number of clients registered with the IBM 8285 integrated LES are shown on this line; here only the integrated LEC has registered.
- 3 The clients registered with the IBM 8285 integrated LES are shown on these lines. This information only appears when you specify either of the servers using the server ID.

```

8285> show device
* 1
*

> Subnet lan emulation Ethernet/802.3
Up 2
Name : "8285eth4"
MAC Address: 420082850001
IP address : 192.168.30.1. Subnet mask: FF.FF.FF.00
ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00
Config LES addr: 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02
Actual LES addr: 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02
BUS ATM address: 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02
Config LECS add: none
Actual LECS add: 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
LEC Identifier: 1. Maximum Transmission Unit: 1492
> Subnet lan emulation token ring
Up 2
Name : "8285tr4"
MAC Address: 400082850002
IP address : 192.168.29.1. Subnet mask: FF.FF.FF.00
ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.01
Config LES addr: 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.03
Actual LES addr: 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.03
BUS ATM address: 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.03
Config LECS add: none
Actual LECS add: 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
LEC Identifier: 2. Maximum Transmission Unit: 4490

* 1
8285>

```

Figure 57. The Console Screen to Check the LANE Registration

- 1 This command can be used to check the status of each LEC on the IBM 8285, especially if they are registered with an external LES.
- 2 The status of each integrated LEC is here. The rest of the screen shows the configuration of each LEC.

4.2.1 Connecting the MSS to the 8285 ELANs

To be able to route and/or bridge between the ELANs created on the 8285 in 4.2, “Configuring ELANs on the IBM 8285” on page 84, we must create and configure two LECs on the MSS that join the appropriate ELAN of the 8285, 8285tr4 or 8285eth4.

4.2.1.1 Creating a LEC for the 8285tr4 ELAN

To enable IP routing for an ELAN, even if it is not created on this MSS, you must first create a LEC for this ELAN and then assign an IP address to it. To create a LEC select **LEC Interfaces** under **Devices...LAN Emulation** in the Navigation Window of the MSS Configuration Program and this will bring up the LEC Interfaces window.

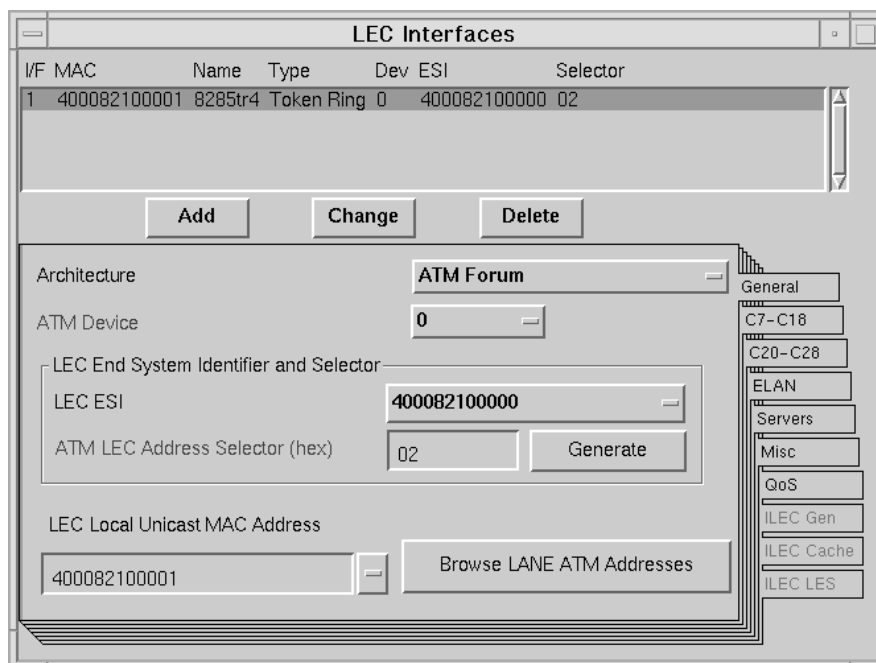


Figure 58. Configuring the LEC

By selecting **General** you can configure the following parameters:

- Architecture

Select either ATM Forum for FC LAN Emulation, or IBM for IBM LAN Emulation; **ATM Forum** is selected.
- ATM Device

This is the ATM device where the LEC will reside. Only one adapter is installed, so **0** is selected. If more than one ATM adapter is installed, there will be more options.
- LEC End System Identifier and Selector
 - LEC ESI

Selections include Use Burned-In Address or any locally administered ESI defined in the Interface Configuration, here **400082100000**.
 - ATM LEC Address Selector (hex)

Created by clicking **Generate** to select the next available Selector for this address, here **02**.
- LEC Local Unicast MAC Address

Used as a MAC address in the ELAN. If you want to enable bridging between ELANs this address has to be unique; **400082100001** is defined.

To assign the LEC to the correct ELAN, select **ELAN**. The following window is displayed.

I/F	MAC	Name	Type	Dev	ESI	Selector
1	400082100001	8285tr4	Token Ring	0	400082100000	02

ELAN Name:

ELAN Type:

Max Frame Size:

General
 C7-C18
 C20-C28
ELAN
 Servers
 Misc
 QoS
 ILEC Gen
 ILEC Cache
 ILEC LES

Figure 59. Assigning the LEC to an ELAN

In Figure 59 select the ELAN name that the LEC should join, either by typing the name in or selecting the correct ELAN from the drop-down window. This ELAN was not configured on the MSS, so enter the ELAN name. Also, configure the correct ELAN Type and Max Frame Size parameters for this ELAN by selecting them from the drop-down windows. **Token-Ring** and **4544** are selected.

In 4.1, “Configuring LECS Support” on page 81 four ways for a LEC to find its LES are described. For this LEC, the LES/BUS address is configured, because the LECS on the MSS is not aware of this ELAN. To configure this, select **Servers** and the following window is displayed.

I/F	MAC	Name	Type	Dev	ESI	Selector
1	400082100001	8285tr4	Token Ring	0	400082100000	02

☐ LECS AutoConfiguration

LECS ATM Address

LE Server ATM Address

39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.03

General
 C7-C18
 C20-C28
 ELAN
 Servers
 Misc
 QoS
 ILEC Gen
 ILEC Cache
 ILEC LES

Figure 60. Configuring LEC to Join LES Directly

To configure a LEC to join an ELAN directly, deselect the LECS AutoConfiguration button and type in the LE Server ATM Address, here:

39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.03.

All other parameters can be left at the default values, so just click **Add** to save this LEC entry.

The LEC that is created will join the ELAN created on the 8285. To enable IP routing for this ELAN, simply assign an IP address to this LEC. This is done by selecting **Interfaces** under Protocols...IP in the Navigation Window of the MSS Configuration Program. The IP interfaces window is displayed.

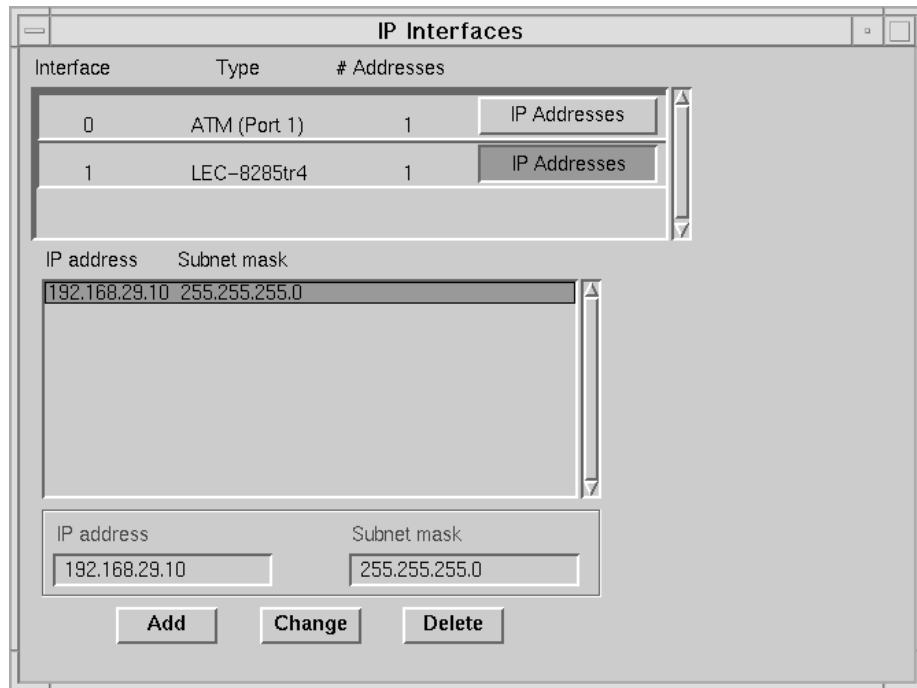


Figure 61. Assigning IP Address to LEC

At this window click **IP Addresses** next to the LEC interface you want to configure, then type in an IP address and a subnet mask for this LEC interface, here 192.168.29.10 and 255.255.255.0. By clicking **Add** the IP address is assigned.

4.2.1.2 Creating the LEC to Join the 8285eth4 ELAN

To enable IP routing for an ELAN, even if it is not created on this MSS, you must create a LEC for this ELAN and then assign an IP address to it. To create a LEC select **LEC interfaces** under **Devices...LAN Emulation** in the Navigation Window of the MSS Configuration Program and the LEC Interfaces window is displayed.

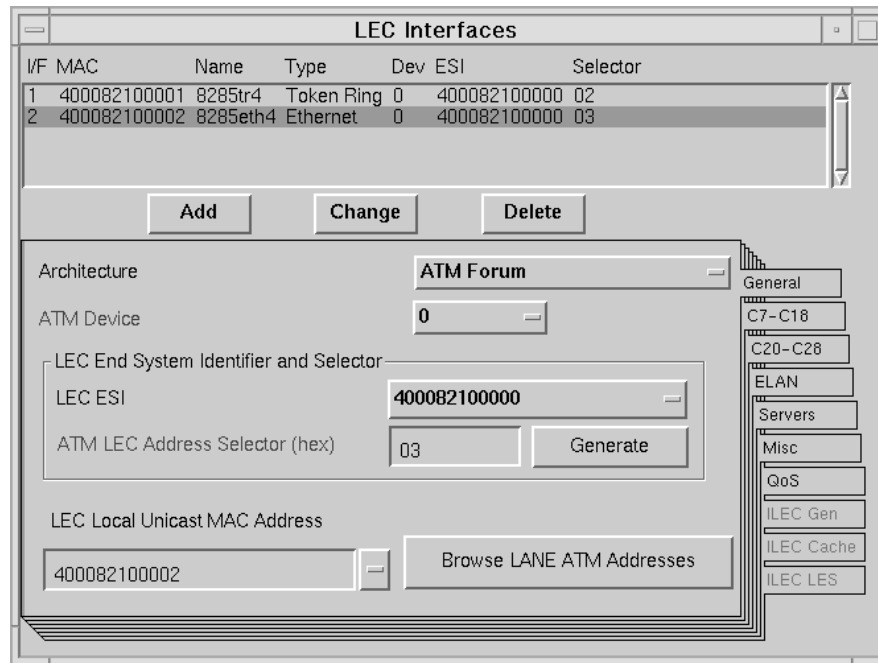


Figure 62. Configuring the LEC

By selecting **General** you can configure the following parameters:

- Architecture
 - We selected **ATM Forum**.
- ATM Device
 - We selected **0** because only one adapter is installed.
- LEC End System Identifier and Selector:
 - LEC ESI
 - A locally administered address, **400082100000**, was defined.
 - ATM LEC Address Selector (hex)
 - Create by clicking **Generate** to select the next available selector for this address, here **03**.
- LEC Local Unicast MAC Address
 - Used as a MAC address in the ELAN. If you want to enable bridging between ELANs this has to be unique, so **400082100002** was defined.

To assign the LEC to the correct ELAN, select **ELAN**. The following window is displayed.

I/F	MAC	Name	Type	Dev	ESI	Selector
1	400082100001	8285tr4	Token Ring	0	400082100000	02
2	400082100002	8285eth4	Ethernet	0	400082100000	03

Buttons: Add, Change, Delete

ELAN Name: 8285eth4

Create ELAN Assignment Policies

ELAN Type: Ethernet

Max Frame Size: 1516

Right Panel Tabs: General, C7-C18, C20-C28, ELAN, Servers, Misc, QoS, ILEC Gen, ILEC Cache, ILEC LES

Figure 63. Assigning the LEC to an ELAN

At this window you select the **ELAN name** that the LEC should join, either by typing the name in or selecting the correct ELAN from the drop-down window. This ELAN was not created on the MSS so you must type in the name of the ELAN and configure the correct **ELAN Type** and **Max Frame Size** parameters for this ELAN by selecting them from the drop-down windows, here **Ethernet** and **1516**.

In 4.1, “Configuring LECS Support” on page 81 we described four ways for a LEC to find its LES. For this LEC, we have to configure the LES/BUS address directly, because the LECS in the MSS does not know this ELAN. To configure this, select **Servers** and the following window is displayed.

I/F	MAC	Name	Type	Dev	ESI	Selector
1	400082100001	8285tr4	Token Ring	0	400082100000	02
2	400082100002	8285eth4	Ethernet	0	400082100000	03

☐ LECS AutoConfiguration

LECS ATM Address

LE Server ATM Address

39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02

General
 C7-C18
 C20-C28
 ELAN
 Servers
 Misc
 QoS
 ILEC Gen
 ILEC Cache
 ILEC LES

Figure 64. Configuring LEC to Join LES with WKA

To have the LEC join the ELAN directly, deselect the LECS AutoConfiguration button and type in the LE Server ATM Address, here:

39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02.

All other parameters can be left at default values, so just click **Add** to save this LEC entry.

Now we have created a LEC that will join the ELAN on the 8285. To enable IP routing for this ELAN we simply assign an IP address to this LEC. We do this by selecting **Interfaces** under Protocols...IP in the Navigation Window of the MSS Configuration Program. The IP interfaces window is displayed.

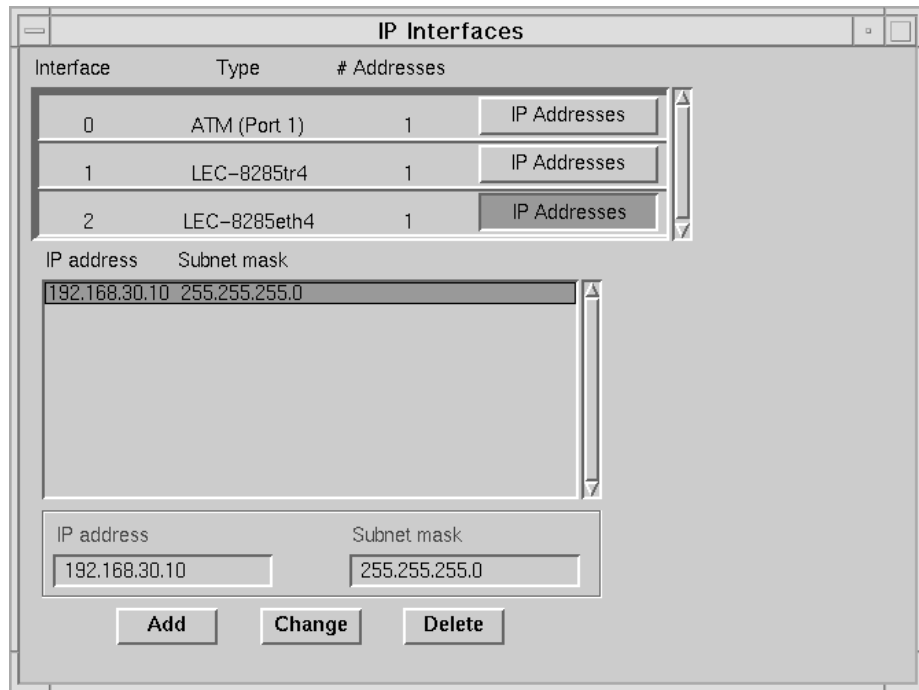


Figure 65. Assigning IP Address to LEC

On this screen just click **IP Addresses** next to the LEC interface you want to configure and type in an IP address and a subnet mask for the LEC interface, here 192.168.30.10 and 255.25.255.0. By clicking **Add** the IP address is assigned.

Now the configuration is done. Just upload the configuration file and reload the MSS.

4.3 Adding an IBM 8274

The IBM 8274 Model 513 is added to the ATM Backbone via a 155 Mbps ATM Switched Module (ASM) port, configured as an ATM uplink. First we will create an Ethernet ELAN, called 8274eth1, on the MSS. Then we'll create a LEC on the MSS with IP routing enabled. In our case, the IP address used is 192.168.25.10. Next a LEC on the 8274 ASM port will be configured to join the 8274eth1 ELAN. The LANE configuration on the 8274 will be configured to use the well known address to acquire the ATM address of the LECS. This LEC will also be in the 192.168.25.0 IP subnet.

Figure 66 on page 98 illustrates the physical topology, representing the existing network plus the new 8274 connection.

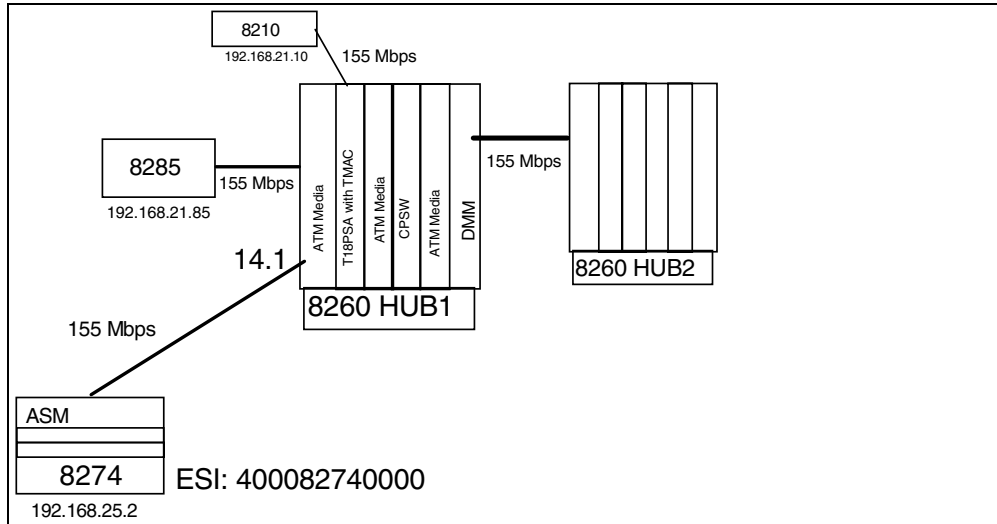


Figure 66. Physical View of 8274 Connection

The 8274 is connected to the 8260_HUB1 at 155 Mbps. A fiber cable connects the 8274 ASM port 4/1 to 8260_HUB1 port 14.1.

Figure 67 illustrates the logical topology of the ELAN, LEC on the MSS, and the LEC on the 8274. The IP addresses are also noted for reference:

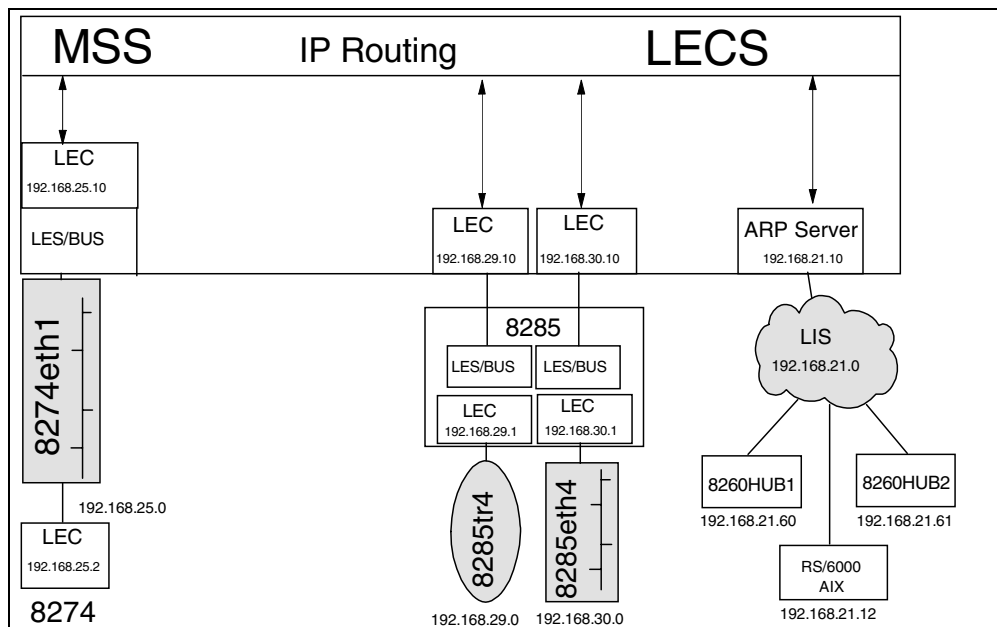


Figure 67. Logical View of 8274 Connection

4.3.1 Configuring the IBM 8210

To provide connectivity of the IBM 8274 to the ATM backbone, we will create the 8274eth1 ELAN, a LAN Emulation Server (LES) for this ELAN and a LAN Emulation Client (LEC) on the MSS to enable IP routing between ELANs and LISs.

4.3.1.1 Creating the 8274eth1 ELAN

We configured the ELAN and LES/BUS function by selecting **ELANs** under **Devices...LAN Emulation** in the Navigation Window of the MSS Configuration Program; the Emulated LANs Configuration window is displayed:

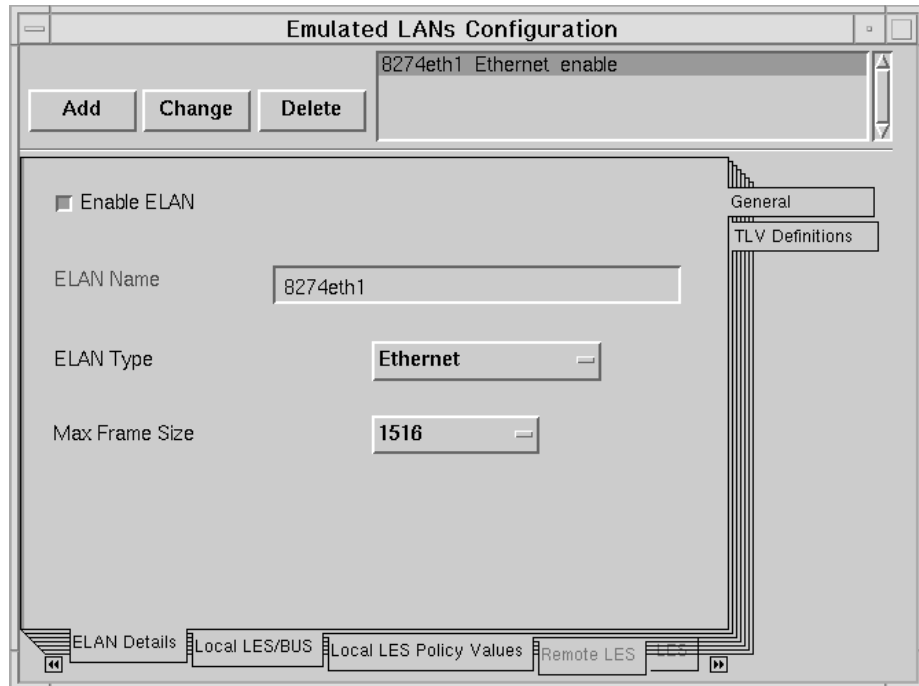


Figure 68. Configuring ELAN Name

To create the ELAN select **ELAN Details** and **General**. Ensure that the Enable ELAN box is marked. In the ELAN Name field fill in the name of the ELAN you want to create, here `8274eth1`. Select the ELAN Type. Here we selected **Ethernet**, and the Max Frame Size will automatically change to the default value for Ethernet, **1516**.

To create the LES/BUS functionality select **Local LES/BUS** and **General**.

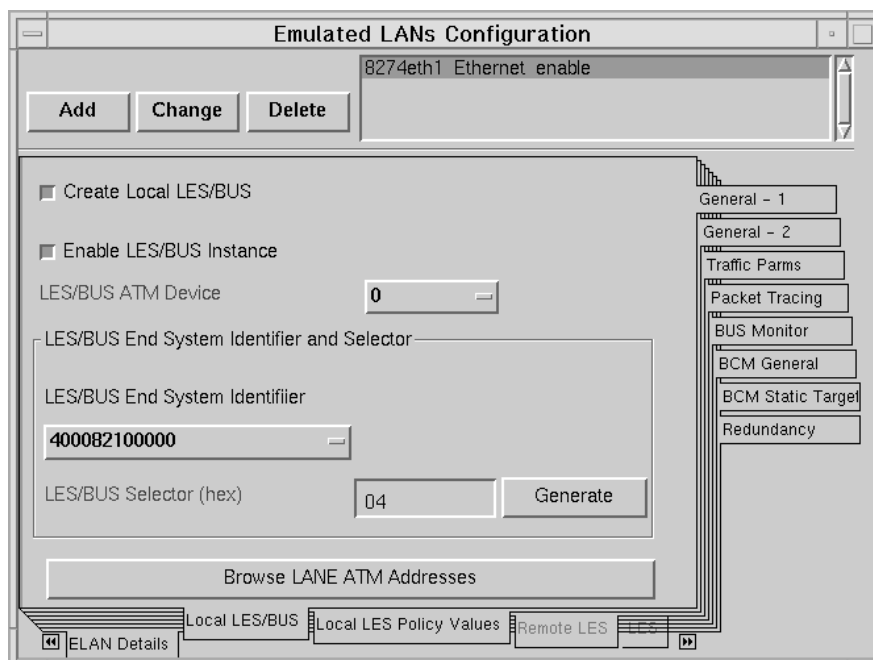


Figure 69. Configuring LES/BUS

At this window make sure **Create Local LES/BUS** and **Enable LES/BUS Instance** are marked. Select the LES/BUS ATM Device, on which the LES/BUS instance should be created. If you have two ATM devices installed you can choose between 0 and 1. Here we have only one ATM device installed so we selected **0**. In the LES/BUS End System Identifier and Selector section we configured the LES/BUS's ESI and Selector. In the LES/BUS End System Identifier pull-down menu you can choose between Use Burned-In Address and any locally administered ESI defined in the Interface Configuration. We selected a locally administered address of **400082100000**. To configure the LES/BUS Selector (hex) click **Generate** to select the next available selector for this address, here **04**.

All other parameters can be left at default values, so just click **Add** to save this ELAN entry.

Note

If you want to enable the BCM for this ELAN, you must first set the Fast BUS mode operation on the Local LES/BUS and General-2 menu to System.

4.3.1.2 Creating a LEC for the 8274eth1 ELAN

To enable IP routing for an ELAN you must first create a LEC for this ELAN and then assign an IP address to it. To create a LEC select **LEC interfaces** under Devices...LAN Emulation in the Navigation Window of the MSS Configuration Program and the LEC Interfaces window is displayed.

I/F	MAC	Name	Type	Dev	ESI	Selector
1	400082100001	8285tr4	Token Ring	0	400082100000	02
2	400082100002	8285eth4	Ethernet	0	400082100000	03
3	400082100003	8274eth1	Ethernet	0	400082100000	05

Add Change Delete

Architecture: ATM Forum
 ATM Device: 0
 LEC End System Identifier and Selector:
 LEC ESI: 400082100000
 ATM LEC Address Selector (hex): 05 Generate
 LEC Local Unicast MAC Address: 400082100003 Browse LANE ATM Addresses

General
 C7-C18
 C20-C28
 ELAN
 Servers
 Misc
 QoS
 ILEC Gen
 ILEC Cache
 ILEC LES

Figure 70. Configuring the LEC

By selecting **General** you can configure the following parameters:

- ATM Device

Here we can only select **0**.

- LEC End System Identifier and Selector:

- LEC ESI

We selected the locally administered address, **400082100000**.

- ATM LEC Address Selector (hex)

Created by clicking **Generate** to select the next available Selector for this address, here **05**.

- LEC Local Unicast MAC Address

Used as a MAC address in the ELAN. If you want to enable bridging between ELANs this has to be unique. Here the address, **400082100003**, is defined.

To assign the LEC to the correct ELAN, select **ELAN**. The following window is displayed.

I/F	MAC	Name	Type	Dev	ESI	Selector
1	400082100001	8285tr4	Token Ring	0	400082100000	02
2	400082100002	8285eth4	Ethernet	0	400082100000	03
3	400082100003	8274eth1	Ethernet	0	400082100000	05

Buttons: Add, Change, Delete

ELAN Name: 8274eth1

Create ELAN Assignment Policies

ELAN Type: Ethernet

Max Frame Size: 1516

Tabs: General, C7-C18, C20-C28, ELAN, Servers, Misc, QoS, ILEC Gen, ILEC Cache, ILEC LES

Figure 71. Assigning the LEC to an ELAN

On this screen you can enter the specific ELAN name that the LEC should join.

Note

When you assign the first LEC to an ELAN you must click **Create ELAN Assignment Policies** and select the ELAN name to create the initial assignment policy values.

For this LEC we chose to request the address from a LECS by using the WKA. To configure this, select **Servers** and the following window is displayed.

I/F	MAC	Name	Type	Dev	ESI	Selector
1	400082100001	8285tr4	Token Ring	0	400082100000	02
2	400082100002	8285eth4	Ethernet	0	400082100000	03
3	400082100003	8274eth1	Ethernet	0	400082100000	05

☐ LECS AutoConfiguration

LECS ATM Address

LE Server ATM Address

General
 C7-C18
 C20-C28
 ELAN
 Servers
 Misc
 QoS
 ILEC Gen
 ILEC Cache
 ILEC LES

Figure 72. Configuring LEC to Join LES with WKA

Click the **LECS AutoConfiguration** button.

All other parameters can be left at the default values, then click **Add** to save this LEC entry.

Now we have created an ELAN with LES/BUS and a LEC that will join this ELAN. To enable IP routing for this ELAN we now assign an IP address to this LEC.

This is done by selecting **Interfaces** under Protocols...IP in the Navigation Window of the MSS Configuration Program. The IP interfaces window is displayed.

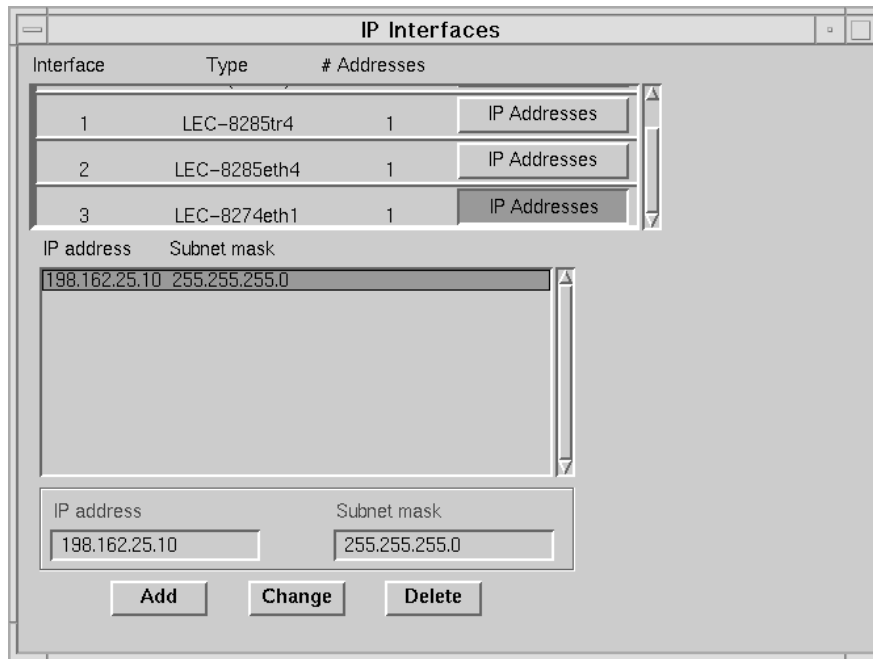


Figure 73. Assigning IP Address to LEC

At this window click **IP Addresses** next to the LEC interface you want to configure and type in an IP address and a subnet mask for the LEC interface, here 192.168.25.10 and 255.255.255.0. By clicking **Add** the IP address is assigned.

Now the configuration is done. Just upload the configuration file and reload the MSS.

4.3.2 Configuring the IBM 8274

Using a terminal program with the command-line interface, we log in to the 8274 with the default logon ID `admin` with the password `switch` as shown in Figure 74 on page 105. The settings for the terminal program are:

none, 1; VT100 emulation, 9600bps.

```

Welcome to the IBM Corporation LAN RouteSwitch! (Serial # 64999795)
login   : admin
password:

*****

IBM Corporation LAN RouteSwitch - Copycorrect (c) 1994, 1995, 1996
      System Name:      no_name
      Command      Main Menu
      -----
      File          Manage system files
      Summary       Display summary info for VLANs, bridge, interfaces, etc.
      VLAN          VLAN management
      Networking    Configure/view network parameters such as routing, etc.
      Interface     Enter the Physical Interface Configuration/Parameter Sub-menu
      Security      Configure system security parameters
      System        View/set system-specific parameters
      Services      View/set service parameters
      Switch        Enter Any to Any Switching Menu
      Help          Help on specific commands
      Exit/Logout   Log out of this session
      ?            Display the current menu contents

```

Figure 74. Logging In to the 8274 Switch

4.3.2.1 ATM Port Configuration

To create a LANE service, the physical port needs to be defined as an SVC type. The ATM port configuration can be viewed by typing `vap` at the command prompt as shown in Figure 75 on page 106.

```
8274/VLAN/Auto-Tracker >vap
```

ATM Port Table

Slot	Port	ATM Port Description	Conn Type	Tran Type	Media Type	UNI Typ	Max VCC	VCI bits
4	1	ATM PORT	PVC	STS3c	Multi	Pri	1023	10 1
4	2	ATM PORT	PVC	STS3c	Multi	Pri	1023	10

Slot Port Loopback Cfg Tx Clk Source

Slot	Port	Loopback	Cfg Tx Clk Source
4	1	NoLoop	LocalTiming
4	2	NoLoop	LocalTiming

Slot	Port	ATM Network Prefix	End System Identifier	Sig Ver	Sig VCI	IIMI Enable	IIMI VCI
4	1	N/A	N/A	N/A	N/A	N/A	N/A
4	2	N/A	N/A	N/A	N/A	N/A	N/A

Status

Slot	Port	Tx Seg Sz	Rx Seg Sz	Tx Buff Sz	Rx Buff Sz	Oper	SSCOP	IIMI
4	1	8192	8192	4600	4600	Enabled	Down	Down
4	2	8192	8192	4600	4600	Disabled	Down	Down

Figure 75. Viewing ATM Port Configuration

Note:

1 Displays the ATM port 4/1 as PVC.

The ATM port configuration is changed to SVC using the `map slot/port` command set as shown in Figure 77 on page 108.

```

8274/VLAN/Auto-Tracker >map 4/1

Slot 4 Port 1 Configuration

1) Description (30 chars max)                : ATM PORT
2) Conn Type { PVC(1), SVC(2) }               : PVC
3) Max VCCs (1-1023)                         : 1023
4) Max VCI bits (1..10)                      : 10
5) UNI Type { Pub(1), Priv(2) }               : Private
6) Tx Segment Size (4096-131072)              : 8192
7) Rx Segment Size (4096-131072)              : 8192
8) Tx Buffer Size (1800-8192)                  : 4600
9) Rx Buffer Size (1800-8192)                  : 4600
10) Pl Scramble { (False(1),True(2)) }         : True
11) Timing Mode { (Loop(1),Local(2)) }         : Local
12) Loopback Config { NoLoop(1), DiagLoop(2),
    LineLoop(3) }                             : NoLoop
13) Phy media { SONET(1),SDH(2)}               : SONET

Enter (option=value/save/cancel) : 2=2      1

Slot 4 Port 1 Configuration

1) Description (30 chars max)                : ATM PORT
2) Conn Type { PVC(1), SVC(2) }               : SVC

30) Sig version { 3.0(1) 3.1(2) }             : 3.0
31) Signaling VCI (0..1023)                   : 5
32) ILMI Enable { (False(1),True(2)) }        : True
33) ESI (12 hex-chars)                       : 0020da6fa8e0
34) ILMI VCI (0..1023)                       : 16

3) Max VCCs (1-1023)                         : 1023
4) Max VCI bits (1..10)                      : 10
5) UNI Type { Pub(1), Priv(2) }               : Private
6) Tx Segment Size (4096-131072)              : 8192
7) Rx Segment Size (4096-131072)              : 8192
8) Tx Buffer Size (1800-8192)                  : 4600
9) Rx Buffer Size (1800-8192)                  : 4600
10) Pl Scramble { (False(1),True(2)) }         : True
11) Timing Mode { (Loop(1),Local(2)) }         : Local
12) Loopback Config { NoLoop(1), DiagLoop(2),
    LineLoop(3) }                             : NoLoop
13) Phy media { SONET(1),SDH(2)}               : SONET

```

Figure 76. Modifying the 8274 ATM Port Configuration to SVC (Part 1 of 2)

```

Enter (option=value/save/cancel) : 33=400082740000 2

Slot 4 Port 1 Configuration

1) Description (30 chars max) : ATM PORT
2) Conn Type { PVC(1), SVC(2) } : SVC

30) Sig version { 3.0(1) 3.1(2) } : 3.0
31) Signaling VCI (0..1023) : 5
32) ILMI Enable { (False(1),True(2)) } : True
33) ESI (12 hex-chars) : 400082740000 2
34) ILMI VCI (0..1023) : 16
3) Max VCCs (1-1023) : 1023
4) Max VCI bits (1..10) : 10
5) UNI Type { Pub(1), Priv(2) } : Private
6) Tx Segment Size (4096-131072) : 8192
7) Rx Segment Size (4096-131072) : 8192
8) Tx Buffer Size (1800-8192) : 4600
9) Rx Buffer Size (1800-8192) : 4600
10) Pl Scramble { (False(1),True(2)) } : True
11) Timing Mode { (Loop(1),Local(2)) } : Local
12) Loopback Config { NoLoop(1), DiagLoop(2),
    LineLoop(3) } : NoLoop
13) Phy media { SONET(1),SDH(2)} : SONET

Enter (option=value/save/cancel) : save

Reset all services on slot 4 port 1 (n)? : y
Resetting port, please wait... 3

```

Figure 77. Modifying the 8274 ATM Port Configuration to SVC (Part 2 of 2)

Notes:

- 1 Change connection type to SVC.
- 2 Change the burned-in ESI address to an LAA of 400082740000.
- 3 Modifying the port will reset the port.

To view ATM port information, type `vap` at the command prompt as shown in Figure 78 on page 109. The 13-byte ATM network prefix of 39 99 99 99 99 99 99 00 00 99 99 01 01 is displayed. This address was learned from the 8260 ATM switch 8260_HUB1 to which this 8274 is physically connected.


```
8274/VLAN/Auto-Tracker >vap
```



```
ATM Port Table
```


Slot	Port	ATM Port Description	Conn Type	Tran Type	Media Type	UNI Type	Max VCC	VCI bits
4	1	ATM PORT	SVC	STS3c	Multi	Pri	1023	10
4	2	ATM PORT	PVC	STS3c	Multi	Pri	1023	10

Slot	Port	Loopback Cfg	Tx Clk Source
4	1	NoLoop	LocalTiming
4	2	NoLoop	LocalTiming

Slot	Port	ATM Network Prefix	End System Identifier	Sig Ver	Sig VCI	IIMI Enable	IIMI VCI
4	1	39999999999999999999000099990101	400082740000	3.0	5	True	16
4	2	N/A	N/A	N/A	N/A	N/A	N/A


```
Status
```


Slot	Port	Tx Seg Sz	Rx Seg Sz	Tx Buff Sz	Rx Buff Sz	Oper	SSCOP	IIMI
4	1	8192	8192	4600	4600	Enabled	Up	Up
4	2	8192	8192	4600	4600	Disabled	Down	Down

Figure 78. Viewing ATM Port Information

Note

The command `varp` on the 8274 also shows the ATM network prefix assigned by the ATM switch.

Note

The command `varp` on the 8274 also shows the ATM network prefix assigned by the ATM switch.

4.3.2.2 Creating a LANE Service

The next three figures show how to create a LANE service. We use the `cas slot/port` command set to create a service.

```
8274/VLAN/Auto-Tracker >cas 4/1
```

Slot 4 Port 1 Service 2 Configuration

- 1) Description (30 chars max) : PTOp Bridging Service 2
- 2) Service type { LAN Emulation (1),
Trunking (4),
Classical IP(5),
PTOP Bridging(6),
VLAN cluster(7) } : PTOp Bridging **1**
- 10) Encaps Type { Private(1),
RFC1483(2) } : Private
- 3) Connection Type { PVC(1),
SVC(2) } : PVC
- 4) PTOp Group : 1
- 5) PTOp connection : none
- 6) Admin Status { disable(1),
enable(2) } : Enable

Enter (option=value/save/cancel) : 2=1 **1**

Slot 4 Port 1 Service 2 Configuration

- 1) Description (30 chars max) : LAN Emulation Service 2
- 2) Service type { LAN Emulation (1),
Trunking (4),
Classical IP(5),
PTOP Bridging(6),
VLAN cluster(7) } : LAN Emulation **1**
- 21) LAN type { 802.3 (1),
802.5 (2) } : 802.3
- 22) Change LANE Cfg { NO (1),
YES (2) } : NO
- 3) Connection Type { PVC(1),
SVC(2) } : SVC
- 30) SEL for the ATM address : 02
- 4) LAN Emulated Group : 1
- 5) LECS Address (40-char-hex) : 47007900000000000000000000000000A03E00000100
2
- 6) Admin Status { disable(1),
enable(2) } : Enable

Figure 79. Create a Service on Port 4/1 (Part 1 of 3)

```

Enter (option=value/save/cancel) : 22=2 3

Slot 4 Port 1 Service 2 LANE Configuration Parameters

1) Proxy { NO (1), YES (2) } : YES
2) Max Frame Size { 1516 (1), 4544 (2)
   9234 (3), 18190 (4) } : 4544
3) Use translation options{NO (1), YES (2) : Yes (use Swch menu to set)
4) Use Fwd Delay time { NO (1), YES (2) } : NO
5) Use LE Cfg Server (LECS){ NO (1), YES (2)}: YES
6) Use Default LECS address { NO(1), YES (2)}: YES
7) Control Time-out (in seconds) : 120
8) Max Unknown Frame Count : 1
9) Max Unknown Frame Time (in seconds) : 1
10) VCC Time-out Period (in minutes) : 20
11) Max Retry Count : 1
12) Aging Time (in seconds) : 300
13) Expectd LE_ARP Resp Time (in seconds) : 1
14) Flush Time-out (in seconds) : 4
15) Path Switching Delay (in seconds) : 6
16) ELAN name (32 chars max) : 4

```

Figure 80. Create a Service on Port 4/1 (Part 2 of 3)

```

Enter (option=value/save/cancel) : 16=8274eth1 4

Slot 4 Port 1 Service 2 LANE Configuration Parameters

1) Proxy { NO (1), YES (2) } : YES
2) Max Frame Size { 1516 (1), 4544 (2)
   9234 (3), 18190 (4) } : 4544
3) Use translation options{NO (1), YES (2) : Yes (use Swch menu to set)
4) Use Fwd Delay time { NO (1), YES (2) } : NO
5) Use LE Cfg Server (LECS){ NO (1), YES (2)}: YES
6) Use Default LECS address { NO(1), YES (2)}: YES
7) Control Time-out (in seconds) : 120
8) Max Unknown Frame Count : 1
9) Max Unknown Frame Time (in seconds) : 1
10) VCC Time-out Period (in minutes) : 20
11) Max Retry Count : 1
12) Aging Time (in seconds) : 300
13) Expectd LE_ARP Resp Time (in seconds) : 1
14) Flush Time-out (in seconds) : 4
15) Path Switching Delay (in seconds) : 6
16) ELAN name (32 chars max) : 8274eth1 4

Enter (option=value/save/cancel) : save

Creating service, please wait...

Enabling service...

```

Figure 81. Create a Service on Port 4/1 (Part 3 of 3)

Notes:

- 1 Modify the service type to LAN Emulation.
- 2 The default LECS address is the ATM well known address. The other option is to configure the ATM address of the LECS directly. In this example, when using the well known address, the 8260 Hub 1 is configured to respond to this well known address request. We achieve this on the 8260 using the `set lan_emul configuration_server active_wka` command as shown in Figure 52.
- 3 Modify the LANE configuration.
- 4 Add an ELAN name. This will be used by the LECS to respond to a LES/BUS ATM address as well as by the LES/BUS during the join process.

Viewing ATM Services

To view the services defined on the 8274 RouteSwitch, the `vas` command is entered at the command prompt. Figure 82 displays the services. In particular we see slot 4, port 1, service 2 configured for LAN Emulation.

```
8274/VLAN/Auto-Tracker >vas
```

ATM Services						
Slot	Port	Serv Num	Service Description	Service Type		
====	====	====	=====	=====		
4	1	1	PTOP Bridging Service 1	PTOP Priv		
4	1	2	LAN Emulation Service 2	LANE		
4	2	1	PTOP Bridging Service 1	PTOP Priv		

ATM Services						
Slot	Port	Serv Num	VC Typ	Oper Status	SEL Groups	Conn VCIs/Addresses
====	====	====	==	=====	==	=====
4	1	1	PVC	Enabled	N/A 1	100
4	1	2	SVC	LANE Op.	02 1	102 103 104 105
4	2	1	PVC	Disabled	N/A 1	100

Figure 82. Viewing ATM Services

The connection to the LES/BUS function on the MSS is successful, as indicated by the Oper Status of LANE Op. and the dynamically allocated Conn VCIs of 102, 103, 104, 105.

4.3.2.3 Creating a VLAN

A new VLAN will be created as it is not recommended to use the default VLAN for application data traffic.

The new VLAN will be created with the following attributes:

1. VLAN number 2 - part of Group 1
2. Network address rule

- Protocol IP, 192.168.25.0 class C subnet
3. Port address rule
 - ATM port 4/1 using the LANE service
 4. Virtual IP router arm - 192.168.25.2.
 5. Default RIP (Silent)
 6. Default framing type (Ethernet II)

To move to the VLAN/Auto-Tracker submenu type `at` at the command prompt. This modifies the command prompt to `8274/VLAN/Auto-Tracker`. We then type `cratv1` at the command prompt to create a VLAN, as shown in Figure 84 on page 114.

```
8274/ >at
8274/VLAN/Auto-Tracker >cratv1
Enter the VLAN Group id for this VLAN ( 1) :
Enter the VLAN Id for this VLAN ( 2) :
Enter the new VLAN's description: VLAN 2 IP Subnet
Enter the Admin status for this vlan (e)nable/(d)isable (d): e
Select rule type:
  1. Port Rule
  2. MAC Address Rule
  3. Protocol Rule
  4. Network Address Rule
  5. User Defined Rule
Enter rule type (1): 4

Set Rule Admin Status to (e)nable/(d)isable (d): e

Select the Network Protocol:
  1. IP
  2. IPX
Enter protocol type: 1
Enter the IP Address: 192.168.25.0
Enter the IP Mask (255.255.255.0):
Configure more rules for this vlan y/n (n): y

Select rule type:
  1. Port Rule
  2. MAC Address Rule
  3. Protocol Rule
  4. Network Address Rule
  5. User Defined Rule
Enter rule type (1): 1

Set Rule Admin Status to (e)nable/(d)isable (d): e
```

Figure 83. Creating an Auto-Tracker VLAN (Part 1 of 2)

```

Enter the list of ports in Slot/Interface format: 4/1
4/1 has the following services configured:
Index  Service Type/Instance
=====
1.      Brg/1
2.      Lne/1
Enter the index of the service/instance to add: 2
1.      Description      = VLAN 2 IP Subnet
2.      Admin Status     = Enabled
3.      Rule Definition
          Rule Num      Rule Type      Rule Status
          1              Net Addr Rule Enabled
          2              Port Rule      Enabled
          3              Port Rule      Enabled
Available options:
1.      Set VLAN Admin Status
2.      Set VLAN Description
3.      Add more rules
4.      Delete a rule
5.      Set rule Admin Status
6.      Quit
Option = 6

VLAN 1: 2 created successfully
Enable IP? (y):
IP Address                      : 192.168.25.2
IP Subnet Mask                  (0xffffffff) :
IP Broadcast Address (192.168.25.255 ) :
Description (30 chars max)      : IP Virtual router arm
IP RIP mode {Deaf(d),
             Silent(s),
             Active(a),
             Inactive(i)}        (s) :
Default framing type {Ethernet II(e),
                     fddi(f),
                     token ring(t),
                     Ethernet 802.3(8),
                     source route token ring(s)} (e)

Created router port for vlan 1: 2

Enable IPX? (y): n

```

Figure 84. Creating an Auto-Tracker VLAN (Part 2 of 2)

Viewing VLAN Information

Figure 85 on page 115 displays the status of the VLAN followed by the Virtual Interface VLAN Membership.

```

8274/VLAN/Auto-Tracker >atvl
VLAN  VLAN  VLAN                               Admin  Operational
Group: Id   Description                        Status   Status
-----
    1: 2     VLAN 2 IP Subnet                    Enabled  Active

8274/VLAN/Auto-Tracker >vivl
                        Virtual Interface VLAN Membership
Slot/Intf/Service/Instance  Group  Member of VLAN#
-----
2   /1   /Rtr   /1      1      1
2   /1   /Rtr   /2      1      2  ❶
3   /1   /Brg   /1      1      1
.
.
.
3   /12  /Brg   /1      1      1
4   /1   /Brg   /1      1      1
4   /1   /Lne   /1      1      1 2  ❷
4   /2   /Brg   /1      1      1
5   /1   /Brg   /1      1      1

```

Figure 85. Viewing Auto-Tracker VLANs and Assignments

Notes:

- ❶ Virtual IP router arm is a member of VLAN 2.
- ❷ LANE service on virtual interface 4/1 is assigned to both the default VLAN and VLAN 2. This port rule ensures the VLAN is always up and operational; otherwise, the VLAN will *only* become operational after a device is assigned to VLAN 2. The virtual router will not activate the VLAN on its own.

Verifying Connectivity

To verify that we have connectivity between the 8274 and the MSS, we type `ping 192.168.25.10` from the command prompt as shown in Figure 86.

```

8274/VLAN/Auto-Tracker >ping 192.168.25.10
Count (0 for infinite) (1) :
Size (64) :
Timeout (1) :
Ping starting, hit <RETURN> to stop
PING 192.168.25.10: 64 data bytes

----192.168.25.10 PING Statistics----
1 packets transmitted, 1 packets received, 0% packet loss

```

Figure 86. Verifying IP Connectivity

For an end device connected to the 8274 with an IP address of 192.168.25.3 to communicate with a device on a separate subnet, that is, 192.168.21.0, it must configure a default gateway of 192.168.25.10 (the MSS). This is because we have not configured a routing protocol (that is, OSPF or RIP) between the 8274 and the MSS to exchange routing tables.

Tip

To view the routing table of the 8274, type `ipx` at the command prompt.

To use the 8274 IP router arm as the default gateway, we could configure the MSS to send RIP updates to the 8274eth1 ELAN. The 8274 is set up by default to listen for RIP updates. This configuration will update the IP routing table on the 8274 with the IP routing table entries found on the MSS.

4.4 Adding an IBM 8281

The next device to be added to the ATM backbone is an IBM 8281 via a 100 Mbps ATM port. An Ethernet ELAN, called 8281eth2, will be created on the MSS. Also created is a LEC on the MSS with IP routing enabled and the IP address will be 192.168.24.10. Then we will connect the IBM 8281 to an IBM 8260 100 Mbps ATM port and configure the LEC on the IBM 8281's ATM port to join the 8281eth2 ELAN. This LEC will also be assigned the IP address of 192.168.24.81.

Figure 87 illustrates the physical topology, representing the existing network plus the new 8281 connection. Figure 88 on page 117 illustrates the logical topology.

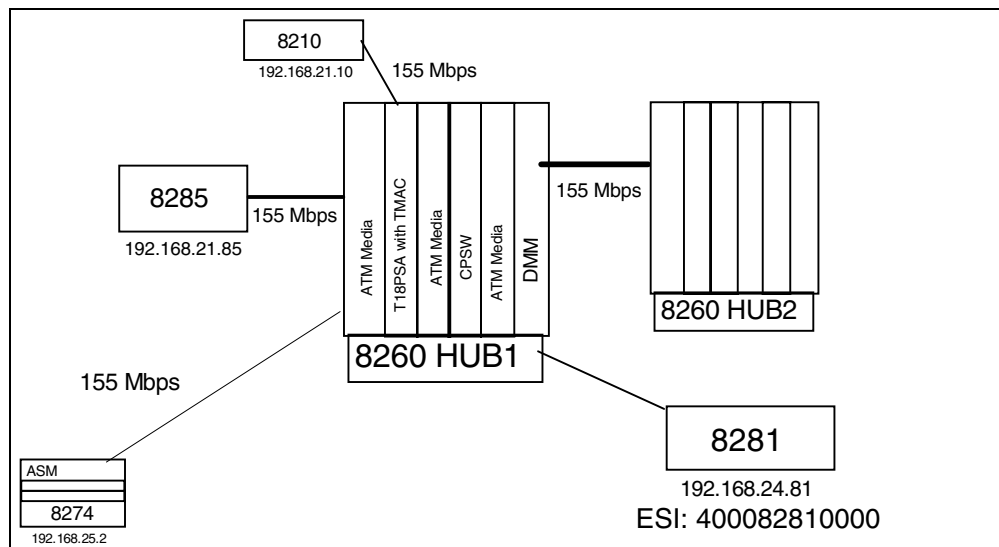


Figure 87. Physical View of 8281 Connection

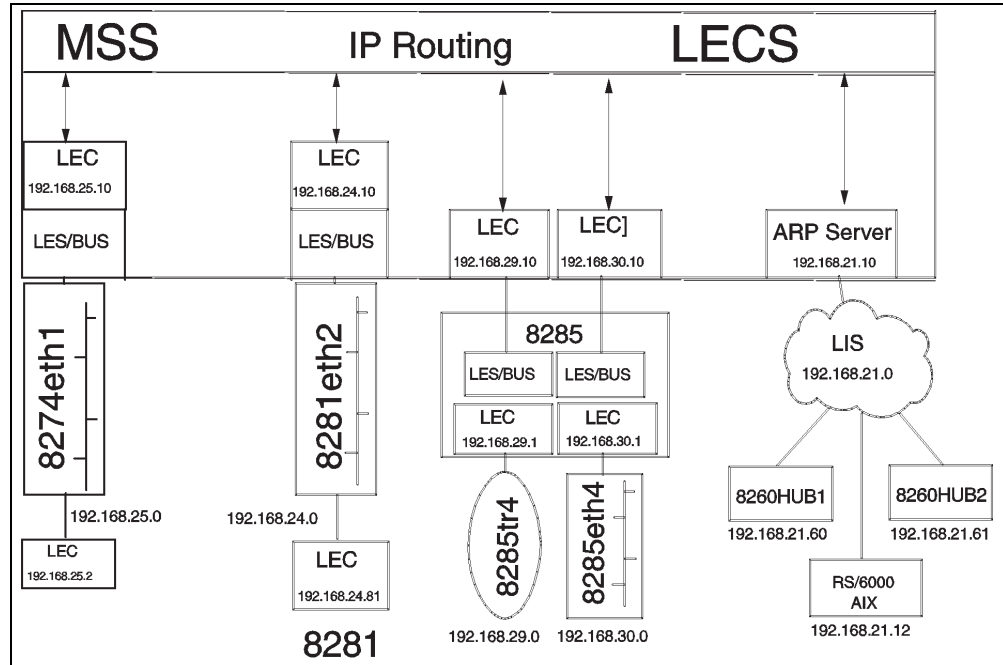


Figure 88. Logical View of 8281 Connection

To provide connectivity of the IBM 8281 to the ATM backbone, we will create the 8281eth2 ELAN, a LAN Emulation Server (LES) for this ELAN, as well as a Broadcast Unknown Server (BUS) on the MSS. We will also configure a LAN Emulation Client (LEC) on the MSS to enable IP routing between ELANs and LISs.

We configured the ELAN and LES/BUS function by selecting **ELANs** under **Devices...LAN Emulation** in the Navigation Window of the MSS Configuration Program and the Emulated LANs Configuration window is displayed:

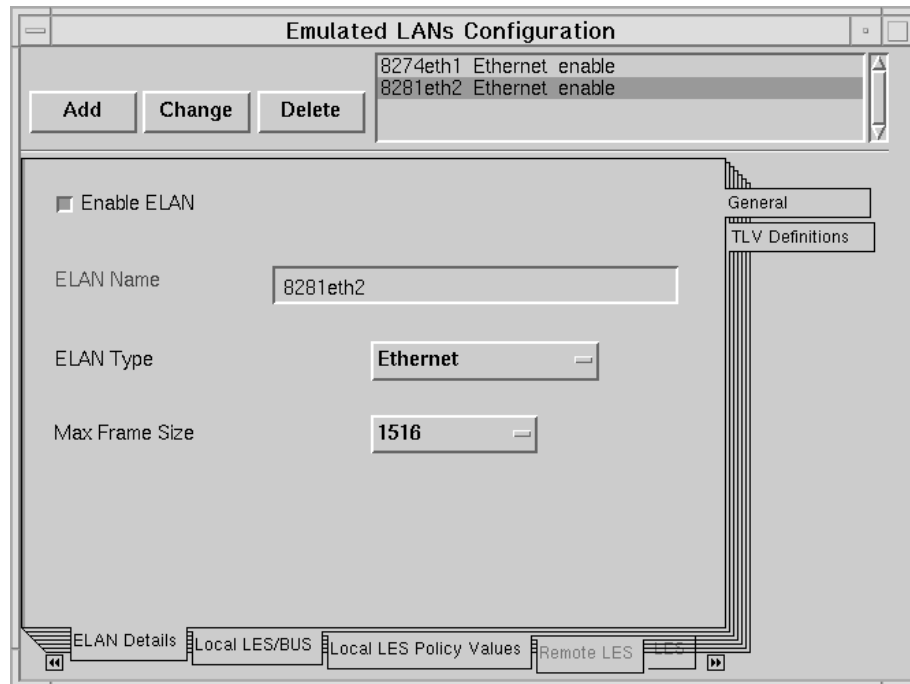


Figure 89. Configuring ELAN Name

To create the ELAN select **ELAN Details** and **General**. Make sure the Enable ELAN box is marked. In the ELAN Name field fill in the Name of the ELAN you want to create; here 8281eth2 is entered. Select the ELAN Type, either Token-Ring or Ethernet; here we selected **Ethernet**. The Max Frame Size will automatically change to the default value for either token-ring or Ethernet, here it is **1516**.

To create the LES/BUS functionality select **Local LES/BUS** and **General-1**.

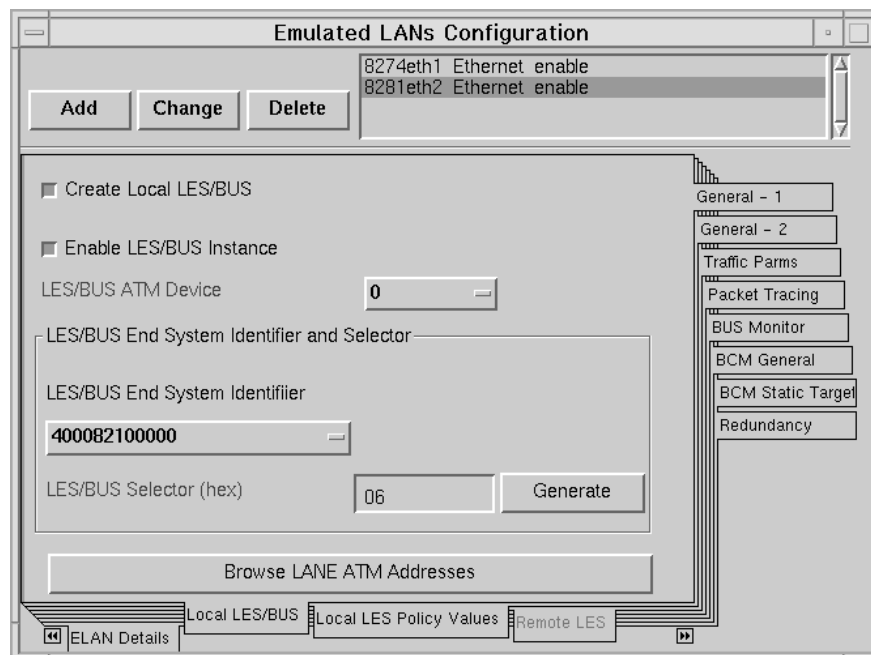


Figure 90. Configuring LES/BUS

At this window ensure that **Create Local LES/BUS** and **Enable LES/BUS Instance** are marked. For the LES/BUS ATM Device, on which the LES/BUS instance should be created, we selected **0**.

We selected **400082100000** as the locally administered address. To configure the LES/BUS Selector (hex) click **Generate** to select the next available selector for this address, here **06**.

All other parameters can be left at the default values. Click **Add** to save this ELAN entry.

Note

If you want to enable the BCM for this ELAN, you must first set the Fast BUS mode operation on the Local LES/BUS and General-2 menu to System.

4.4.0.1 Creating a LEC for the 8281eth2 ELAN

To enable IP routing for an ELAN you must first create a LEC for this ELAN and then simply assign an IP address to it. To create a LEC, select **LEC interfaces** under **Devices...LAN Emulation** in the Navigation Window of the MSS Configuration Program, and the LEC Interfaces window is displayed.

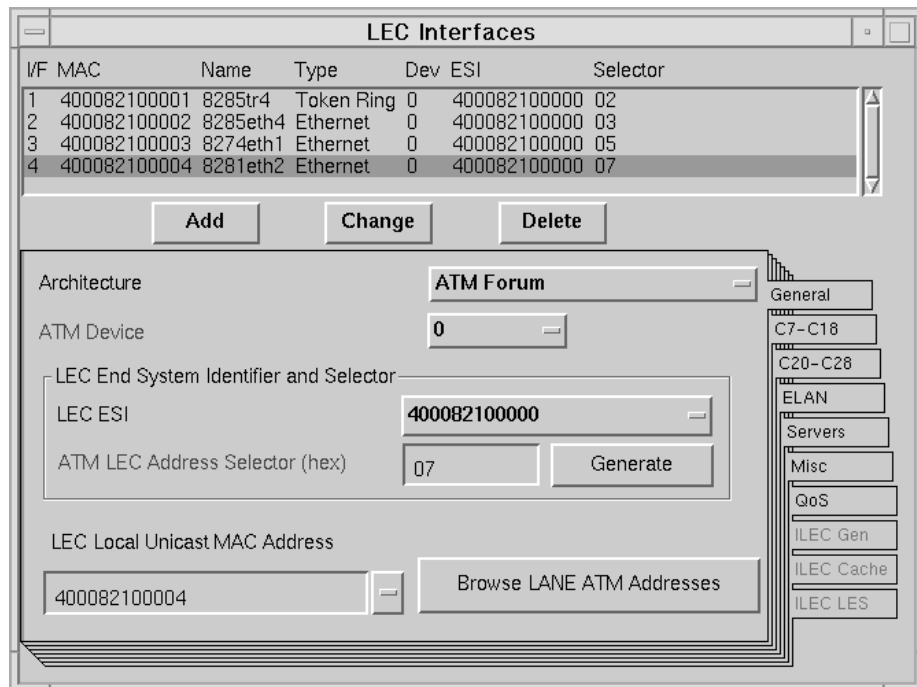


Figure 91. Configuring the LEC

By selecting **General** you can configure the following parameters:

- Architecture
ATM Forum was selected.
- ATM Device
Select **0**.
- LEC End System Identifier and Selector:

- LEC ESI

We selected the locally administered ESI value of **400082100000**.

- ATM LEC Address Selector (hex)

Created by clicking **Generate** to select the next available selector for this address, here **07**.

- LEC Local Unicast MAC Address

Used as a MAC address in the ELAN. If you want to enable bridging between ELANs this has to be unique. In this case, **400082100004** was defined.

To assign the LEC to the correct ELAN, select **ELAN**. The following window will be displayed:

IF	MAC	Name	Type	Dev	ESI	Selector
1	400082100001	8285tr4	Token Ring	0	400082100000	02
2	400082100002	8285eth4	Ethernet	0	400082100000	03
3	400082100003	8274eth1	Ethernet	0	400082100000	05
4	400082100004	8281eth2	Ethernet	0	400082100000	07

Buttons: Add, Change, Delete

ELAN Name: 8281eth2

Create ELAN Assignment Policies

ELAN Type: Ethernet

Max Frame Size: 1516

Right sidebar tabs: General, C7-C18, C20-C28, ELAN, Servers, Misc, QoS, ILEC Gen, ILEC Cache, ILEC LES

Figure 92. Assigning the LEC to an ELAN

The ELAN name assigned was 8281eth2 and the was LEC defined to use the WKA.

I/F	MAC	Name	Type	Dev	ESI	Selector
1	400082100001	8285tr4	Token Ring	0	400082100000	02
2	400082100002	8285eth4	Ethernet	0	400082100000	03
3	400082100003	8274eth1	Ethernet	0	400082100000	05
4	400082100004	8281eth2	Ethernet	0	400082100000	07

☐ LECS AutoConfiguration

LECS ATM Address

LE Server ATM Address

General
 C7-C18
 C20-C28
 ELAN
 Servers
 Misc
 QoS
 ILEC Gen
 ILEC Cache
 ILEC LES

Figure 93. Configuring LEC to Join LES with WKA

Click the **LECS AutoConfiguration** button.

All other parameters can be left at default values. Click **Add** to save this LEC entry.

Now we have created an ELAN with LES/BUS and a LEC that will join this ELAN. To enable IP routing for this ELAN an IP address is assigned to this LEC. This is done by selecting **Interfaces** under Protocols...IP in the Navigation Window of the MSS Configuration Program. The IP interfaces window will be displayed:

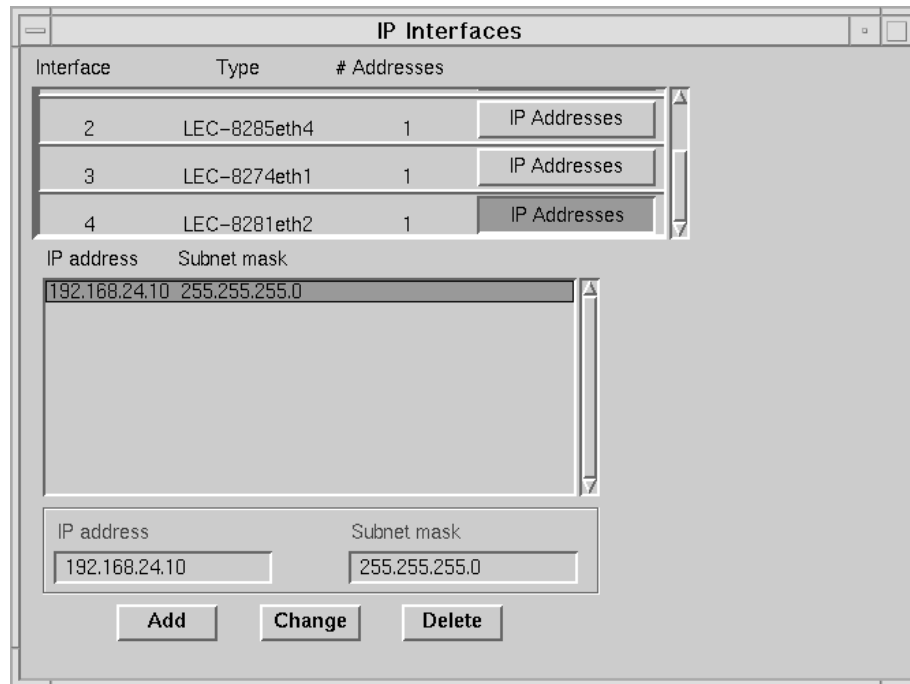


Figure 94. Assigning an IP Address to LEC

At this window click **IP Addresses** next to the LEC interface that was just created and type in an IP address and a subnet mask for the LEC interface, here 192.168.24.10 and 255.255.255.0. By clicking **Add** the IP address is assigned.

Now the configuration is done. Upload the configuration file and reload the MSS.

4.4.1 Configuring the IBM 8281

The 8281 will be connected to the backbone via its 100 Mbps port. A fiber cable connects the 8281 100 Mbps port to the 8260_HUB1. We are going to configure the 8281's ATM, LAN Emulation, IP and SNMP parameters, as well as the port configuration parameters. The 8281 will be configured as an Ethernet transparent bridge.

We will also configure an additional IBM 8281 for network management purposes. This 8281 will be configured as a token-ring source-route bridge to provide connectivity from the ATM network management station to the token-ring ports of the 8260s.

All this is done with the Configuration Utility Program.

4.4.1.1 The Configuration Utility Program

The Configuration Utility Program is a DOS/Windows-based application that enables a user to modify the 8281's configuration parameters.

To use the Configuration Utility Program to manage the 8281, the workstation running this program must be able to communicate with the 8281 using any of the following connections:

1. Direct attachment to the serial port on the 8281. In this case the workstation must be configured to use TCP/IP over the SLIP interface.

2. LAN attachment. In this case the workstation must be configured to use TCP/IP over a LAN (token-ring or Ethernet) interface to communicate with the IBM 8281.
3. ATM attachment. In this case the workstation must be configured to use TCP/IP over an emulated LAN to communicate with the 8281 via the ATM interface.

4.4.1.2 Creating a Configuration for the IBM 8281

The following sections describe the steps required to create the new configuration profile for the IBM 8281.

Bridge Type Configuration

From the main menu of the Configuration Utility Program double-click the profile template for the type of bridge you want to configure. On the Bridge Type Selection panel activate the radio button for Token Ring or Ethernet. That defines the IBM 8281 as being configured for either token-ring or Ethernet. When you select **OK** on this panel, the bridge configuration window will be displayed as shown in Figure 95.

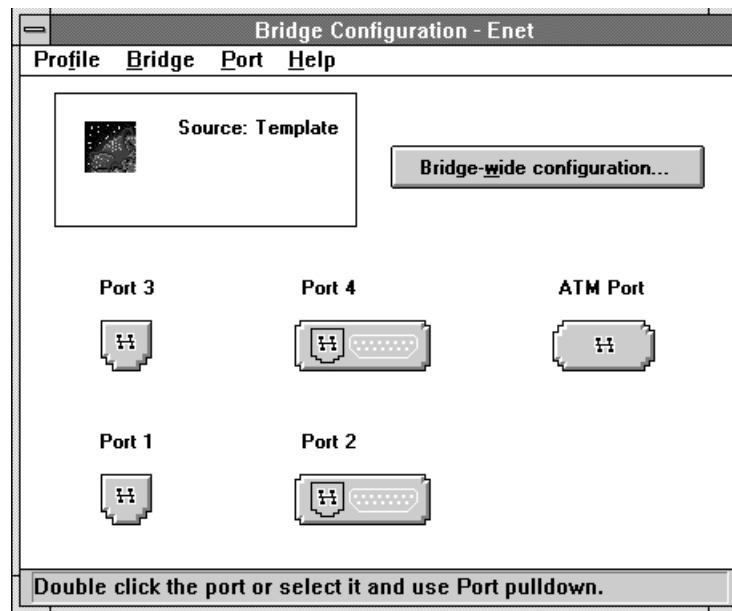


Figure 95. The IBM 8281 Configuration Window for Ethernet

The panel in Figure 95 shows the Ethernet (Enet) IBM 8281 configuration window (all ports are indicated as Ethernet). If the IBM 8281 had been configured for token-ring, all ports would be indicated as token-ring.

On this panel there is a button for bridge-wide configuration and an icon for each of the possible four LAN ports and the ATM port. Double-click each one to configure the relevant parameters.

Bridge-wide Configuration

The Bridge-wide Configuration panel is divided into two sections; see Figure 96.

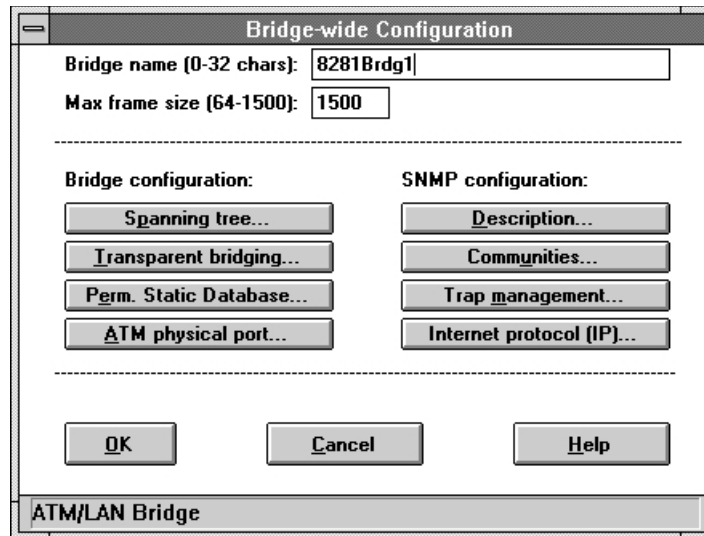


Figure 96. The Bridge-wide Configuration Panel

In the upper section, the following parameters must be entered:

- Bridge name

This parameter identifies the IBM 8281 and is used to distinguish the IBM 8281 from other bridges in the network. Every IBM 8281 in the network must have a unique name; for this 8281 we used the name 8281Brdg1.

The token-ring 8281 will have a name of 8281Brdg2.

- Maximum frame size

This parameter is selected by choosing among a list of values displayed in a pull-down list. This parameter has different ranges for token-ring and for Ethernet. The token-ring default is 4399 with a range of 516-17749; the Ethernet default is 1500 with a range of 64-1500.

Note

No port can be configured to handle larger frame sizes than the maximum value that is specified in this parameter. This parameter sets the limit of the frame size for any single port on the IBM 8281. Frames larger than the maximum transmission unit (MTU) size will be discarded.

For both 8281s we leave this parameter at the default, 1500, for the Ethernet and 4399 for the token-ring 8281.

In the lower section of the panel are the following two groups of configuration parameters:

1. Bridge configuration

- Ethernet configuration:
 - Spanning tree
 - Transparent bridging
 - Permanent static database
 - ATM physical port

- Token-ring configuration:
 - Spanning tree
 - Source routing
 - ATM physical port

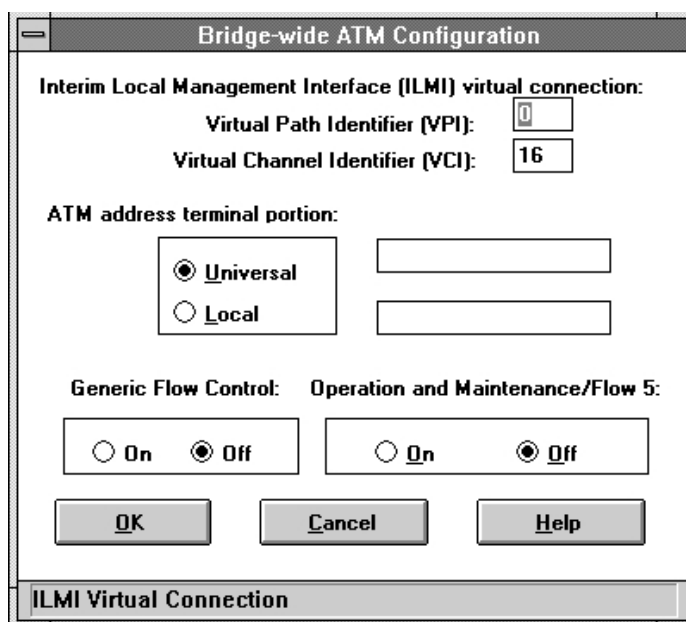
2. SNMP configuration

- Description
- Communities
- Trap management
- Internet protocol (IP)

Default values may be used for these parameters, unless a specific circumstance exists in your network that requires one or more of them to be changed. We also used the default values for both 8281s in our configuration.

4.4.1.3 ATM Physical Port Parameters - Token-Ring and Ethernet

The ATM physical port button on the Bridge-wide Configuration panel allows you to display the Bridge-wide ATM Configuration panel, as shown in Figure 97.



The image shows a dialog box titled "Bridge-wide ATM Configuration". It contains the following fields and controls:

- Interim Local Management Interface (ILMI) virtual connection:**
 - Virtual Path Identifier (VPI):** A text box containing the value "0".
 - Virtual Channel Identifier (VCI):** A text box containing the value "16".
- ATM address terminal portion:**
 - Two radio buttons: **Universal** (selected) and **Local**.
 - Two empty text boxes for input, one next to each radio button.
- Generic Flow Control:**
 - Two radio buttons: **On** and **Off** (selected).
- Operation and Maintenance/Flow 5:**
 - Two radio buttons: **On** and **Off** (selected).
- At the bottom are three buttons: **OK**, **Cancel**, and **Help**.
- A status bar at the very bottom reads "ILMI Virtual Connection".

Figure 97. The Bridge-wide ATM Configuration Panel

This panel allows you to specify the following parameters:

- ILMI Virtual Path Identifier (VPI)
The default is 0.
- ILMI Virtual Channel Identifier (VCI)
The default is 16.

Note

The ILMI VPI and the ILMI VCI should be left at their default values unless you have a specific need to change them. ILMI VP/VC values of 0/16 are the only VP/VC ILMI values that work with the IBM 8260 ATM control point and switch. Do not change the default values for these parameters if you are connected to an IBM 8260.

We connect the 8281 to an 8260, so we leave these parameters at their defaults.

- **ATM address terminal portion**

This parameter allows you to specify the Endsystem Identifier (ESID) portion of your IBM 8281's ATM address:

- Universal

If the universal ATM address terminal portion is specified for this parameter, the IBM 8281 derives the terminal portion of its ATM address from its own universally administered base MAC address. This address has the form X'ZZ-ZZ-ZZ-ZZ-Z0', in which the Zs represent any hexadecimal numbers. It is in canonical format, with the least significant bit (LSB) of each byte first.

- Local

If the local ATM address terminal portion is specified for this parameter, the IBM 8281 derives the terminal portion of its ATM address from the locally administered MAC address that you must provide.

The 13-byte ATM network prefix is always provided to UNI-attached stations as a result of the ILMI address registration process. Note that the IBM 8281 will always use 0 as the value for the selector byte.

- **Generic Flow Control**

This parameter can have a value of On or Off. If this parameter is On, the IBM 8281 will use the generic flow control (GFC) bits in the ATM header for flow control. These are the first 4 bits in the ATM cell header. In this case, the ATM switch that the IBM 8281 is attached to must support generic flow control.

- **Operation and Maintenance/Flow 5**

This parameter can have a value of On or Off. If this parameter is On, the IBM 8281 will use the Operation and Maintenance/Flow 5 for flow control.

Depending on the switch to which the IBM 8281 is attached, both generic flow control and Operation and Maintenance/Flow 5 may be used.

Default values may be used for these parameters, unless a specific circumstance exists in your network that requires one or more of them to be changed. We used the default values for both 8281s in our configuration.

SNMP Parameters - Token-Ring and Ethernet

These panels allow the specification of the following SNMP parameters:

- **SNMP Description Parameters.**

This panel allows you to specify the following parameters:

- Bridge contact

- Bridge location

- **SNMP Communities Parameters**

The SNMP community configuration parameters establish the community names for the hosts that can access the SNMP agent in the IBM 8281.

The following four levels of functions are identified in the SNMP Community View panel:

1. Monitor view

SNMP managers with this view can read and view the MIB variables that represent the values of running and stored parameters.

2. Run-time control view

SNMP managers with this view can both read and change certain running parameters and can read the stored parameters.

3. Configuration view

SNMP managers with this view can read and modify the configuration parameters such as the community name.

4. Security views

SNMP managers that are allowed read and write access to all the MIB objects supported by the IBM 8281. They can also change the values of all the other views.

These community names and IP addresses act as passwords to allow you to change the values of the other community names and IP addresses.

Each of the view panels allows you to identify the authorized SNMP managers via the following parameters:

- Community name

A community name acts as a security password that lets the agent know that it should accept the request from the manager.

- IP address

This is the IP address of the host that can use this community name to access the SNMP agent in the IBM 8281.

- IP address mask

This is the IP subnetwork mask of the host that can use this community name to access the SNMP agent in the IBM 8281.

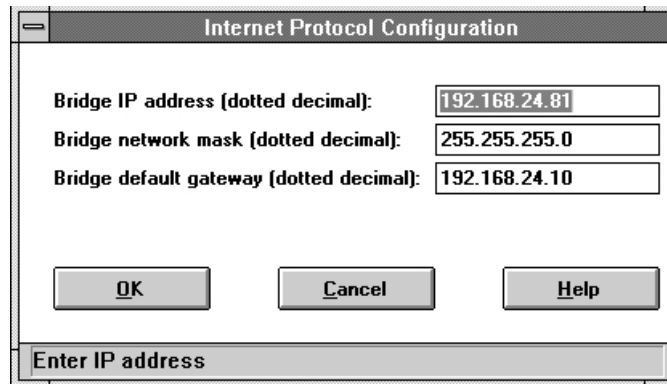
We configured the Community Name as `public` and for the IP address the addresses of our Network Management Station, `192.168.21.12`.

Trap Management Parameters

If an exception event occurs in the IBM 8281, such as when a link fails, the SNMP agent in the IBM 8281 sends an immediate, unsolicited notification of the occurrence to a management station in the form of an SNMP trap.

Internet Protocol (IP) Parameters

This group of parameters allows the IBM 8281 to use IP to communicate with the SNMP manager. When you click the Internet Protocol (IP) button in the Bridge-wide Configuration panel, the panel shown in Figure 98 will be displayed.



The image shows a dialog box titled "Internet Protocol Configuration". It contains three text input fields with labels: "Bridge IP address (dotted decimal):", "Bridge network mask (dotted decimal):", and "Bridge default gateway (dotted decimal):". The values entered in the fields are "192.168.24.81", "255.255.255.0", and "192.168.24.10" respectively. Below the fields are three buttons: "OK", "Cancel", and "Help". At the bottom of the dialog is a status bar with the text "Enter IP address".

Figure 98. The Internal Protocol Configuration Panel

This panel allows you to define the following parameters:

- Bridge IP address

This is the unique IP address of the SNMP agent in the IBM 8281, here 192.168.24.81 for the Ethernet 8281.

- Bridge network mask

This is the subnet mask for the IBM 8281, here 255.255.255.0 for the bridge.

- Bridge default gateway

This is the IP address of the default gateway used by the IBM 8281, here 192.168.24.10 for the Ethernet 8281.

This is the IP address of the MSS's LEC for the appropriate ELAN. The ELAN for the token-ring 8281 has not yet been created, but we went ahead and entered the value.

Note

During the startup procedure, the IP address of the IBM 8281 will be associated with the MAC address of one of the 8281's ports. This is the MAC address of the first available port.

Port Configuration Parameters (Token-Ring and Ethernet)

When the bridge-wide configuration is finished and saved, the menu window that shows icons of the ports reappears. By clicking the icon for the port or by clicking port and configuration from the menu bar, you bring up the port configuration panel as shown in Figure 99 on page 129.

Figure 99. The Ethernet Port Configuration Panel

This panel allows you to specify the following parameters for both token-ring and Ethernet:

- Port name
The identifying name of the port, expressed as 0 to 32 alphanumeric characters.
- MAC address to use
This parameter allows you to choose either Universal or Local.
If you choose Local, you must provide the value of the MAC address. If you choose Universal, the universally administered MAC address that is assigned to this port at the factory will be used.
- Spanning tree initial port state
The choices are Enabled and Disabled. If you choose Disabled, the port does not participate in the spanning tree.

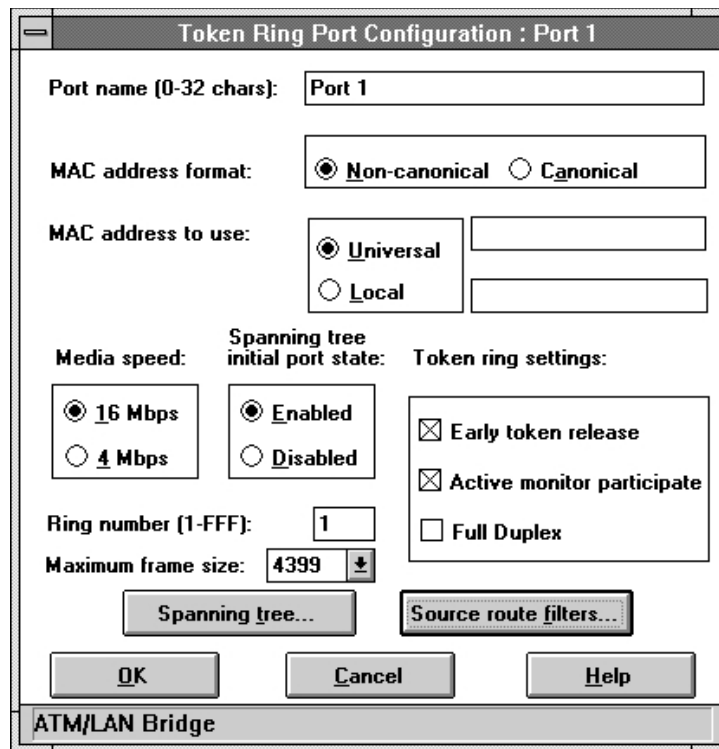
Port Parameters for Ethernet

- Maximum frame size
This parameter specifies the size in bytes of the largest frame that is permitted to cross this port. This value cannot be larger than the maximum frame size configured at the bridge level. Note that the value of this parameter is different for Ethernet than for token-ring. The Ethernet default is 1500 and the range is 64-1500.
- Physical Connector type
This parameter allows you to choose which connector type (RJ 45 or AUI) is used for port 2 and port 4. Note that for ports 1 and 3, the only allowed type is RJ 45.

We left all parameters at their default values, so every port will use the RJ 45 connector with the spanning tree enabled and run half-duplex.

Port Parameters for Token-Ring

The Token Ring Port Configuration panel as shown in Figure 100, allows you to configure the following parameters.



The image shows a dialog box titled "Token Ring Port Configuration : Port 1". It contains several configuration fields and buttons. At the top, there is a text field for "Port name (0-32 chars):" with the value "Port 1". Below this is a section for "MAC address format:" with two radio buttons: "Non-canonical" (selected) and "Canonical". Underneath is "MAC address to use:" with two radio buttons: "Universal" (selected) and "Local", each followed by an empty text field. The next row has three sections: "Media speed:" with radio buttons for "16 Mbps" (selected) and "4 Mbps"; "Spanning tree initial port state:" with radio buttons for "Enabled" (selected) and "Disabled"; and "Token ring settings:" with checkboxes for "Early token release" (checked), "Active monitor participate" (checked), and "Full Duplex" (unchecked). Below these are a "Ring number (1-FFF):" field with the value "1" and a "Maximum frame size:" field with the value "4399" and a dropdown arrow. At the bottom of the configuration area are two buttons: "Spanning tree..." and "Source route filters...". The very bottom of the dialog has three buttons: "OK", "Cancel", and "Help". A status bar at the bottom left of the dialog reads "ATM/LAN Bridge".

Figure 100. The Token Ring Port Configuration Panel

- MAC address format

This parameter informs the IBM 8281 whether the MAC address provided is in canonical or non-canonical format. In non-canonical format, the most significant bit is first within each byte. This format is used for token-ring networks. In canonical format, the least significant bit is first within each byte. This format is used for Ethernet.

- Early token release

This parameter tells the IBM 8281 whether or not to use early token release on the token-ring connected to this port.

- Active monitor participate

This parameter determines whether the 8281 will participate in active monitor contention on the token-ring connected to this port.

- Ring number (1-FFF)

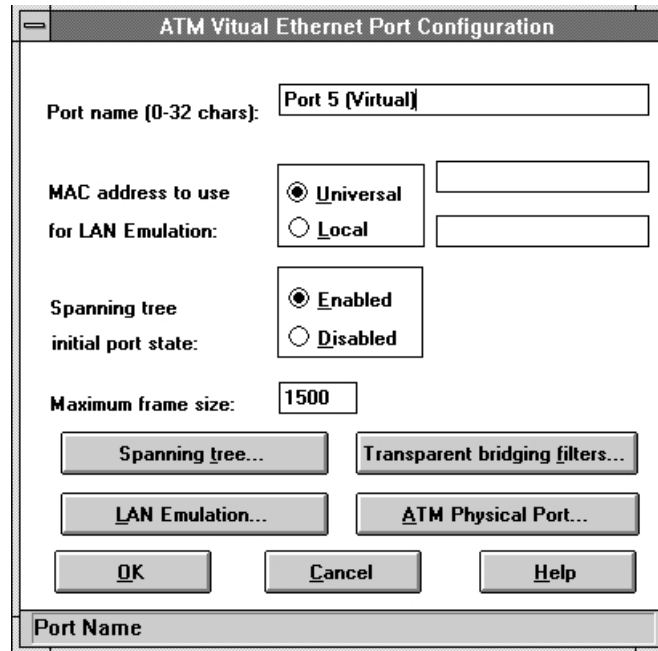
The parameter is used to identify the segment number of the token-ring LAN attached to this port. When you configure a ring number, be sure that all the other bridges on the network are configured with the same ring number for this ring. If two or more bridges are configured with different ring numbers for the same ring, traffic will not be forwarded as expected. The IBM 8281 does not inform you if you have made this configuration error.

- Maximum frame size

This parameter specifies the size in bytes of the largest frame that is permitted to cross this port. This value cannot be larger than the maximum frame size configured at the bridge level, and the range is 516-17749.

4.4.1.4 ATM Virtual Port Configuration - Token-Ring and Ethernet

Double-clicking the ATM port icon will show Figure 101.



The image shows a configuration window titled "ATM Virtual Ethernet Port Configuration". It contains several fields and buttons:

- Port name (0-32 chars):** A text field containing "Port 5 [Virtual]".
- MAC address to use for LAN Emulation:** Two radio buttons: "Universal" (selected) and "Local". To the right of each is an empty text field.
- Spanning tree initial port state:** Two radio buttons: "Enabled" (selected) and "Disabled".
- Maximum frame size:** A text field containing "1500".
- Buttons:** "Spanning tree...", "Transparent bridging filters...", "LAN Emulation...", "ATM Physical Port...", "OK", "Cancel", and "Help".
- Port Name:** A label at the bottom of the window.

Figure 101. The ATM Virtual Ethernet Port Configuration Panel

This panel allows you to specify the following parameters for both token-ring and Ethernet:

- Port name

The identifying name of the port, expressed as 0 to 32 alphanumeric characters.

- MAC address to use

This parameter allows you to choose either Universal or Local.

If you choose Local, you must provide the value of the MAC address. If you choose Universal, the universally administered MAC address that is assigned to this port at the factory will be used.

- Spanning tree initial port state

The choices are Enabled and Disabled. If you choose Disabled, the port does not participate in the spanning tree.

4.4.1.5 ATM Virtual Port Parameters for Ethernet

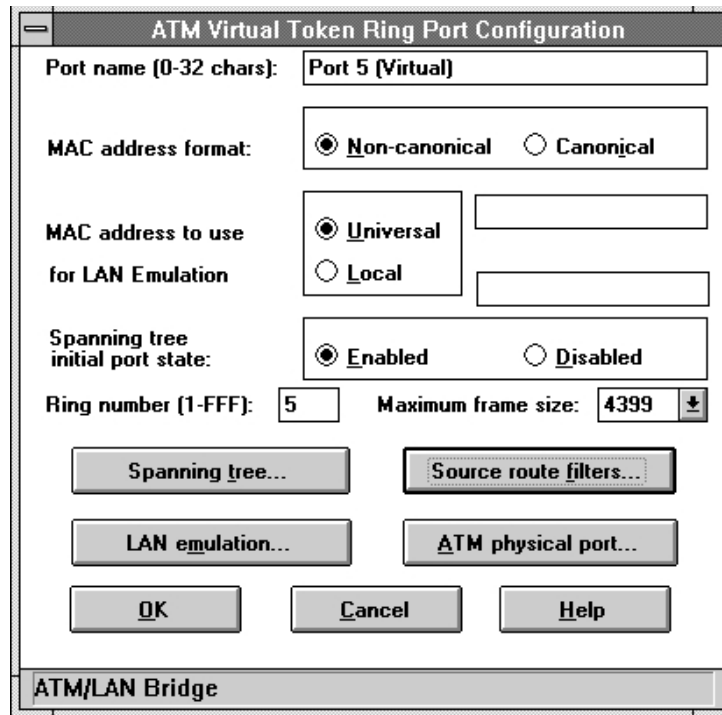
- Maximum frame size

This parameter specifies the size in bytes of the largest frame that is permitted to cross this port. This value cannot be larger than the maximum frame size configured at the bridge level. Note that the value of this parameter is different

for Ethernet than for token-ring. The Ethernet default is 1500 and the range is 64-1500.

4.4.1.6 ATM Port Parameters for Token-Ring

The ATM virtual token ring port configuration panel as shown in Figure 102, allows you to configure the following parameters:



The image shows a software configuration window titled "ATM Virtual Token Ring Port Configuration". It contains several input fields and radio buttons for configuring an ATM port. The "Port name (0-32 chars):" field is set to "Port 5 (Virtual)". The "MAC address format:" has two radio buttons: "Non-canonical" (selected) and "Canonical". The "MAC address to use for LAN Emulation" section has two radio buttons: "Universal" (selected) and "Local", each followed by an empty text box. The "Spanning tree initial port state:" has two radio buttons: "Enabled" (selected) and "Disabled". The "Ring number (1-FFF):" is set to "5" and the "Maximum frame size:" is set to "4399" with a dropdown arrow. Below these are four buttons: "Spanning tree...", "Source route filters...", "LAN emulation...", and "ATM physical port...". At the bottom are "OK", "Cancel", and "Help" buttons. A status bar at the very bottom reads "ATM/LAN Bridge".

Figure 102. The ATM Virtual Token Ring Port Configuration Panel

- MAC address format

This parameter informs the IBM 8281 whether the MAC address provided is in canonical or non-canonical format. In non-canonical format, the most significant bit is first within each byte. This format is used for token-ring networks. In canonical format, the least significant bit is first within each byte. This format is used for Ethernet.

- Ring number (1-FFF)

The parameter is used to identify the segment number of the token-ring LAN attached to this port. When you configure a ring number, be sure that all the other bridges on the network are configured with the same ring number for this ring. If two or more bridges are configured with different ring numbers for the same ring, traffic will not be forwarded as expected. The IBM 8281 does not inform you if you have made this configuration error.

- Maximum frame size

This parameter specifies the size in bytes of the largest frame that is permitted to cross this port. This value cannot be larger than the maximum frame size configured at the bridge level, and the range is 516-17749.

Additional Choices for Token-Ring and Ethernet

On both the token-ring and Ethernet panels there is a link to the Bridge-wide ATM Configuration panel, as well as configuration panels for the Virtual Token-Ring/Ethernet Port Spanning Tree and Port Source-Route/Transparent bridging filter configuration (source route filters/transparent bridging filters).

By clicking the **LAN emulation...** button, the ATM Port LAN Emulation panel as shown in Figure 103 appears:

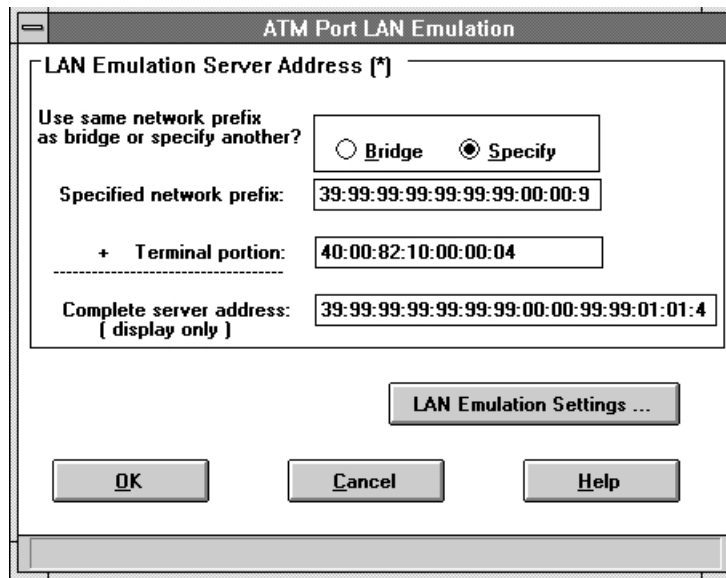


Figure 103. The ATM Port LAN Emulation Configuration Panel

These parameters are required to enable the ATM bridge to communicate with the LAN Emulation server.

- Complete server address

This value consists of a 13-byte local network prefix and a 7-byte terminal portion of the 20-byte ATM network address of the LAN Emulation server. Its value is determined by the values entered in the Use same network prefix as bridge or specify another? and Terminal portion parameters that follow.

- Use same network prefix as bridge or specify another?

The choices are Bridge and Specify, and the default value is Bridge.

If the ATM LAN Emulation server and the ATM bridge are on the same ATM switch, you should choose Bridge. In this case, the ATM switch tells the ATM bridge what the network prefix is, using the Interim Local Management Interface (ILMI) address register. The ATM bridge will use that network prefix to address the LAN Emulation server.

If you choose Specify, you must provide the complete ATM address of the LAN Emulation server. In this parameter, you must enter a 13-byte hexadecimal value for the network prefix of the LES.

- Terminal portion

This is the 7-byte ESI of the LAN Emulation server.

For both bridges, the Specify setting was used, even though they are connected to the same switch to which each LES is connected. The advantage of specifying

the ATM address of the LES is realized if and when you move the 8281 or MSS to another switch, in which case there is no need to reconfigure the 8281. So, the network prefix will be 39:99:99:99:99:99:00:00:99:99:01:01.

The Terminal portion, for example, the ESI of the LES, will be different according to the ELAN the bridges will be in. The ESI of the 8281eth2 ELAN's LES is 40:00:82:10:00:00:06. The ELAN, and the LES for the token-ring 8281, has not been created yet, so the configuration of the ESI for this bridge will be done later.

By clicking the **LAN Emulation Settings...** button, the LAN Emulation Settings panel in Figure 104 is displayed.

LAN Emulation Settings

Control time-out (10-300 seconds) : 120

VCC time-out (1 - 65,535 seconds) : 1200

Flush time-out (1-4 seconds) : 4

Path Switching Delay (1-8 seconds) : 6

Connection Completion timeout (1-10 seconds) : 4

Max LE_ARP Response time (1-30 seconds) : 1

Max LE_ARP Retry count (0-2 retries) : 1

Max Unknown frame count (1-10 frames) : 10

Data Direct VCC Up after control failure (0-3600) : 0

Emulated LAN name (0-32 chars) : 8281eth2

LE_ARP cache aging timeout

Aging Time (also used for TB filtering database): 300

Forward delay time (also used for spanning tree): 15

OK Cancel Help

Emulated LAN name

Figure 104. The LAN Emulation Settings Panel

This dialog defines many of the LAN emulation settings that apply to the LAN Emulation Client (LEC).

Default values may also be used for these parameters, unless a specific circumstance exists in your network that requires one or more of them to be changed. We also used the default values in our configuration.

4.5 Adding an IBM 8271

This section will show how to add an IBM 8271 Model 108 to the ATM backbone via an ATM uplink UFC. First we will create an Ethernet ELAN, called 8271eth3, on the MSS. We will also create a LEC on the MSS with no IP routing enabled and connect it via transparent-bridging to an additional LEC in the 8274eth1 ELAN. Then we will connect the IBM 8271 to an IBM 8260 155 Mbps ATM port and configure one LEC on this ATM uplink to join the 8271eth3 ELAN. To provide IP connectivity to the other IP subnets, the 8271eth3 ELAN will be in the same IP

subnet as the 8274eth1 ELAN, 192.168.25.0. Figure 105 shows the physical layout of our network with the addition of the 8271.

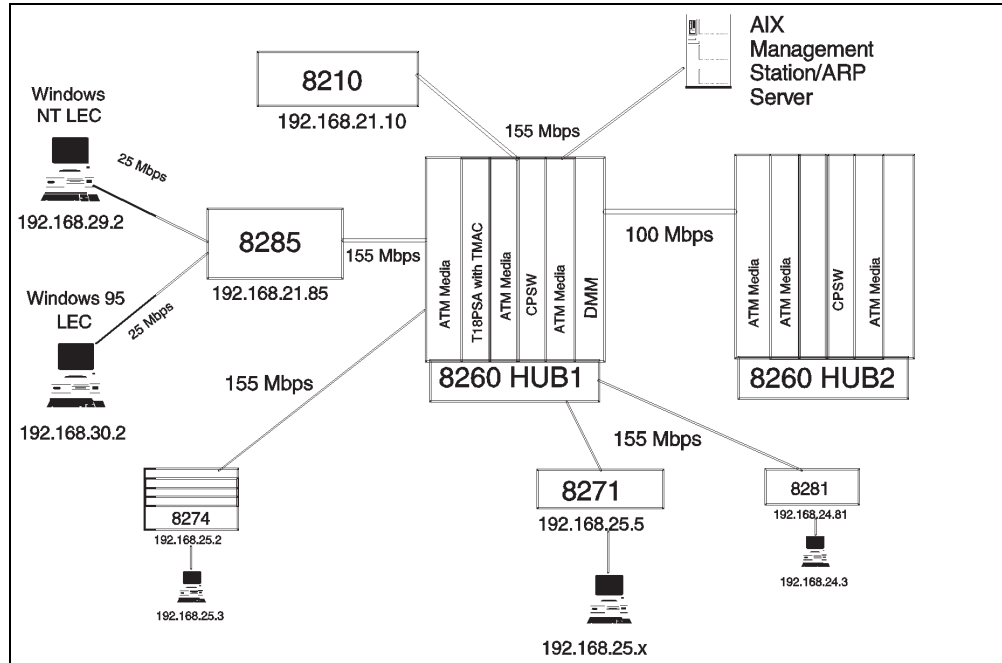


Figure 105. Physical View of 8271 Connection

To provide connectivity of the IBM 8271 to the ATM backbone, we will create the 8271eth3 ELAN on the MSS. We will also configure a LEC on the MSS to enable bridging but no IP routing to this ELAN. Figure 106 shows how the 8271 LEC will connect logically to the newly configured ELAN and its relation to the rest of the network:

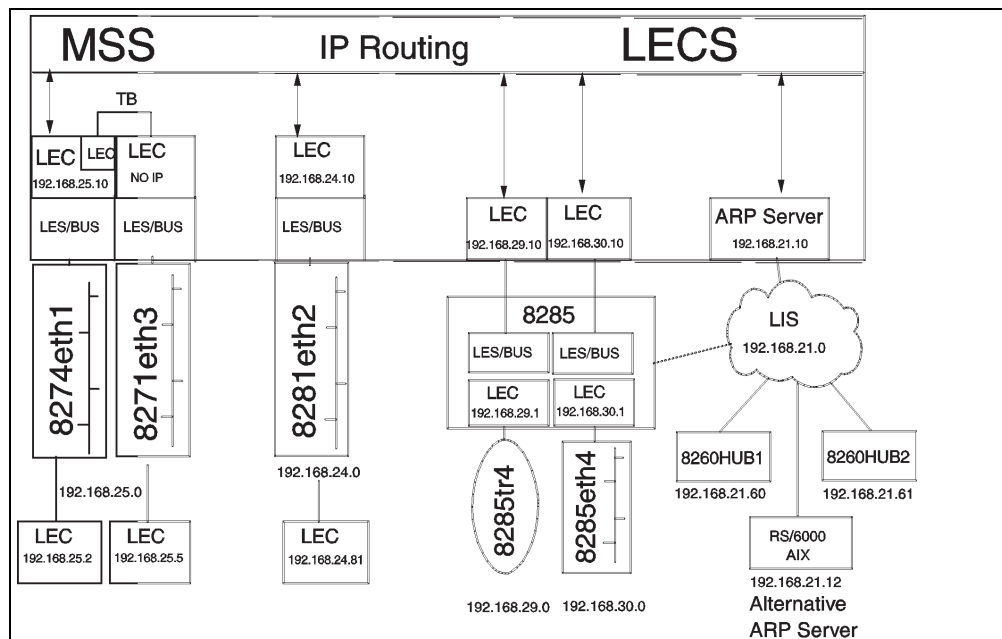


Figure 106. Logical View of the 8271 Connection

4.5.0.1 Creating the 8271eth3 ELAN

We configured the ELAN and LES/BUS function by selecting **ELANs** under **Devices...LAN Emulation** in the Navigation Window of the MSS Configuration Program and the Emulated LANs Configuration window displays:

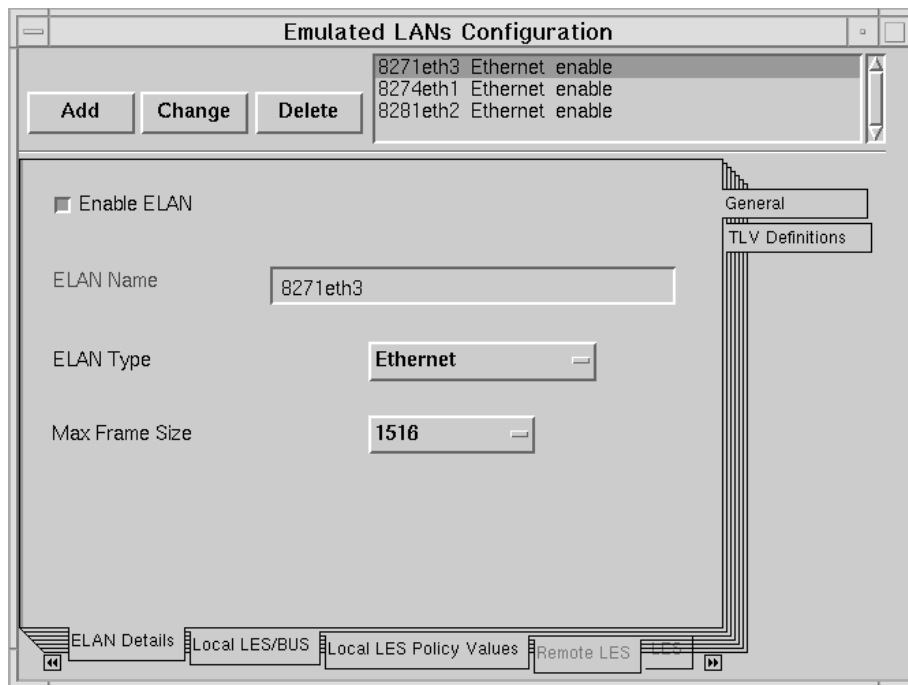


Figure 107. Configuring ELAN Name

To create the ELAN select **ELAN Details** and **General**. Ensure the Enable ELAN button is clicked. In the ELAN Name field, enter the name of the ELAN you want to create, here 8271eth3. Select **Ethernet** for the ELAN Type. The Max Frame Size will automatically change to the default value for Ethernet, which is **1516**.

To create the LES/BUS functionality select **Local LES/BUS** and **General-1**.

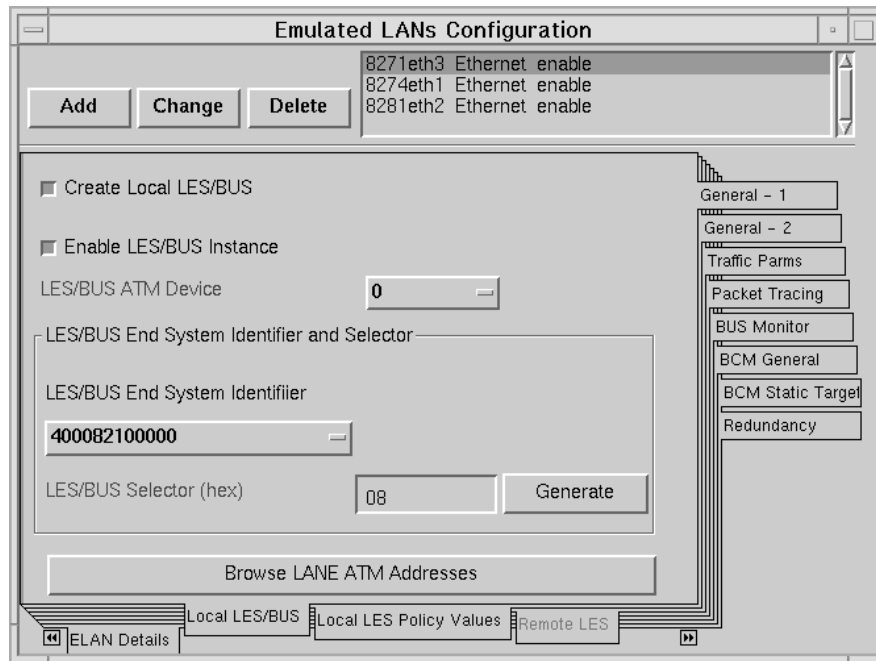


Figure 108. Configuring LES/BUS

At this window, make sure **Create Local LES/BUS** and **Enable LES/BUS Instance** are marked. At **LES/BUS ATM Device**, the LES/BUS instance should be created. If you have two ATM devices installed you can choose between 0 and 1. Here we have only one ATM device installed, so we select **0**.

In the **LES/BUS End System Identifier and Selector** section we configured the LES/BUS's ESI and Selector.

We used the locally administered ESI **400082100000**.

To configure the **LES/BUS Selector (hex)**, click **Generate** to select the next available Selector for this address, here **08**.

All other parameters can be left at their default values. Click **Add** to save this ELAN entry.

Note

If you want to enable the BCM for this ELAN, you must first set the Fast BUS mode operation on the Local LES/BUS and General-2 menu to System.

4.5.0.2 Creating a LEC for the 8271eth3 ELAN

To enable bridging for an ELAN you must first create a LEC for this ELAN and then configure and enable bridging to and from it. To create a LEC select **LEC interfaces** under **Devices...LAN Emulation** in the Navigation Window of the MSS Configuration Program and the LEC Interfaces window is displayed.

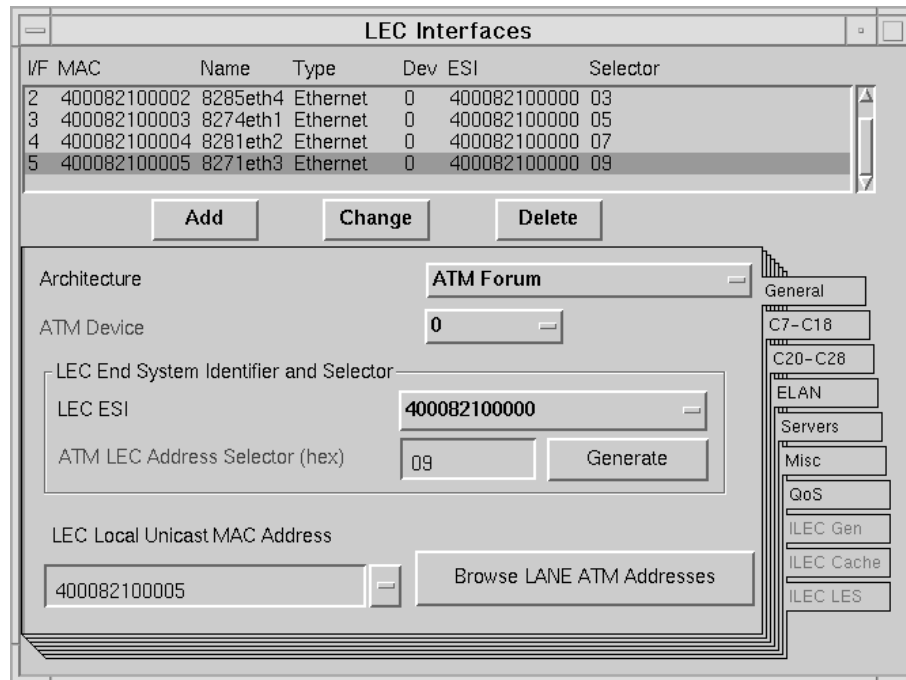


Figure 109. Configuring the LEC

By selecting **General** you can configure the following parameters:

- Architecture
Here **ATM Forum** was selected.
- ATM Device
Here we can only select **0**.
- LEC End System Identifier and Selector
 - LEC ESI
400082100000 was selected as the locally administered address.
 - ATM LEC Address Selector (hex)
Create by clicking **Generate** to select the next available Selector for this address, here **09**.
- LEC Local Unicast MAC Address
Used as a MAC address in the ELAN. If you want to enable bridging between ELANs this has to be unique; **400082100005** was defined.

To assign the LEC to the correct ELAN, select **ELAN**. The following window is displayed.

I/F	MAC	Name	Type	Dev	ESI	Selector
2	400082100002	8285eth4	Ethernet	0	400082100000	03
3	400082100003	8274eth1	Ethernet	0	400082100000	05
4	400082100004	8281eth2	Ethernet	0	400082100000	07
5	400082100005	8271eth3	Ethernet	0	400082100000	09

Buttons: Add, Change, Delete

ELAN Name: 8271eth3

Create ELAN Assignment Policies

ELAN Type: Ethernet

Max Frame Size: 1516

Tabs: General, C7-C18, C20-C28, ELAN, Servers, Misc, QoS, ILEC Gen, ILEC Cache, ILEC LES

Figure 110. Assigning the LEC to an ELAN

At this window you select the ELAN Name that the LEC should join, either by typing the name in or by selecting the correct ELAN from the pull-down menu.

Note

When you assign the first LEC to this ELAN you have to click **Create ELAN Assignment Policies** and select the ELAN name to create the assignment policy.

If the ELAN was created on this MSS the ELAN Type and Max Frame Size parameters automatically adjust to the correct values for this ELAN. If not, you have to select the correct parameters for this specific ELAN.

In 4.1, “Configuring LECS Support” on page 81 we described four ways for a LEC to find its LES. For this LEC we chose to request the address from a LECS by using the well known address. To configure this, select **Servers** and the following window appears.

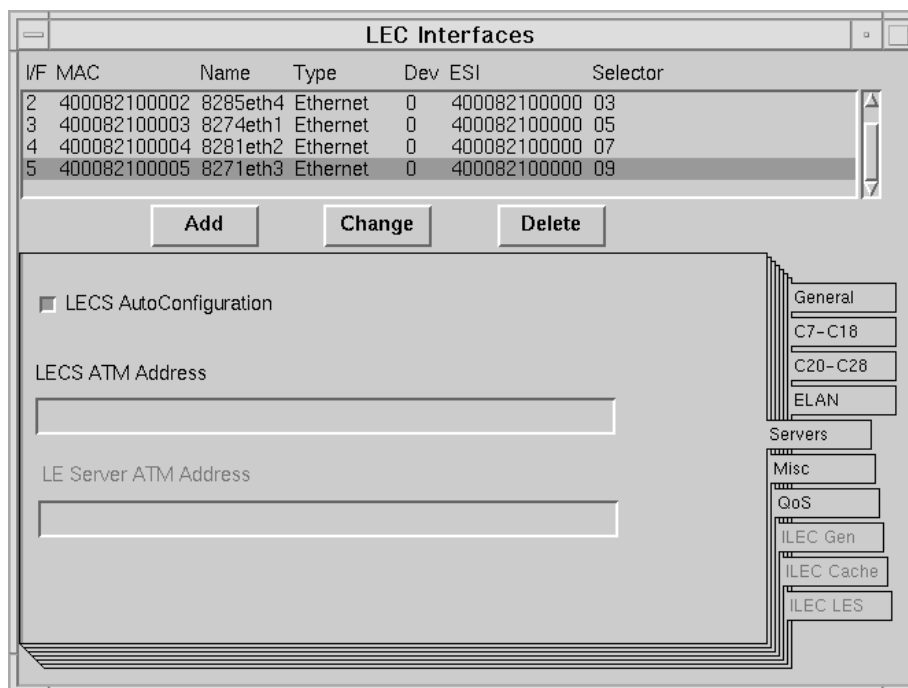


Figure 111. Configuring LEC to Join LES with WKA

Click the **LECS AutoConfiguration** button.

All other parameters can be left at their default values. Click **Add** to save this LEC entry.

Now we have created an ELAN with LES/BUS and a LEC that will join this ELAN.

4.5.0.3 Configuring Transparent Bridging

To configure and enable transparent-bridging for this ELAN we first create a bridging LEC in the 8274eth1, enable and configure transparent bridging for both LECs, then enable bridging and configure the global parameters for transparent-bridging on the MSS.

Note

You have to configure an additional LEC in the 8274eth1 ELAN; otherwise, IP will not be bridged but routed. And the 8271eth3 ELAN has no router arm, so there will be no IP connectivity between these ELANS.

The LEC we are going to create for the 8274eth1 ELAN must not have an IP address; otherwise, IP will also be routed instead of bridged. We created this LEC as shown in 4.3.1.2, “Creating a LEC for the 8274eth1 ELAN” on page 100, but we didn't configure any IP address for this LEC. To configure bridging for each of the two LECs first select **Interfaces** under Bridging in the Navigation Window of the MSS Configuration Program.

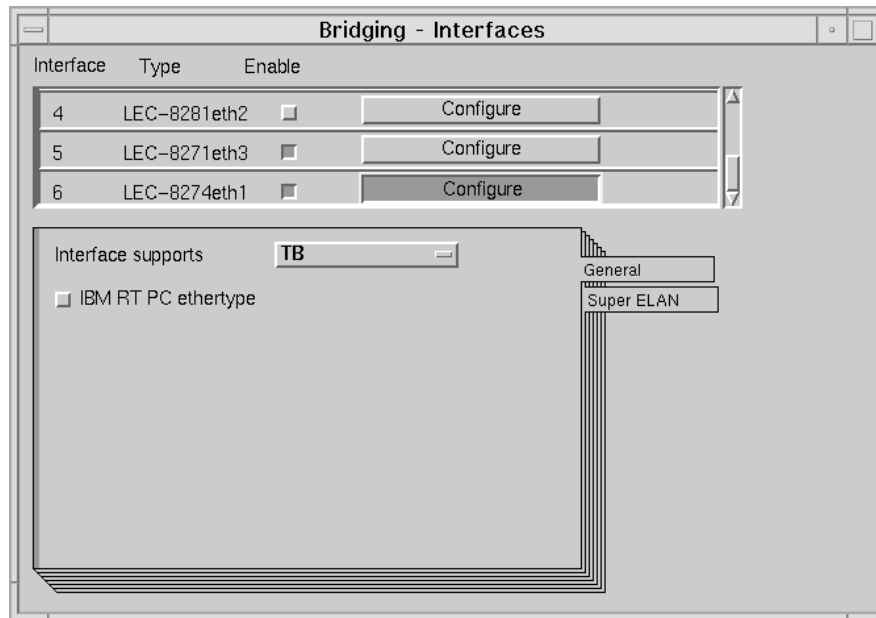


Figure 112. Enabling and Configuring Bridging for a LEC

Here we enable bridging for both LECs by clicking the **Enable** button for each LEC. Also click **Configure** next to the one LEC enabled for bridging and select **General**. Here you can choose the kind of bridging you want to enable:

- TB: Transparent Bridging
- SRB: Source-Route Bridging
- SRT: Source-Route Transparent Bridging
- SR-TB: Source-Route Translational Bridging
- No Bridging

You can choose between the different kinds of bridging the LEC interface supports. Here it is only TB and No Bridging, so we select **TB**. Do this for the 8271eth3 LEC and the 8274eth1 bridging LEC.

After this we have to make sure bridging is enabled and the Filtering database has the correct size. You do this by selecting **General** under **Bridging** in the Navigation Window of the MSS Configuration Program.

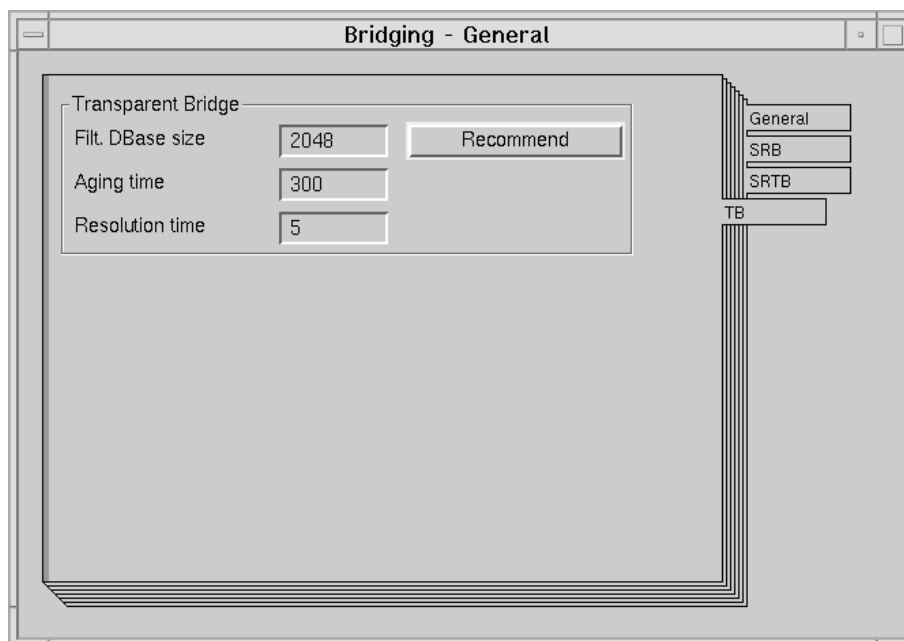


Figure 113. Configuring Transparent Bridging

Select **General** and make sure **Enable Bridging** is marked.

Select **TB** to configure transparent bridging. Click **Recommend** next to Filt. DBase size to configure the proper size for the Filtering database. All other values can be left at their defaults.

Next, upload the configuration file and reload the MSS.

4.5.1 Configuring the IBM 8271

First we configured the IBM 8271's IP and SNMP parameters. The IP address is 192.168.25.5, and the default gateway will be 192.168.25.10. The trap receivers are the management stations. The rest of the configuration is left at the default values.

To install the ATM uplink UFC, the microcode-level of the IBM 8271 must be at least 3.1. We were at microcode-level 3.5.2. After installing, we connected the ATM uplink to a 155 Mbps port on the 8260, which is configured and enabled as a UNI port.

To configure the ATM uplink and LEC from the console screen choose **Non-Ethernet Ports Menu...** from the Main Menu.

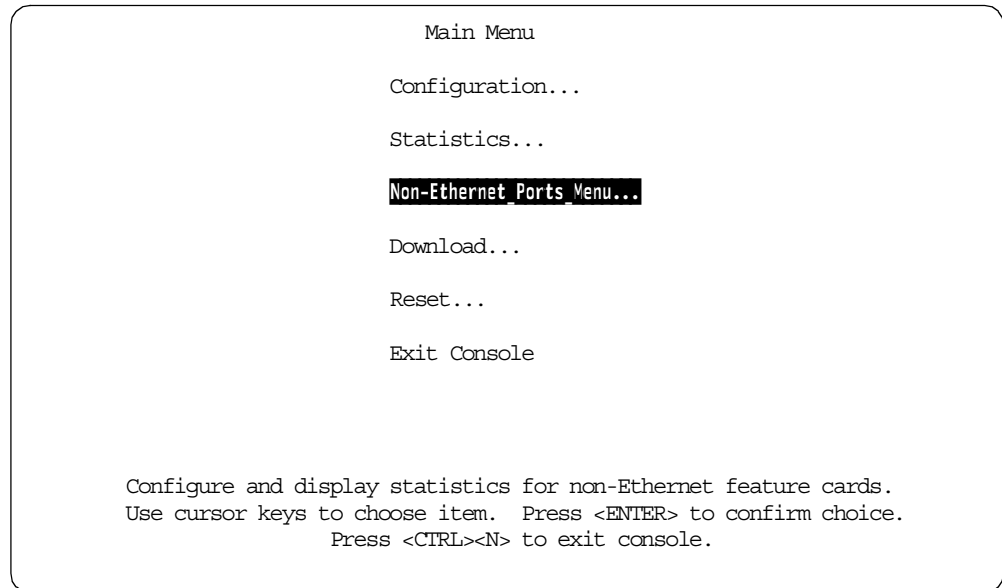


Figure 114. Main Menu

The following screen appears and we choose the port where the ATM Fiber UFC is installed, here port 1-1. This port number might differ from your configuration.

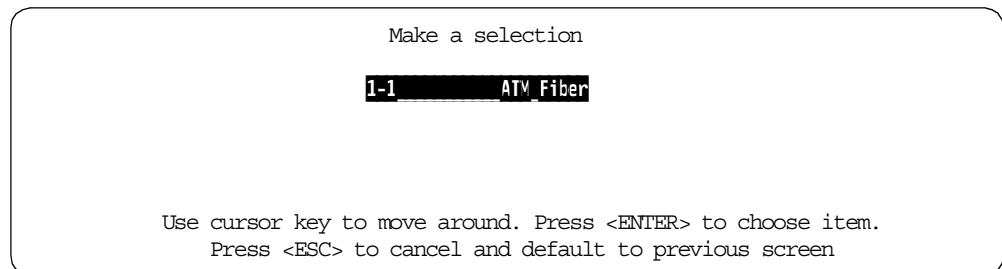


Figure 115. Non-Ethernet Ports Menu

The following screen shows the ATM Port Menu. Here you can choose between configuring the ATM physical port, **Configure ATM Port Parameters...** or the **Configure LAN Emulation Client (LEC)...**

Slot 1
Port is UP

ATM Port Menu

ATM Port Configuration
 Configure ATM Port Parameters...
 Configure LAN Emulation Client (LEC)...

ATM Port Status/Statistics
 ATM Product Information...
 ATM Port Status/Statistics...
 LAN Emulation Client (LEC) Status/Statistics...

Return To Previous Menu

Return to the previous menu.
 Use cursor keys to choose item. Press <ENTER> to confirm choice.
 Press <CTRL><N> to return to Main Menu.

Figure 116. ATM Port Menu

You can leave the ATM port parameters at their default values and configure the IBM 8271's LEC by choosing the appropriate menu entry.

The Configure LAN Emulation Client (LEC) menu appears, as seen in Figure 117:

Slot 1
Port is UP

Configure LAN Emulation Client (LEC)

LEC	Domain Name	Domain Ports	Emulated LAN Name	Status
101	default			Adm. Disabled
102	default			Adm. Disabled
103	default			Adm. Disabled
104	default			Adm. Disabled
105	default			Adm. Disabled
106	default			Adm. Disabled
107	default			Adm. Disabled
108	default			Adm. Disabled
109	default			Adm. Disabled
110	default			Adm. Disabled
111	default			Adm. Disabled
112	default			Adm. Disabled
113	default			Adm. Disabled
114	default			Adm. Disabled

Return More Quick Config Advanced Config Reset Enable Disable

Choose the LEC domain name and specify the ELAN name (minimal configuration).
 Use cursor keys to choose item. Press <ENTER> to confirm choice.
 Press <CTRL><N> to return to Main Menu.

Figure 117. Configure LAN Emulation Client (LEC)

Select **Quick Config** to configure a LEC for the IBM 8271. At the bottom of the screen, Enter a LEC Index (between 101 and 132): appears. Enter the first available LEC index; for our example it's 101.

On the screen that appears you define all the values needed to enable the LEC and allow it to join an ELAN.

Quick Config LAN Emulation Client (LEC)

LEC Index 101

Slot 1
Port is UP

Domain Name	default	1
ELAN Name	8271eth3	2
LES Address	Get from LECS (Automatic)	3
ESI	400082710000	4

For Quick Config, specify the Domain Name that the LEC is assigned to. Optionally, configure the other parameters as necessary for your LECS/LES/BUS implementation.

Save and Return Cancel and Return

Assign the LEC to a domain. Select this to choose a domain from a list.
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

Figure 118. Quick Config LAN Emulation Client (LEC)

Notes:

- 1 Domain Name - The virtual switch for which the LEC is defined, here default.
- 2 ELAN Name - The name of the ELAN the LEC will join, here 8271eth3.
- 3 LES Address - Define either the LES's ATM address, or the LEC will obtain the LES address from a LECS; we defined *Get from LECS (Automatic)*.
- 4 ESI - The End System Identifier of the LEC, either burned-in or locally administered. We defined 400082710000 (locally administered).

After configuring these values, choose **Save and Return** to save them.

Back at the Configure LAN Emulation Client (LEC) menu you must enable the LEC you configured, by choosing **Enable** and typing the LEC's index.

Configure LAN Emulation Client (LEC)

Slot 1
Port is UP

LEC Index	Domain Name	Domain Ports	Emulated LAN Name	Status
101	default	1 2 3 4 5 6 7 8	8271eth3	up
102	default			Adm. Disabled
103	default			Adm. Disabled
104	default			Adm. Disabled
105	default			Adm. Disabled
106	default			Adm. Disabled
107	default			Adm. Disabled
108	default			Adm. Disabled
109	default			Adm. Disabled
110	default			Adm. Disabled
111	default			Adm. Disabled
112	default			Adm. Disabled
113	default			Adm. Disabled
114	default			Adm. Disabled

Return
More
Quick Config
Advanced Config
Reset
Enable
Disable

Choose the LEC domain name and specify the ELAN name (minimal configuration).
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

Figure 119. Configure LAN Emulation Client (LEC)

If the status of the LEC is up, then the LEC has joined its LE and is operational.

Note

If the LEC will not join its LES and the configuration is correct, reset the LEC at the Configure LAN Emulation Client (LEC) menu. If the status of the LEC is still down try to reset the port at the Configure ATM Port Parameters menu.

4.6 Adding an IBM 8272 to the Backbone

Added next to the ATM backbone will be an IBM 8272 Model 108 via an ATM Uplink UFC. First we will create a token-ring ELAN, called 8272tr3, on the MSS. We will also create a LEC on the MSS with IP routing enabled and connect it via source-route bridging to the LEC in the 8285tr4 ELAN. The IP address of the LEC will be 192.168.27.10 and the segment numbers 721, for the 8272tr3 ELAN, and 851, for the 8285tr4 ELAN. The IP address assigned to the 8272 LEC will be 192.168.27.5

We will connect the IBM 8272 to an IBM 8260 155 Mbps ATM port and configure one LEC on this ATM uplink to join the 8272tr3 ELAN. This LEC will also be in the 192.168.27.0 IP subnet.

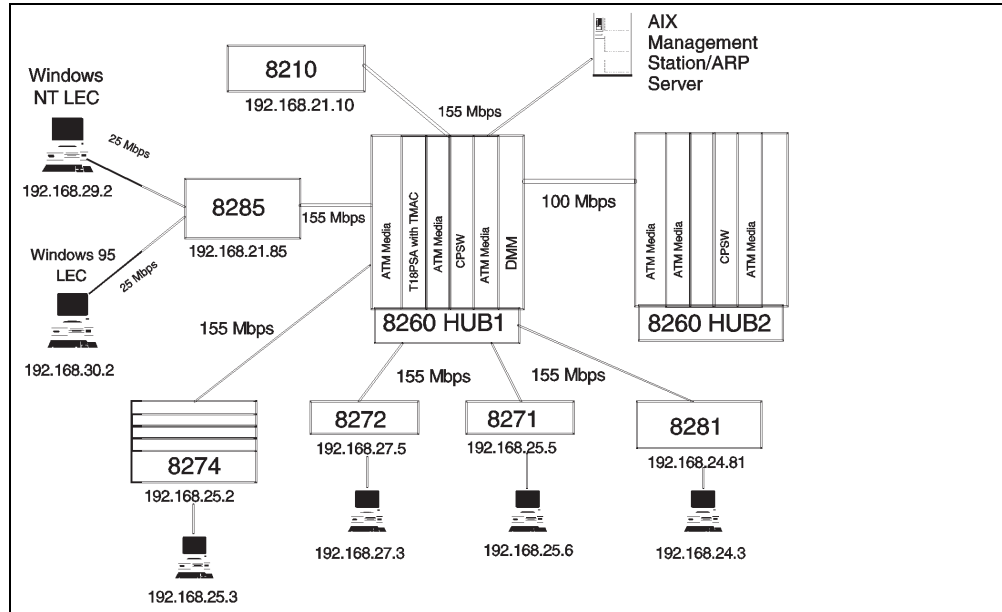


Figure 120. Physical View of the 8272 Connection

Figure 121 shows the logical connectivity of the IBM 8272 to the ATM backbone. We will create the 8272tr3 ELAN on the MSS. We will also configure a LAN Emulation Client (LEC) on the MSS to enable IP routing between ELANs and LISs.

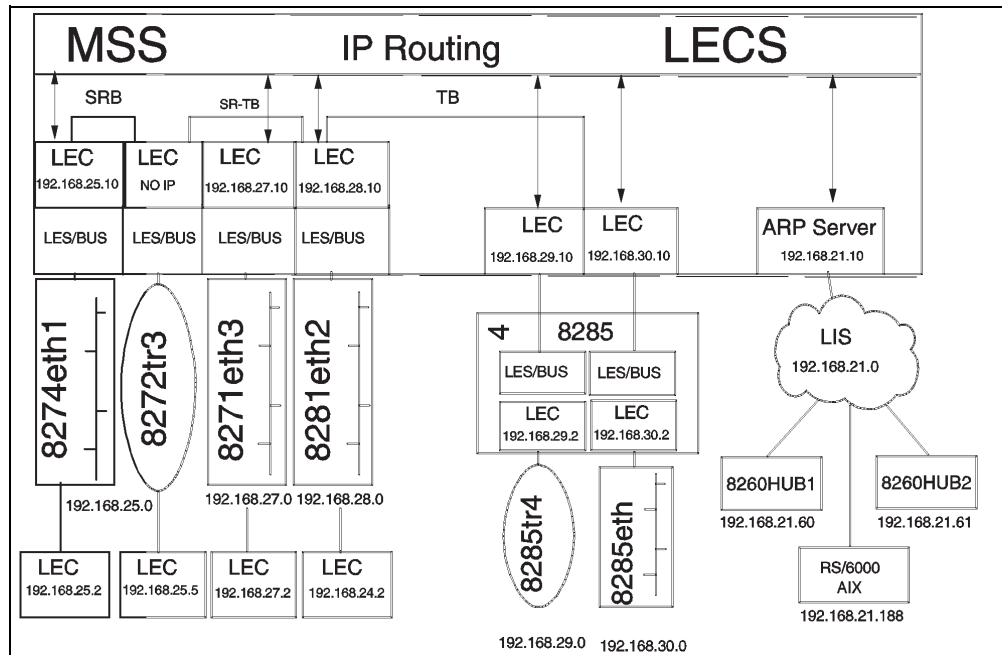


Figure 121. Logical View of the 8272 Connection

4.6.1 Configuring the MSS

The base configuration has already been shown in 3.8.1, “MSS Base Configuration” on page 70, so we will just describe the ELAN and LEC configuration.

4.6.1.1 Creating the 8272tr3 ELAN

We configured the ELAN and LES/BUS function by selecting **ELANs** under **Devices...LAN Emulation** in the Navigation Window of the MSS Configuration Program. The Emulated LANs Configuration window is displayed.

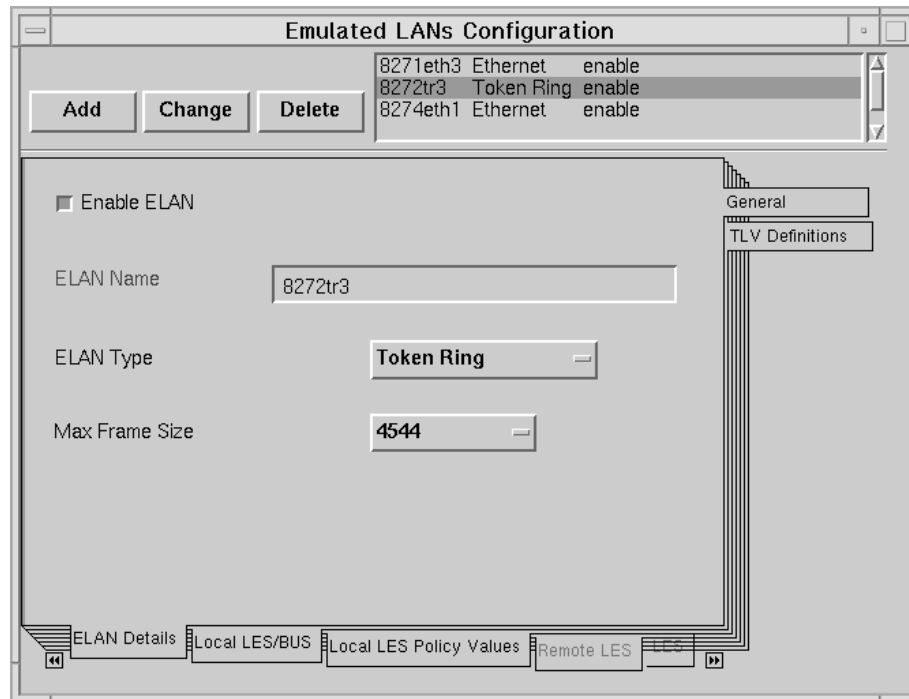


Figure 122. Configuring ELAN Name

To create the ELAN select **ELAN Details** and **General**. Make sure the Enable ELAN button is clicked. In the ELAN Name field fill in the name of the ELAN you want to create, here 8272tr3. Select the ELAN Type, which is either **Token Ring** or **Ethernet**. Here we selected **Token Ring**. The Max Frame Size will automatically change to the default value for token-ring, **4544**.

To create the LES/BUS functionality select **Local LES/BUS** and **General-1**.

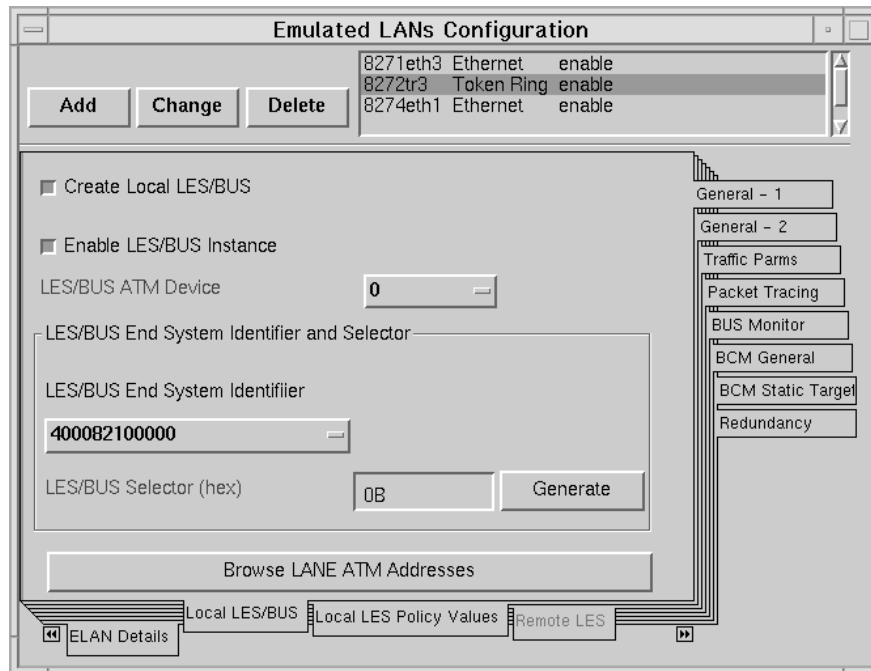


Figure 123. Configuring LES/BUS

Click **Create Local LES/BUS** and **Enable LES/BUS Instances**.

Select **0** for the LES/BUS ATM Device.

Enter the locally administered address of **400082100000**.

To configure the LES/BUS Selector (hex), click **Generate** to select the next available selector for this address, here **0B**.

All other parameters can be left at their default values. Click **Add** to save this ELAN entry.

Note

If you want to enable the BCM for this ELAN, you must first set the Fast BUS mode operation on the Local LES/BUS and General-2 menu to System.

4.6.1.2 Creating a LEC for the 8272tr3 ELAN

To enable IP routing for an ELAN you must first create a LEC for this ELAN and then simply assign an IP address to it. To create a LEC select **LEC interfaces** under **Devices...LAN Emulation** in the Navigation Window of the MSS Configuration Program and the LEC Interfaces window is displayed.

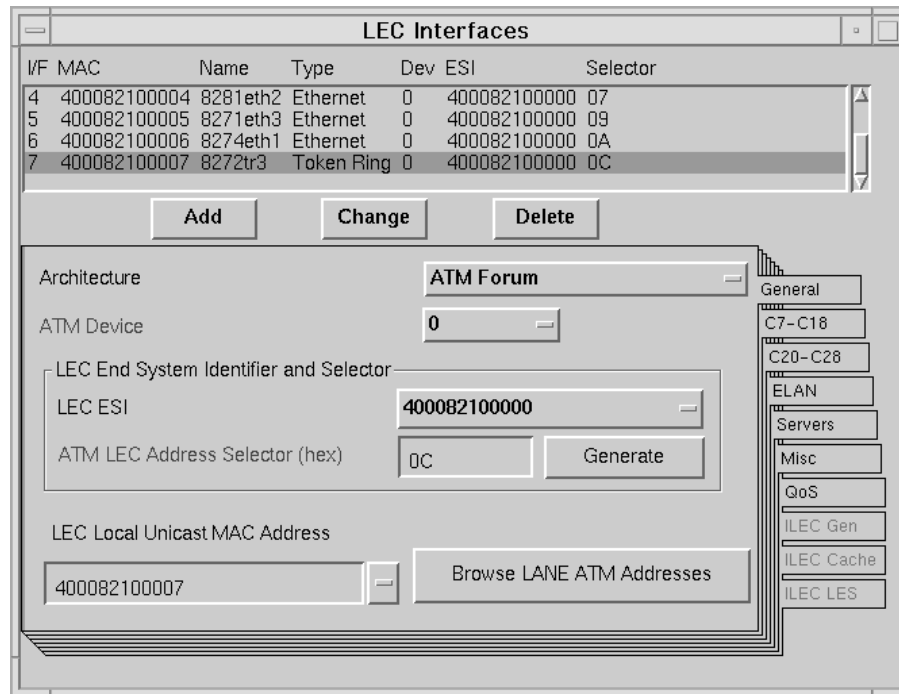


Figure 124. Configuring the LEC

By selecting **General** you can configure the following parameters:

- Architecture
 - Select **ATM Forum**.
- ATM Device
 - Select **0**.
- LEC End System Identifier and Selector
 - LEC ESI
 - Enter the locally administered address of **400082100000**.
 - ATM LEC Address Selector (hex)
 - Create by clicking **Generate** to select the next available Selector for this address, here **0C**.
- LEC Local Unicast MAC Address
 - Used as a MAC address in the ELAN. If you want to enable bridging between ELANs this has to be unique, so we defined **400082100007**.

To assign the LEC to the correct ELAN, select **ELAN**. The following window will appear.

I/F	MAC	Name	Type	Dev	ESI	Selector
4	400082100004	8281eth2	Ethernet	0	400082100000	07
5	400082100005	8271eth3	Ethernet	0	400082100000	09
6	400082100006	8274eth1	Ethernet	0	400082100000	0A
7	400082100007	8272tr3	Token Ring	0	400082100000	0C

ELAN Name: 8272tr3

ELAN Type: Token Ring

Max Frame Size: 4544

General
 C7-C18
 C20-C28
 ELAN
 Servers
 Misc
 QoS
 ILEC Gen
 ILEC Cache
 ILEC LES

Figure 125. Assigning the LEC to an ELAN

At this window, select the ELAN Name that the LEC should join, either by typing the name in or by selecting the correct ELAN from the pull-down menu, here **8272tr3** was entered with an ELAN type of Token Ring.

In 4.1, “Configuring LECS Support” on page 81 we described four ways for a LEC to find its LES. For this LEC, we chose to request the address from a LECS by using the well known address. To configure this, select **Servers** and the following window appears:

I/F	MAC	Name	Type	Dev	ESI	Selector
4	400082100004	8281eth2	Ethernet	0	400082100000	07
5	400082100005	8271eth3	Ethernet	0	400082100000	09
6	400082100006	8274eth1	Ethernet	0	400082100000	0A
7	400082100007	8272tr3	Token Ring	0	400082100000	0C

☐ LECS AutoConfiguration

LECS ATM Address

LE Server ATM Address

General
 C7-C18
 C20-C28
 ELAN
 Servers
 Misc
 QoS
 ILEC Gen
 ILEC Cache
 ILEC LES

Figure 126. Configuring LEC to Join LES with WKA

Click the **LECS AutoConfiguration** button.

All other parameters can be left at their default values; click **Add** to save this LEC entry.

Now we have created an ELAN with LES/BUS and a LEC that will join this ELAN. To enable IP routing for this ELAN, assign an IP address to this LEC. We do this by selecting **Interfaces** under **Protocols...IP** in the Navigation Window of the MSS Configuration Program and the IP interfaces window is displayed.

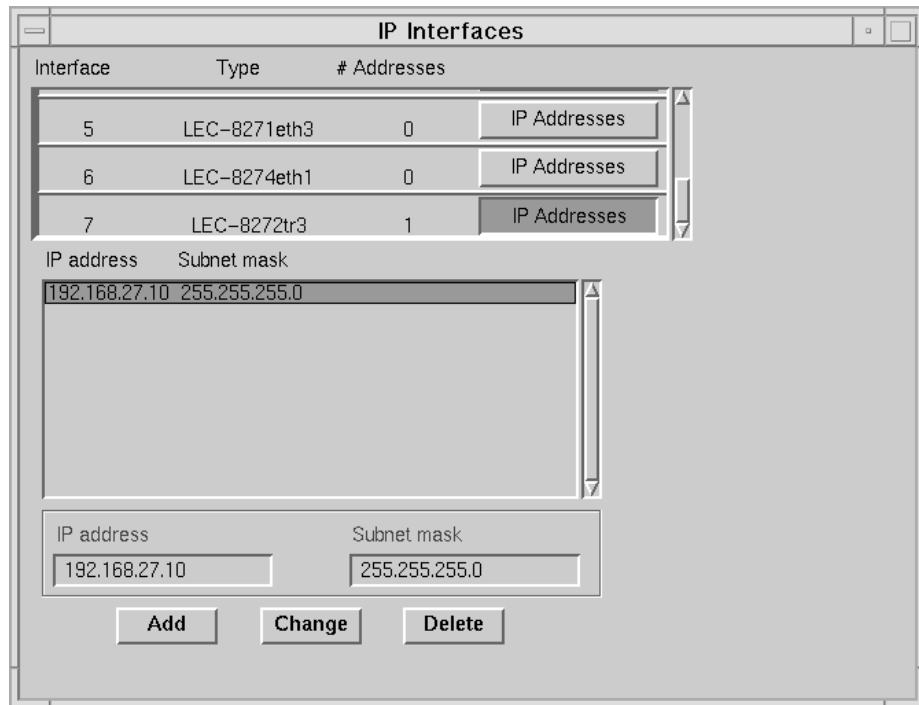


Figure 127. Assigning IP Address to LEC

At this window click **IP Addresses** next to the LEC interface we just created and type in an IP address and a subnet mask for the LEC interface. By clicking **Add** the IP address is assigned.

4.6.1.3 Configuring Source-Route Bridging

To configure and enable source-route bridging between ELANs we enable and configure source-route bridging for both LECs, then enable bridging and configure the global parameters for source-route bridging on the MSS.

Note

All IP traffic from and to this ELAN will be routed. Only non-IP traffic will be bridged.

To configure bridging for each of the two LECs first select **Interfaces** under Bridging in the Navigation Window of the MSS Configuration Program.

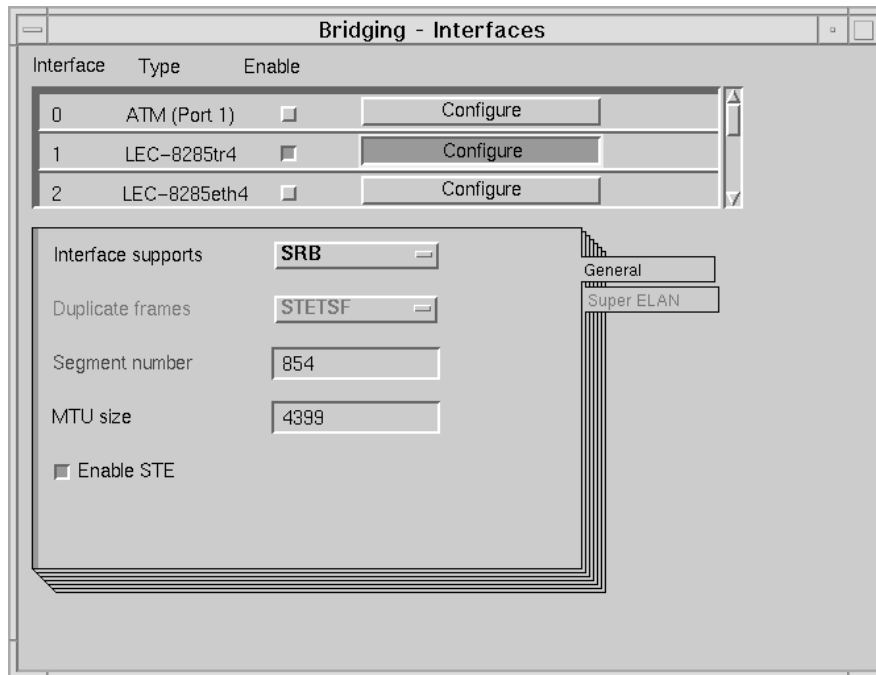


Figure 128. Enabling Bridging for a LEC

Here we enable bridging for both LECs by clicking the **Enable** button for each LEC. Then click **Configure** next to each LEC enabled for bridging and select **General**. Here you can select what kind of bridging you want to enable:

- TB: Transparent Bridging
- SRB: Source-Route Bridging
- SRT: Source-Route Transparent Bridging
- SR-TB: Source-Route Translation Bridging
- No Bridging

You can choose between the different kinds of bridging the LEC interface supports. Here we select **SRB**. Do this for the 8272tr3 LEC and the 8285tr4 LEC. Next you must also assign a segment number for this ELAN; we assigned 723 for the 8272tr3 ELAN and 854 for the 8285tr4 ELAN.

After this you have to make sure bridging is enabled and the parameters for source-route bridging are defined. This is done by selecting **General** under **Bridging** in the Navigation Window of the MSS Configuration Program.

Select **General** and ensure **Enable Bridging** is marked.

Select **SRB** to configure source-route bridging.

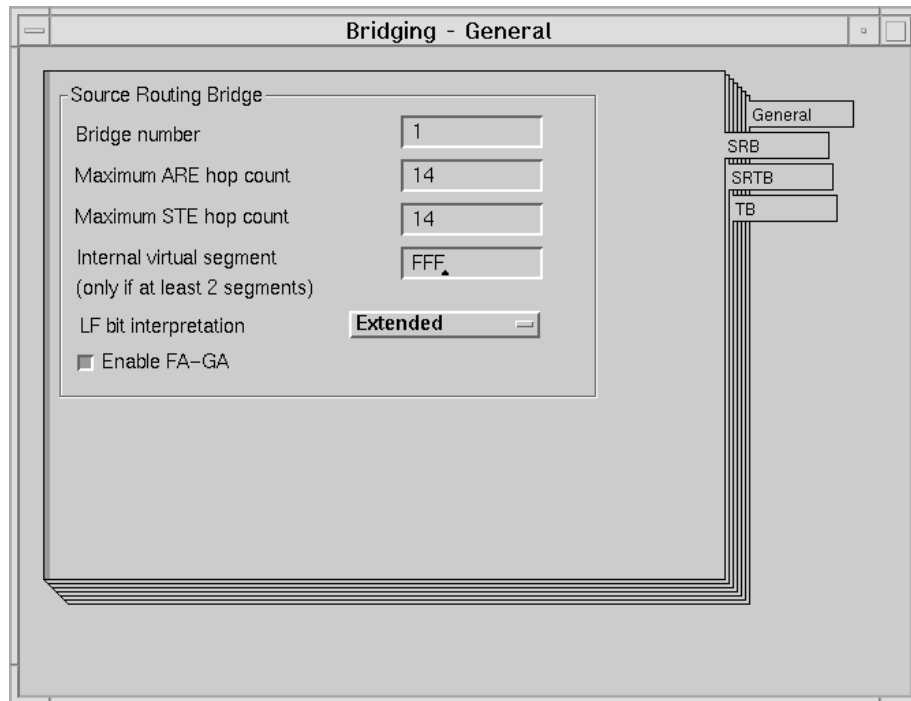


Figure 129. Configuring Source-Route Bridging

Here you can configure:

- Bridge number
Type in the number of the bridge, here 1 (default).
- Maximum ARE hop count
Gives the maximum hop count for All Route Explorer frames, here 14 (default).
- Maximum STE hop count
Gives the maximum hop count for Spanning Tree explorer frames, here 14 (default).
- Internal virtual segment
Gives the segment number of the internal virtual segment. Only used if you have more than one port configured, here **FFF**.
- LF bit interpretation
The largest frame bit interpretation can be set to **Extended** or **Basic**. This sets the number of bits in the Routing Information Field (RIF), which determines the largest frame size that can be sent over the bridge, here **Extended** (default).
- Enable FA-GA
Enables the mapping between functional and group addresses, here enabled (default).

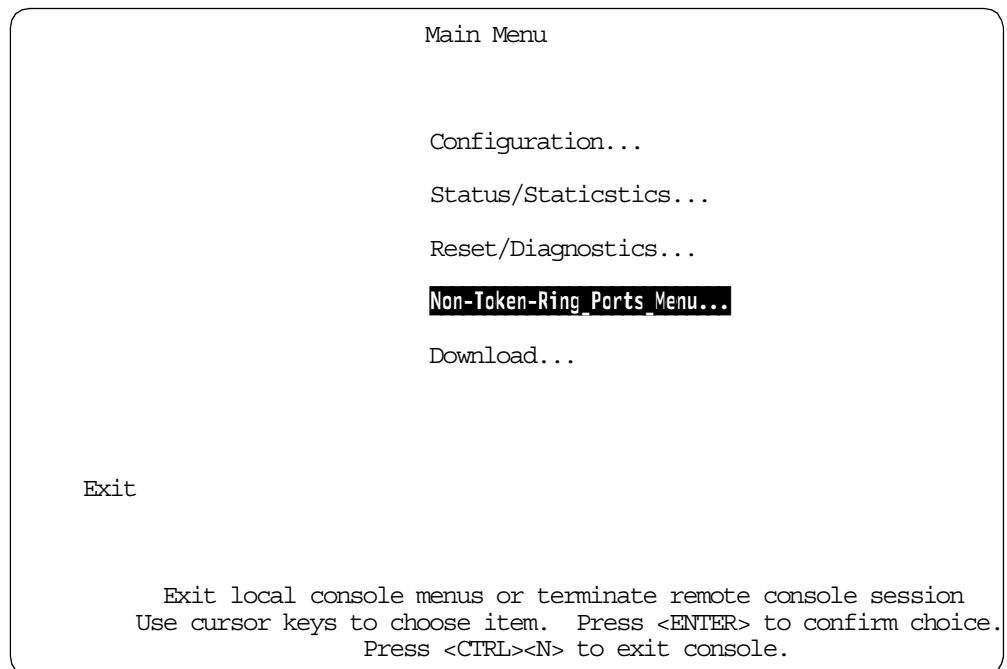
The configuration is done. Upload the configuration file and reload the MSS.

4.6.2 Configuring the IBM 8272

First we configured the IBM 8272's IP and SNMP parameters. The IP address is 192.168.27.2, and the default gateway will be 192.168.25.10. The trap receivers are the management stations. The rest of the configuration is left at the default values.

To install the ATM uplink UFC the microcode-level of the IBM 8272 must be at least 3.1. We installed 3.11. After installing we connected the ATM uplink to a 155 Mbps port on the 8260, which is configured and enabled as a UNI port.

To configure the ATM uplink and LEC choose **Non-Token-Ring Ports Menu...** from the Main Menu:



A screen similar to Figure 115 on page 143 appears. You need to select the port where the ATM Fiber UFC is installed. You do this by choosing **Select UFC** and then entering the port number of the ATM UFC, here 1-1. This port number might differ from your configuration.

The following screen shows the ATM Port Menu. Here you can choose between, **Configure ATM Port Parameters...**, or **Configure LAN Emulation Client (LEC)....**


```

ATM Port Menu
Slot 1
Port is UP

ATM Port Configuration
Configure ATM Port Parameters...

Configure LAN Emulation Client (LEC)...

ATM Port Status/Statistics
ATM Product Information...

ATM Port Status/Statistics...

LAN Emulation Client (LEC) Status/Statistics...

Return To Previous Menu

Return to the previous menu.
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

```

You can leave the ATM port parameters at their default values and configure the IBM 8272's LEC by choosing the appropriate menu entry.

The Configure LAN Emulation Client (LEC) menu appears:

```

Configure LAN Emulation Client (LEC)
Slot 1
Port is UP

LEC
Index Domain Name      Domain Ports  Emulated LAN Name      Status
101  default
102  default
103  default
104  default
105  default
106  default
107  default
108  default
109  default
110  default
111  default
112  default
113  default
114  default
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled
Adm. Disabled

Return  More  Quick Config  Advanced Config  Reset  Enable  Disable

Choose the LEC domain name and specify the ELAN name (minimal configuration).
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

```

Select **Quick Config** to configure a LEC for the IBM 8272. At the bottom of the screen Enter a LEC Index (between 101 and 132): appears. Enter the first available LEC index; for our example it's 101.

On the screen that appears you define all the values needed to enable the LEC to join an ELAN.

Quick Config LAN Emulation Client (LEC)

LEC Index 101

Slot 1
Port is UP

Domain Name	default	1
ELAN Name	8272tr3	2
LES Address	Get from LECS (Automatic)	3
ESI	400082720000 (Locally administered)	4

For Quick Config, specify the Domain Name that the LEC is assigned to. Optionally, configure the other parameters as necessary for your LECS/LES/BUS implementation.

Save and Return Cancel and Return

Assign the LEC to a domain. Select this to choose a domain from a list.
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

Notes:

- 1** Domain Name - The virtual switch for which the LEC is defined, here default.
- 2** ELAN Name - The name of the ELAN the LEC will join, here 8272tr3.
- 3** LES Address - You can define either the LES's ATM address or the LEC will obtain the LES address from a LECS; we define Get from LECS (Automatic).
- 4** ESI - The End-System-Identifier of the LEC is either burned-in or locally-administered; we defined 400082720000 (locally administered).

After configuring these values choose **Save and Return** to save them.

Back at the Configure LAN Emulation Client (LEC) menu you must enable the LEC you configured by choosing **Enable** and typing the LEC's index.

Configure LAN Emulation Client (LEC)

Slot 1
Port is UP

LEC Index	Domain Name	Domain Ports	Emulated LAN Name	Status
101	default	3 4 5 6 7 8	8272tr3	up
102	default			Adm. Disabled
103	default			Adm. Disabled
104	default			Adm. Disabled
105	default			Adm. Disabled
106	default			Adm. Disabled
107	default			Adm. Disabled
108	default			Adm. Disabled
109	default			Adm. Disabled
110	default			Adm. Disabled
111	default			Adm. Disabled
112	default			Adm. Disabled
113	default			Adm. Disabled
114	default			Adm. Disabled

Return
More
Quick Config
Advanced Config
Reset
Enable
Disable

Choose this to administratively enable a LEC.
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

If the status of the LEC is up, the LEC has joined its LES and is operational.

Note

If the LEC will not join its LES and the configuration is correct, reset the LEC in the Configure LAN Emulation Client (LEC) menu. If the status of the LEC is still down try to reset the port at the Configure ATM Port Parameters menu.

4.7 Adding an IBM 2210/2216 to the Backbone

This section briefly describes the configuration steps to connect the 2210 to the ATM backbone.

Figure 130 on page 160 shows the Navigation Window of the 2216 configuration program. To configure ATM, start by selecting **Slots**. This allows you to add the adapters as they are physically installed in the 2216. The ATM adapter must be added in the configuration program before the interface parameters or LE clients can be configured.

Note: This step is not necessary for the 2210.

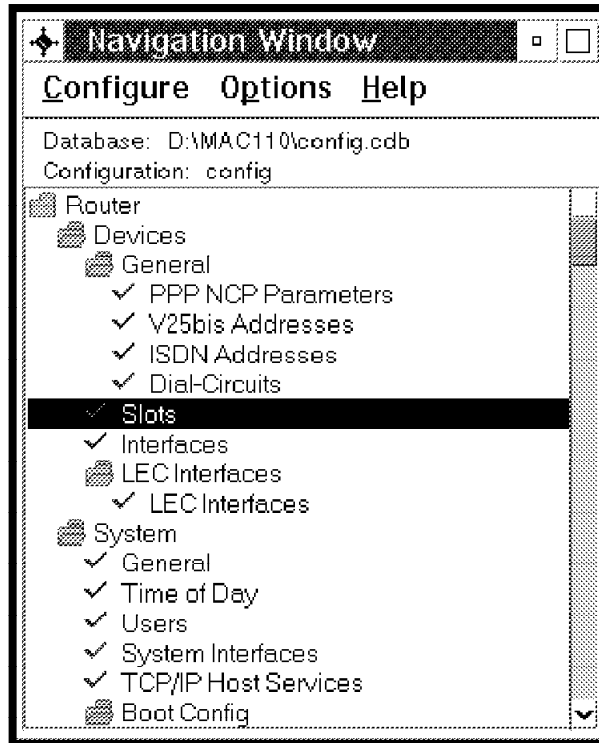


Figure 130. Navigation Window of the Configuration Program

Next, select **Interfaces** from the Navigation Window. This will allow you to configure any of the interfaces already added under the Slots section.

Select the interface that you want to configure and you will see a screen like the one shown in Figure 131 on page 161.

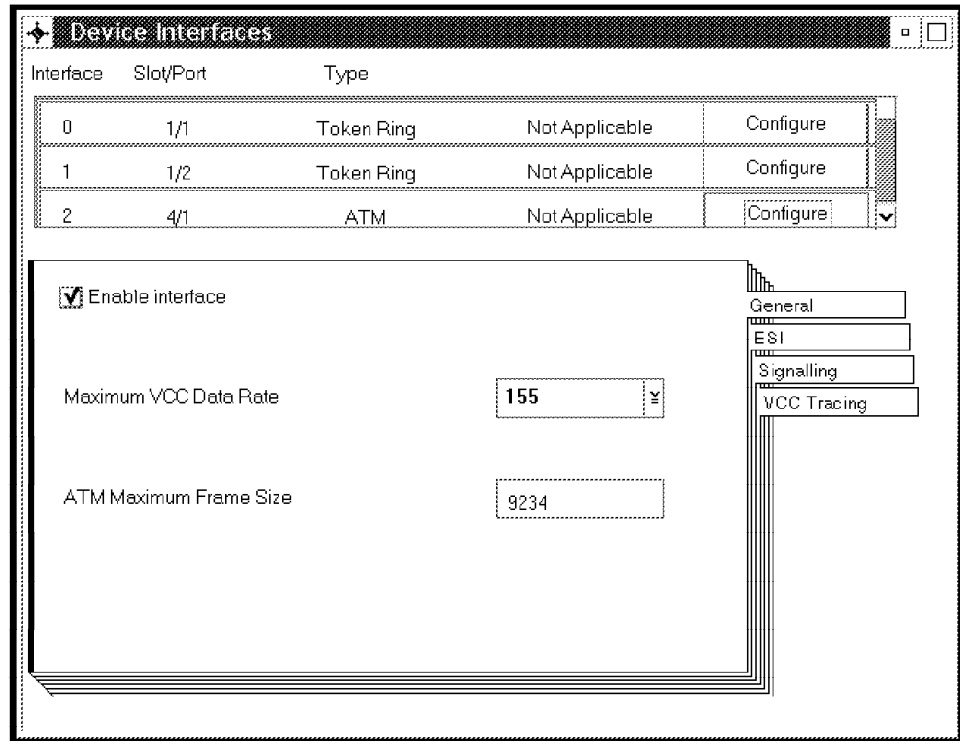


Figure 131. Configuring the ATM Interface: General

Figure 131 reveals the three submenus available after clicking **ESI**, **Signalling** and **VCC Tracing**, respectively. These are shown next.

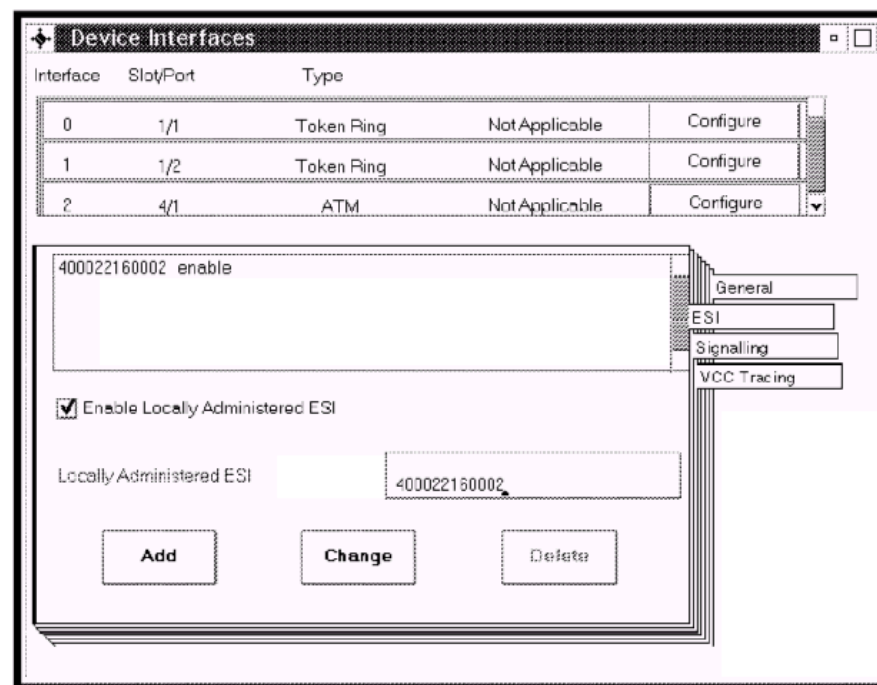


Figure 132. Configuring the ATM Interface: ESI

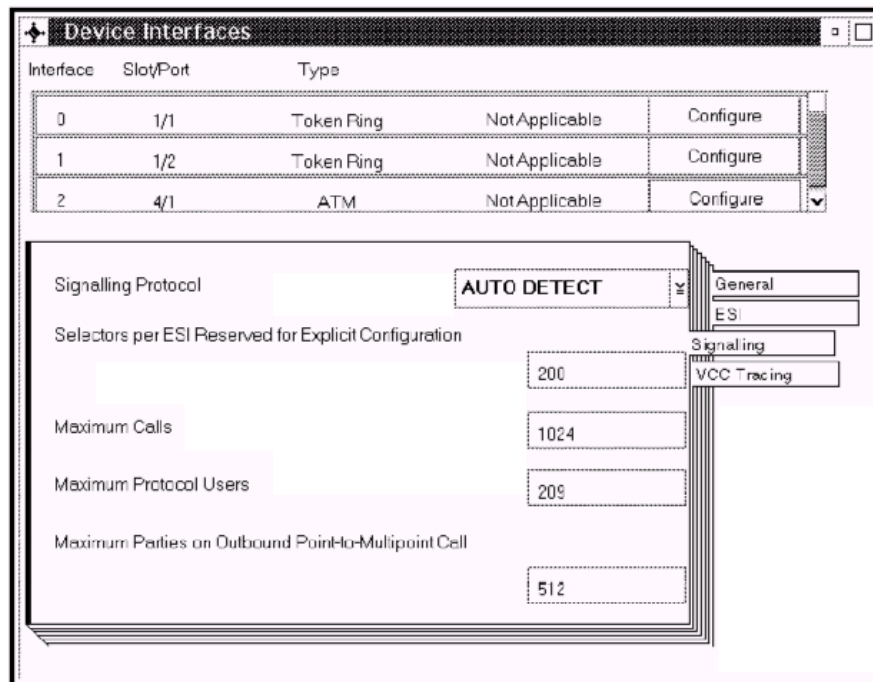


Figure 133. Configuring the ATM Interface: Signalling

Figure 134 reveals the three submenus available after clicking **ESI**, **Signalling** and **VCC Tracing**, respectively.

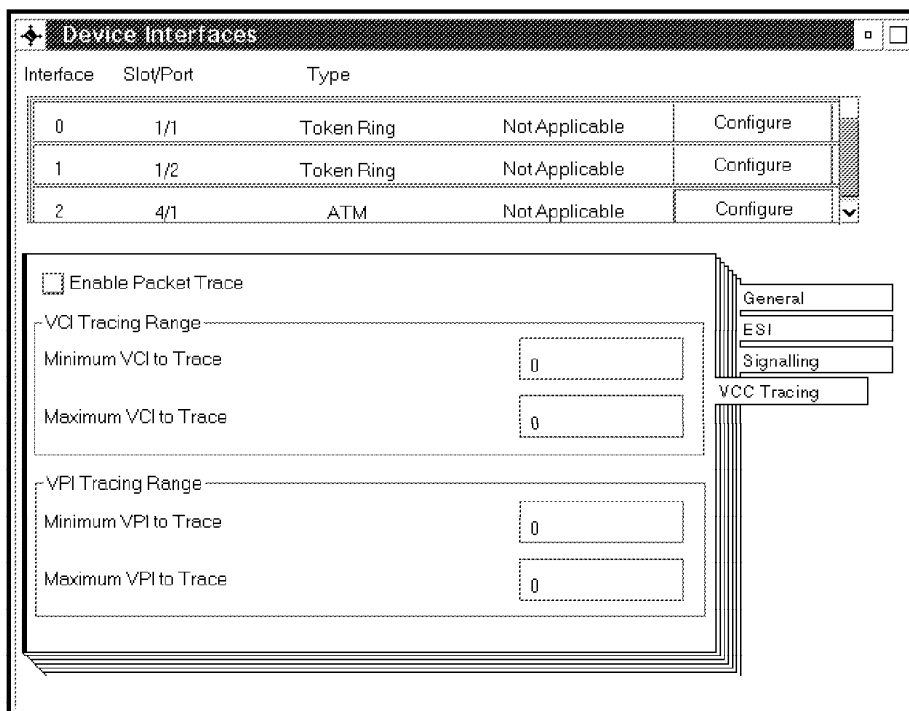


Figure 134. ATM Interface Configuration

4.7.1 Configuring LE Clients

To configure an LE client you need to first select **LEC Interfaces** in the Navigation Window, as shown in Figure 135:

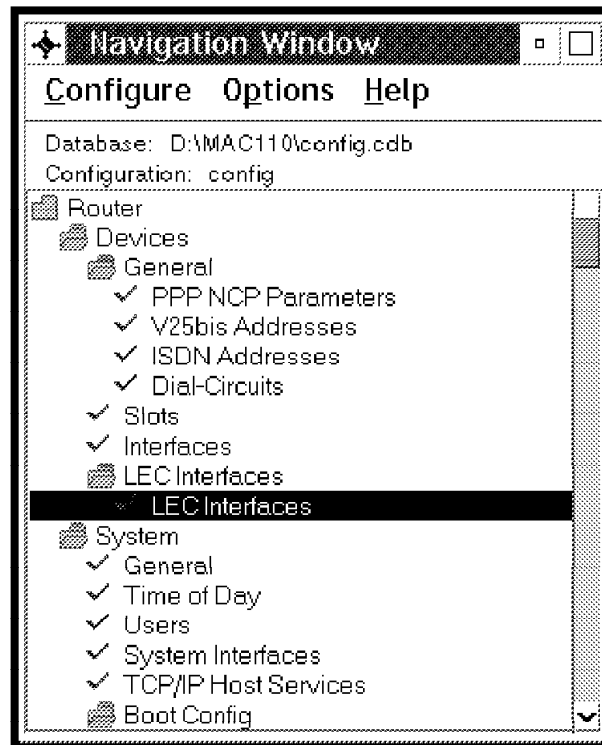


Figure 135. Define LEC Interfaces

The configuration steps discussed in this section need to be repeated for each LE client that you want to define.

To define an LE client, the following steps need to be performed:

1. Define LE client addresses.

After selecting **LEC Interfaces** from the Navigation Window, Figure 136 on page 164 will appear.

Figure 136. LEC Interfaces

During LE client definition, indicate the ATM interface it is associated with, the ESI and SEL used to construct the LE client's ATM address, and the MAC address associated with the LE client. To simplify problem determination, a locally administered ESI is recommended. Use a selector that is generated by the configurator. Make sure the MAC address is unique.

Notes:

- LE clients can be ATM Forum or IBM compliant. The 2210 and 2216 code provides support for ATM Forum-compliant LE services only.
 - When the LE client is added, a logical interface number will be generated. This interface number (I/F) is required when configuring higher layer functions such as IP or bridging for this LEC.
 - To change the MAC address from the default burned-in address, you need to type over the text in the box.
1. Define the ELAN name and type.

After selecting **ELAN** in Figure 136, Figure 137 on page 165 will appear.

I/F	MAC	Name	Type	Dev	ESI	Selector
3	400022160002	TR_ELAN_8285	Token Ring	2	400022160002	02

ELAN Name:

ELAN Type:

Max Frame Size:

General
 C7-C18
 C20-C28
ELAN
 Servers
 Misc

Figure 137. LEC Interfaces - ELAN

It is mandatory that you specify the ELAN type (token-ring or Ethernet) and maximum frame size. The ELAN name is optional. We advise that you define the same name on the LE client as on the LECS and LES.

2. Define the LE servers.

LE clients either obtain their LES address from the LECS, or use a hard-coded LES ATM address. The LECS can be hardcoded or, using ILMI, learned from the adjacent ATM switch.

The screenshot shows a window titled "LEC Interfaces". At the top is a table with columns: I/F, MAC, Name, Type, Dev, ESI, and Selector. It contains one row with values: 3, 400022160002, TR_ELAN_0205, Token Ring, 2, 400022160002, and 02. Below the table are three buttons: "Add", "Change", and "Delete". The main area of the window has a checked checkbox for "LECS AutoConfiguration". Below this are two text input fields labeled "LECS ATM Address" and "LE Server ATM Address". On the right side, there is a vertical stack of tabs: "General", "C7-C18", "C20-C28", "ELAN", "Servers", and "Misc". The "Servers" tab is currently selected.

Figure 138. LEC Interfaces - LECS AutoConfiguration

Figure 138 results from selecting **Server** during the LEC interface definition. Checking **LECS AutoConfiguration** specifies that the LE client will learn the LECS address from the adjacent ATM switch. Alternatively, a hard-coded LECS or hard-coded LES ATM address can be specified.

3. Define the higher layer functions.

In addition to the basic LE client configuration steps listed earlier, configuration of higher layer (bridging or routing) functions is required before the LE client can be used.

This completes the configuration of the 2210 and 2216 LAN emulation components.

4.8 Classical IP

The following sections explain in detail how to define Classical IP for the 2210 and 2216 devices.

4.8.1 LIS Client Using Dynamic SVCs

In this section, we used the 2216 configuration program for the screen captures. The 2210 configuration program has very similar windows and the same procedures used here can be directly applied to the 2210. The only major difference is that the 2216 can have two ATM interfaces configured, whereas the 2210 can only have one.

If you are configuring the 2216, you initially need to configure slots to add adapters as they are physically installed. You then need to configure the ATM

interface. If you are configuring the 2210, you need to initially configure the ATM interface as for the 2216.

To start the Classical IP configuration select **Interfaces** in the Navigation Window as shown in Figure 139:

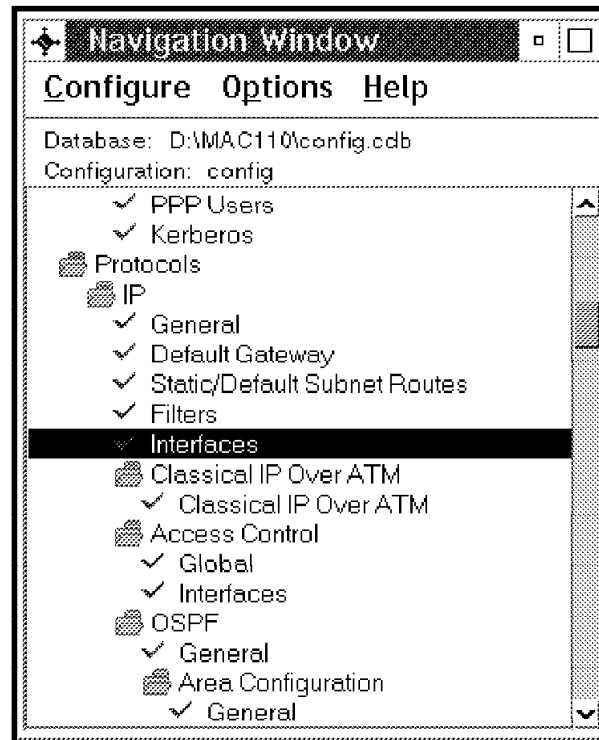


Figure 139. Interfaces

As a result of selecting Interfaces, Figure 140 on page 168 appears. Click **IP Addresses** on the interface that you want to use for this LIS client. Add a unique IP address that is consistent with the range of IP addresses associated with the LIS. Make sure that all LIS clients within the same LIS use the same subnet mask.

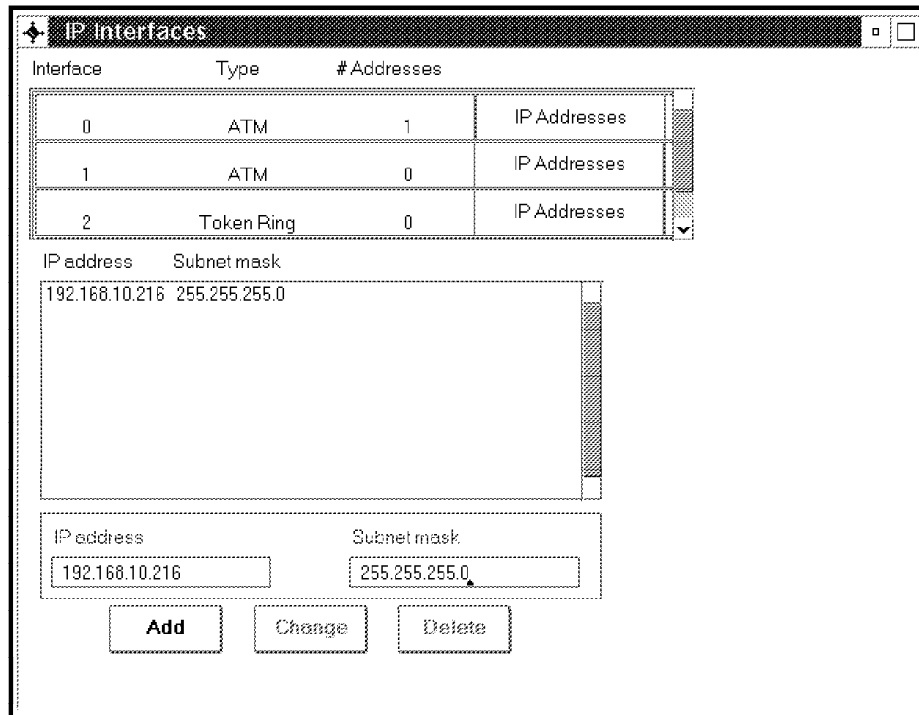


Figure 140. Add IP Address

Once an IP address is added to an ATM interface, Classical IP definitions are required. To configure Classical IP, select **Classical IP Over ATM** in the Navigation Window as depicted in Figure 141.

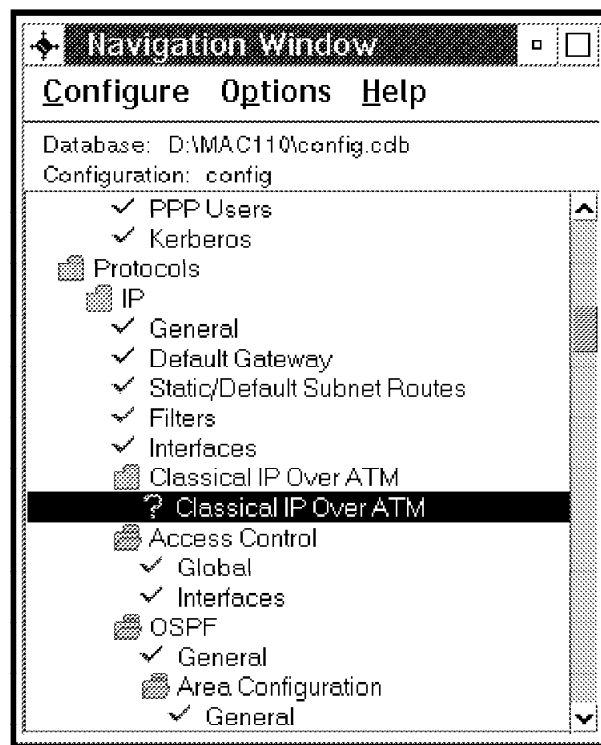


Figure 141. Classical IP over ATM Definitions

After clicking **Classical IP Over ATM**, Figure 142 will appear. The configuration of the LIS client's specific parameters can start after you have selected the proper IP address (the address defined in Figure 140).

IP Address	Interface Number	Interface Name	
192.168.10.216	0	ATM	Configure
192.168.2.216	1	ATM	Configure

☐ Client is also an ARP Server

Remote Server Address

Address

39098511111111111111010340002210000502

ARP Server
Refresh
Client Addr
Incoming VCCs
Control VCCs
Data VCCs
ARP Entries
Misc

Figure 142. ARP Server

When defining a LIS client, do *not* enable Client is also an ARP Server. Instead, enter the 20-byte ATM address of the ARP server.

Using default values in the remaining configurator screens completes the LIS client configuration. Two screens, however, are worth mentioning.

Figure 143 on page 170 shows that for a LIS client the configurator assumes that the selector is assigned at run time. This setting is adequate, unless using predefined SVCs between two clients (see 4.8.4, "LIS Client Using Static SVCs" on page 174). In this case, you have to make sure that on at least one of the clients, a preconfigured selector is used.

Figure 144 on page 170 shows the maximum SDU that is used by the LIS clients. Make sure that all LIS clients within the same LIS use the same value. Also make sure that this value is less than the maximum size allowed on the ATM interface.

IP Address	Interface Number	Name
192.168.10.216	0	ATM
192.168.2.216	1	ATM

ESI: 400022160002

☒ Use Runtime Generated Selector

Assigned Selector (hex): Generate

Browse Classic IP and IPX/ATM Addresses

ARP Server
Refresh
Client Addr
Incoming VCCs
Control VCCs
Data VCCs
ARP Entries
Misc

Figure 143. Runtime Selector

IP Address	Interface Number	Name
192.168.10.216	0	ATM
192.168.2.216	1	ATM

Maximum SDU Size on Outgoing VCC(s) (bytes): 9186

ARP Server
Refresh
Client Addr
Incoming VCCs
Control VCCs
Data VCCs
ARP Entries
Misc

Figure 144. Maximum SDU Size

4.8.2 Configuring an ARP Server

ARP server and LIS client (see 4.8.1, "LIS Client Using Dynamic SVCs" on page 166) configurations are defined using the same configuration screens. For an

ARP server you also have to define an IP address (+subnet mask) first and associate this address with a specific ATM interface (see Figure 139, Figure 140, and Figure 141).

Figure 145 will appear after clicking **Configure** for the IP address of the ATM interface to which you want to add the ARP server.

IP Address	Number	Interface	Name
192.168.10.216	0	ATM	Configure
192.168.2.216	1	ATM	Configure

☒ Client is also an ARP Server

Remote Server Address

Address

ARP Server
Refresh
Client Addr
Incoming VCCs
Control VCCs
Data VCCs
ARP Entries
Misc

Figure 145. ARP Server Definition

When defining an ARP server, enable **Client is also an ARP Server**. Leave the Remote Server Address field empty.

One configuration screen that needs special attention is Figure 146 on page 172. This screen becomes available after selecting **Client Addr**. As the ARP server's ATM address needs to be specified during the configuration of remote LIS clients, the variables that comprise the address (in particular ESI and SEL) need to be fixed. It is, therefore, advised that you use a locally administered ESI and a user-defined selector.

For the remainder of the configuration screens, default values can be used. Make sure that the maximum SDU size does not conflict with the value configured on other LIS clients (see Figure 144).

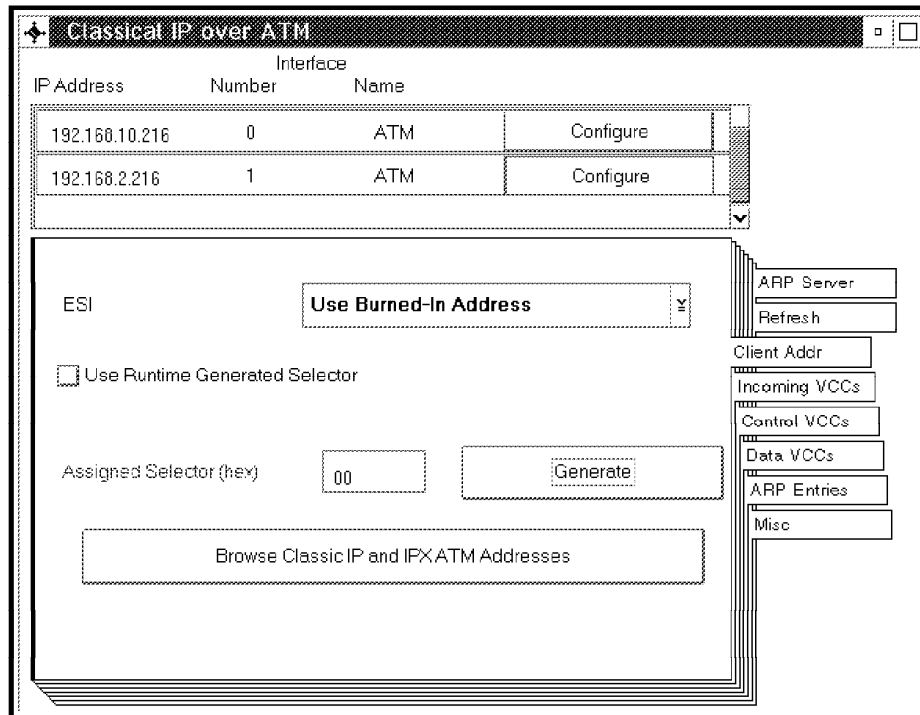


Figure 146. ESI and Selector

4.8.3 LIS Client Using PVCs

When defining a LIS client, you have the option to provide connectivity using SVCs or PVCs. The use of SVCs is more flexible and is recommended. However, in situations where your ATM switches do not support SVCs, or no ARP server is available for your LIS, PVC connections can be considered. PVCs can also be considered if UNI incompatibilities exist.

Note: PVCs can be used in conjunction with SVCs as well.

Defining a PVC to a remote LIS client requires:

- Definition of a LIS client
- Definition of a PVC

The LIS client definitions have been discussed in 4.8.1, “LIS Client Using Dynamic SVCs” on page 166 and are not repeated. They are required at both ends of the PVC. The LIS client definitions define the throughput characteristics of the VCCs.

The PVC definition requires similar configuration at both ends. PVC definitions are entered during the definition of the LIS client. You can define multiple PVCs per LIS client (identified by its IP address).

The parameters that can be entered become available after selecting **ARP Entries** during the configuration of Classical IP over ATM. Figure 147 on page 173 appears once you have selected **ARP Entries**.

Figure 147. PVC Definition

Make sure that the virtual path identifier (VPI) and virtual channel identifier (VCI) match the definitions on the adjacent switch (see 4.8.3.1, “Defining PVCs on the ATM Switch” on page 173). If you enable **Specify Destination Address**, enter the IP address of the remote LIS client. We recommend that you disable this option and let the 2210 or 2216 learn the IP address of the other end dynamically. This, however, requires InATMARP support at the other end. InATMARP is supported on the 2210 and 2216.

4.8.3.1 Defining PVCs on the ATM Switch

Figure 148 on page 174 shows the `set pvc` command used to define a PVC between two devices, port 16.01 and port 1.01. The PVC is verified using the `show pvc` command.

The same VPI but different VCI numbers are used at the ends of the PVC. In this case we use one device attached to port 16.01 on an IBM 8260 and the other device attached to port 1.01 on an IBM 8285. The 8260 is hub number 1 in our network and the 8285 is hub number 3. These values may be replaced with those relevant for your configuration.

Define the PVC:

```

8260ATM1>set pvc
Enter local port: 16
Enter local port: 1
Enter PVC id: 50
Enter remote port: 1
Enter remote port: 1
Enter remote hub number: 3
Enter call type: channel
Enter local VPI: 0.
Enter local VCI: 200
Enter remote VPI: 0.
Enter remote VCI: 100
Enter quality of service: best_effort

```

Figure 148. PVC Definitions on an ATM Switch

Verify PVC definition:

```

8260ATM1> show pvc
Enter port: 16.
Enter port: 1
Enter pvc id: 50

```

Local end point				! Remote end point !						
Port	id	type	Vpi/Vci	! Port	Vpi/Vci	HNb!	role	!QOS!	Status	
16.01	50	PTP-PVC	0/200	! 1.01	0/100	3!	Primary	! BE!	Active	

```

8260ATM1>

```

Figure 149. PVC Definitions on an ATM Switch

Note: PVC identifier 50 has been assigned to the PVC definition.

4.8.4 LIS Client Using Static SVCs

The 2216 and the 2210 provide an interesting option of being able to configure LIS clients that are using SVCs for their LIS-to-LIS client connections but do not require the presence of an ARP server. Similar to using PVCs, this approach has the advantage that no ARP server is needed. In addition, because the LIS-to-LIS client connections are established using SVCs, no ATM switch definitions are required to enable the VCCs.

Note: Static SVCs can be used in conjunction with dynamic SVCs and PVCs.

4.8.4.1 Active and Passive LIS Client

Predefined SVCs require that, for each client-to-client connection, one client's ATM address is defined on the partner client. This results in definitions that are not symmetrical; one (active) client defines the ATM address of the other end and is responsible for VCC establishment and one (passive) client awaits VCC establishment. After the connection has been established, full-duplex IP transport between both clients is possible.

Note: If the SVC has been defined at both ends, depending on timing, two VCCs can be established which are each used for traffic in one direction.

4.8.4.2 Definitions Required

Defining a static SVC to a remote LIS client requires:

- Definition of a LIS client
- Definition of an SVC

The LIS client definitions have been discussed in 4.8.1, “LIS Client Using Dynamic SVCs” on page 166 and are not repeated. They are required at both ends of the SVC. The LIS client definitions define the throughput characteristics of the VCCs.

The SVC definitions need to be entered at one end only. This end is referred to as the active LIS client because it is responsible for VCC establishment. Definitions are added during the definition of the LIS client. You can define multiple static SVCs per LIS client (identified by its IP address).

The parameters that can be entered become available after selecting **ARP Entries** during the configuration of Classical IP over ATM. Figure 150 results.

The screenshot shows the 'Classical IP over ATM' configuration window. At the top, there is a table with columns 'IP Address', 'Number', 'Interface', and 'Name'. It lists two entries: 192.168.10.216 (Number 0, Interface ATM) and 192.168.2.216 (Number 1, Interface ATM), each with a 'Configure' button. Below this is a table for SVC definitions with columns 'Type', 'Dest Address', 'VPI', and 'VCI'. The first row is 'PVC' with 'Dest Address' 390985111111111111111010340002210000502, 'VPI' 0, and 'VCI' 100. The second row is 'SVC' with the same 'Dest Address', 'VPI' 0, and 'VCI' 0. Below the table are 'Add', 'Change', and 'Delete' buttons. Further down is a 'Channel Type' dropdown set to 'SVC', a checkbox for 'Specify Destination Address' (unchecked), an 'Address' field containing the same long number, and 'VPI (dec)' and 'VCI (dec)' fields both set to 0. On the right side, there is a vertical stack of buttons: 'ARP Server', 'Refresh', 'Client Addr', 'Incoming VCCs', 'Control VCCs', 'Data VCCs', 'ARP Entries', and 'Misc'.

Figure 150. Static SVC Definition

If **Specify Destination Address** has been enabled, the IP address of the remote LIS client needs to be entered. We recommend that you disable this option and let the 2210 or 2216 learn the IP address of the other end dynamically. This, however, requires InATMARP support at the other end. InATMARP is supported on the 2210 and 2216.

The Address field must match the ATM address of the remote LIS client. To make sure that the ATM address of the passive LIS client is fixed, we recommend that you specify a locally administered ESI and a preconfigured selector during its configuration. During the definition of the active LIS client you can specify the use of a runtime selector.

Using the point-to-point (PtP) concept, more complex network structures can be built. Therefore, be aware that within each LIS:

- Every LIS client requires only a single IP address and a single LIS client definition.
- For each PtP connection, at least one end must be assigned as the active client. This active client is responsible for VCC establishment and requires an ARP entry.
- Clients can be active for one PtP connection, while being passive for another.

Chapter 5. ATM Native Client Configuration Examples

In this chapter we describe the configuration steps required to connect ATM native clients to an ATM network. The clients covered include:

- Windows 95, Windows NT
- OS/2
- Novell NetWare
- AIX

5.1 Configuring Windows 95 and Windows NT Clients

For the Windows 95 and Windows NT clients we used the TURBOWAYS 25 Mbps ATM ISA adapter. After the ATM card was installed in the PC the driver was downloaded from <http://www.raleigh.ibm.com>.

Additional information pertaining to the TURBOWAYS adapter can be found at <http://www.networking.ibm.com>.

The Windows NT workstation was connected to the 8285 as shown in Figure 4 on page 52.

From the Windows NT control panel double-click the **Network** icon to reveal Figure 151.

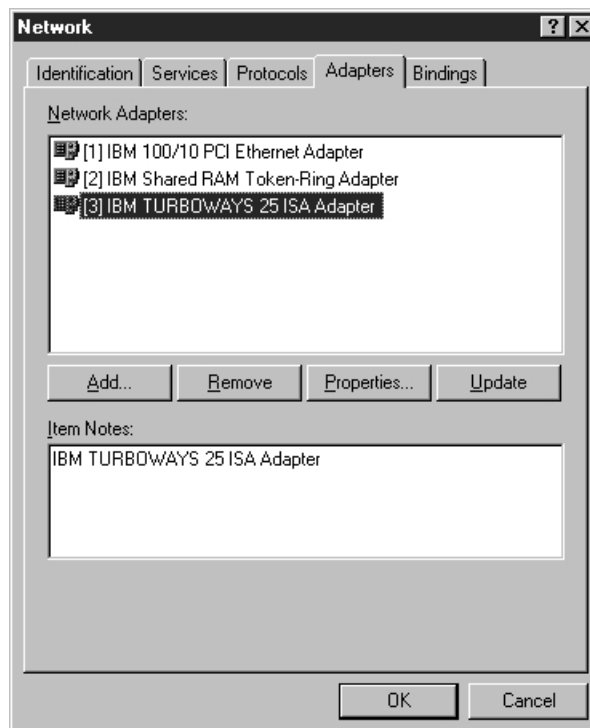


Figure 151. Configuring the ATM Network Adapter for Windows NT

The README file contained with the driver package explains step by step how to install the adapter. There are two drivers that can be installed, one for Classical

IP and one for LAN Emulation. The two drivers cannot be installed simultaneously.

To configure the TURBOWAYS 25 ATM adapter for Forum-Compliant LAN Emulation we performed the procedure shown below. Here we connected the PC to the 8274tr4 ELAN.

- Select **Properties** (see Figure 152).
- Select **Token Ring** for the LAN type.
- Enter the ATM address of the LES on the 8285 in the field LAN Emulation Server ATM Address.

If you are connecting to a device with LECS functionality such as the MSS then you can check Automatic Configuration Mode to use the WKA for the LES.

- Enter 400007500001 in the network address field to provide a value for the ESI address of the PC.
- Enter the ELAN name of 8285tr4.

LAN Emulation Parameter Configuration

Required Parameters

LAN Type: Token Ring Max. Frame Size: 4544

Automatic Configuration Mode: ☐

LAN Emulation Server ATM Address

39	99	99	99	99	99	99	00	00	99	hex
1	2	3	4	5	6	7	8	9	10	
99	01	02	40	00	82	85	01	02	03	hex
11	12	13	14	15	16	17	18	19	20	

Network Address: 400007500001 hex

Emulated LAN Name: 8285tr4

Enhanced Mode: ☒

OK Advanced Cancel Help

Figure 152. Additional Parameters for the ATM Driver for Windows NT

Additional parameters can be modified by clicking the Advanced button (see Figure 153 on page 179). We left these values at their defaults.

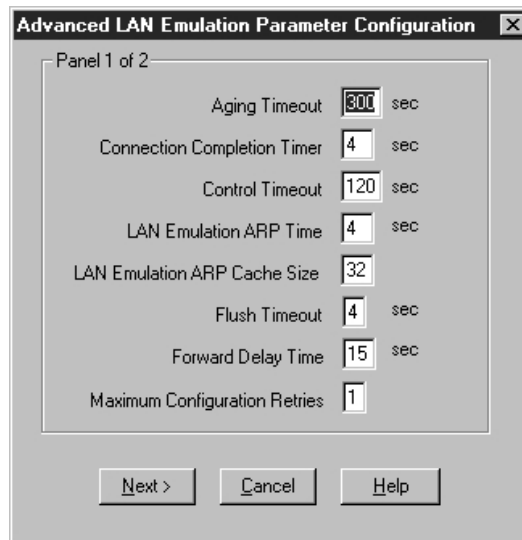


Figure 153. Advanced LAN Emulation Parameters

After clicking **Next**, Figure 153 appears. Here you can set the UNI version to Auto. Detect.

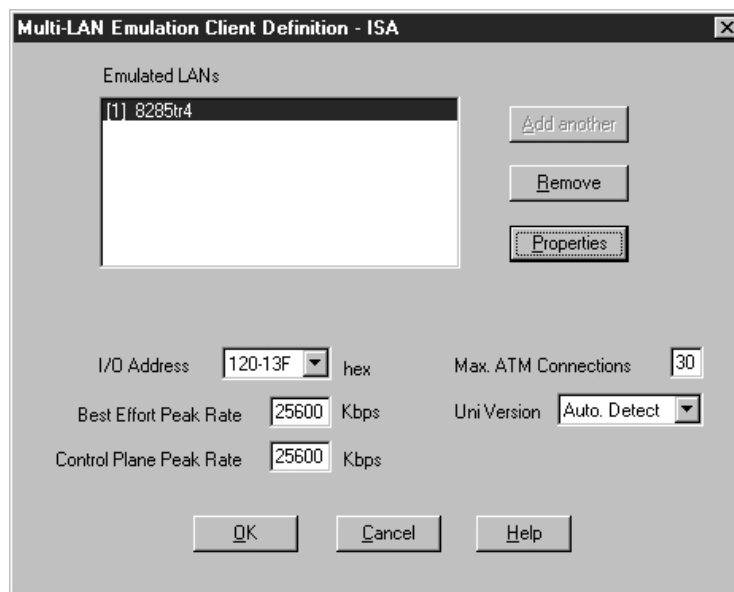
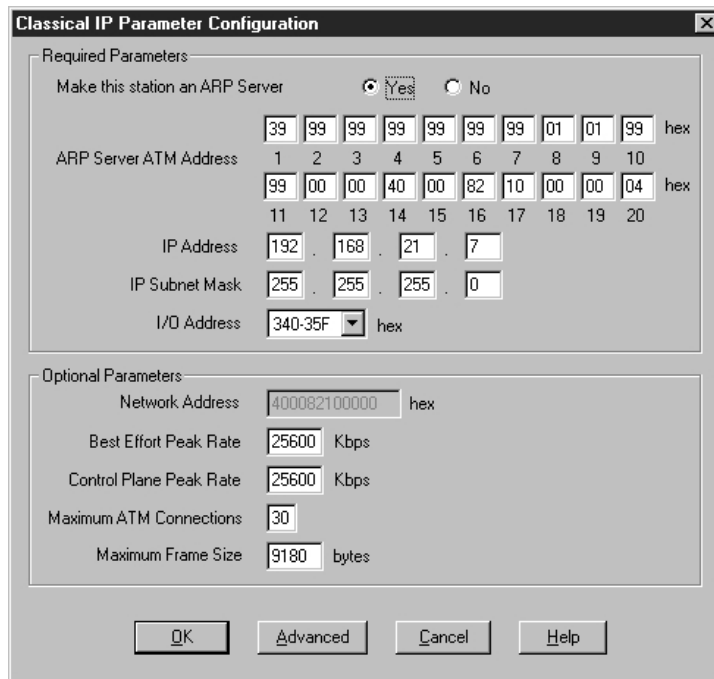


Figure 154. LAN Emulation Client Definition

The PC must be rebooted before the LAN Emulation Services can be accessed.

5.1.1 Classical IP Configuration

The Classical IP driver is installed the same way as the LAN Emulation driver. The options we selected here are shown in Figure 155 on page 180.



Classical IP Parameter Configuration

Required Parameters

Make this station an ARP Server ☒ Yes ☐ No

ARP Server ATM Address

1	2	3	4	5	6	7	8	9	10	hex
39	99	99	99	99	99	99	01	01	99	
11	12	13	14	15	16	17	18	19	20	hex
99	00	00	40	00	82	10	00	00	04	

IP Address 192 . 168 . 21 . 7

IP Subnet Mask 255 . 255 . 255 . 0

I/O Address 340-35F hex

Optional Parameters

Network Address 400082100000 hex

Best Effort Peak Rate 25600 Kbps

Control Plane Peak Rate 25600 Kbps

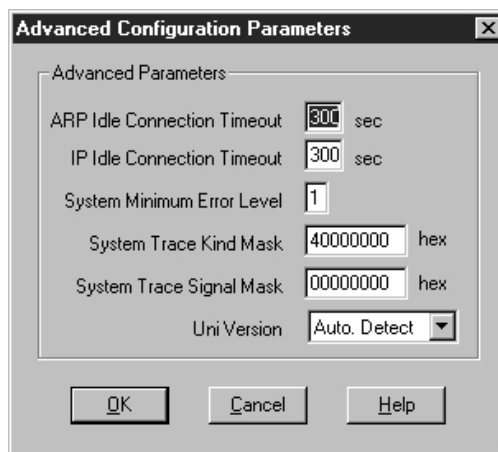
Maximum ATM Connections 30

Maximum Frame Size 9180 bytes

OK Advanced Cancel Help

Figure 155. Classical IP Parameters

In this scenario we used the MSS as a CIP ARP server and assigned an IP address of 192.168.21.7 to the PC. By clicking **Advanced** (see Figure 156) the UNI version can be set.



Advanced Configuration Parameters

Advanced Parameters

ARP Idle Connection Timeout 300 sec

IP Idle Connection Timeout 300 sec

System Minimum Error Level 1

System Trace Kind Mask 40000000 hex

System Trace Signal Mask 00000000 hex

Uni Version Auto. Detect

OK Cancel Help

Figure 156. Advanced CIP Configuration

The PC must be rebooted before the CIP configuration will work.

5.2 Configuring the OS/2 ATM Adapter

This section explains how to configure the ATM TURBOWAYS 100 Mbps adapter for OS/2 for the following ATM functions:

- Classical IP
- Forum-Compliant LAN Emulation

Assuming that the device drivers have been installed and the communications applications (PCOMM, LAN Requester, and TCP/IP) preconfigured, the following steps will show you how to add the network adapter interface and protocol. Always follow ATM client configuration with a connectivity test.

To add an ATM adapter network interface, start MPTS by typing MPTS in an OS/2 window or double-clicking the MPTS icon on the desktop. At the main MPTS dialog box click **Configure**. At the LAPS Configure panel, click **LAN Adapters and Protocols** then **Configure**. On the LAPS Configuration panel under Network Adapters scroll down and select **TURBOWAYS 100 OS/2 LAN Emulation** and click **Add**.

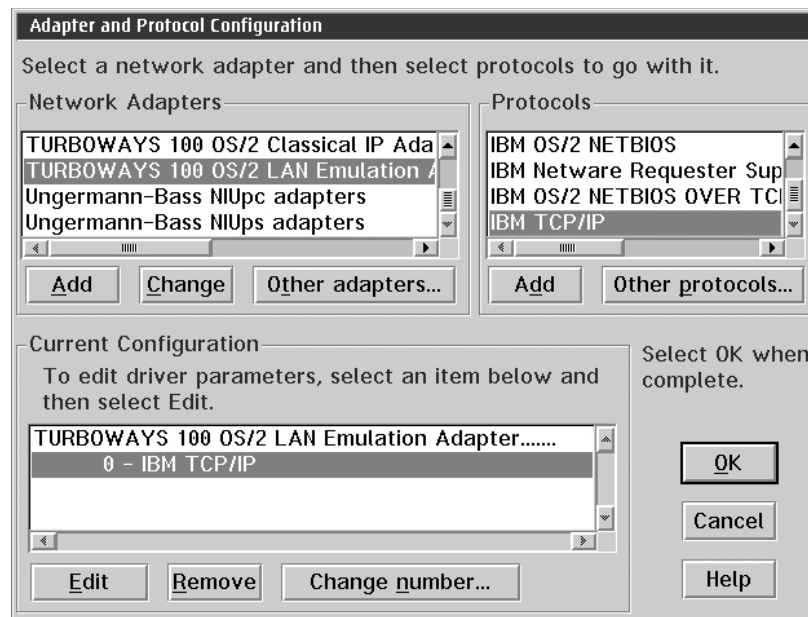


Figure 157. Selecting the TURBOWAYS 100 Adapter -- LAN Emulation

The adapter will then appear in the current configuration section of the LAPS Configuration panel. Next, under the Protocols section of the LAPS Configuration panel you need to select the protocol (for example, TCP/IP) and click **Add** for each protocol you wish to use over LANE.

After specifying the TURBOWAYS 100 Mbps configuration parameters, go to the LAPS Configuration panel, select TURBOWAYS 100 OS/2 LAN Emulation adapter under the current configuration section and click **Edit**.

Parameter	Value
LAN Emulation Server ATM address	
Locally administered adapter address	
Automatic configuration mode	YES
LAN type	802.3+V2
Emulated LAN name	
Maximum frame size	1516
Address request response time (sec)	4
Flush timeout (sec)	4
Maximum configuration retries	1
Control timeout (sec)	120
Maximum number of multicast addresses	8
Enhanced mode	NO
UNI Version	AUTO
Maximum number of SVC connections	260

Buttons: OK, Range, Cancel, Help

Figure 158. LAN Emulation Setup Parameters

There are a number of parameters that you can specify, and we focus on a few:

- Locally administered adapter address
- Automatic configuration mode - YES

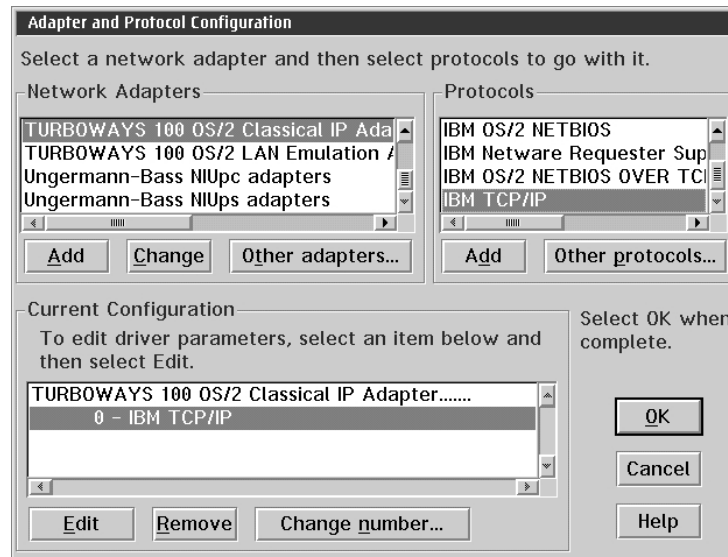
Note

When automatic configuration mode is set to YES, you do not have to hardcode the LES address. The LECS address will be obtained from ILMI or the well known address process.

- LAN type - for example, 802.3
- Emulated LAN name - enter ELAN name
- Maximum frame size - 1516 for Ethernet and 4544 for token-ring

Exit MPTS and reboot the PC.

The configuration for Classical IP is almost identical. At the LAPS Configure panel, click **LAN Adapters** -> **Protocols** -> **Configure**. On the LAPS Configuration panel under Network Adapters scroll down and select **TURBOWAYS 100 OS/2 Classical IP Adapter** and click **Add**.



There are a number of parameters that you can specify, and we focus on a few:

- ARP Server's ATM address
MSS ARP Server address - 399999999999999901019999000040008210000004
- The Adapter's IP Address
Match the Classical IP subnet, for example - 192.168.21.8
- The Adapter's IP Mask
Match the Classical IP subnet mask, example -- 255.255.255.0

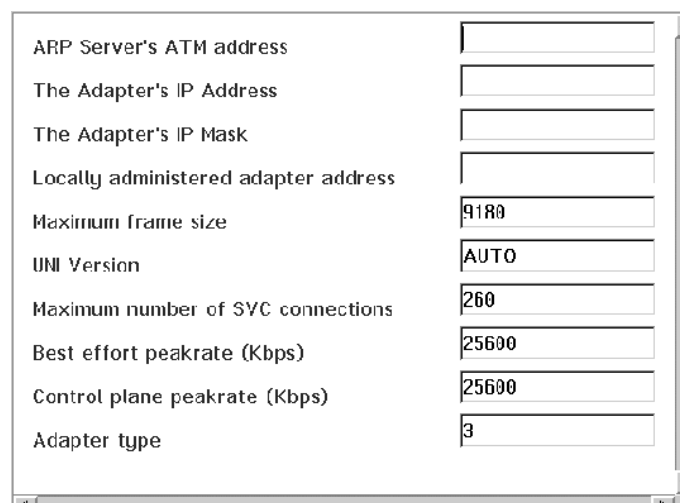


Figure 160. Test Classical IP Setup Parameters

5.3 Configuring the Novell Server

The following screen capture is the autoexec.ncf file from our Novell NetWare server. The server is running V4.01 of NetWare and you can see that the server has an Ethernet card, as well as, the ATM adapter defined. The file loads and

binds the TURBOWAYS 155 adapter in slot four to IPX with the Ethernet frame type of 802.2 and IP with the ethernet_snap frame type. The server's name is PCSRV320, and the IPX network number is two. The driver used is the ATMENFC.LAN, which is used to connect to an ATM Forum-compliant ELAN.

Figure 161. Novell NetWare AUTOEXEC.NCF File

5.4 Configuring a RISC System/6000 Workstation

The adapters for RISC systems are listed at <http://www.raleigh.ibm.com/tbo/tboprod.html>. The examples below show the configuration panels for a RISC System/6000 workstation for the following:

There are currently two ATM adapters available for providing ATM connectivity to a RISC System/6000 running AIX. These are as follows:

Both of these adapters provide LAN Emulation and Classical IP functions.

Change / Show Characteristics of an ATM Adapter : root@marco	
ATM Adapter	atm0
Description	100 Mbps ATM Fiber Adapter (8f7
Status	Available
Location	00-03
User Best Effort Peak Rate (kbits/sec)	1500 List
Enable ALTERNATE ATM MAC address	no List ▲ ▼
ALTERNATE ATM MAC address (12 hex digits)	0x
ATM Adapter Maximum PDU size (bytes)	9188 List
DMA bus memory width	0x1000000 List
Maximum Small ATM mbufs	50 List
Maximum Medium ATM mbufs	100 List
<input type="button" value="OK"/> <input type="button" value="Command"/> <input type="button" value="Reset"/> <input type="button" value="Cancel"/> <input type="button" value="?"/>	

Figure 162. TURBOWAYS Driver for AIX

5.4.2 LAN Emulation Configuration for the TURBOWAYS Adapter

Using the SMIT menus you can define the LAN Emulation parameters for the ATM card. (See Figure 163.)

Change / Show an ATM LE Client : root@marco	
LE Client Device Name	tok1
Local LE Client's LAN MAC Address (dotted hex)	40.00.60.00.ab.04
Automatic Configuration via LECS	Yes List ▲ ▼
If No, enter the LES ATM Address (dotted hex)	
If Yes, enter the LECS ATM Address (dotted hex)	
Local ATM Device Name	atm0 List
Emulated LAN Type	TokenRing
Maximum Frame Size	4544 List ▲ ▼
Emulated LAN Name	8272tr3
Control Timeout (seconds)	120 List
Maximum Configuration Retries	1 List
Data Direct VCC Timeout Period (seconds)	1200 List
Expected ARP Response Time (seconds)	1 List
Maximum Retry LE_ARP_REQUEST Count	1 List
ARP Cache Size	32 List
<input type="button" value="OK"/> <input type="button" value="Command"/> <input type="button" value="Reset"/> <input type="button" value="Cancel"/> <input type="button" value="?"/>	

Figure 163. TURBOWAYS LAN Emulation for AIX

The ESI can be entered in the Local LE Client's LAN MAC address field. In this example we are connecting the ATM client to the 8272tr3 ELAN using the MSS server (ILMI).

5.4.3 CIP Configuration for the TURBOWAYS Adapter

The Classical IP parameters can be entered using the smit panel shown in Figure 164. The CIP address for the AIX device was set to 192.168.21.12 and the connection type set to svc_c, which means that this device is set up as a client. The AIX adapter can also be configured as a CIP server.

Figure 164. Classical IP Configuration for AIX

The ATM server address entered is the ATM address of the ARP server defined on the MSS.

5.4.4 Interphase 155 Mbps Adapter

The Interphase adapter provides a full-duplex, 155 Mbps ATM network connection for PCI broad platform compatibility for multimode fiber, single-mode fiber, and UTP copper media, and uses ATM Forum UNI 3.0/3.1 signaling. The card supports up to 2,048 user configurable virtual channel identifiers.

The driver is installed using smit and can be configured using either the smit menus or the supplied configuration tool called CellView.

5.4.5 Interphase 155 Mbps Adapter for LAN Emulation

The CellView application can be started from the AIX command line, and is located in the directory /usr/bin. The initial window is shown in Figure 165 on page 187.

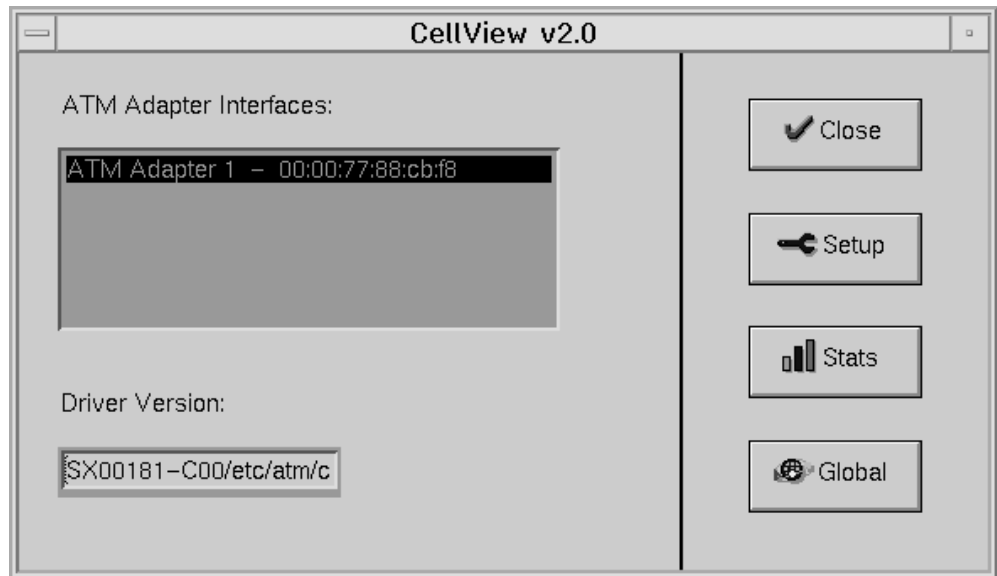


Figure 165. CellView Main Window

The configuration window shown in Figure 166 on page 188 can be found by clicking **Setup**.

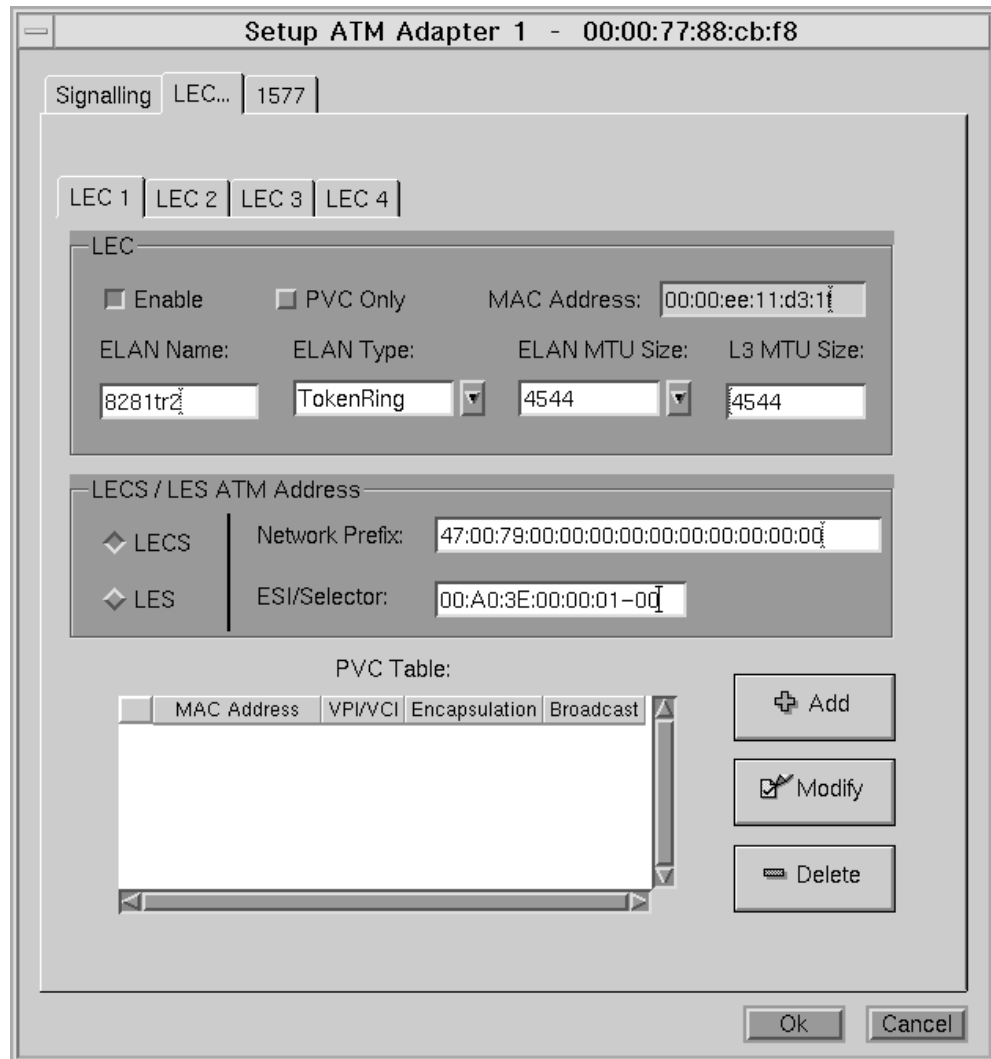
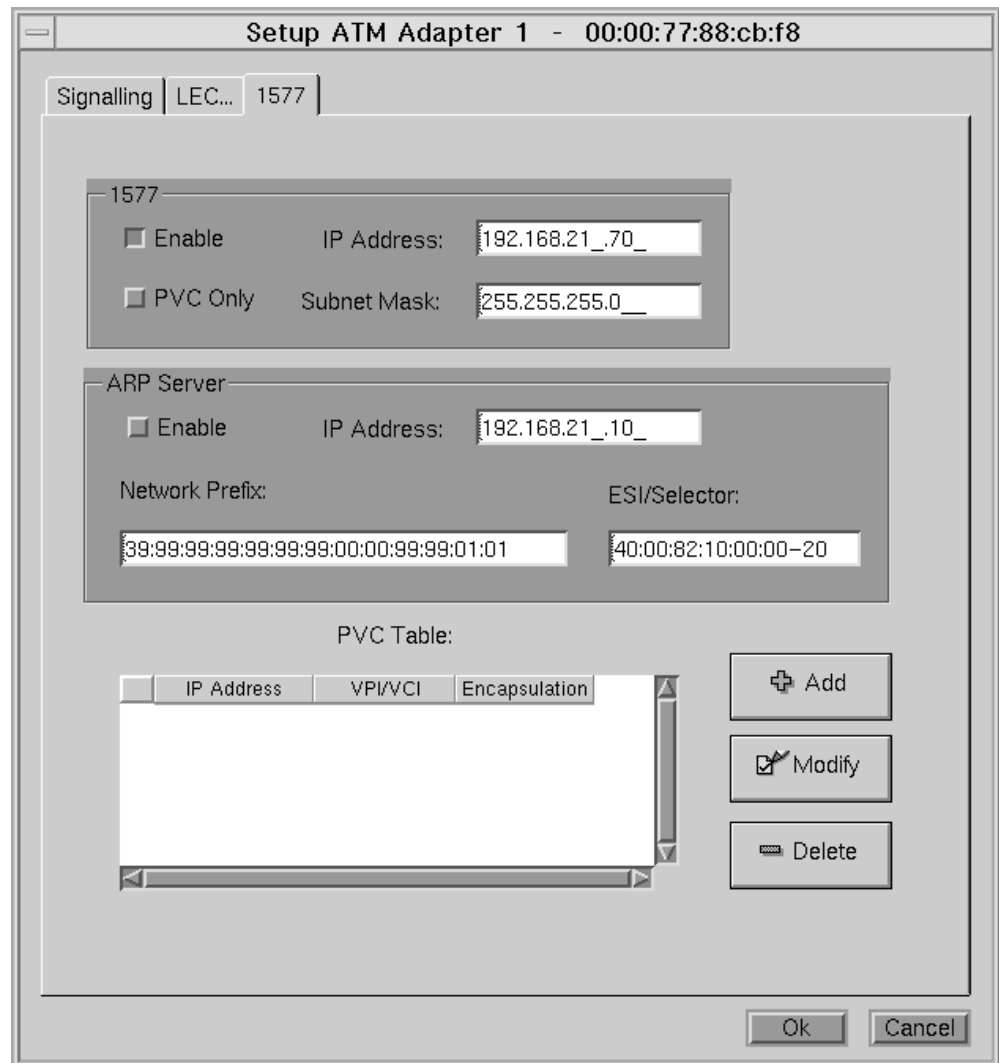


Figure 166. LAN Emulation Configuration for AIX

The adapter allows up to four LECs to be defined. In this example we are connecting to the 8281tr2 ELAN and will use the WKA to resolve the LES ATM address. The ESI address of the adapter can be entered in the MAC address field.

The CIP configuration can be located by clicking the **1577** tab. In the example shown in Figure 167 on page 189 the IP address of the client is set to 192.168.21.70. The ARP server IP address and ATM address were configured to point to the MSS.

5.4.6 Interphase 155 Mbps Adapter for Classical IP



The image shows a configuration window titled "Setup ATM Adapter 1 - 00:00:77:88:cb:f8". It has a tabbed interface with "Signalling" and "LEC..." tabs. The "Signalling" tab is active, showing a "1577" label. Below this, there are two main sections: "1577" and "ARP Server".

The "1577" section contains:

- ☐ Enable IP Address: 192.168.21_.70_
- ☐ PVC Only Subnet Mask: 255.255.255.0_

The "ARP Server" section contains:

- ☐ Enable IP Address: 192.168.21_.10_
- Network Prefix: 39:99:99:99:99:99:00:00:99:99:01:01
- ESI/Selector: 40:00:82:10:00:00-20

Below these sections is a "PVC Table" with a table structure:

IP Address	VPI/VCI	Encapsulation
------------	---------	---------------

To the right of the table are three buttons: "Add", "Modify" (with a checkmark icon), and "Delete" (with a minus icon). At the bottom right of the window are "Ok" and "Cancel" buttons.

Figure 167. CIP Configuration for AIX

By selecting **Stats** from the CellView main screen you can view the ATM traffic and SVC/PVC connection values reported by the driver. This is useful for diagnostics and connectivity issues (see Figure 168 on page 190).

Statistics ATM Adapter 1 - 00:00:77:88:cb:f8

Signalling
AAL5
LEC ...
1577

Signalling State

ILMI:
QSAAL:
Signalling:

State Detail

ILMI:
QSAAL:
Signalling:

ATM End Station Address (AES)

Network Prefix:
ESI/Selector:

Signalling Statistics:

	VPI/VCI	Frames In	Frames Out
ILMI	0/ 16	0	63106
Signalling	0/ 5	0	0

Clear
Close

Figure 168. ATM Statistics for Interphase Adapter

[illegible]

Figure 170. Show Device for 8260_HUB1(Pre-PNNI)

The result of typing the `show port` command for the NNI connection is seen in Figure 171.

```
8260_HUB1> show port 15.2 verbose
```

Type	Mode	Status

15.02:	NNI enabled	UP-OKAY
VPI.VCI range	: 15.1023 (4.10 bits)	
Connector	: SC DUPLEX	
Media	: multimode fiber	
Port speed	: 155000 kbps	
Remote device is active		
IX status	: IX OK	
Logical links indexes: 1		
Frame format	: SONET STS-3c	
Scrambling mode	: frame and cell	
Clock mode	: internal..	

Figure 171. Show Port for the NNI Connection

Figure 172 is the result of the `show port` command for the SSI connection to the 8285_HUB1:

```
8260_HUB1> show port 17.1 verbose
```

Type	Mode	Status

17.01:	SSI enabled	UP-OKAY
SSI Bandwidth	: 155000 kbps	
VPI.VCI range	: 15.1023 (4.10 bits)	
Connector	: SC DUPLEX	
Media	: multimode fiber	
Port speed	: 155000 kbps	
Remote device is active		
IX status	: IX OK	
Scrambling mode	: frame and cell	
Clock mode	: internal.	

Figure 172. Show Port for the SSI Connection

The `show logical_link` command displays the logical connection between the clusters. See Figure 173:

```
8260_HUB1> show logical link all
```

Port	Vpi	Acn	Side	Mode	Sig	Traf	Bwidth	Status	Index

15.02	0	02	user	enab	3.1	NRB	0	UP	1
63 entries empty..									

Figure 173. Show logical_link all

Connectivity exists between the switches as shown with the `ping` command in Figure 174.

```
8260_HUB1> ping 192.168.21.61
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.61: 1 packets sent, 1 received
Ping 192.168.21.61: 2 packets sent, 2 received
Ping 192.168.21.61: 3 packets sent, 3 received
Ping 192.168.21.61: 4 packets sent, 4 received

8260_HUB1> ping 192.168.21.85
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.85: 1 packets sent, 1 received
Ping 192.168.21.85: 2 packets sent, 2 received
Ping 192.168.21.85: 3 packets sent, 3 received
Ping 192.168.21.85: 4 packets sent, 4 received
```

Figure 174. Ping Command

6.1.2 8285_HUB1 in Cluster 1

Figure 175 shows the result of typing the `show device` command.


```

8285_HUB1> show device
8285 Nways ATM Workgroup Switch
Name : 8285_HUB1
Location :

For assistance contact :

Manufacture id: VIM
Part Number: 51H4119 EC Level: E59245
Serial Number: 2110
Boot EEPROM version: v.1.5.2
Flash EEPROM version: v.1.5.2
Flash EEPROM backup version: V.1.5.0
Last Restart : 13:53:31 Tue 11 May 99 (Restart Count: 1)

A-8285
-----
ATM address: 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00

> Subnet atm: Up
IP address: 192.168.21.85. Subnet mask: FF.FF.FF.00

> Subnet lan emulation ethernet/802.3
  Not Started
  Name : ""
  MAC Address: 000000000000
  IP address : 0.0.0.0. Subnet mask: 00.00.00.00
  ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00
  Config LES addr:none
  Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
  BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
  Config LECS add:none
  Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
  LEC Identifier: 0. Maximum Transmission Unit: 0
> Subnet lan emulation token ring
  Not Started
  Name : ""
  MAC Address: 000000000000
  IP address : 0.0.0.0. Subnet mask: 00.00.00.00
  ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.01
  Config LES addr:none
  Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
  BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
  Config LECS add:none
  Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
  LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
-----
IP address: 192.168.21.12

ARP Server:
-----
ATM address: 39.99.99.99.99.99.00.00.99.99.02.01.40.00.82.10.00.01.0A

Dynamic RAM size is 16 MB. Migration: off. Diagnostics: enabled.This is screen.

```

Figure 175. Show Device for 8285_HUB1

The result of typing the `show port` command for the SSI connection to the 8260_HUB1 is seen in Figure 176.

```
8285_HUB1> show port 1.13 verbose
```

Type	Mode	Status

1.13:SSI enabled UP-OKAY		
SSI Bandwidth	:	155000 kbps
VPI.VCI range	:	15.1023 (4.10 bits)
Connector	:	SC DUPLEX
Media	:	multimode fiber
Port speed	:	155000 kbps
Remote device is active		
IX status	:	IX OK
Scrambling mode	:	frame and cell
Clock mode	:	internal.

Figure 176. Show Port for 8285_HUB1

Connectivity exists between switches as shown in Figure 177:

```
8285_HUB1> ping 192.168.21.60
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.60: 1 packets sent, 1 received
Ping 192.168.21.60: 2 packets sent, 2 received
Ping 192.168.21.60: 3 packets sent, 3 received
Ping 192.168.21.60: 4 packets sent, 4 received

8285_HUB1> ping 192.168.21.61
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.61: 1 packets sent, 1 received
Ping 192.168.21.61: 2 packets sent, 2 received
Ping 192.168.21.61: 3 packets sent, 3 received
Ping 192.168.21.61: 4 packets sent, 4 received
```

Figure 177. Ping at 8285_HUB1

6.1.3 8260_HUB2 in Cluster 2

Figure 178 shows the result of typing the `show device` command.


```
8260_HUB2> show port 14.2 verbose
```

Type	Mode	Status

14.02: NNI enabled UP-OKAY		
VPI.VCI range	: 15.1023 (4.10 bits)	
Connector	: SC DUPLEX	
Media	: multimode fiber	
Port speed	: 155000 kbps	
Remote device is active		
IX status	: IX OK	
Logical links indexes: 1		
Frame format	: SONET STS-3c	
Scrambling mode	: frame and cell	
Clock mode	: internal.	

Figure 179. Show Port for 8260_HUB2's NNI Connection

The `show port` command for the UNI connection to the 8272 switch is seen in Figure 180:

```
8260_HUB2> show port 14.1 verbose
```

Type	Mode	Status

14.01: UNI enabled UP-OKAY		
Signalling Version	: with ILMI	
Flow Control	: Off	
VPI.VCI range	: 15.1023 (4.10 bits)	
Connector	: SC DUPLEX	
Media	: multimode fiber	
Port speed	: 155000 kbps	
Remote device is active		
IX status	: IX OK	
Frame format	: SONET STS-3c	
Scrambling mode	: frame and cell	
Clock mode	: internal	

Figure 180. Show Port for 8260_HUB2's UNI Connection

The result of typing the `show logical_link all` command is seen in Figure 181:

```
8260_HUB2> show logical_link all
```

Port	Vpi	Acn	Side	Mode	Sig	Traf	Bwidth	Status	Index

14.02	0	01	netw	enab	3.1	NRB	0	UP	1
63 entries empty.									

Figure 181. Show Logical Link for 8260_HUB2

The `show atm_esi` command is used to see which devices have registered with the switch. See Figure 182.

```
8260_HUB2> show atm_esi all
Port    ATM_ESI          Type
-----
5.01 40.00.82.10.00.01 dynamic
14.1 40.00.82.72.00.00 dynamic
```

Figure 182. Show atm_esi for 8260_HUB2

Connectivity with the other switches exists as shown in Figure 183.

```
8260_HUB2> ping 192.168.21.60
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.60: 1 packets sent, 1 received
Ping 192.168.21.60: 2 packets sent, 2 received
Ping 192.168.21.60: 3 packets sent, 3 received
Ping 192.168.21.60: 4 packets sent, 4 received
8260_HUB2>
8260_HUB2> ping 192.168.21.85
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.85: 1 packets sent, 1 received
Ping 192.168.21.85: 2 packets sent, 2 received
Ping 192.168.21.85: 3 packets sent, 3 received
Ping 192.168.21.85: 4 packets sent, 4 received
```

Figure 183. PING Command at 8260_HUB2

6.2 Migration Considerations

The release notes and installation instructions for the microcode give detailed step-by-step instructions on how to upgrade the switch microcode to PNNI. If you are not familiar with the process read these instructions thoroughly before starting. One example of the download and activation is given in 6.3, “Migration Process” on page 202 for reference.

Some of the points you should be aware of are listed here:

- Check the FPGA code level on all the blades in the switches being upgraded to ensure it is at a level compatible with PNNI code. Check the IBM networking Web site (<http://www.networking.ibm.com>) for the latest level of code.
- Back up all the switch configurations before you start. If you have to abort the process and reload the old Version 2 code, all the configuration information will be erased.
- Download the boot and operational code to all the switches involved.
- Make the new code active starting with the switch farthest away in the network. Depending on your network design you may lose connectivity to the farthest switches if you first activate the new code in the closer switches.
- The switch ATM address will be migrated to the PNNI node_0 address with a default level identifier of 96 bits.
- All SSI ports are converted to PNNI ports and the ports will be enabled. All other port parameters are retained.
- All NNI ports will convert to IISP ports. The ports will start *disabled*. All other port parameters are retained. (If you are activating the code using a session

through the same ports that you are converting you will lose connectivity to the switch when the new code is made active. Check this out before you start. Our experience showed that the ports were all Enabled but both Network-side. This allows you to get the connectivity back by changing one of them to User-side.)

- There are major differences between the way PNNI and SSI code operates. When the code is upgraded all PVCs will be cleared. All logical link and static routes will be deleted. These must be re-entered after using the `SET REACHABLE ADDRESS` command which replaces the `set logical link` and `set static route` commands. Make sure you have documented all your logical links, static routes and PVCs before you start.
- UNI ports are not changed.

6.3 Migration Process

The current non-PNNI version will upgrade to PNNI. You can see the current code level on non-PNNI in 6.1, “Pre-PNNI Configuration” on page 193. Figure 169 on page 193 shows that the TFTP server is attached to the 8272 which joins an ELAN in the MSS. The IP address of the TFTP server is 11.1.1.99.

1. Make sure you can reach the TFTP server. We did this by issuing the `ping 11.1.1.99` command.
2. Save the current configuration to the TFTP server.

Set up the TFTP file type as “configuration” and upload to the TFTP server with `upload inband` command. Remember to check the status after each transfer with the `show tftp` command. The Last Transfer Result displays OKAY... if the command was executed without problems.

```
8260_HUB1> show tftp
TFTP Parameters:
Server IP address   : 11.1.1.99.
File Name           : d:\temp\60hub1.cfg.
File type           : Configuration.
Last Transfer Date  : 12 May 99.
Last Transfer Result : This file has not been transferred yet...
```

Figure 184. Show TFTP for Configuration Upload

3. Download any FPGA picocode that is needed to the blades and CP/SW. The code levels on the blades can be checked with the `Show module <n> verbose` command.
4. Download inband the CP/SW operational code.
 - a. Set up the TFTP parameters.

```

8260_HUB1> set server_ip_address 11.1.1.99      1
TFTP Server set

8260_HUB1> set tftp file_type operational        2
File type set

8260_HUB1> set tftp file_name                    3
Enter file name: d:\temp\60opv322.ope
File name set

8260_HUB1> show tftp
TFTP Parameters:
Server IP address   : 11.1.1.99.
File Name           : d:\temp\60opv322.ope.
File type           : Operational.
Last Transfer Date  : 12 May 1999.
Last Transfer Result : This file has not been transferred yet.  4
8260_HUB1> save tftp

```

Figure 185. TFTP Configuration to Download the Operational Code

Notes:

- 1 server_ip_address
This is the IP address of TFTP server in the format *n.n.n.n*.
 - 2 file_type
The file types you are going to download. If you are going to download operational code, you can choose **operational**.
 - 3 file_name
Specify the path and file name on the TFTP server. Up to 128 alphanumeric characters are allowed.
 - 4 Transfer Result
This line shows the status of the last upload or download operation. You can always issue the `show tftp` to confirm the last transfer result.
- b. Download the operational code from the TFTP server by entering the command:
- ```
download inband
```
- Wait for the download operation to complete. If successful the message, **Download successful**, is displayed.

```

8285_HUB1> download inband
You are about to download a new version.
Are you sure ? (Y/N) Y 1
Number of characters expected: (Typing Ctrl+C terminates the transfer)
Download successful.

8285_HUB1> show tftp
TFTP Parameters:
Server IP address : 11.1.1.99.
File Name : d:\temp\60opv322.ope.
File type : Operational.
Last Transfer Date : 12 May 99.
Last Transfer Result : OKAY... 2

```

Figure 186. Download Inband Configuration

5. Download inband the CP/SW boot code as in step 4.

**Notes:**

- 1** You must start the download by confirming with a Y
  - 2** If successful the Last Transfer Result line will show OKAY...
6. After downloading the operation and boot code, you can see the code status by issuing the `show device`

```

8285_HUB1> show device
8285 Nways ATM Workgroup Switch
Name : 8285_HUB1
Location :
For assistance contact :
Manufacture id: VIM
Part Number: 51H4119 EC Level: E59245
Serial Number: 2110
Boot EEPROM version: v.3.2.2 1
Flash EEPROM version: v.1.5.2
Flash EEPROM backup version: v.3.2.2 2
Last Restart : 13:53:31 Tue 11 May 99 (Restart Count: 1)

```

Figure 187. Show Device Screen

**Notes:**

- 1** Boot code  
Updated to v.3.2.2.
  - 2** Operation code  
The new code is loaded into the backup EEPROM. This will be made active when the `swap microcode` command is issued.
7. Save all information by entering the command:
- ```
save all
```
8. Activate the new version of FPGA picocode by entering the command (if necessary):
- ```
SWAP FPGA_PICOCODE
```
- As the switch restarts, the TELNET session (if used) will be broken.
9. Verify the new version of FPGA picocode by entering the command:



```

8260_HUB1> show module 9 verbose

Slot Install Connect Operation General Information

 9 Y Y Y 8260 ATM Control Point and Switch Module:Active

status: connected / hardware okay
 enable / Normal

P/N:58G9605 EC level:C38846 Manufacture:VIME

Operational FPGA version : B52 1
Backup FPGA version : B51

```

Figure 188. FPGA Level

**Note:**

- 1 The current FPGA level for CP/SW (module 9) in IBM 8260 is B52. In IBM 8265 (module 1) it is C32.

10. Activate the new version of microcode by entering the command:

SWAP MICROCODE and confirm with Y.

Verify the code level by entering the command `show device`.

```

8285_HUB1> show device
8285 Nways ATM Workgroup Switch
Name : 8285_HUB1
Location :
For assistance contact :
Manufacture id: VIM
Part Number: 51H4119 EC Level: E59245
Serial Number: 2110
Boot EEPROM version: v.3.2.2 1
Flash EEPROM version: v.3.2.2 2
Flash EEPROM backup version: v.1.5.2
Last Restart : 13:53:31 Tue 11 May 99 (Restart Count: 1)

```

Figure 189. Show Device Screen

**Notes:**

- 1 Boot code  
Updated to v.3.2.2.
- 2 Operation code  
Updated to v.3.2.2. The previous code will remain in the backup EEPROM.

## 6.4 Final Configuration

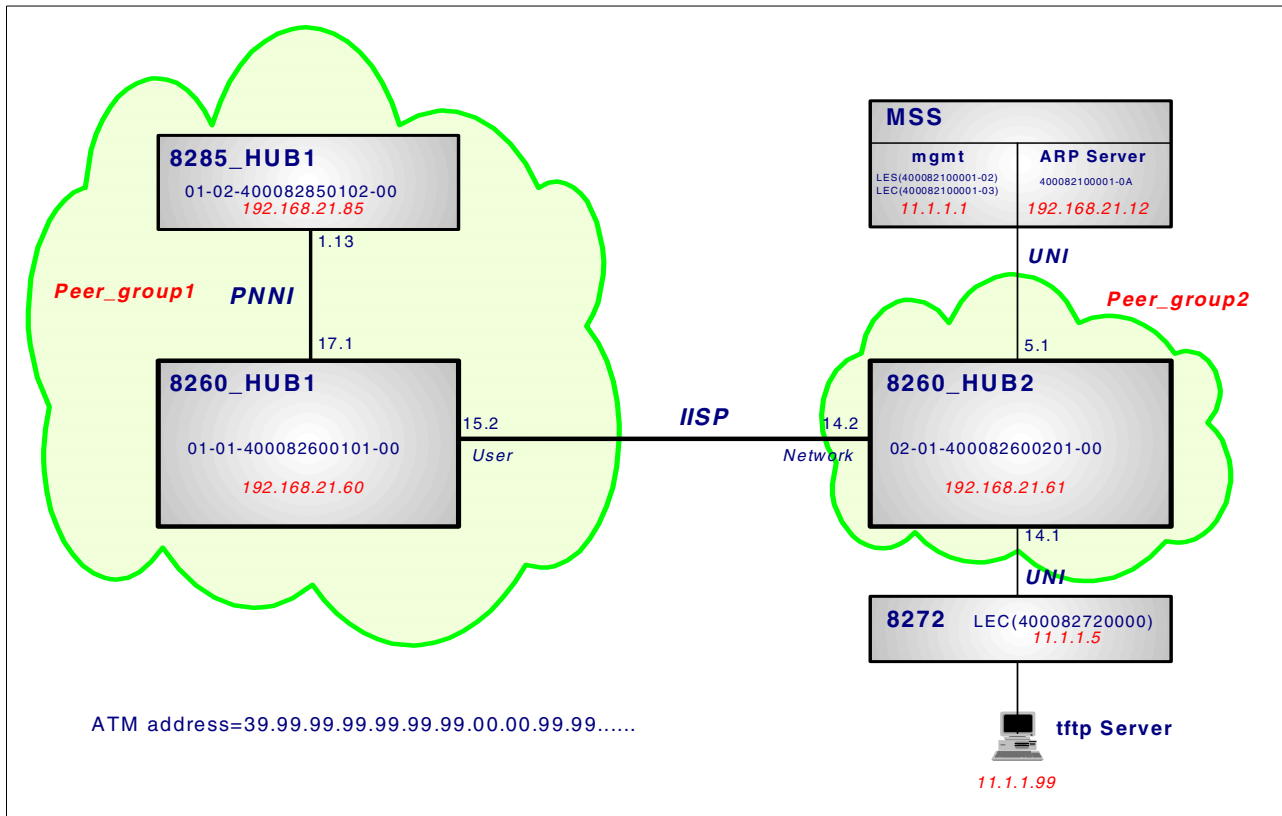


Figure 190. Final Configuration (PNNI)

### 6.4.1 8285\_HUB1 Configuration in Peer Group 1

We can verify the PNNI configuration after migration with the following commands:

1. Figure 191 is the result of typing the `show device` command.



```

8285_HUB1> show port 1.13 verbose

```

| Type      | Mode    | Status                                  |
|-----------|---------|-----------------------------------------|
| 1.13:PNNI | enabled | UP <span style="float: right;">1</span> |

```

ILMI status : UP
ILMI vci : 0.16
NNI Bandwidth : 155000 kbps
RB Bandwidth : unlimited
Signalling vci : 0.5
Routing vci : 0.18
Administrative weight: 5040
VPI.VCI range : 15.1023 (4.10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Remote device is active
Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal

```

Figure 192. Show Port to See the PNNI Interface

**Note:**

- 1 The SSI interface is automatically updated to PNNI.

3. The ATM address is now displayed using the `show pnni node_0` command:

```

8285_HUB1> show pnni node_0
----- Node 0 -----
ATM addr : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00 1
Level Identifier : 96 (24 half-bytes and 0 bits) 2
PGroup Id: 60.39.99.99.99.99.00.00.99.99.01
Node Id : 60.A0.39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00
Unrestricted Transit.

```

Figure 193. Show pnni node\_0 to See the Switch Information

**Notes:**

- 1 The previous ATM address is migrated to the PNNI Node\_0 ATM address.
- 2 The Level Identifier is set to the default of 96 bits.

4. You can display which switches (within the peer group) this switch physically connects to using the `show pnni neighbor` command:

```

8285_HUB1> show pnni neighbor
----- Neighbors of Node 0-----
60.A0.39.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.01.01.00:Full
Port 1.13 vpi=0

```

Figure 194. Show pnni neighbor to See the Neighbor Node IDs

5. The `show pnni peer_group_members` command will display all the switches in the peer group as listed:

```
8285_HUB1> show pnni peer_group_members
----- Peer Group of Node 0-----
 60.A0.39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00 connected
 60.A0.39.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.01.01.00 connected 1
2 Members.
```

Figure 195. Peer Group Members for 8285\_HUB1

**Note:**

- 1 This line shows that 8260\_HUB1 belongs to the peer group.

#### 6.4.1.1 8260\_HUB1 Configuration in Peer Group 1

The result of typing the `show device` command is seen in Figure 196.

[illegible]

Figure 196. Show Device for 8260\_HUB1 (PNNI)

Issue the `show port 15.2 verbose` command to check the IISP interface which previously was configured as NNI.

```

8260_HUB1> show port 15.2 verbose
Type Mode Status

15.02:IISP enabled UP

Signalling Version : 3.1
No ILMI
NNI Bandwidth : 155000 kbps
RB Bandwidth : unlimited
Signalling role : network
Signalling vci : 0.5
Administrative weight: 5040
VPI.VCI range : 15.1023 (4.10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Remote device is active
-
Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal

8260_HUB1> set port 15.2 disable
15.02:Port set

8260_HUB1> set port 15.2 enable iisp user
15.02:Port set

8260_HUB1> show port 15.2 verbose
Type Mode Status

15.02:IISP enabled UP

Signalling Version : 3.1
No ILMI
NNI Bandwidth : 155000 kbps
RB Bandwidth : unlimited
Signalling role : user
Signalling vci : 0.5
Administrative weight: 5040
VPI.VCI range : 15.1023 (4.10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Remote device is active

```

Figure 197. Port Status of 15.2 for 8260\_HUB1

#### Notes:

##### 1 Signalling role

Set to `network` in migration.

##### 2 Signalling role

Need to change this to `user`. The signalling role on 8260\_HUB2 remains as `network`.

Figure 198 shows the result of the `show port` for PNNI connection.

```

8260_HUB1> show port 17.1 verbose
Type Mode Status

17.01:PNNI enabled UP

ILMI status : UP
ILMI vci : 0.16
NNI Bandwidth : 155000 kbps
RB Bandwidth : unlimited
Signalling vci : 0.5
Routing vci : 0.18
Administrative weight: 5040
VPI.VCI range : 15.1023 (4.10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Remote device is active

Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal

```

Figure 198. Show Port for PNNI Connection on 8260\_HUB1

**Note:**

- ❶ SSI is automatically updated to PNNI.

The result of typing the `show pnni node_0` command is seen in Figure 199.

```

8260_HUB1> show pnni node_0
----- Node 0 -----
ATM addr : 39.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.01.01.00 ❶
Level Identifier : 96 (24 half-bytes and 0 bits) ❷
PGroup Id: 60.39.99.99.99.99.99.00.00.99.99.01
Node Id : 60.A0.39.99.99.99.99.00.00.99.99.01.01.40.00.82.60.01.01.00
Unrestricted Transit.

```

Figure 199. Show the ATM Address for 8260\_HUB1

**Notes:**

- ❶ The ATM address remains as non-PNNI.
- ❷ The Level Identifier is peer group identification.

See Figure 200 for the result of typing the `show pnni peer_group_members` command.

```

T8260_HUB1> show pnni peer_group_members
----- Peer Group of Node 0-----
60.A0.39.99.99.99.99.00.00.99.99.01.01.40.00.82.60.01.01.00 connected
60.A0.39.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00 connected
2 Members.

```

Figure 200. Shows Two Members in Peer Group 1



The result of typing the `set reachable_address` command is shown in Figure 201.

Following the migration all the static route and logical link information will be deleted. This has to be re-entered using the `set reachable_address` command. Here we show the entry for 8260\_HUB1. This one entry enables all the hubs in cluster 1 to reach cluster 2.

```
8260_HUB1> set reachable_address 15.2 96
Enter reachable address : 39.99.99.99.99.99.00.00.99.99.02
Entry set.
8260_HUB1> save all
```

Figure 201. `set reachable_address` for 8260\_HUB1

**Note:**

**1** This is the reachable address to reach peer group 2.

The result of typing the `show reachable_address all` command is seen in Figure 202.

```
8260_HUB1> show reachable_address all
Port Len Address Active Idx VPI

15.02 96 39.99.99.99.99.99.00.00.99.99.02. Y 1 -
```

Figure 202. `show reachable_address` for 8260\_HUB1

## 6.4.2 8260\_HUB2 Configuration in Peer Group 2

The result of typing the `show device` command for 8260\_HUB2 in peer group 2 is seen in Figure 203.

```
8260_HUB2> show device
8260 ATM Control Point and Switch Module
Name : 8260_HUB2
Location :

For assistance contact :

Manufacture id: VIME
Part Number: 10J2001 EC Level: E28230
Boot EEPROM version: v.3.2.2
Flash EEPROM version: v.3.2.2
Flash EEPROM backup version: v.2.5.4
Last Restart : 23:37:42 Sun 21 Feb 1999 (Restart Count: 2)

A-CPSW

> Subnet atm: Up
IP address: 192.168.21.61. Subnet mask: FF.FF.FF.00

> Subnet lan emulation ethernet/802.3
Not Started
Config ELAN Name :""
Actual ELAN Name :""
MAC Address: 000000000000
IP address : 0.0.0.0. Subnet mask: 00.00.00.00
ATM address :39.99.99.99.99.99.00.00.99.99.02.01.40.00.82.60.02.01.00
Config LES addr:none
Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
Config LECS add:none
Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
LEC Identifier: 0. Maximum Transmission Unit: 0

> Subnet lan emulation token ring
Not Started
Config ELAN Name :""
Actual ELAN Name :""
MAC Address: 000000000000
IP address : 0.0.0.0. Subnet mask: 00.00.00.00
ATM address :39.99.99.99.99.99.00.00.99.99.02.01.40.00.82.60.02.01.01
Config LES addr:none
Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
Config LECS add:none
Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK

IP address: 192.168.21.12

ARP Server:

ATM address: 39.99.99.99.99.99.00.00.99.99.02.01.40.00.82.10.00.01.0A

Device configured for PNNI port capability. No LES can start.
Dynamic RAM size is 16 MB. Migration: off. Diagnostics: enabled.
Device defined as primary.
Duplicate ATM addresses are allowed.
```

Figure 203. Show Device for 8260\_HUB2 (PNNI)

Use the `show port 14.2 verbose` command to check the IISP interface to peer group 1. This has been migrated from NNI to IISP.

```

8260_HUB2> show port 14.2 verbose

 Type Mode Status

14.02:IISP enabled UP

Signalling Version : 3.1
No ILMI
NNI Bandwidth : 155000 kbps
RB Bandwidth : unlimited
Signalling role : network
Signalling vci : 0.5
Administrative weight: 5040
VPI.VCI range : 15.1023 (4.10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Remote device is active

Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal

```

Figure 204. Port Status of 14.2 for 8260\_HUB2

**Note:**

- ❶ The NNI interface is automatically updated to IISP.

Below is the show port command for the 8272's UNI connection. This remains unchanged after the migration.

```

8260_HUB2> show port 14.1 verbose

 Type Mode Status

14.01:UNI enabled UP

Signalling Version : Auto
> Oper Sig. Version : 3.1
ILMI status : UP
ILMI vci : 0.16
RB Bandwidth : unlimited
Signalling vci : 0.5
Administrative weight: 5040
VPI.VCI range : 15.1023 (4.10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Remote device is active

Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal

```

Figure 205. 8272's UNI Connection to 8260\_HUB2

The result of typing the `show pnni node_0` command is seen in Figure 206:

```

8260_HUB2> show pnni node 0
----- Node 0 -----
ATM addr : 39.99.99.99.99.99.00.00.99.99.02.01.40.00.82.60.02.01.00 1
Level Identifier : 96 (24 half-bytes and 0 bits) 2
PGroup Id: 60.39.99.99.99.99.99.00.00.99.99.02
Node Id : 60.A0.39.99.99.99.99.00.00.99.99.02.01.40.00.82.60.02.01.00
Unrestricted Transit.

```

Figure 206. node\_0 Information for 8260\_HUB2

#### Notes:

- 1 The ATM address remains unchanged.
- 2 The Level Identifier is peer group identification.

The `show pnni peer_group_members` command is seen in Figure 207.

```

8260_HUB2> show pnni peer_group_members
----- Peer Group of Node 0-----
60.A0.39.99.99.99.99.00.00.99.99.02.01.40.00.82.60.02.01.00 connected
1 Members.

```

Figure 207. Peer Group Members for 8260\_HUB2

The `set reachable_address` command is seen in Figure 208.

```

8260_HUB2> set reachable_address 14.2 96 1
Enter reachable address : 39.99.99.99.99.99.00.00.99.99.01
Entry set.

8260_HUB2> save all

```

Figure 208. set reachable address for 8260\_HUB2

#### Note:

- 1 This entry enables peer group 2 to reach peer group 1.

The result of typing the `show reachable_address all` command is seen in Figure 209.

```

8260_HUB2> show reachable_address all
Port Len Address Active Idx VPI

14.02 96 39.99.99.99.99.99.00.00.99.99.01. Y 1 -
5.01 152 39.99.99.99.99.99.00.00.99.99.02.01.40.00.82.10.00.01 Y Dyn 0
5.01 152 47.00.79.00.00.00.00.00.00.00.00.00.00.00.A0.3E.00.00.01 Y Dyn 0
14.01 152 39.99.99.99.99.99.00.00.99.99.02.01.42.00.82.72.00.00 Y Dyn 0

```

Figure 209. Show Reachable Address for 8260\_HUB2

Connectivity with the other switches exists as shown in Figure 210:

```
8260_HUB2> ping 192.168.21.60
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.60: 1 packets sent, 1 received
Ping 192.168.21.60: 2 packets sent, 2 received
Ping 192.168.21.60: 3 packets sent, 3 received
Ping 192.168.21.60: 4 packets sent, 4 received
8260_HUB2>
8260_HUB2> ping 192.168.21.85
Starting ping (hit CTRL-C to stop) ...
Ping 192.168.21.85: 1 packets sent, 1 received
Ping 192.168.21.85: 2 packets sent, 2 received
Ping 192.168.21.85: 3 packets sent, 3 received
Ping 192.168.21.85: 4 packets sent, 4 received
```

*Figure 210. PING Command at 8260\_HUB2*



---

## Chapter 7. PNNI

PNNI (Private Network-to-Network Interface) is an ATM forum standard that supports routing and signaling to establish connections in private ATM networks. IBM has integrated PNNI into its control point switches. The hierarchical nature of PNNI provides smooth scalability of growth from small to large ATM networks. It includes protocols for distributing the network topology information among the ATM switches. Switches then use this information to select the optimum path through the network.

PNNI supports a mechanism that allows groups of switches to be clustered together. (These clusters are known as peer groups.) Clusters of switches can then be further clustered in a hierarchical fashion.

At the bottom level (node 0) these clusters are a group of physical ATM switches. At the next level (node 1) the lower level peer groups are represented by a logical group node. Thus the next level (node 1) is a group of logical group nodes. Within the peer group at the lowest level (node 0) a leader called the peer group leader is chosen from among the switches to represent that group at the next highest level (node 1). This group leader creates the logical group node that represents the peer group. The same process continues within the logical group nodes at node 1 to elect a leader to represent them at the next highest level, node 2 and so on.

---

### 7.1 PNNI Reachability

Within a PNNI peer group, reachability information is propagated throughout the peer group and there is no need for static definitions. Reachability information is NOT propagated outside the peer group, that is, across IISP links. Where IISP links are used to interconnect peer groups static reachability information has to be defined using the *set reachable\_address* command.

#### 7.1.1 PNNI Reachability in a Hierarchical Network

If you have designed a hierarchical peer group network and the peer groups are interconnected with PNNI links, the peer group leader will advertise the reachability information from within its peer group to all other peer groups within the hierarchy. There is no need to manually configure reachability information.

However, the last statement is only true for ATM switches running Version 4 code that will understand any reachability information propagated across the peer group hierarchy. If you have a network that contains switches running Version 3 code (the IBM 8260 and IBM 8285 can only run Version 3 PNNI code) this reachability information will not be understood by them. Where you have this situation the static reachability definitions required for interconnecting the peer groups with IISP links are still required. This is the only way the Version 3 code switches will learn what is outside their peer group. This in itself may introduce another problem because any static routes defined must not conflict with the learned routes the Version 4 switches want to use that have been propagated across the peer group hierarchy. The solution to this is to make sure the static definitions have a shorter length than the learned routes from the peer group hierarchy.

That is, if the Node\_0 peer group is using the default length of 96 bits, make sure any static route definitions are no longer than 95 bits. This way the Version 4 code switches will use the learned route from across the peer group hierarchy because they give a longer address match leaving the Version 3 code machines to use the statically defined routes.

### 7.1.2 LECS Address Propagation

In a LECS running in an MSS, the LECS well-known address (x47.00.79.....) will be advertised by the MSS to the switch. This will be propagated throughout the peer group in which the MSS resides. The static LECS definitions that can be defined in the switches are not necessary (the `SET LAN_EMULATION CONFIGURATION_SERVER` command). If you have peer groups interconnected with the peer group hierarchy these addresses will be propagated to the other peer groups automatically. If you have more than one LECS running in your network, clients now have the ability to find all these LECS automatically without defining them manually in the switches. Within a peer group clients will be routed to the local LECS first before going to the remote LECS.

This works with switches running Version 4 code. If you have switches running Version 3 code they will not understand the reachability information received across the hierarchy for any remote LECS. Here static reachability information has to be defined for the LECS well known address (using the `SET REACHABLE_ADDRESS` command) in order that clients attached to Version 3 switches can find LECS in other peer groups.

In this situation manually defining the addresses of the LECS in the Version 3 switches (using the `SET LAN_EMULATION CONFIGURATION_SERVER` command) may not work. As the Version 3 switches do not understand reachability information propagated across the peer group hierarchy they will not find a path to a remote LECS unless the `SET REACHABLE_ADDRESS` definitions have been made for the x47.00.79..... address on the appropriate ports of the PNNI border nodes.

#### Note: Multiple Active LECS

In an ATM network with more than one active LECS you may not know at a given time which LECS gives its services to a LEC. You must make sure that each of the LECS is configured to serve all the LECs in your peer groups. Some of the LECs may not retry if the first response from LECS does not return with valid connecting information.

---

## 7.2 Configuration Overview

We will now configure a two peer group PNNI network consisting of six 8265 hubs and an 8260 hub. Initially these switches will be configured as two peer groups interconnected with IISP links. We will then migrate this configuration to two peer groups interconnected with the PNNI hierarchy, showing how you configure peer group leadership. Finally we will add a WAN connection to another 8265 in peer group 2.

A diagram of the configuration is shown in Figure 211 on page 221.



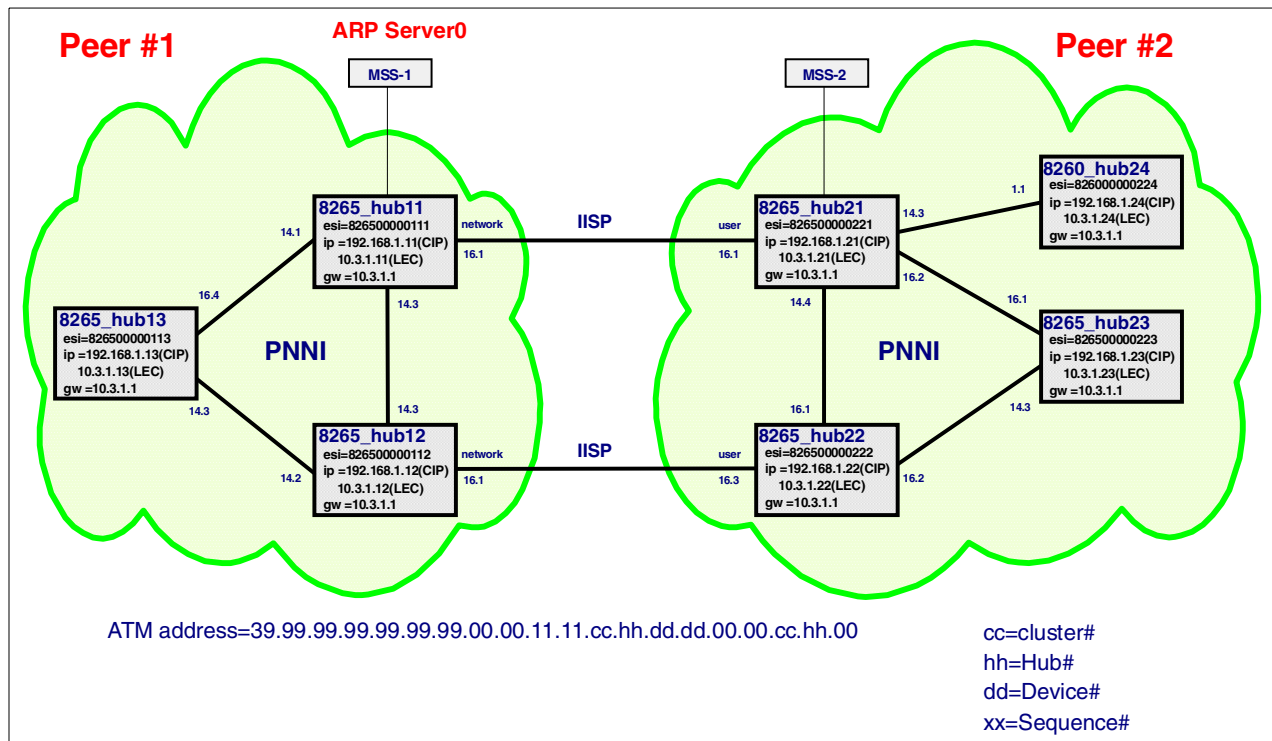


Figure 211. IISP Configuration Diagram

The address rule that was used is shown in Table 10. The 20-byte address consists of the 12-byte prefix 39.99.99.99.99.99.00.00.11.11. The last 8 bytes of the address are documented in the table:

Table 10. Address Rule

| Device      | Instance   | Peer group | HUB | ESI          | MAC          | Sel | CIP IP       | LEC IP    |
|-------------|------------|------------|-----|--------------|--------------|-----|--------------|-----------|
| 826x Switch | 8265#11    | 01         | 11  | 826500000111 | 400082650111 | 00  | 192.168.1.11 | 10.3.1.11 |
|             | 8265#12    | 01         | 12  | 826500000112 | 400082650112 | 00  | 192.168.1.12 | 10.3.1.12 |
|             | 8265#13    | 01         | 13  | 826500000113 | 400082650113 | 00  | 192.168.1.13 | 10.3.1.13 |
|             | 8265#21    | 02         | 21  | 826500000221 | 400082650221 | 00  | 192.168.1.21 | 10.3.1.21 |
|             | 8265#22    | 02         | 22  | 826500000222 | 400082650222 | 00  | 192.168.1.22 | 10.3.1.22 |
| MSS1        | 8265#23    | 02         | 23  | 826500000223 | 400082650223 | 00  | 192.168.1.23 | 10.3.1.23 |
|             | 8260#24    | 02         | 24  | 826000000224 | 400082600224 | 00  | 192.168.1.24 | 10.3.1.24 |
|             | 8265#25    | 02         | 25  | 826500000225 | 400082650225 | 00  | 192.168.1.25 | 10.3.1.25 |
|             | ARP server | 01         | 11  | 821000000001 |              | 0A  | 192.168.1.1  | -         |
|             | LECS       | 01         | 11  | 821000000001 |              | 00  | -            | -         |
| MSS2        | LES(et1)   | 01         | 11  | 821000000001 |              | 02  | -            | 10.1.1.1  |
|             | LES(tr1)   | 01         | 11  | 821000000001 |              | 03  | -            | 10.2.1.1  |
|             | LES(mgmt)  | 01         | 11  | 821000000001 |              | 04  | -            | 10.3.1.1  |
|             | ARP Client | 02         | 21  | 821000000002 |              | 0A  | 192.168.1.2  | -         |
|             | LECS       | 02         | 21  | 821000000002 |              | 00  | -            | -         |
| MSS2        | LES(et1)   | 02         | 21  | 821000000002 |              | 02  | -            | 10.1.1.1  |
|             | LES(tr1)   | 02         | 21  | 821000000002 |              | 03  | -            | 10.2.1.1  |
|             | LES(mgmt)  | 02         | 21  | 821000000002 |              | 04  | -            | 10.3.1.1  |

## 7.3 Configuring a Two Peer Group Flat PNNI Network

We will configure the network shown in Figure 211 on page 221 in stages. First we will configure the two hubs (8265\_hub11 and 8260\_hub13) in peer group 1 as shown in Figure 212 on page 223. The aim here is to show how to configure two hubs with PNNI connectivity within a peer group.

Next we will configure hub 8265\_hub21 in peer group 2 with an IISIP link to peer group 1. This will show how to connect two peer groups together with an IISIP link.

We will then show the configuration steps for 8260\_hub24 in peer group 2.

### 7.3.1 Configuring PNNI between Two 8265 Switches in Peer Group 1

In this section, we will show the configuration of two switches, 8265\_hub11 and 8260\_hub13. For clarity, a diagram of these two switches, taken from Figure 211 on page 221 is shown in Figure 212.

We will show the detailed steps to configure both switches. This could be used to configure any two switches within a peer group.

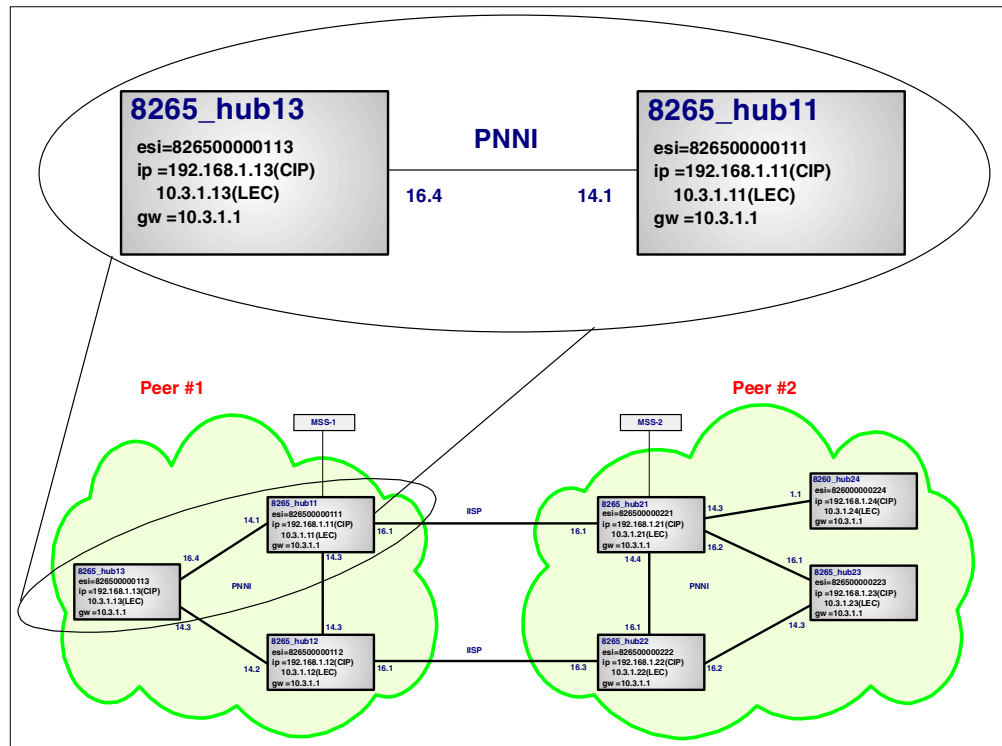


Figure 212. PNNI between 8265\_hub11 and 8260\_hub13

#### 7.3.1.1 Configuring 8265\_hub11

The following `show device` command shows the state of the hub before any configuration information is entered. Each hub comes with the same default ATM address which needs changing before the hub is connected to the network.

```

8265ATM>show device

8265 ATM Control Point and Switch Module
Name : 8265ATM
Location :
For assistance contact :
Manufacture id: 930
Part Number: 02L3457 EC Level: F12519
Boot EEPROM version: v.4.1.2
Flash EEPROM version: v.4.1.2 (PNNI)
Flash EEPROM backup version: v.4.0.1 (PNNI)
Last Restart : 10:02:48 Wed 26 May 1999 (Restart Count: 0)

A-CPSW

> Subnet ethernet:
 IP address: 0.0.0.0. Subnet mask: 00.00.00.00
 MAC Address: 0006291F93B4 (BIA)
> Subnet atm:
 IP address: 0.0.0.0. Subnet mask: 00.00.00.00

> Subnet lan emulation ethernet/802.3
 Not Started
 Config ELAN Name : ""
 Actual ELAN Name : ""
 MAC Address: 0006291F13B4
 IP address : 0.0.0.0. Subnet mask: 00.00.00.00
 ATM address : 39.99.99.99.99.99.00.00.99.99.01.01.99.99.99.99.99.00
 Config LES addr:none
 Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
 BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
 Config LECS add:none
 Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
 LEC Identifier: 0. Maximum Transmission Unit: 0
> Subnet lan emulation token ring
 Not Started
 Config ELAN Name : ""
 Actual ELAN Name : ""
 MAC Address: 0006297713B4
 IP address : 0.0.0.0. Subnet mask: 00.00.00.00
 ATM address : 39.99.99.99.99.99.00.00.99.99.01.01.99.99.99.99.99.01
 Config LES addr:none
 Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
 BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
 Config LECS add:none
 Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
 LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway :

 IP address: 0.0.0.0
 ARP Server:

 ATM address: 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00

Device configured for PNNI port capability.
Device configured for Lan Emulation Servers.
Dynamic RAM size is 32 MB. Migration: off. Diagnostics: enabled.
Device defined as primary.
Memory profile: Mixed (32_P_M)
Duplicate ATM addresses are allowed.
Accounting is disabled.

```

Figure 213. SHOW DEVICE Command before Configuring 8265 8265\_hub11

We will start by configuring this hub's ATM address. The peer group number will be 01 and the hub number 11. The command used is `Set PNNI Node:0 atm_address`.

```
8265ATM> set pnni node:0 atm_address:
Enter atm_address : 39.99.99.99.99.99.00.00.11.11.01.11.82.65.00.00.01.11.00
Set request executed.
Issue COMMIT PNNI to activate if this is your final 'SET PNNI' entry.
Issue UNCOMMIT PNNI to cancel, removes all 'set pnni' since last
COMMIT PNNI..
```

Figure 214. Setting the ATM address on 8265\_hub11

Version 3 and 4 code allows you to enter the ATM address configuration commands before making them active. Use the `commit PNNI` command to make the already entered commands active.

```
8265ATM> commit pnni
COMMIT execution will first SAVE pnni configuration updates then RESET Hub..
Are you sure ? (Y/N) Y
```

Figure 215. Issuing COMMIT PNNI

By default you can allow duplicate ATM addresses within the switch. We are going to turn this off. In doing so this command will reset the switch. Make sure you do not have any unsaved changes before issuing it.

```
8265ATM> set device duplicate_atm_addresses:not_allowed
This call will reset the ATM subsystem.
Are you sure ? (Y/N) Y
```

Figure 216. Issuing Command for Not Allowing the Duplicate ATM Address

The `set terminal prompt` command is used to set the command-line prompt. Use this to give each hub a different command-line prompt. It's very helpful to see this as confirmation that you are connected to the correct hub when using network access.

```
8265ATM> set terminal prompt 8265_hub11>

8265_hub11>
```

Figure 217. Terminal Prompt Setting

We will now set the classical IP address, subnet mask and ARP server address. (The ARP server is running in MSS1 as shown in Figure 211 on page 221).

```

8265_hub11> set device ip_address atm 192.168.1.11 ff.ff.ff.00

8265_hub11> set device arp_server
Enter atm_address :
39.99.99.99.99.99.99.00.00.11.11.82.10.00.00.00.01.0a.01.11.82.10.00.00.00.01.0a
ATM Address set

```

Figure 218. Setting CIP Information

The next screen shows the LAN Emulation Client settings. We are going to set the token-ring client to join an ELAN called mgmt. The default gateway setting in the switches will also be set to the default gateway for this ELAN. The first command shows a number of the parameters being entered together. Most of the parameters can be entered individually. The client will only start when it has all the required parameters entered. The `set device lan_emulation_client tr no_les_with_lecs:none` command is used to tell the client to request a LECS address from the switch.

```

8265_hub11> set device lan_emulation_client tr ip_address:10.3.1.11
subnet_mask:ff.ff.ff.00 mac_address:400082650111
emulated_lan_name
Enter Emulated LAN Name:
mgmt
Client starting.

8265_hub11> set device lan_emulation_client tr no_les_with_lecs:none
Client starting.

8265_hub11> set device default_gateway 10.3.1.1
Default gateway set.

```

Figure 219. Setting LEC Information

We will now enable modules and ports to give us connectivity outside this switch.

First we will enable modules 7 and 14. Module 7 is our MSS server and module 14 a 4-port 155 Mbps MMF blade.

```
8265_hub11> set module 7 14 connected
Slot 7:Module set
Slot 14:Module set

8265_hub11> show module all

Slot Install Connect Operation General Information

 1 Y n n -
 2 n n n -
 3 Y n n -
 4 n n n -
 5 Y n n -
 6 n n n -
 7 Y Y Y 8265 A-MSS 3 (FC5403) Module 1
 8 n n n -
 9 Y Y Y 8265 ATM Control Point and Switch Module:Active
10 Y n n < Extension >
11 n p n -
12 n n n -
13 n n n -
14 Y Y Y 8265 ATM 4 ports 155 Mbps Module 2
15 n n n -
16 Y n n -
17 n n n -
18 Y n Y Active Controller Module
19 n n n -
```

Figure 220. Enabling the Modules

**Notes:**

- 1** This is an MSS blade.
- 2** The adjacent 8265 hub will connect to port 14.1.

To enable the port, issue the command `set port`.

We will use the default parameters for the port. These are shown below with the `show port` command:

```
8265_hub11> set port 7.1 enable uni
7.01:Port set
8265_hub11> set port 14.1 enable pnni
14.01:Port set

8265_hub11> show port 14.1 verbose

 Type Mode Status

14.01:PNNI enabled no activity 1

ILMI status : DOWN:Not in service
ILMI vci : 0.16
RB Bandwidth : unlimited
Police admin. : off
Signalling vci : 0.5
Routing vci : 0.18
Aggregation token : 0
RB Admin weight : 5040
NRB Admin weight : 5040
VPI range admin. : 0-15 (4 bits)
VCI range admin. : 0-1023 (10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Connection shaping : Off.
Remote device is inactive

Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal
```

Figure 221. Enabling Ports

#### Note

1 At the moment this link is down. The status will change to UP-OKAY when a connection is established.

#### Note

If the port parameters have been changed earlier, the default values might have been changed. Verify that all the values are what you expect them to be.



[illegible]

PNNI 229

**Notes:**

- 1** Shows the code level of the switch.
- 2** The CIP client has successfully contacted the ARP server.
- 3** The token-ring LEC has joined the ELAN.
- 4** The address of the default gateway.
- 5** The address of the ARP server.

You can display the ATM node\_0 address, peer group and node IDs using the `show pnni node:0` command:

```
8265_hub11> show pnni node:0

NODE 0 CONFIG PARAMS (IN ACTIVE CONFIG REPOSITORY):
 leadership priority: 0
 level id: 96 6
 peer group id 60.39999999999990000111101
 node id: 60.a0.3999999999999000011110111.826500000111.00 7
 node's atm addr: 39.99999999999000011110111.826500000111.00
 nodal representation: simple
 node's transit capab: unrestricted
 additional branching: supported

NODE 0 OPERATIONAL:
 is not peer group leader
 is not a border node
```

Figure 223. `show pnni node:0` Command

**Notes:**

- 6** By default the level ID is set to 96 bits covering the first 12 bytes of the ATM address.
- 7** The node ID is set to the ATM address of the hub. The first byte, 60, is the length of 96 bits in hex. The a0 is a separator byte.

To display summary address, enter `show pnni summary_address`.

```
8265_hub11> show pnni summary_address
----- Internal Summary Addresses of Node 0-----
 Entry 1: Prefix Length=104, default, used:
 39.99.99.99.99.99.00.00.11.11.01.11.
 50 summary addresses still available for configuration.
```

Figure 224. `Show PNNI Summary Address`

To display a list of neighbor nodes to which this switch has direct connectivity, use the `show pnni neighbor` command. As this is the only switch configured so far, there are none.

```
8265_hub11> show pnni neighbor
Node 0 contained in peer group identified by level id 96 has no neighbors
```

Figure 225. `Show PNNI Neighbor`

The `show pnni peer_group_members` command will list all the hubs that have joined this peer group. As the figure shows, this hub is the only one:

```
8265_hub11> show pnni peer_group members
VERTX THIS UP CONN IS NODE_ID
NUMBER SWITCH LINK CTED PGL THEN ATM_ADDR
 0 yes no yes no 60.a0.3999999999999999000011110111.826500000111.00
 39.9999999999999999000011110111.826500000111.00
Peer group contains 1 member(s)
```

Figure 226. Show PNNI Peer Group Members

This concludes the basic configuration for 8265\_hub11. We will now continue with the configuration steps for 8260\_hub13.

### 7.3.1.2 Configuring 8260\_hub13 in Peer Group 1

The basic configuration procedures are the same as we have just made for 8265\_hub11. The differences being the hub ATM address, the CIP and ELAN client IP and MAC address. The screens for these commands will not be duplicated here.

We will next enable the modules we are using.

```
8260_hub13> set module 14 16 connected
Slot 14:Module set
Slot 16:Module set

8260_hub13> show module all
Slot Install Connect Operation General Information

 1 Y n n -
 2 n n n -
 3 Y n n -
 4 n n n -
 5 Y n n -
 6 n n n -
 7 Y n n -
 8 n n n -
 9 Y Y Y 8265 ATM Control Point and Switch Module:Active
10 Y n n < Extension >
11 n p n -
12 n n n -
13 n n n -
14 Y Y Y 8265 ATM 4 ports 155 Mbps Module
15 n n n -
16 Y Y Y 8265 ATM 4 ports 155 Mbps Module
17 n n n -
18 Y n Y Active Controller Module
19 n n n -
```

Figure 227. Enabling Modules

Next we will enable the port that connects to 8265\_hub11 using PNNI protocols.  
Again we will take the default parameters.

```
8260_hub13> set port 16.4 enable pnni
16.04:Port set

8260_hub13> show port 16.4 verbose
 Type Mode Status

16.04:PNNI enabled UP
ILMI status : UP
ILMI vci : 0.16
RB Bandwidth : unlimited
Police admin. : off
Police oper. : off
Signalling vci : 0.5
Routing vci : 0.18
Aggregation token : 0
RB Admin weight : 5040
NRB Admin weight : 5040
VPI range admin. : 0-15 (4 bits)
VCI range admin. : 0-1023 (10 bits)
VPI range oper. : 0-15 (4 bits)
VCI range oper. : 0-1024 (10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Connection shaping : Off.
Remote device is active
Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal
```

Figure 228. Enabling Ports

```
8260_hub13> show device

8265 ATM Control Point and Switch Module
Name : 8265ATM
Location :
For assistance contact :
Manufacture id: 930
Part Number: 02L3099 EC Level: F12445
Boot EEPROM version: v.4.1.2
Flash EEPROM version: v.4.1.2 (PNNI)
Flash EEPROM backup version: v.4.0.1 (PNNI)
Last Restart : 10:23:20 Wed 26 May 1999 (Restart Count: 2)

A-CPSW

> Subnet ethernet:
 IP address: 0.0.0.0. Subnet mask: 00.00.00.00
 MAC Address: 0006291F85DB (BIA)
> Subnet atm: Up
IP address: 192.168.1.13. Subnet mask: FF.FF.FF.00
> Subnet lan emulation ethernet/802.3
Not Started
Config ELAN Name :""
Actual ELAN Name :""
MAC Address: 0006291F05DB
IP address : 0.0.0.0. Subnet mask: 00.00.00.00
ATM address :39.99.99.99.99.99.00.00.11.11.01.13.82.65.00.00.01.13.00
Config LES addr:none
Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
Config LECS add:none
Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
LEC Identifier: 0. Maximum Transmission Unit: 0
> Subnet lan emulation token ring
Up
Config ELAN Name : "mgmt"
Actual ELAN Name : "mgmt"
MAC Address: 400082650113
IP address : 10.3.1.13. Subnet mask: FF.FF.FF.00
ATM address :39.99.99.99.99.99.00.00.11.11.01.13.82.65.00.00.01.13.01
Config LES addr:none
Actual LES addr:39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.04
BUS ATM address:39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.04
Config LECS add:none
Actual LECS add:C5.00.79.00.00.00.00.00.00.00.00.00.00.00.A0.3E.00.00.01.00
LEC Identifier: 3. Maximum Transmission Unit: 4490

Default Gateway : OK

IP address: 10.3.1.1

ARP Server:

ATM address: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.0A

Device configured for PNNI port capability.
Dynamic RAM size is 32 MB. Migration: off. Diagnostics: enabled.
Device defined as primary.
Memory profile: P2P (32_P_P)
Duplicate ATM addresses are not allowed.
Accounting is disabled.
```

## 234 ATM Configuration Examples

The following screen shows the hub PNNI configuration parameters.

```
8260_hub13> show pnni node:0

NODE 0 CONFIG PARAMS (IN ACTIVE CONFIG REPOSITORY):
 leadership priority: 0
 level id: 96
 peer group id 60.39999999999990000111101
 node id: 60.a0.3999999999999000011110113.826500000113.00
 node's atm addr: 39.9999999999999000011110113.826500000113.00
 nodal representation: simple
 node's transit capab: unrestricted
 additional branching: supported

NODE 0 OPERATIONAL:
 is not peer group leader
 is not a border node
 peer group containing this node has 2 members (includes this node)
```

Figure 230. Show PNNI Node:0

To display the summary address, enter the following command:

```
8260_hub13> show pnni summary_address
----- Internal Summary Addresses of Node 0-----
Entry 1: Prefix Length=104, default, used:
39.99.99.99.99.99.00.00.11.11.01.13.
50 summary addresses still available for configuration
```

Figure 231. Show PNNI Summary Address

If we now enter the `show pnni neighbor` command in this hub it shows that 8265\_hub11 is directly attached to it.

```
8260_hub13> show pnni neighbor

NEIGHBORS OF NODE 0 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 96:

neighbor_1 node id: 60.a0.3999999999999000011110111.826500000111.00
neighbor atm addr 39.9999999999999000011110111.826500000111.00
 state: Full
 slot.phys-port: 16.04
```

Figure 232. Show PNNI Neighbor

The `show pnni peer_group_members` command now shows two hubs in this peer group: this hub and its neighbor, 8265\_hub11.

```
8260_hub13> show pnni peer_group_members
VERTX THIS UP CONN IS NODE_ID
NUMBER SWITCH LINK CTED PGL THEN ATM_ADDR
 0 yes no yes no 60.a0.3999999999999999000011110113.826500000113.00
 0 yes no yes no 39.9999999999999999000011110113.826500000113.00
 10 no no yes no 60.a0.3999999999999999000011110111.826500000111.00
 10 no no yes no 39.9999999999999999000011110111.826500000111.00
Peer group contains 2 member(s)
```

Figure 233. Show PNNI Peer Group Members

### 7.3.2 Configuring an IISP Link between Peer Groups 1 and 2

We are going to configure an IISP link between 8265\_hub11 and 8265\_hub21 which are in different peer groups. To configure an IISP connection between the ATM switch, you must:

1. Configure the appropriate ATM address. Each switch's peer group identifier is different.
2. Configure the interconnecting ports between the switches for IISP connectivity.
3. Configure the reachable address information in the switch at each end of the IISP link. No reachability information is propagated across an IISP link. Each peer group has to be told the ATM addresses it can reach at the other end of each IISP link. This is done using the `set reachable address` command which has to be defined in the switch that has the IISP link.

Figure 234 on page 237 shows the link we are going to configure.



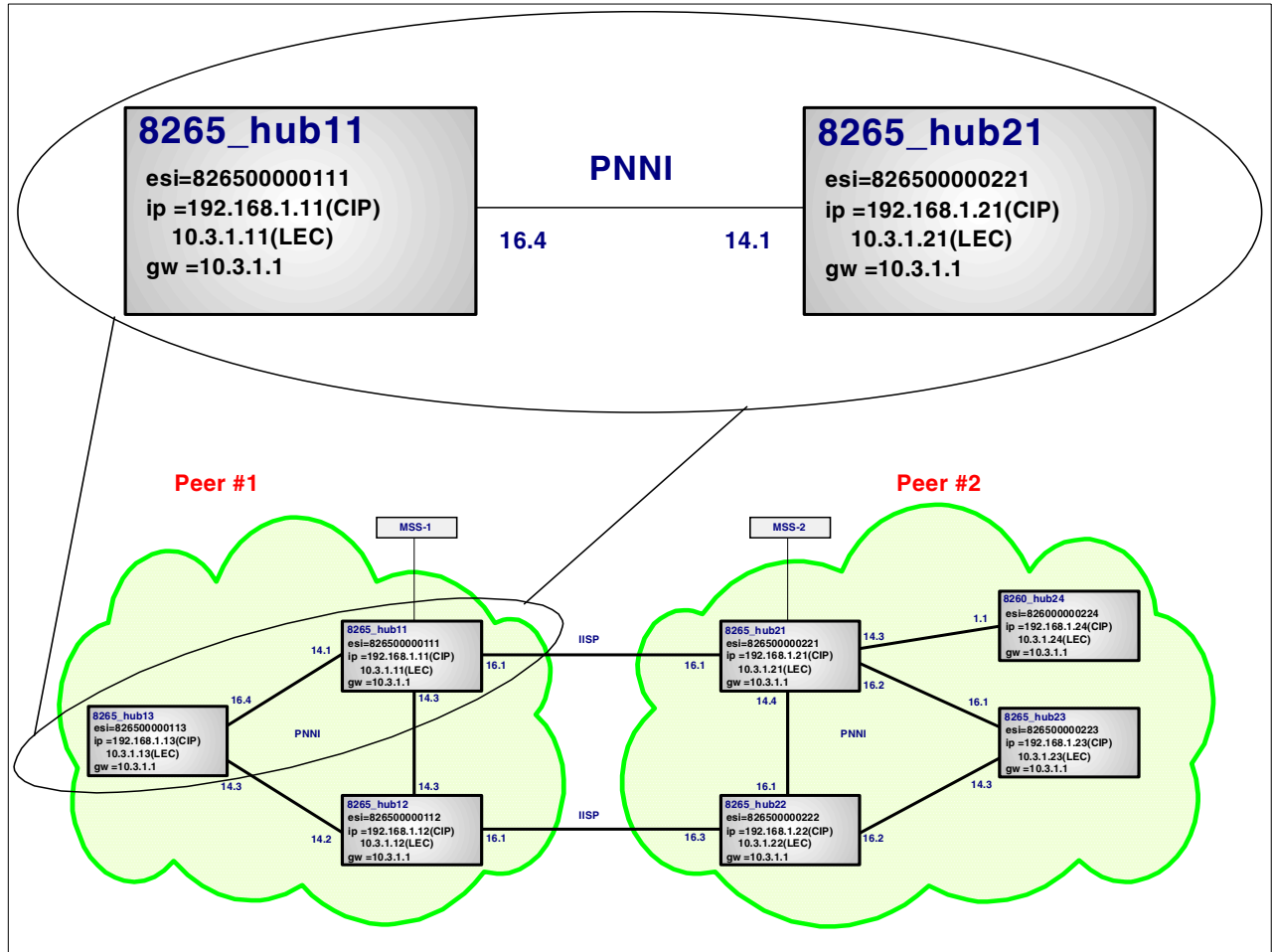


Figure 234. IISP Link between the Two Peer Groups

### 7.3.2.1 Configuring IISP 8265\_hub11 in Peer Group 1

We have already done most of the configuration for 8265\_hub11. What we will show here are the extra steps now required to configure the IISP port and the reachability information.

We show the `set port` command for this link on the next screen. Again we are taking the default parameters. When setting IISP links one end has to be defined as network and the other end as user. In our example 8265\_hub11 is the network end and 8265\_hub21 in peer group 2 the user end.

```
8265_hub11> set port 16.1 enable iisp network
16.01:Port set
```

```
8265_hub11> show port 16.1 verbose
```

| Type                      | Mode               | Status      |
|---------------------------|--------------------|-------------|
| -----                     |                    |             |
| 16.01:IISP                | enabled            | no activity |
| Signalling Version        | : 3.1              |             |
| No IIMI                   |                    |             |
| RB Bandwidth              | : unlimited        |             |
| Police admin.             | : off              |             |
| Signalling role           | : network          |             |
| Signalling vci            | : 0.5              |             |
| RB Admin weight           | : 5040             |             |
| NRB Admin weight          | : 5040             |             |
| VPI range admin.          | : 0-15 (4 bits)    |             |
| VCI range admin.          | : 0-1023 (10 bits) |             |
| Connector                 | : SC DUPLEX        |             |
| Media                     | : multimode fiber  |             |
| Port speed                | : 155000 kbps      |             |
| Connection shaping        | : Off.             |             |
| Remote device is inactive |                    |             |
| Frame format              | : SONET STS-3c     |             |
| Scrambling mode           | : frame and cell   |             |
| Clock mode                | : internal         |             |

Figure 235. Enabling the IISP Port

The following screen shows the reachability information being set in 8265\_hub11:

```
8265_hub11> show reachable_address all
```

| Port  | Len | Address                                         | Active | Idx | VPI | Scope |
|-------|-----|-------------------------------------------------|--------|-----|-----|-------|
| ----- |     |                                                 |        |     |     |       |
| 7.01  | 152 | 3999.9999.9999.9900.0011.1101.1100.2035.9905.27 | Y      | Dyn | 0   | 15    |
| 7.01  | 152 | 3999.9999.9999.9900.0011.1101.1182.1000.0000.01 | Y      | Dyn | 0   | 15    |
| 7.01  | 152 | 4700.7900.0000.0000.0000.0000.0000.A03E.0000.01 | Y      | Dyn | 0   | 15    |
| 7.01  | 152 | C500.7900.0000.0000.0000.0000.0000.A03E.0000.01 | Y      | Dyn | 0   | 15    |

```
8265_hub11> set reachable_address 16.1 96 39.99.99.99.99.99.00.00.11.11.02
```

Entry set.

```
8265_hub11> set reachable_address 16.1 8 47
```

Entry set.

```
8265_hub11> show reachable_address all
```

| Port  | Len | Address                                         | Active | Idx | VPI | Scope |
|-------|-----|-------------------------------------------------|--------|-----|-----|-------|
| ----- |     |                                                 |        |     |     |       |
| 16.01 | 96  | 3999.9999.9999.9900.0011.1102. . . . .          | N      | 1   | -   | 1     |
| 16.01 | 8   | 47 . . . . .                                    | N      | 2   | -   | 1     |
| 7.01  | 152 | 3999.9999.9999.9900.0011.1101.1100.2035.9905.27 | Y      | Dyn | 0   | 15    |
| 7.01  | 152 | 3999.9999.9999.9900.0011.1101.1182.1000.0000.01 | Y      | Dyn | 0   | 15    |
| 7.01  | 152 | 4700.7900.0000.0000.0000.0000.0000.A03E.0000.01 | Y      | Dyn | 0   | 15    |
| 7.01  | 152 | C500.7900.0000.0000.0000.0000.0000.A03E.0000.01 | Y      | Dyn | 0   | 15    |

-----

16.01 96 3999.9999.9999.9900.0011.1102. . . . . N 1 - 1

16.01 8 47 . . . . . N 2 - 1

7.01 152 3999.9999.9999.9900.0011.1101.1100.2035.9905.27 Y Dyn 0 15

7.01 152 3999.9999.9999.9900.0011.1101.1182.1000.0000.01 Y Dyn 0 15

7.01 152 4700.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15

7.01 152 C500.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15

```
8265_hub11> save all
```

Figure 236. Setting Reachable Address to Another Peer Group

#### Notes:

- 1 This entry is to tell switches in peer group 1 that peer group 2 exists through port 16.1. That is, ATM addresses beginning with

39.99.99.99.99.99.00.00.11.11.02 (96 bits) can be reached through port 16.1.

- 2 In our configuration we have two MSS servers each with a LECS. So that switches in peer group 1 can reach the LECS in MSS2 if a failure occurs in MSS1 we need to tell peer group 1 that the LECS well known address can be reached through port 16.1

At this point both these connections are down as we have not configured the other hub yet.

### 7.3.2.2 Configuring 8265\_hub21 in Peer Group 2

Now we are going to configure 8265\_hub21, which is in peer group 2. First, we will configure the ATM address.

```
8265ATM> set pnni node:0
Enter parameter: atm_address:
Enter atm_address : 39.99.99.99.99.99.00.00.11.11.02.21.82.65.00.00.02.21.00
Set request executed.
Issue COMMIT PNNI to activate if this is your final 'SET PNNI' entry.
Issue UNCOMMIT PNNI to cancel, removes all 'set pnni' since last COMMIT PNNI.

8265ATM> commit pnni
COMMIT execution will first SAVE pnni configuration updates then RESET Hub..
Are you sure ? (Y/N) Y

8265ATM> set device duplicate_atm_addresses:not_allowed
This call will reset the ATM subsystem.
Are you sure ? (Y/N) Y.
```

Figure 237. Set ATM Address

We will now enable port 16.1 for IISP. Note this end is defined with the parameter user.

```

8265_hub21> set port 16.1 enable iisp user
16.01:Port set

8265_hub21> show port 16.1 verbose
 Type Mode Status

16.01:IISP enabled UP
Signalling Version : 3.1
No IIMI
RB Bandwidth : unlimited
Police admin. : off
Signalling role : user
Signalling vci : 0.5
RB Admin weight : 5040
NRB Admin weight : 5040
VPI range admin. : 0-15 (4 bits)
VCI range admin. : 0-1023 (10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Connection shaping : Off.
Remote device is active

Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal

```

Figure 238. Enable Ports

**Note:**

**1** The signalling role is user.

We will now set the reachability information needed to enable switches in peer group 2 to find the addresses in peer group 1.

```

8265_hub21> show reachable_address all
No match

8265_hub21> set reachable_address 96 16.1 96 39.99.99.99.99.99.00.00.11.11.01
Entry set.

8265_hub21> set reachable_address a 16.1 8 47
Entry set.

8265_hub21> show reachable_address all
Port Len Address Active Idx VPI Scope

16.01 96 3999.9999.9999.9900.0011.1101. . . . Y 1 - 1
16.01 8 47 Y 2 - 1
7.01 152 3999.9999.9999.9900.0011.1102.2100.2035.997E.EC Y Dyn 0 15
7.01 152 3999.9999.9999.9900.0011.1102.2182.1000.0000.02 Y Dyn 0 15
7.01 152 4700.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
7.01 152 C500.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
8265_hub21> save all

```

Figure 239. Set Reachable Address

**Notes:**

- 1** This entry informs switches in peer group 2 of the addresses in peer group 1 that can be reached through port 16.1.
- 2** As with the reachability information defined in 8265\_hub11, this entry allows switches in peer group 2 to find the LECS well known address being advertised by MSS1 in peer group 1.

Now we display the device status using the `show device` command.

```

8265_hub21> show device
8265 ATM Control Point and Switch Module
Name : 8265ATM
Location :
For assistance contact :
Manufacture id: 930
Part Number: 02L3457 EC Level: F12519
Boot EEPROM version: v.4.1.2
Flash EEPROM version: v.4.1.2 (PNNI)
Flash EEPROM backup version: v.4.0.1 (PNNI)
Last Restart : 12:38:48 Wed 26 May 1999 (Restart Count: 10)

A-CPSW

> Subnet ethernet:
 IP address: 0.0.0.0. Subnet mask: 00.00.00.00
 MAC Address: 0006291F8948 (BIA)
> Subnet atm: Up
 IP address: 192.168.1.21. Subnet mask: FF.FF.FF.00

> Subnet lan emulation ethernet/802.3
 Not Started
 Config ELAN Name :""
 Actual ELAN Name :""
 MAC Address: 0006291F0948
 IP address : 0.0.0.0. Subnet mask: 00.00.00.00
 ATM address :39.99.99.99.99.99.00.00.11.11.02.21.82.65.00.00.02.21.00
 Config LES addr:none
 Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
 BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
 Config LECS add:none
 Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
 LEC Identifier: 0. Maximum Transmission Unit: 0
> Subnet lan emulation token ring
 Up
 Config ELAN Name : "mgmt"
 Actual ELAN Name : "mgmt"
 MAC Address: 400082650221
 IP address : 10.3.1.21. Subnet mask: FF.FF.FF.00
 ATM address :39.99.99.99.99.99.00.00.11.11.02.21.82.65.00.00.02.21.01
 Config LES addr:none
 Actual LES addr:39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.04
 BUS ATM address:39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.04
 Config LECS add:none
 Actual LECS add:47.00.79.00.00.00.00.00.00.00.00.00.00.00.00.00.A0.3E.00.00.01.00
 LEC Identifier: 8. Maximum Transmission Unit: 4490

Default Gateway : OK

 IP address: 10.3.1.1

ARP Server:

 ATM address: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.0A

Device configured for PNNI port capability.
Device configured for Lan Emulation Servers.
Dynamic RAM size is 32 MB. Migration: off. Diagnostics: enabled.
Device defined as primary.
Memory profile: Mixed (32_P_M)
Duplicate ATM addresses are not allowed.
Accounting is disabled.

```

Figure 240. Show Device

To display the ATM PNNI Node\_0 parameters for this switch use the `show pnni node:0` command:

```
8265_hub21> show pnni node:0

NODE 0 CONFIG PARAMS (IN ACTIVE CONFIG REPOSITORY) :
 leadership priority: 0
 level id: 96
 peer group id 60.39999999999990000111102
 node id: 60.a0.3999999999999000011110221.826500000221.00
 node's atm addr: 39.99999999999000011110221.826500000221.00
 nodal representation: simple
 node's transit capab: unrestricted
 additional branching: supported

NODE 0 OPERATIONAL:
 is not peer group leader
 is not a border node
 peer group containing this node has 1 members (includes this node)
```

Figure 241. Show PNNI node:0

To display the summary address, use the following command:

```
8265_hub21> show pnni summary address
----- Internal Summary Addresses of Node 0-----
Entry 1: Prefix Length=104, default, used:
 39.99.99.99.99.99.00.00.11.11.02.21.
50 summary addresses still available for configuration
```

Figure 242. Show PNNI Summary Address

To complete the configuration of this switch there are three other PNNI ports that need enabling: ports 14.3, 14.4 and 16.2. (Please refer to Figure 211 on page 221.) As this has been shown before we will not duplicate it here.

### 7.3.3 Remaining 8265 Hubs

We have shown detailed steps for configuring hubs 8265\_hub11, 8260\_hub13 and 8265\_hub21.

Hubs 8265\_hub12 and 8265\_hub22, which contain the other IISP link between the peer groups are configured the same way as hubs 8265\_hub11 and 8265\_hub21, apart from the different address information (ATM, IP and MAC address). Hub 8265\_hub23 is configured the same way as 8260\_hub13.

### 7.3.4 8260\_hub24 Configuration

Now we are going to configure 8260\_hub24 which is in peer group 2. First, we will configure the ATM address.

```

8260ATM> set pnni node_0 atm address:
Enter ATM address : 39.99.99.99.99.99.00.00.11.11.02.24.82.60.00.00.02.24.00
To activate issue COMMIT after your last 'set pnni...' entry.
To cancel all changes since previous COMMIT, issue UNCOMMIT.
8260ATM> commit pnni
COMMIT execution will first SAVE pnni configuration updates then RESET Hub..
Are you sure ? (Y/N) Y

8260ATM> set device duplicate_atm_addresses:not_allowed
This call will reset the ATM subsystem.
Are you sure ? (Y/N)

```

Figure 243. ATM Address Setting on 8260\_hub24

To set the terminal prompt on 8260\_hub24, use the `set terminal` command.

We have set the prompt to 8260\_hub24>.

```

8260ATM> set terminal prompt 8260_hub24>
8260_hub24>

```

Figure 244. Terminal Prompt Setting on 8260\_hub24

We will now set the classical IP address, subnet mask and ARP server address.

```

8260_hub24> set device arp_server ip_address atm 192.168.1.24 ff.ff.ff.00
IP address and mask set
8260_hub24> set device arp_server
Enter atm address :
39.99.99.99.99.99.00.00.11.11.82.10.00.00.00.01.0a.01.11.82.10.00.00.00.01.0a
ATM Address set

```

Figure 245. Setting Classical IP Information on 8260\_hub24

The next screen shows the LAN Emulation Client settings. We are going to set the token-ring client to join an ELAN called mgmt. The default gateway will also be set to the default gateway for this ELAN.

```

8260_hub24> set device lan_emulation_client tr ip_address:10.3.1.24
subnet_mask:ff.ff.ff.00 mac_address:400082600224 emulated_lan_name
Enter Emulated LAN Name:
mgmt
Client starting.
8260_hub24> set device lan_emulation_client tr no_les_with_lecs:none
Client starting.
8260_hub24> set device default_gateway 10.3.1.1
Default gateway set
8260_hub24> save all

```

Figure 246. Setting LAN Emulation Client Information on 8260\_hub24

We will now enable a module and port to give us connectivity outside this switch.



First we will enable module 1. Module 1 is a three-port 155 Mbps MMF blade.

```
8260_hub24> set module 1 connected
Slot 1:Module set
8260_hub24> set port 1.1 enable pnni
1.01:Port set
8260_hub24> show port 1.1 verbose
```

| Type                    | Mode                  | Status |
|-------------------------|-----------------------|--------|
| -----                   |                       |        |
| 1.01:PNNI               | enabled               | UP     |
| ILMI status             | : UP                  |        |
| ILMI vci                | : 0.16                |        |
| NNI Bandwidth           | : 155000 kbps         |        |
| RB Bandwidth            | : unlimited           |        |
| Signalling vci          | : 0.5                 |        |
| Routing vci             | : 0.18                |        |
| Administrative weight   | : 5040                |        |
| VPI.VCI range           | : 15.1023 (4.10 bits) |        |
| Connector               | : SC DUPLEX           |        |
| Media                   | : multimode fiber     |        |
| Port speed              | : 155000 kbps         |        |
| Remote device is active |                       |        |
| Frame format            | : SONET STS-3c        |        |
| Scrambling mode         | : frame and cell      |        |
| Clock mode              | : internal            |        |

Figure 247. Enabling the Module and Port

A `show device` command shows the status of the hub.

```

8260_hub24> show device
8260_hub24 ATM Control Point and Switch Module
Name : 8260ATM
Location :

For assistance contact :

Manufacture id: VIME
Part Number: 10J2001 EC Level: E28230
Boot EEPROM version: v.3.2.2
Flash EEPROM version: v.3.2.2
Flash EEPROM backup version: v.3.1.8
Last Restart : 11:52:59 Wed 26 May 1999 (Restart Count: 2)

A-CPSW

> Subnet atm: Up
IP address: 192.168.1.24. Subnet mask: FF.FF.FF.00

> Subnet lan emulation ethernet/802.3
Not Started
Config ELAN Name : ""
Actual ELAN Name : ""
MAC Address: 000000000000
IP address : 0.0.0.0. Subnet mask: 00.00.00.00
ATM address : 39.99.99.99.99.99.00.00.11.11.02.24.82.60.00.00.02.24.00
Config LES addr:none
Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
Config LECS add:none
Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
LEC Identifier: 0. Maximum Transmission Unit: 0
> Subnet lan emulation token ring
Up
Config ELAN Name : "mgmt"
Actual ELAN Name : "mgmt"
MAC Address: 400082600224
IP address : 10.3.1.24. Subnet mask: FF.FF.FF.00
ATM address : 39.99.99.99.99.99.00.00.11.11.02.24.82.60.00.00.02.24.01
Config LES addr:none
Actual LES addr:39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.04
BUS ATM address:39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.04
Config LECS add:none
Actual LECS add:C5.00.79.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.01.00
LEC Identifier: 9. Maximum Transmission Unit: 4490

Default Gateway : OK

IP address: 10.3.1.1

ARP Server:

ATM address: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.0A

Device configured for PNPI port capability. No LES can start.
Dynamic RAM size is 16 MB. Migration: off. Diagnostics: enabled.
Device defined as primary.
Duplicate ATM addresses are not allowed.

```

Figure 248. show device Command on 8260\_hub24

To display the ATM node\_0 address, peer group and node IDs, use the `show pnni node:0` command.

```
8260_hub24> show pnni node 0
----- Node 0 -----
ATM addr : 39.99.99.99.99.99.99.00.00.11.11.02.24.82.60.00.00.02.24.00
Level Identifier : 96 (24 half-bytes and 0 bits)
PGroup Id: 60.39.99.99.99.99.99.00.00.11.11.02
Node Id : 60.A0.39.99.99.99.99.99.00.00.11.11.02.24.82.60.00.00.02.24.00
Unrestricted Transit.
```

Figure 249. `show pnni node_0` Command on 8260\_hub24

To display a list of neighbor nodes to which this switch has direct connectivity, use the `show pnni neighbor` command:

```
8260_hub24> show pnni neighbor
----- Neighbors of Node 0-----
60.A0.39.99.99.99.99.99.00.00.11.11.02.21.82.65.00.00.02.21.00:Full
Port 1.01 vpi=0
```

Figure 250. `show pnni neighbor` Command on 8260\_hub24

To display a list all the hubs that have joined this peer group use the `show pnni peer_group_members` command.

Four members are shown in this peer group now.

```
8260_hub24> show pnni peer_group_members
----- Peer Group of Node 0-----
60.A0.39.99.99.99.99.99.00.00.11.11.02.24.82.60.00.00.02.24.00 connected
60.A0.39.99.99.99.99.99.99.00.00.11.11.02.22.82.65.00.00.02.22.00 connected
60.A0.39.99.99.99.99.99.99.00.00.11.11.02.23.82.65.00.00.02.23.00 connected
60.A0.39.99.99.99.99.99.99.00.00.11.11.02.21.82.65.00.00.02.21.00 connected
4 Members.
```

Figure 251. `show pnni peer_group_members` Command on 8260\_hub24

## 7.3.5 Displaying the Connectivity Status of the Network

### 7.3.5.1 8265\_hub11 in Peer Group 1

The following screens are taken from 8265\_hub11 and show the connectivity from that hub.

The `show pnni node:0` command for 8265\_hub11 shows the ATM address, node and peer group for this hub.

```

8265_hub11> show pnni node:0

NODE 0 CONFIG PARAMS (IN ACTIVE CONFIG REPOSITORY):
 leadership priority: 0
 level id: 96
 peer group id 60.39999999999990000111101
 node id: 60.a0.3999999999999000011110111.826500000111.00
 node's atm addr: 39.99999999999000011110111.826500000111.00
 nodal representation: simple
 node's transit capab: unrestricted
 additional branching: supported

NODE 0 OPERATIONAL:
 is not peer group leader
 is not a border node
 peer group containing this node has 3 members (includes this node)

```

Figure 252. show pnni node:0 Command on 8265\_hub11

The show pnni neighbor command lists the hubs in peer group 1 that are directly attached to 8265\_hub11. As can be seen from the following screen, hubs 8265\_hub12 and 8260\_hub13 are direct PNNI neighbors of this hub.

```

8265_hub11> show pnni neighbor

NEIGHBORS OF NODE 0 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 96:

neighbor_1 node id: 60.a0.3999999999999000011110112.826500000112.00
neighbor atm addr 39.99999999999000011110112.826500000112.00
 state: Full
 slot.phys-port: 14.03

neighbor_2 node id: 60.a0.3999999999999000011110113.826500000113.00
neighbor atm addr 39.99999999999000011110113.826500000113.00
 state: Full
 slot.phys-port: 14.01

```

Figure 253. show pnni neighbor on 8265\_hub11

The show pnni peer\_group\_members command lists all the hubs in the peer group that are up and active. As can be seen from the display in Figure 254 on page 248 all three hubs in peer group 1 have joined the peer group.

```

8265_hub11> show pnni peer_group_members

```

| VERTX | THIS   | UP   | CONN | IS  | NODE_ID                                         |
|-------|--------|------|------|-----|-------------------------------------------------|
| NUMBR | SWITCH | LINK | CTED | PGL | THEN ATM_ADDR                                   |
| 0     | yes    | no   | yes  | no  | 60.a0.3999999999999000011110111.826500000111.00 |
|       |        |      |      |     | 39.99999999999000011110111.826500000111.00      |
| 11    | no     | no   | yes  | no  | 60.a0.3999999999999000011110112.826500000112.00 |
|       |        |      |      |     | 39.99999999999000011110112.826500000112.00      |
| 10    | no     | no   | yes  | no  | 60.a0.3999999999999000011110113.826500000113.00 |
|       |        |      |      |     | 39.99999999999000011110113.826500000113.00      |

```

Peer group contains 3 member(s)

```

Figure 254. show pnni peer\_group\_members Command on 8265\_hub11

The first two entries displayed with this `show reachable_address` command show that the static routes defined to hub 8265\_hub21 in peer group 2 across the IISP link are active. The remaining entries are dynamically learned addresses from devices directly attached to this hub.

```
8265_hub11> show reachable_address all
```

| Port  | Len  | Address                                         | Active | Idx | VPI | Scope   |
|-------|------|-------------------------------------------------|--------|-----|-----|---------|
| 16.01 | 96   | 3999.9999.9999.9900.0011.1102.                  | .      | .   | .   | Y 1 - 1 |
| 16.01 | 8 47 | .                                               | .      | .   | .   | Y 2 - 1 |
| 7.01  | 152  | 3999.9999.9999.9900.0011.1101.1100.2035.9905.27 | Y      | Dyn | 0   | 15      |
| 7.01  | 152  | 3999.9999.9999.9900.0011.1101.1182.1000.0000.01 | Y      | Dyn | 0   | 15      |
| 7.01  | 152  | 4700.7900.0000.0000.0000.0000.0000.A03E.0000.01 | Y      | Dyn | 0   | 15      |
| 7.01  | 152  | C500.7900.0000.0000.0000.0000.0000.A03E.0000.01 | Y      | Dyn | 0   | 15      |
| 14.04 | 152  | 3999.9999.9999.9900.0011.1101.1182.7000.0001.11 | Y      | Dyn | 0   | 15      |

Figure 255. Show Reachable Address on 8265\_hub11

### 7.3.5.2 8265\_hub21 in Peer Group 2

Figure 256 shows the result of typing the `show pnni node:0` command for 8265\_hub21:

```
8265_hub21> show pnni node:0
```

NODE 0 CONFIG PARAMS (IN ACTIVE CONFIG REPOSITORY):

```

leadership priority: 0
level id: 96
peer group id 60.39999999999990000111102
node id: 60.a0.3999999999999000011110221.826500000221.00
node's atm addr: 39.99999999999000011110221.826500000221.00
nodal representation: simple
node's transit capab: unrestricted
additional branching: supported

```

NODE 0 OPERATIONAL:

```

is not peer group leader
is not a border node
peer group containing this node has 4 members (includes this node)

```

Figure 256. Show PNNI Node:0 on 8265\_hub21

The `show pnni neighbor` command shows what switches within the peer group have direct connectivity to this switch.

```

8265_hub21> show pnni neighbor

NEIGHBORS OF NODE 0 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 96:

neighbor_1 node id: 60.a0.399999999999000011110224.826000000224.00
neighbor atm addr 39.999999999999000011110224.826000000224.00
 state: Full
 slot.phys-port: 14.03

neighbor_2 node id: 60.a0.399999999999000011110223.826500000223.00
neighbor atm addr 39.999999999999000011110223.826500000223.00
 state: Full
 slot.phys-port: 16.02

neighbor_3 node id: 60.a0.399999999999000011110222.826500000222.00
neighbor atm addr 39.999999999999000011110222.826500000222.00
 state: Full
 slot.phys-port: 14.04

```

Figure 257. Show PNNI Neighbor on 8265\_hub21

The `show pnni peer_group_members` command is used to list all the active hubs that have joined this peer group. As can be seen below all four hubs in peer group 2 have joined the peer group.

```

8265_hub21> show pnni peer_group_members

```

| VERTX<br>NUMBER | THIS<br>SWITCH | UP<br>LINK | CONN<br>CTED | IS<br>PGL | NODE ID<br>THEN ATM_ADDR                                                                      |
|-----------------|----------------|------------|--------------|-----------|-----------------------------------------------------------------------------------------------|
| 0               | yes            | no         | yes          | no        | 60.a0.399999999999000011110221.826500000221.00<br>39.999999999999000011110221.826500000221.00 |
| 12              | no             | no         | yes          | no        | 60.a0.399999999999000011110222.826500000222.00<br>39.999999999999000011110222.826500000222.00 |
| 11              | no             | no         | yes          | no        | 60.a0.399999999999000011110223.826500000223.00<br>39.999999999999000011110223.826500000223.00 |
| 10              | no             | no         | yes          | no        | 60.a0.399999999999000011110224.826000000224.00<br>39.999999999999000011110224.826000000224.00 |

```

Peer group contains 4 member(s)

```

Figure 258. Show PNNI Peer Group Members on 8265\_hub21

The `show reachable address` command shows reachability across the IISP link to 8265\_hub11. The active address is shown by the Y under the active heading in Figure 259 on page 251. You can see that both statically defined reachable addresses are active. The remaining four from port 7.1 have been dynamically learned.

```

8265_hub21> show reachable_address all
Port Len Address Active Idx VPI Scope

16.01 96 3999.9999.9999.9900.0011.1101. . . . Y 1 - 1
16.01 8 47 Y 2 - 1
7.01 152 3999.9999.9999.9900.0011.1102.2100.2035.997E.EC Y Dyn 0 15
7.01 152 3999.9999.9999.9900.0011.1102.2182.1000.0000.02 Y Dyn 0 15
7.01 152 4700.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
7.01 152 C500.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15

```

Figure 259. Show Reachable Address on 8265\_hub21

## 7.4 Configuring PNNI Hierarchy

We will now take the configuration we have just built (based on two PNNI peer groups interconnected with IISP links) and reconfigure this so the peer groups are connected using the PNNI hierarchy. We will start with the configuration we have just completed (as shown in Figure 211 on page 221). The final configuration will be as shown in Figure 260.

### 7.4.1 Overview

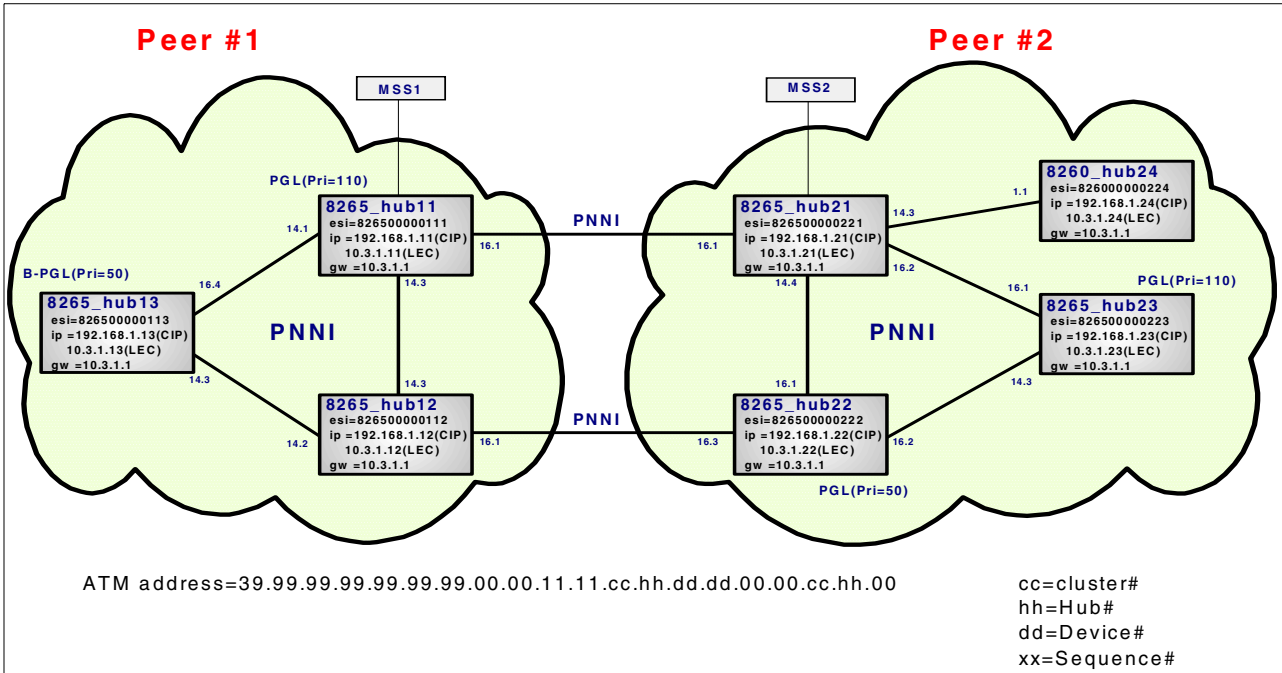


Figure 260. PNNI Configuration Diagram

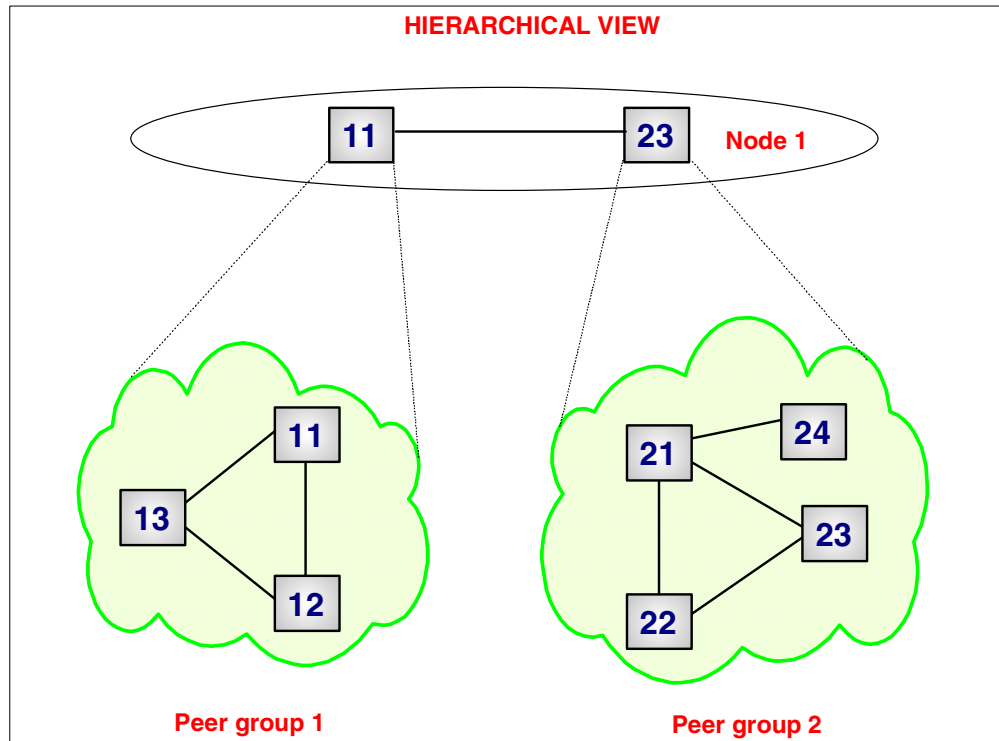


Figure 261. Hierarchical View of the PNNI Network

A summary of the process follows:

- Remove any static reachable address definitions that are not required.
- Redefine the IISP links as PNNI links.
- Set the NODE\_0 Leadership Priority.

The reachable address definitions are not needed when you migrate to a peer group hierarchy environment as reachability is propagated across the hierarchy. This is fine if all your switches have Version 4 code. If you have a switch running Version 3 code as we have, 8260\_hub24 is an 8260, it will not understand the reachability information propagated across the peer group hierarchy. Reachability information is still required on the exit ports of the border switches to enable non-Version 4 switches to reach other peer groups. In our example you will see that not all the reachable addresses are deleted when we migrate our network to a hierarchical one. This is the reason for this.

To set the Node\_0 leadership priority within each peer group, one of the switches will be elected peer group leader. This switch will advertise reachability information from within its peer group to other peer groups. The default value for this parameter is 0. A switch with a leadership priority value of 0 can never be a peer group leader. To enable a switch to take part in the negotiation for peer group leader that goes on when the leader is being chosen, this value must be set to at least 1. The range is from 1 to 255, but the settable range is up to 205. When a switch is elected peer group leader it adds 50 to its configured priority value and uses this in any further negotiation. Consequently any switch joining a peer group has to have a configured peer group leadership priority 50 higher than the current active peer group leaders to be able to take over as peer group leader. This is



done deliberately to prevent needless swapping of the peer group leadership role in a running network.

If there are two hubs with the same leadership priority negotiating to become peer group leader, the one with the higher address wins.

If you set the leadership priority to 1 in all your switches they will all take part in the election process, but unless they were all powered on at the same time it may not be the one with the highest address that becomes leader. Once a switch is elected peer group leader, 50 is added to its configured priority. For this reason we suggest you take the following approach.

Decide which hub you want to become peer group leader and in the event of its failing, which hub you would want to become its backup.

Make sure the peer group leader has a configured peer group priority of 51 over the backup. To ensure the backup always assumes the responsibility this should have a priority of at least 51 over the other switches.

If you are not interested in which switch takes over if the switch you configure to be peer group leader fails, just give one switch a priority of 51 above all others.

## **7.4.2 Migration Procedure**

We are going to show the configuration steps required for 8265\_hub11 in peer group 1 and 8265\_hub21 in peer group 2. The steps required for hubs 8265\_hub12 and 8265\_hub22 are the same and will not be repeated here. The configuration steps for 8260\_hub13, which does not have any IISP links, and 8260\_hub24 will also be shown.

In our network we are going to make hubs 8265\_hub11 and 8265\_hub23 the peer group leaders by giving them a leadership priority of 110. We want hubs 8260\_hub13 and 8265\_hub22 to take over the leadership priority role if either 8265\_hub11 or 8265\_hub23 fails so we will configure them with a priority of 50. The remaining 8265 switches will have a priority of 1. The 8260 running Version 3 code cannot be a peer group leader.

### **7.4.2.1 Configuration Steps for 8265\_hub11**

The following screen shows the reachable address entry for the static IISP route to peer group 1 being deleted. A new entry is then made for the 8260 Version 3 hub 8260\_hub24. This is to ensure it can reach peer group 1. Note its length is less than the 96 bit length of the reachability information propagated across the hierarchy. This is to ensure this entry does not interfere with the reachability information the Version 4 switches will use.

```

8265_hub11> show reachable_address all
Port Len Address Active Idx VPI Scope

16.01 96 3999.9999.9999.9900.0011.1102. . . . Y 1 - 1
16.01 8 47 Y 2 - 1
7.01 152 3999.9999.9999.9900.0011.1101.1100.2035.9905.27 Y Dyn 0 15
7.01 152 3999.9999.9999.9900.0011.1101.1182.1000.0000.01 Y Dyn 0 15
7.01 152 4700.7900.0000.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
7.01 152 C500.7900.0000.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
14.04 152 3999.9999.9999.9900.0011.1101.1182.7000.0001.11 Y Dyn 0 15
8265_hub11> clear reachable_address 1
Entry cleared
8265_hub11> set reachable_address 16.1 95 39.99.99.99.99.99.00.00.11.11.02
Warning:some unused bits are set in last byte (0x02, only 7 significant bits)
Entry set.
8265_hub11> show reachable_address all
Port Len Address Active Idx VPI Scope

16.01 95 3999.9999.9999.9900.0011.1102. . . . N 1 - 1
16.01 8 47 N 2 - 1
7.01 152 3999.9999.9999.9900.0011.1101.1100.2035.9905.27 Y Dyn 0 15
7.01 152 3999.9999.9999.9900.0011.1101.1182.1000.0000.01 Y Dyn 0 15
7.01 152 4700.7900.0000.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
7.01 152 C500.7900.0000.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
14.04 152 3999.9999.9999.9900.0011.1101.1182.7000.0001.11 Y Dyn 0 15

```

Figure 262. Results of the Reachable Address Command

The following screen shows the commands entered to change link 16.1 from IISP to PNNI.

```

8265_hub11> show port 16.1 verbose
 Type Mode Status

16.01:IISP enabled UP
8265_hub11> set port 16.1 disable
16.01:Port set
8265_hub11> set port 16.1 enable pnni
16.01:Port set
8265_hub11> show port 16.1 verbose
 Type Mode Status

16.01:PNNI enabled DOWN:Establishing

ILMI status : DOWN:Establishing
ILMI vci : 0.16
RB Bandwidth : unlimited
Police admin. : off
Signalling vci : 0.5
Routing vci : 0.18
Aggregation token : 0
RB Admin weight : 5040
NRB Admin weight : 5040
VPI range admin. : 0-15 (4 bits)
VCI range admin. : 0-1023 (10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Connection shaping : Off.
Remote device is active

Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal

```

Figure 263. Set Port for PNNI

**Note:**

- 1** This is the set port enable pnni command. The default parameters are taken.

The leadership priority is set for 8265\_hub11. We are setting the value to 110 to ensure this hub always becomes peer group leader. The show pnni node:0 command shows this node has become peer group leader.

```

8265_hub11> set pnni node:0 leader_priority:110 1
Set request executed. Caused, previously unconfig
node 1 to be config with leader prior 0 & level id 88.
If you want to modify it do so before issuing COMMIT PNNI.
Issue UNCOMMIT PNNI to cancel, removes all 'set pnni' since last COMMIT PNNI.
8265_hub11> commit pnni
COMMIT execution may cause new peer group leaders(s) to be created..
Are you sure ? (Y/N) Y
COMMIT successfully executed, results in more configured levels.
To save new configuration issue SAVE.
8265_hub11> save all

8265_hub11> show pnni node:0
NODE 0 CONFIG PARAMS (IN ACTIVE CONFIG REPOSITORY):
 leadership priority: 110 1
 level id: 96
 peer group id 60.3999999999999990000111101
 node id: 60.a0.399999999999999000011110111.826500000111.00
 node's atm addr: 39.999999999999999000011110111.826500000111.00
 nodal representation: simple
 node's transit capab: unrestricted
 additional branching: supported

NODE 0 OPERATIONAL:
 is peer group leader with leadership priority 160 2
 is a border node
 peer group containing this node has 3 members (includes this node)

```

Figure 264. Setting the Leadership Priority

#### Notes:

- 1** The leadership priority is set to 110.
- 2** This node has become peer group leader.

```

8265_hub11> show pnni neighbor
NEIGHBORS OF NODE 0 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 96:
neighbor_1 node id: 60.a0.399999999999999000011110112.826500000112.00
neighbor atm addr 39.999999999999999000011110112.826500000112.00
 state: Full
 slot.phys-port: 14.03

neighbor_2 node id: 60.a0.399999999999999000011110113.826500000113.00
neighbor atm addr 39.999999999999999000011110113.826500000113.00
 state: Full
 slot.phys-port: 14.01

NEIGHBORS OF NODE 1 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 88:
neighbor_1 NodeId: 58.60.399999999999999000011110200.826500000223.00
neighbor atm addr 39.999999999999999000011110223.826500000223.40
 state: Full

```

Figure 265. show pnni neighbor Command

The next screen shows the peer group members. The top part of the screen shows the switch in each peer group that is leader. Underneath this the switches that have joined this peer group are listed. The figure shows three members:

```

8265_hub11> show pnni peer group members
VERTX THIS UP CONN IS NODE_ID
NUMBER SWITCH LINK CTED PGL THEN ATM_ADDR
 1 yes no yes no 58.60.3999999999999999000011110100.826500000111.00
 13 no no yes no 39.9999999999999999000011110111.826500000111.40
 13 no no yes no 58.60.3999999999999999000011110200.826500000223.00
 13 no no yes no 39.9999999999999999000011110223.826500000223.40
Peer group contains 2 member(s)
 0 yes yes yes yes 60.a0.3999999999999999000011110111.826500000111.00
 11 no yes yes no 39.9999999999999999000011110111.826500000111.00
 11 no yes yes no 60.a0.3999999999999999000011110112.826500000112.00
 11 no yes yes no 39.9999999999999999000011110112.826500000112.00
 10 no no yes no 60.a0.3999999999999999000011110113.826500000113.00
 10 no no yes no 39.9999999999999999000011110113.826500000113.00
Peer group contains 3 member(s)

```

Figure 266. Show PNNI Peer Group Members for 8265\_hub11

#### 7.4.2.2 Configuring 8265\_hub21

The following figure shows the reachable address information changes for 8265\_hub21:

```

8265_hub21> show reachable_address all
Port Len Address Active Idx VPI Scope

16.01 96 3999.9999.9999.9900.0011.1101. . . . Y 1 - 1
16.01 8 47 Y 2 - 1
 7.01 152 3999.9999.9999.9900.0011.1102.2100.2035.997E.EC Y Dyn 0 15
 7.01 152 3999.9999.9999.9900.0011.1102.2182.1000.0000.02 Y Dyn 0 15
 7.01 152 4700.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
 7.01 152 C500.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
8265_hub21> clear reachable_address 1
Entry cleared
8265_hub21> set reachable_address 16.1 95 39.99.99.99.99.99.00.00.11.11.01
Warning:some unused bits are set in last byte (0x01, only 7 significant bits)
Entry set.
8265_hub21> show reachable_address all
Port Len Address Active Idx VPI Scope

16.01 95 3999.9999.9999.9900.0011.1100. . . . N 1 - 1
16.01 8 47 N 2 - 1
 7.01 152 3999.9999.9999.9900.0011.1102.2100.2035.997E.EC Y Dyn 0 15
 7.01 152 3999.9999.9999.9900.0011.1102.2182.1000.0000.02 Y Dyn 0 15
 7.01 152 4700.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15
 7.01 152 C500.7900.0000.0000.0000.0000.0000.A03E.0000.01 Y Dyn 0 15

```

Figure 267. Reachable Address Command

The IISP port in 8265\_hub21 is changed to PNNI. Again the default parameters are chosen.

```

8265_hub21> show port 16.1 verbose
 Type Mode Status

16.01:IISP enabled UP
8265_hub21> set port 16.1 disable
16.01:Port set
8265_hub21> set port 16.1 enable pnni
16.01:Port set
8265_hub21> show port 16.1 verbose
 Type Mode Status

16.01:PNNI enabled up

IIMI status : up
IIMI vci : 0.16
RB Bandwidth : unlimited
Police admin. : off
Signalling vci : 0.5
Routing vci : 0.18
Aggregation token : 0
RB Admin weight : 5040
NRB Admin weight : 5040
VPI range admin. : 0-15 (4 bits)
VCI range admin. : 0-1023 (10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Connection shaping : Off.
Remote device is active

Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal

```

Figure 268. IISP to PNNI Port Change for 8265\_hub21

The PNNI Node\_0 leadership priority is set for 8265\_hub21 to a value of 1. With this value it is eligible to become the peer group leader but will only do so if both hubs 8265\_hub23 and 8265\_hub22 are not operational.

```

8265_hub21> set pnni node:0 leader_priority:1
Set request executed. Caused, previously unconfig
node 1 to be config with leader prior 0 & level id 88.
If you want to modify it do so before issuing COMMIT PNNI.
Issue UNCOMMIT PNNI to cancel, removes all 'set pnni' since last COMMIT PNNI.
8265_hub21> commit pnni
COMMIT execution may cause new peer group leaders(s) to be created..
Are you sure ? (Y/N) Y
COMMIT successfully executed, results in more configured levels.
To save new configuration issue SAVE.
8265_hub21> save all

```

Figure 269. Set Pnni Node:0 Leader Priority for 8265\_hub21

Figure 270 shows the result of typing the `show pnni node:0` command for 8265\_hub21.

```

8265_hub21> show pnni node:0
NODE 0 CONFIG PARAMS (IN ACTIVE CONFIG REPOSITORY):
 leadership priority: 1
 level id: 96
 peer group id 60.3999999999990000111102
 node id: 60.a0.399999999999000011110221.826500000221.00
 node's atm addr: 39.999999999999000011110221.826500000221.00
 nodal representation: simple
 node's transit capab: unrestricted
 additional branching: supported

NODE 0 OPERATIONAL:
 is not peer group leader
 is a border node
 peer group containing this node has 4 members (includes this node)

```

Figure 270. The show pnni node:0 Command for 8265\_hub21

Figure 271 shows the hubs directly attached to 8265\_hub21:

```

8265_hub21> show pnni neighbor
NEIGHBORS OF NODE 0 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 96:

neighbor_1 node id: 60.a0.399999999999000011110222.826500000222.00
neighbor atm addr 39.999999999999000011110222.826500000222.00
 state: Full
 slot.phys-port: 14.04

neighbor_2 node id: 60.a0.399999999999000011110223.826500000223.00
neighbor atm addr 39.999999999999000011110223.826500000223.00
 state: Full
 slot.phys-port: 16.02

neighbor_3 node id: 60.a0.399999999999000011110224.826000000224.00
neighbor atm addr 39.999999999999000011110224.826000000224.00
 state: Full
 slot.phys-port: 14.03

```

Figure 271. The show pnni neighbor Command for 8265\_hub21

The next figure shows the peer group members as seen from 8265\_hub21. The top two entries show the peer group leaders for both peer groups while the bottom four entries show the hubs that have joined this peer group.

```

8265_hub21> show pnni peer_group members
VERTX THIS UP CONN IS NODE_ID
NUMBR SWITCH LINK CTED PGL THEN ATM_ADDR
 15 no no - no 58.60.3999999999999999000011110100.826500000111.00
 39.9999999999999999000011110111.826500000111.40
 13 no no - no 58.60.3999999999999999000011110200.826500000223.00
 39.9999999999999999000011110223.826500000223.40
Peer group contains 2 member(s)
 0 yes yes yes no 60.a0.3999999999999999000011110221.826500000221.00
 39.9999999999999999000011110221.826500000221.00
 12 no yes yes no 60.a0.3999999999999999000011110222.826500000222.00
 39.9999999999999999000011110222.826500000222.00
 11 no no yes yes 60.a0.3999999999999999000011110223.826500000223.00
 39.9999999999999999000011110223.826500000223.00
 10 no no yes no 60.a0.3999999999999999000011110224.826000000224.00
 39.9999999999999999000011110224.826000000224.00
Peer group contains 4 member(s)

```

Figure 272. The show pnni peer\_group\_members Command for 8265\_hub21

### 7.4.2.3 Configuring 8265\_hub13

We have decided to make this hub the backup peer group leader for peer group 1.

The PNNI Node:0 leadership priority is set to 50 for 8265\_hub13.

```

8265_hub13> set pnni node:0 leader_priority:50
Set request executed.
Issue COMMIT PNNI to activate if this is your final 'SET PNNI' entry.
Issue UNCOMMIT PNNI to cancel, removes all 'set pnni' since last COMMIT PNNI.
8265_hub13> commit pnni
COMMIT execution may generate new peer group leaders(s)
or remove existing peer group leader(s) ..
Are you sure ? (Y/N) Y
COMMIT successfully, may result in new peer group leaders(s)
or loss of existing peer group leader(s).
8265_hub13> save all

```

Figure 273. Setting Leadership Priority on 8265\_hub13

In Figure 274 the show pnni node:0 command shows this hub has a leadership priority of 50 but is not the peer group leader. It will take over leadership if 8265\_hub11 fails.



```
8265_hub13> show pnni node:0
NODE 0 CONFIG PARAMS (IN ACTIVE CONFIG REPOSITORY):
 leadership priority: 50
 level id: 96
 peer group id 60.39999999999990000111101
 node id: 60.a0.3999999999999000011110113.826500000113.00
 node's atm addr: 39.999999999999000011110113.826500000113.00
 nodal representation: simple
 node's transit capab: unrestricted
 additional branching: supported

NODE 0 OPERATIONAL:
 is not peer group leader
 is not a border node
 peer group containing this node has 3 members (includes this node)
```

Figure 274. *show pnni node:0* Command for 8265\_hub13

#### 7.4.2.4 Configuring Hubs 8265\_hub12, 8265\_hub22 and 8260\_hub24

Hubs 8265\_hub12 and 8265\_hub22 contain the other IISP link between the peer groups that has to be upgraded to PNNI. The upgrade of these two hubs is exactly the same as has been described for hubs 8265\_hub11 and 8265\_hub21 with the exception of the leadership priority value. Hub 8265\_hub12 has a leadership priority of 1 and 8265\_hub22 is 50.

Hub 8260\_hub24 cannot take part in the peer group leadership election process. There are no changes to the 8260\_hub24 configuration when migrating to peer group hierarchy. The 8260 can only run Version 3 code and cannot be a peer group leader or border node. The minimum code level for an 8260 to be part of a network with peer group hierarchy is 3.2.0.

#### 7.4.2.5 Monitor 8260 hub24

The following screens show the network as viewed from the 8260\_hub24:

```
8260_hub24> show pnni node_0
----- Node 0 -----
ATM addr : 39.99.99.99.99.99.00.00.11.11.02.24.82.60.00.00.02.24.00
Level Identifier : 96 (24 half-bytes and 0 bits)
PGroup Id: 60.39.99.99.99.99.99.00.00.11.11.02
Node Id : 60.A0.39.99.99.99.99.99.00.00.11.11.02.24.82.60.00.00.02.24.00
Unrestricted Transit.
```

Figure 275. *show pnni node 0 Command for 8260\_hub24*

```
8260_hub24> show pnni neighbor
----- Neighbors of Node 0-----
60.A0.39.99.99.99.99.99.00.00.11.11.02.21.82.65.00.00.02.21.00:Full
 Port 1.01 vpi=0
```

Figure 276. *show pnni neighbor* Command for 8260\_hub24

```

8260_hub24> show pnni peer_group_members
----- Peer Group of Node 0-----
 60.A0.39.99.99.99.99.99.00.00.11.11.02.24.82.60.00.00.02.24.00 connected
 60.A0.39.99.99.99.99.99.00.00.11.11.02.22.82.65.00.00.02.22.00 connected
 60.A0.39.99.99.99.99.99.00.00.11.11.02.23.82.65.00.00.02.23.00 connected
 60.A0.39.99.99.99.99.99.00.00.11.11.02.21.82.65.00.00.02.21.00 connected
4 Members.

```

Figure 277. show pnni peer\_group\_members Command for 8260\_hub24

#### 7.4.2.6 Configuring 8265\_hub23

The only configuration changes here are to set the leadership priority. We have decided to make this hub the peer group leader for peer group 2. We will set the leadership priority to 110 to accomplish this.

```

8265_hub23> set pnni node:0 leader_priority:110
Set request executed.
Issue COMMIT PNNI to activate if this is your final 'SET PNNI' entry.
Issue UNCOMMIT PNNI to cancel, removes all 'set pnni' since last COMMIT PNNI.

8265_hub23> commit pnni
COMMIT execution may generate new peer group leaders(s)
or remove existing peer group leader(s) ..
Are you sure ? (Y/N) Y
COMMIT successfully executed, may result in new peer group leaders(s)
or loss of existing peer group leader(s).
8265_hub23> save all

```

Figure 278. set pnni node:0 leader\_priority Command for 8265\_hub23

Following this set command, the PNNI Node:0 configuration is shown below.

```

8265_hub23> show pnni node:0
NODE 0 CONFIG PARAMS (IN ACTIVE CONFIG REPOSITORY):
 leadership priority: 110
 level id: 96
 peer group id 60.39999999999999990000111102
 node id: 60.a0.3999999999999999000011110223.826500000223.00
 node's atm addr: 39.9999999999999999000011110223.826500000223.00
 nodal representation: simple
 node's transit capab: unrestricted
 additional branching: supported

NODE 0 OPERATIONAL:
 is peer group leader with leadership priority 160
 is not a border node
 peer group containing this node has 4 members (includes this node)

```

Figure 279. show pnni node:0 Command for 8265\_hub23

The following show pnni neighbor command shows the hubs directly connected to 8265\_hub23 within this peer group and its partner node\_1 peer group leader (8265\_hub11) in peer group 1. Its node\_1 partner is shown at the bottom of the screen.

```

8265_hub23> show pnni neighbor
NEIGHBORS OF NODE 0 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 96:

neighbor_1 node id: 60.a0.3999999999999000011110222.826500000222.00
neighbor atm addr 39.9999999999999000011110222.826500000222.00
 state: Full
 slot.phys-port: 14.03

neighbor_2 node id: 60.a0.3999999999999000011110221.826500000221.00
neighbor atm addr 39.9999999999999000011110221.826500000221.00
 state: Full
 slot.phys-port: 16.01

NEIGHBORS OF NODE 1 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 88:

neighbor_1 NodeId: 58.60.3999999999999000011110100.826500000111.00
neighbor atm addr 39.9999999999999000011110111.826500000111.40
 state: Full

```

Figure 280. Show PNNI Neighbor

The `show pnni peer_group_members` command shows that it and 8265\_hub11 are the two peer group leaders in this network. All four hubs in this peer group are shown at the bottom.

```

8265_hub23> show pnni peer_group_members
VERTX THIS UP CONN IS NODE_ID
NUMBER SWITCH LINK CTED PGL THEN ATM_ADDR
 14 no no yes no 58.60.3999999999999000011110100.826500000111.00
 14 no no yes no 39.9999999999999000011110111.826500000111.40
 1 yes no yes no 58.60.3999999999999000011110200.826500000223.00
 1 yes no yes no 39.9999999999999000011110223.826500000223.40
Peer group contains 2 member(s)
 0 yes no yes yes 60.a0.3999999999999000011110223.826500000223.00
 0 yes no yes yes 39.9999999999999000011110223.826500000223.00
 12 no yes yes no 60.a0.3999999999999000011110222.826500000222.00
 12 no yes yes no 39.9999999999999000011110222.826500000222.00
 11 no no yes no 60.a0.3999999999999000011110224.826000000224.00
 11 no no yes no 39.9999999999999000011110224.826000000224.00
 10 no yes yes no 60.a0.3999999999999000011110221.826500000221.00
 10 no yes yes no 39.9999999999999000011110221.826500000221.00
Peer group contains 4 member(s)

```

Figure 281. Show PNNI Peer Group Members Command for 8265\_hub23.

This completed the configuration for 8265\_hub23.

### 7.4.3 Adding a WAN Connection to a Remote Hub

We will now take our ATM network (running the PNNI hierarchy as shown in Figure 260 on page 251) and add another hub (8265\_hub25). This hub will be connected to 8265\_hub23 using a DS3 WAN connection. This is shown in Figure 282 on page 264.

The new switch will be part of the existing peer group 2. We will define the ports at both ends of the connection as VOID and set a VPC across the void to carry the PNNI connection.

We will show the configuration of the WAN link. The basic hub and PNNI configuration has been done earlier in this book starting at 7.2, “Configuration Overview” on page 220.

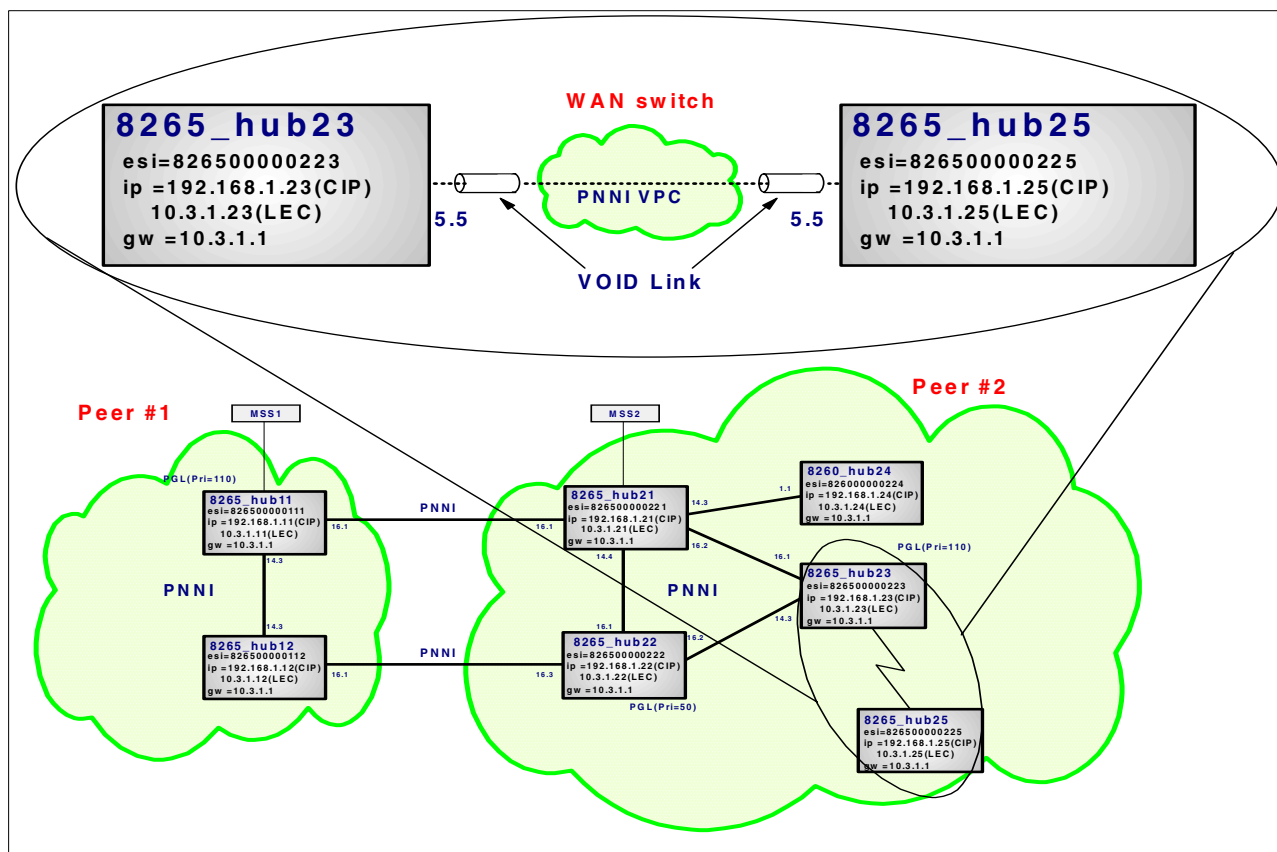


Figure 282. Switch (8265\_hub25) Is WAN Connected to the Existing Network

#### 7.4.3.1 Configuration for 8265\_hub23

We will now configure the WAN connection in 8265\_hub23.

Our A8-WAN blade is installed in slot 5.

```
8265_hub23> set module 5 connected
Slot 5:Module set
8265_hub23> show module 5

Slot Install Connect Operation General Information

5 Y Y Y 8265 ATM WAN Module with OC3 + DS3 Ports
```

Figure 283. Setting the WAN Module Connected

Next we will enable the port we are using as void and set the port parameters we need. (Check *8265 Nways ATM Switch Command Reference Guide*, SA33-0458 for details of all the parameters.)

```
8265_hub23> set port 5.5 disable void shaping:44000
5.05:Port set
8265_hub23> set port 5.5 parm timing_source 0
8265_hub23> set port 5.5 parm descramble_rcv_cells enable
8265_hub23> set port 5.5 parm scramble_xmt_cells enable
8265_hub23> set port 5.5 parm discard_idle_cells enable
8265_hub23> set port 5.5 parm address 10b
Actual Value 02
Enter value: 02
8265_hub23> set port 5.5 parm address 10d
Actual Value 01
Enter value: 00
8265_hub23> set port 5.5 enable void
5.05:Port set
```

*Figure 284. Setting the Void Port in 8265\_hub23*

The show port 5.5 verbose command screen follows.

```

8265_hub23> show port 5.5 verbose

```

| Type      | Mode    | Status | Daughter Card Description |
|-----------|---------|--------|---------------------------|
| 5.05:VOID | enabled | UP     | DS3 Port                  |

```

No ILMI
VPI range admin. : 0-15 (4 bits)
VCI range admin. : 0-1023 (10 bits)
Connector : BNC
Media : coaxial cable
Port speed : 44736 kbps
Connection shaping : Off.
Shaping bandwidth : 44000 kbps
Remote device is active

DAUGHTER CARD INFORMATION:

Type : DS3
Software Version : 0.5.1.J

CONFIGURATION CONTROL:

Failure Integration Time : 2500 ms
Failure Decay Time : 10 s
Timing Source : PARM_EXTERNAL_FACILITY_TMGM
Descramble Received Cells : Yes
Discard Idle Cells : Yes
Scramble Transmitted Cells : Yes
DS3 Format : C-bit
PLCP Framing : No

DIAGNOSTICS CONTROL:

Diagnostic Pattern : 00 00 00 00 00 00 00 00
Performance Monitoring : DISABLED
Internal Wrap : disabled
Reply Mode Wrap : disabled
Far End Mode Wrap : disabled

EQUIPMENT TEST RESULT:

Tests Results : OK

FAILURE STATUS:

Loss of Signal : inactive
Loss of Frame : inactive
Equipment Failure : inactive
Loss of Synchronization : inactive
Loss of Cell Delineation : inactive
DS3 Alarm Indication Signal (AIS) : inactive
DS3 Remote Alarm Indication (RAI) : inactive
PLCP Loss of Frame : inactive
PLCP Remote Alarm Indication (RAI) : inactive
Idle Signal : inactive

FAILURE SUMMARY STATUS:

No Failure.

```

Figure 285. The Show Port Command for the VOID Port

We will now configure the VPC link across the void to 8265\_hub25.

We have been given a VPI value of 1 by the supplier of the wide area link for the connection. We are also going to use 44 Mbps of the connection for this link. A detailed description of all the parameters for the `set vpc_link` command can be found in the *8265 Nways ATM Switch Command Reference Guide*, SA33-0458.

```
8265_hub23> show vpc_link all
No match

8265_hub23> set vpc_link 5.5 1 enable pnni bandwidth:44000
bandwidth_rb:unlimited police:off shaping:off ilmi_vci:none vpci:1
5.05 1:Accepted

8265_hub23> show vpc_link 5.5 1 verbose
```

| VPI  | Type   | Mode   | Status |
|------|--------|--------|--------|
| 5.05 | 1:PNNI | enable | UP     |

No ILMI

VPC Bandwidth : 44000 kbps

RB Bandwidth : unlimited

Police admin. : off

Signalling vci : 1.5

Routing vci : 1.18

Aggregation token : 0

RB Admin weight : 5040

NRB Admin weight : 5040

VPCI : 1

Shaping : Off

Figure 286. Set vpc\_link Command for the WAN Link

**Note:**

**1** VPI is set to 1.

The following `show pnni neighbor` command (after configuring 8265\_hub25) shows that 8265\_hub23 now has three neighbors including 8265\_hub25.

```

8265_hub23> show pnni neighbor

NEIGHBORS OF NODE 0 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 96:
neighbor_1 node id: 60.a0.3999999999999000011110225.826500000225.00
neighbor atm addr 39.9999999999999000011110225.826500000225.00
 state: Full
 slot.phys-port: 05.05

neighbor_2 node id: 60.a0.3999999999999000011110221.826500000221.00
neighbor atm addr 39.9999999999999000011110221.826500000221.00
 state: Full
 slot.phys-port: 16.01

neighbor_3 node id: 60.a0.3999999999999000011110222.826500000222.00
neighbor atm addr 39.9999999999999000011110222.826500000222.00
 state: Full
 slot.phys-port: 14.03

NEIGHBORS OF NODE 1 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 88:

neighbor_1 NodeId: 58.60.3999999999999000011110100.826500000111.00
neighbor atm addr 39.9999999999999000011110111.826500000111.40
 state: Full

```

Figure 287. Show PNNI Neighbor Command for 8265\_hub23

This is the `show pnni peer_group_members` command for 8265\_hub23:

```

8265_hub23> show pnni peer_group members
VERTX THIS UP CONN IS NODE_ID
NUMBR SWITCH LINK CTED PGL THEN ATM_ADDR
 1 yes no yes no 58.60.3999999999999000011110200.826500000223.00
 11 no no yes no 58.60.3999999999999000011110100.826500000111.00
 12 no yes yes no 58.60.3999999999999000011110111.826500000111.40
Peer group contains 2 member(s)
 0 yes no yes yes 60.a0.3999999999999000011110223.826500000223.00
 17 no no yes no 60.a0.3999999999999000011110225.826500000225.00
 12 no yes yes no 60.a0.3999999999999000011110221.826500000221.00
 15 no no yes no 60.a0.3999999999999000011110224.826000000224.00
 10 no yes yes no 60.a0.3999999999999000011110222.826500000222.00
Peer group contains 5 member(s) .

```

Figure 288. Show PNNI Peer Group Members Command for 8265\_hub23

This completes the WAN configuration for 8265\_hub23.

### 7.4.3.2 8265\_hub25 Configuration

The WAN configuration for this hub is exactly the same as for 8265\_hub23. Points to remember here are that the VPCI value in the `set vpc_link` command must match at both ends of the link.



```
8265_hub25> set port 5.5 disable void shaping:44000
5.05:Port set
8265_hub25> set port 5.5 parm timing_source 0
8265_hub25>
8265_hub25> set port 5.5 parm descramble_rcv_cells enable
8265_hub25> set port 5.5 parm scramble_xmt_cells enable
8265_hub25> set port 5.5 parm discard_idle_cells enable
8265_hub25> set port 5.5 parm address 10b
Actual Value 02
Enter value: 02
8265_hub25> set port 5.5 parm address 10d
Actual Value 01
Enter value: 00
8265_hub25> set port 5.5 enable void
5.05:Port set
```

*Figure 289. Setting the Void Port in 8265\_hub25*

8265\_hub25> **show port 5.5 verbose**

| Type      | Mode    | Status | Daughter Card Description |
|-----------|---------|--------|---------------------------|
| -----     |         |        | -----                     |
| 5.05:VOID | enabled | UP     | DS3 Port                  |

No ILMI  
VPI range admin. : 0-15 (4 bits)  
VCI range admin. : 0-1023 (10 bits)  
Connector : BNC  
Media : coaxial cable  
Port speed : 44736 kbps  
Connection shaping : Off.  
Shaping bandwidth : 44000 kbps  
Remote device is active

DAUGHTER CARD INFORMATION:  
-----

|                  |           |
|------------------|-----------|
| Type             | : DS3     |
| Software Version | : 0.5.1.J |

CONFIGURATION CONTROL:  
-----

|                            |                             |
|----------------------------|-----------------------------|
| Failure Integration Time   | : 2500 ms                   |
| Failure Decay Time         | : 10 s                      |
| Timing Source              | : PARM_EXTERNAL_FACILITY_TM |
| Descramble Received Cells  | : Yes                       |
| Discard Idle Cells         | : Yes                       |
| Scramble Transmitted Cells | : Yes                       |
| DS3 Format                 | : C-bit                     |
| PLCP Framing               | : No                        |

DIAGNOSTICS CONTROL:  
-----

|                        |                           |
|------------------------|---------------------------|
| Diagnostic Pattern     | : 00 00 00 00 00 00 00 00 |
| Performance Monitoring | : DISABLED                |
| Internal Wrap          | : disabled                |
| Reply Mode Wrap        | : disabled                |
| Far End Mode Wrap      | : disabled                |

EQUIPMENT TEST RESULT:  
-----

|               |      |
|---------------|------|
| Tests Results | : OK |
|---------------|------|

FAILURE STATUS:  
-----

|                                    |            |
|------------------------------------|------------|
| Loss of Signal                     | : inactive |
| Loss of Frame                      | : inactive |
| Equipment Failure                  | : inactive |
| Loss of Synchronization            | : inactive |
| Loss of Cell Delineation           | : inactive |
| DS3 Alarm Indication Signal (AIS)  | : inactive |
| DS3 Remote Alarm Indication (RAI)  | : inactive |
| PLCP Loss of Frame                 | : inactive |
| PLCP Remote Alarm Indication (RAI) | : inactive |
| Idle Signal                        | : inactive |

FAILURE SUMMARY STATUS:  
-----

No Failure.

Figure 290. Show Port Command for the WAN Link

In this case we set the VPI value to 1 at both ends of the link.

The VPI value may not be the same as that used at the other end. It can be whatever the WAN service provider supplies.

```
8265_hub25> show vpc_link all
No match

8265_hub25> set vpc_link 5.5 1 enable pnni bandwidth:44000 bandwidth_rb:unlimited
police:off shaping:off ilmi_vci:none vpci:1
5.05 1:Accepted
8265_hub25> show vpc_link all verbose
```

| VPI  | Type   | Mode   | Status |
|------|--------|--------|--------|
| 5.05 | 1:PNNI | enable | UP     |

No ILMI

VPC Bandwidth : 44000 kbps  
RB Bandwidth : unlimited  
Police admin. : off  
Signalling vci : 1.5  
Routing vci : 1.18  
Aggregation token : 0  
RB Admin weight : 5040  
NRB Admin weight : 5040  
VPCI : 1  
Shaping : Off  
VCI range admin. : 0-1023 (10 bits)

Figure 291. Show VPC\_LINK Command for the VPC link

#### Note:

**1** VPI is set to 1.

The show pnni neighbor command shows 8265\_hub25 has one neighbor, 8265\_hub23.

```
8265_hub25> show pnni neighbor

NEIGHBORS OF NODE 0 CONTAINED IN PEER GROUP IDENTIFIED BY LEVEL ID 96:

neighbor_1 node id: 60.a0.39999999999999000011110223.826500000223.00
neighbor atm addr 39.999999999999000011110223.826500000223.00
 state: Full
 slot.phys-port: 05.05
```

Figure 292. Show PNNI Neighbor Command

The show pnni peer\_group\_members command follows:

```

8265 hub25> show pnni peer_group members
VERTX THIS UP CONN IS NODE_ID
NUMBR SWITCH LINK CTED PGL THEN ATM_ADDR
 15 no no - no 58.60.3999999999999999000011110200.826500000223.00
 39.9999999999999999000011110223.826500000223.40
 14 no no - no 58.60.3999999999999999000011110100.826500000111.00
 39.9999999999999999000011110111.826500000111.40
Peer group contains 2 member(s)
 0 yes no yes no 60.a0.3999999999999999000011110225.826500000225.00
 39.9999999999999999000011110225.826500000225.00
 12 no yes yes no 60.a0.3999999999999999000011110222.826500000222.00
 39.9999999999999999000011110222.826500000222.00
 11 no yes yes no 60.a0.3999999999999999000011110221.826500000221.00
 39.9999999999999999000011110221.826500000221.00
 13 no no yes no 60.a0.3999999999999999000011110224.826000000224.00
 39.9999999999999999000011110224.826000000224.00
 10 no no yes yes 60.a0.3999999999999999000011110223.826500000223.00
 39.9999999999999999000011110223.826500000223.00
Peer group contains 5 member(s) .

```

Figure 293. Show PNNI Peer Group Members Command

---

## Chapter 8. MSS Configuration

We are now going to show the MSS configuration we used for the migration from pre-PNNI to PNNI, in the network when we built the PNNI configuration and migrated to the PNNI hierarchy and when we produced the client configurations.

We have two MSS servers, MSS1 and MSS2, each attached to separate switches. Each MSS has the following components configured.

---

### 8.1 LECS

Both MSS servers have a LECS running. Introduced with MSS code Version 2.2 is the ability to specify redundancy between LECS running in MSS servers. We have redundancy defined; MSS1 is the primary and MSS2 the secondary, therefore, with this feature we only need to make LECS changes to MSS1. Then we can copy the LECS database to the other LECS in the network. This can be done manually through the MSS command-line interface (T 5) or it will happen automatically every time the MSS starts up or the LECS function is restarted. This means you only have to maintain the primary LECS configuration thus avoiding the risk of different LECS databases in the network.

For a detailed description of how this function works please refer to the *Layer 3 Switching Using MSS and MSS Release 2.2 Enhancements*, SG24-5311.

---

### 8.2 ELANs

We have three ELANs configured in our network:

- 1 Ethernet ELAN et1
- 1 token-ring ELAN tr1
- 1 management token-ring ELAN, mgmt

Each is defined with LES/BUS redundancy. The primary is running in MSS1 and the backup in MSS2. (You will see on some of the MSS1 screens an ELAN called tkr-prod. This ELAN was used to link our test environment in the lab and the main network running in our office. It has no bearing on the scenarios documented here but was used to allow easy access to the test lab from our office.)

---

### 8.3 ARP Server

An ARP server is defined in MSS1 for Classical IP. There is an RS/6000 network management station running NetView6000. All the ATM components are connected using Classical IP as well as the mgmt ELAN LECs.

There is a LEC defined for each of the ELANs in both MSS servers. The et1 and tr1 ELANs each have more than one IP address range. For each there is an IP address on the client and a default gateway that has redundancy between the two MSSs. Some of the clients that join the tr1 and et1 ELANs are switches that have LANs with more than one IP address range. To enable local shortcuts to be created within the switch the MSS server must know about all the IP address ranges on its interfaces. MSS1 is set up as the primary default gateway with MSS2 as the redundant.

---

## 8.4 Bridging

Each MSS has a bridge defined and ports enabled on et1 and tr1. Transparent bridging is defined on et1 and source-route transparent on tr1. Both MSS servers have the bridge defined for redundancy. To split the workload between MSS servers we have defined MSS2 to have its bridge ports forwarding while MSS1 is blocking. (By default the IP routing is being done by MSS1.) We have adjusted the spanning tree bridge priorities to 100 on MSS2 and 200 on MSS1. MSS2 is the root bridge and has its TB port forwarding while MSS1 is in the blocking state.

### Note

Prior to MSS 2.2 code an IP address on an interface meant IP packets were passed to the router code only and they would not be bridged. With the 2.2 release of code MSS will route *and* bridge IP and IPX broadcast and multicast packets. To prevent this a bridge filter needs to be installed. The release notes with the 2.2 code do mention this but it is not obvious. We did *not* configure these filters.

---

## 8.5 IPX

Both MSS servers are defined as IPX routers on the et1 and tr1 ELANs.

---

## 8.6 MPOA

Both MSS servers are defined as MPOA servers. In our examples of showing clients we will be creating MPOA shortcuts between an Ethernet switch MPOA client (IBM 8371) and the MSS client running in an IBM 8270. That is, token-ring to Ethernet shortcuts across the ATM network.

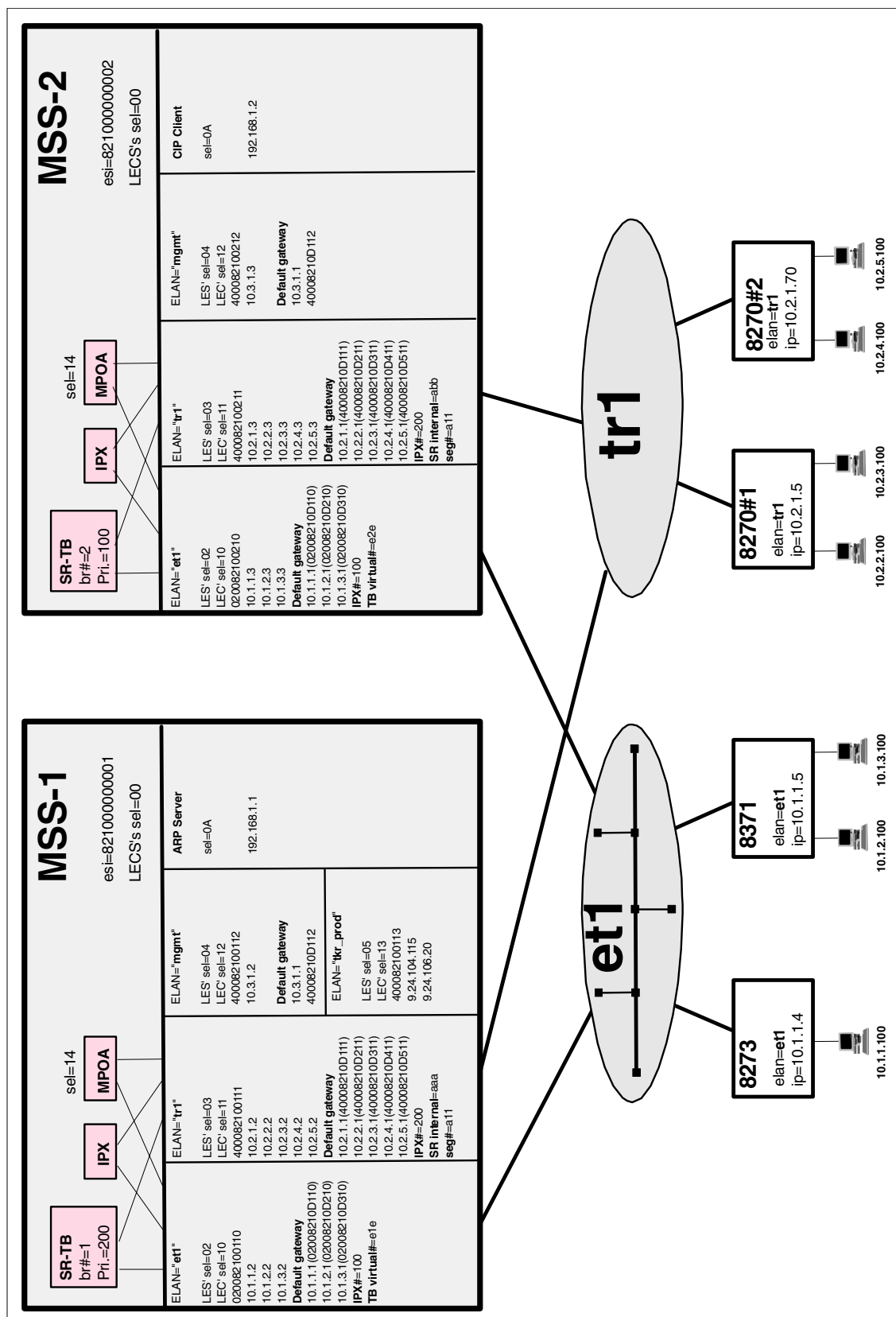


Figure 294. Logical Network

The address rule used in this lab is summarized in the following table. The 20-byte address consists of a 12-byte prefix, **39.99.99.99.99.99.00.00.11.11** and the rest of the address in the table.

Table 11. Address Table

| Device      | Instance   | Cluster | HUB | ESI          | MAC          | Sel | CIP IP       | LEC IP    |
|-------------|------------|---------|-----|--------------|--------------|-----|--------------|-----------|
| 826x Switch | 8265#11    | 01      | 11  | 826500000111 | 400082650111 | 00  | 192.168.1.11 | 10.3.1.11 |
|             | 8265#12    | 01      | 12  | 826500000112 | 400082650112 | 00  | 192.168.1.12 | 10.3.1.12 |
|             | 8265#13    | 01      | 13  | 826500000113 | 400082650113 | 00  | 192.168.1.13 | 10.3.1.13 |
|             | 8265#21    | 02      | 21  | 826500000221 | 400082650221 | 00  | 192.168.1.21 | 10.3.1.21 |
|             | 8265#22    | 02      | 22  | 826500000222 | 400082650222 | 00  | 192.168.1.22 | 10.3.1.22 |
|             | 8265#23    | 02      | 23  | 826500000223 | 400082650223 | 00  | 192.168.1.23 | 10.3.1.23 |
|             | 8260#24    | 02      | 24  | 826000000224 | 400082600224 | 00  | 192.168.1.24 | 10.3.1.24 |
|             | 8265#25    | 02      | 25  | 826500000225 | 400082650225 | 00  | 192.168.1.25 | 10.3.1.25 |
| MSS1        | ARP server | 01      | 11  | 821000000001 |              | 0A  | 192.168.1.1  | -         |
|             | LECS       | 01      | 11  | 821000000001 |              | 00  | -            | -         |
|             | LES(et1)   | 01      | 11  | 821000000001 |              | 02  | -            | 10.1.1.1  |
|             | LES(tr1)   | 01      | 11  | 821000000001 |              | 03  | -            | 10.2.1.1  |
|             | LES(mgmt)  | 01      | 11  | 821000000001 |              | 04  | -            | 10.3.1.1  |
| MSS2        | ARP Client | 02      | 21  | 821000000002 |              | 0A  | 192.168.1.2  | -         |
|             | LECS       | 02      | 21  | 821000000002 |              | 00  | -            | -         |
|             | LES(et1)   | 02      | 21  | 821000000002 |              | 02  | -            | 10.1.1.1  |
|             | LES(tr1)   | 02      | 21  | 821000000002 |              | 03  | -            | 10.2.1.1  |
|             | LES(mgmt)  | 02      | 21  | 821000000002 |              | 04  | -            | 10.3.1.1  |



An overview of the routing and bridging in the network follows.

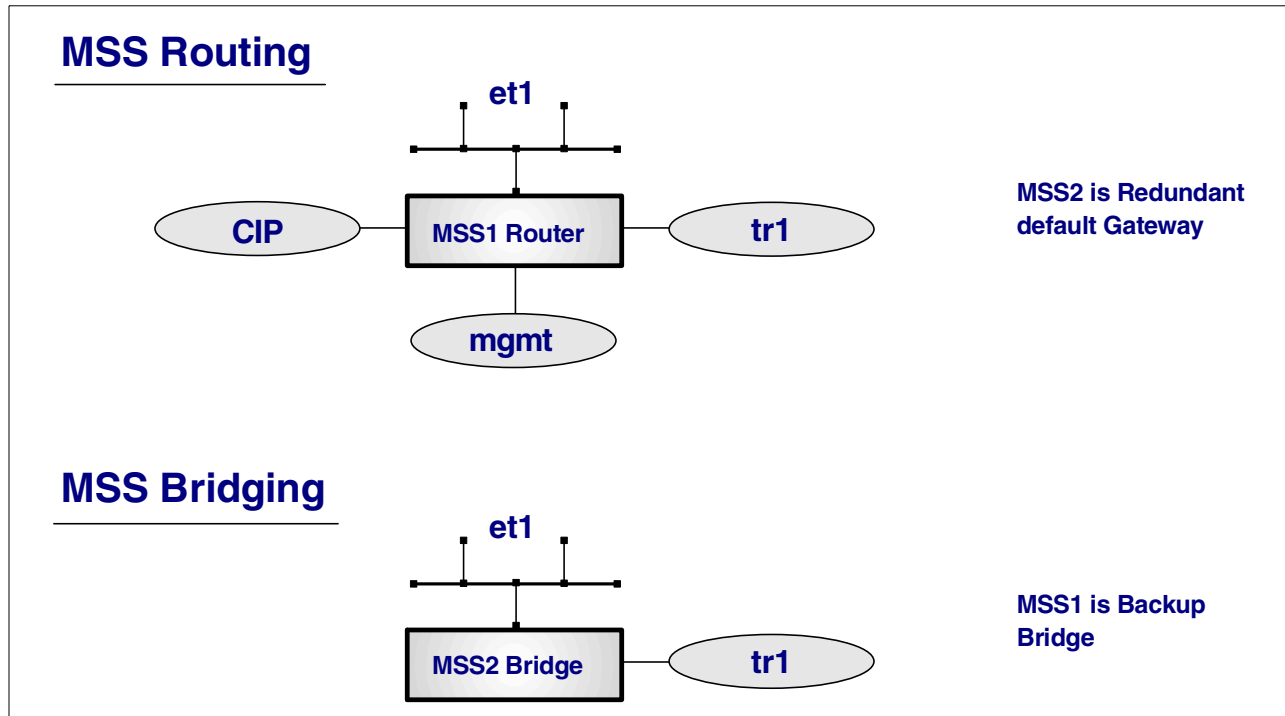


Figure 295. MSS Routing and Bridging

## 8.7 MSS1 Configuration

We use the configuration program to configure the MSS server. The initial screen in the Navigation Window is shown below:

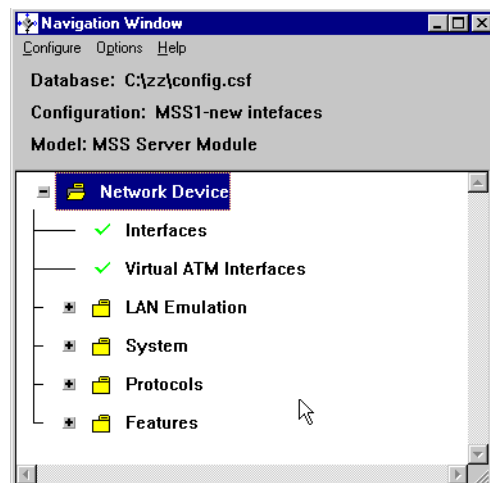


Figure 296. Navigation Window

**Note**

The version of the Configuration program must match the version of the MSS code you are running. Please refer to the release notes of the MSS version you are running.

To start a new configuration select the **Configure** pull-down. Then select **New** -> **MSS Server Module**.

Select **Interfaces** from the navigation screen.

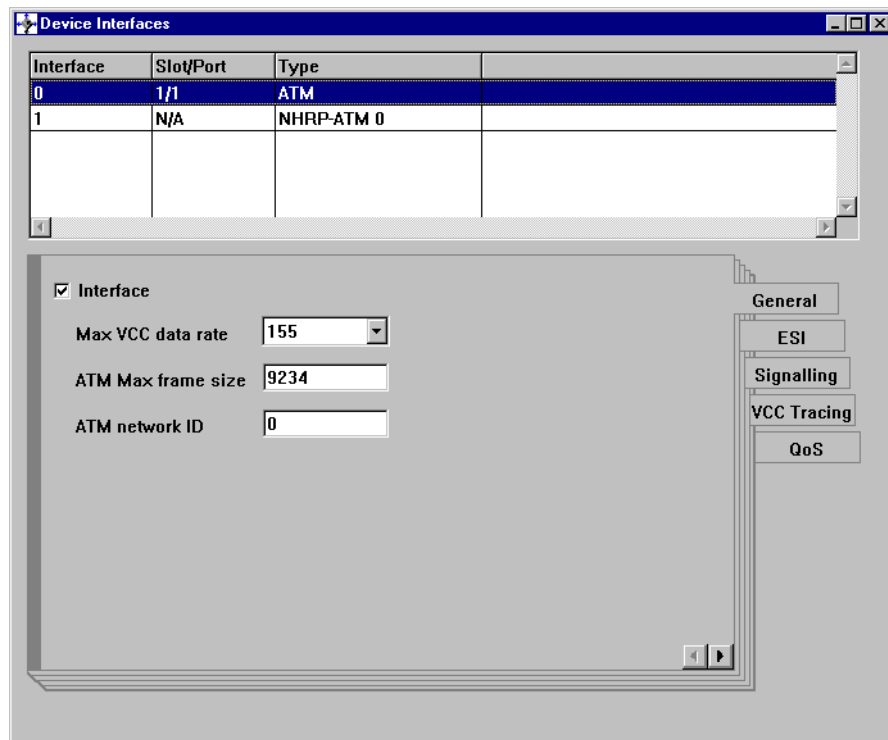


Figure 297. Interface General Screen

Select the **ESI** tab.

We need to configure one ESI for MSS1, 821000000001. Enter this value in the locally administered ESI field and click **Add**.

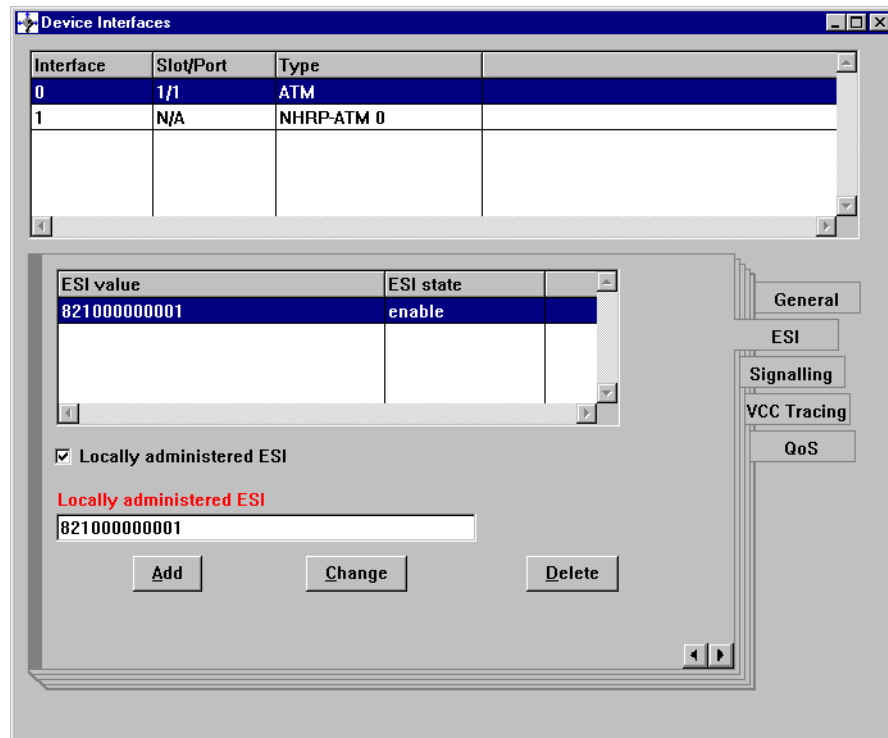


Figure 298. Device Interface Window

Now select the **Signalling** tab.

We set the signalling protocol to UNI\_3.1. The other parameters are the defaults.

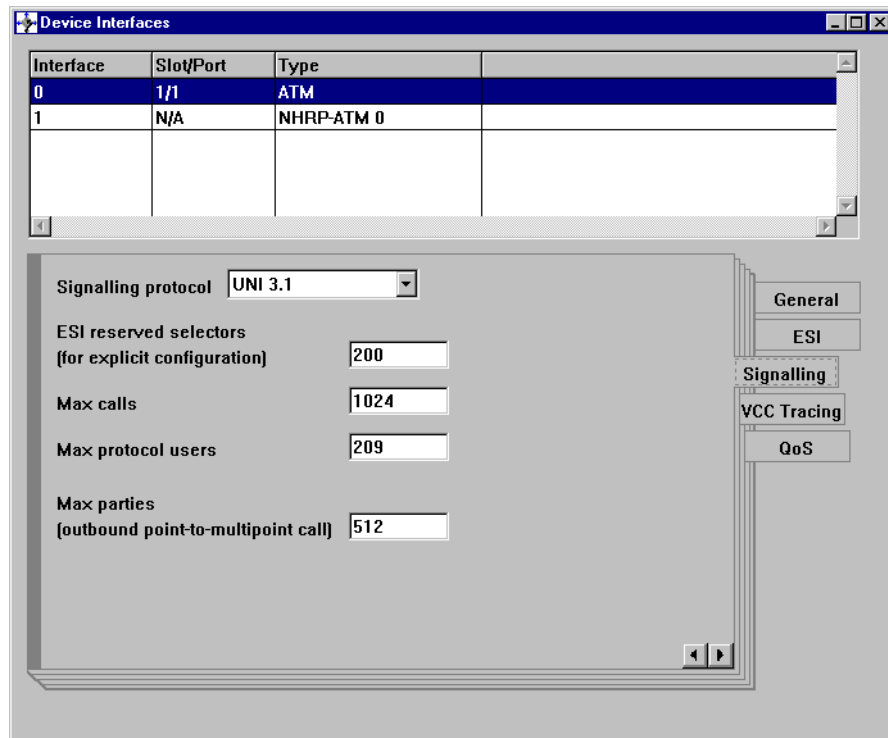


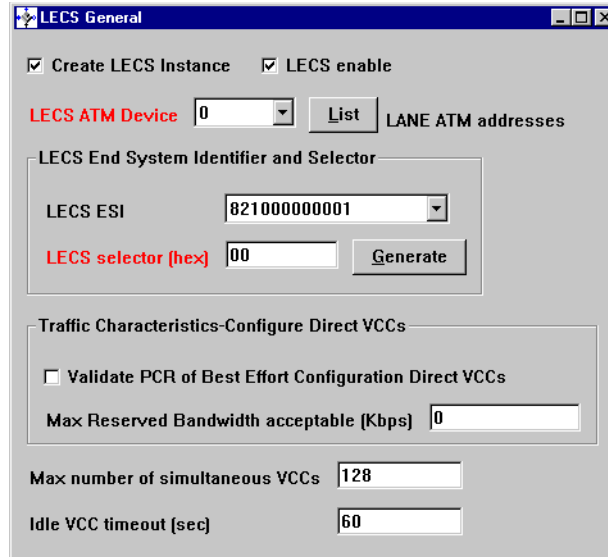
Figure 299. Setting the Device Interface Signalling Information

### 8.7.1 LECS Configuration

Go back to the Navigation Window and under **LAN Emulation** select **LECS** -> **General**.

Select ATM device **0** from the pull-down menu. Select ESI **821000000001** from the pull-down menu then generate a selector. It should be 00 at this stage in the configuration.

Take the rest of the defaults.



**LECS General**

☒ Create LECS Instance    ☒ LECS enable

LECS ATM Device:   LANE ATM addresses

LECS End System Identifier and Selector

LECS ESI:

LECS selector (hex):

Traffic Characteristics-Configure Direct VCCs

☐ Validate PCR of Best Effort Configuration Direct VCCs

Max Reserved Bandwidth acceptable (Kbps):

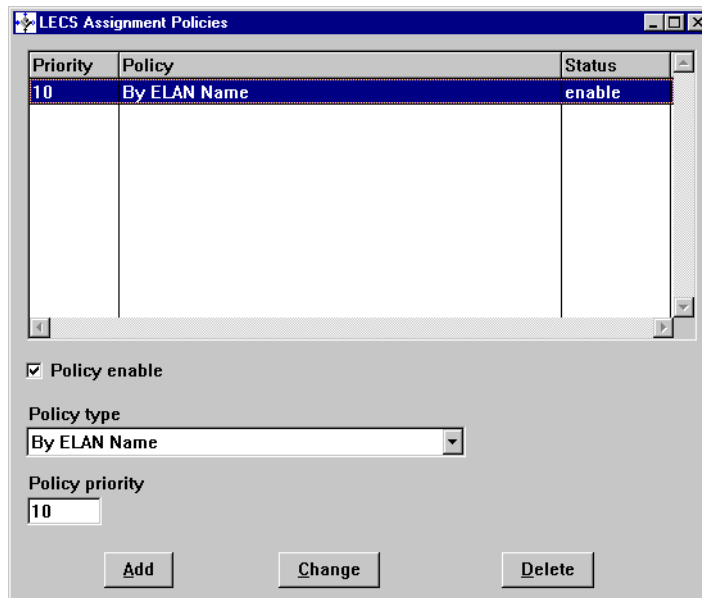
Max number of simultaneous VCCs:

Idle VCC timeout (sec):

Figure 300. LECS General Window

Select **LECS Assignment Policies** from the Navigation Window.

The only policy we will define is the ELAN name. Select **By ELAN Name** from the policy type pull-down then click **Add**. This will generate this policy type with a default priority of 10.



| Priority | Policy       | Status |
|----------|--------------|--------|
| 10       | By ELAN Name | enable |

☒ Policy enable

Policy type:

Policy priority:

Figure 301. LECS Policy Assignment Window

We have two LECS in our network and want to use the LECS database synchronization facility. We will define MSS1 as the primary where we will make changes and copy these to MSS2, which will act as a secondary. This term only applies to the LECS synchronization. Both LECS will be active on the network.

From the Navigation Window select **LECS database synchronization**, then **General**. MSS1 is going to be our primary LECS so check **Automatic LECS database synchronization**.

Figure 302. LECS Synchronization Screen

The screenshot shows a Windows-style dialog box titled "LECS DB Sync. Remote Addresses". It contains a table with two columns: "Enable" and "ATM Address". The first row has "enable" in the "Enable" column and a long hexadecimal string in the "ATM Address" column. Below the table is a checkbox labeled "Enable remote LECS address" which is checked. Underneath the checkbox is the label "ATM address of redundant LECS" in red, followed by a text input field containing the same hexadecimal string as in the table. At the bottom of the dialog are three buttons: "Add", "Change", and "Delete".

| Enable | ATM Address                             |
|--------|-----------------------------------------|
| enable | 399999999999900001111022182100000000200 |

☒ Enable remote LECS address

ATM address of redundant LECS

399999999999900001111022182100000000200

Add Change Delete

Figure 303. LECS Remote Addresses

### 8.7.2 ELAN Configuration

From the Navigation Window select **ELANs** -> **Local ELANs** -> **General**.

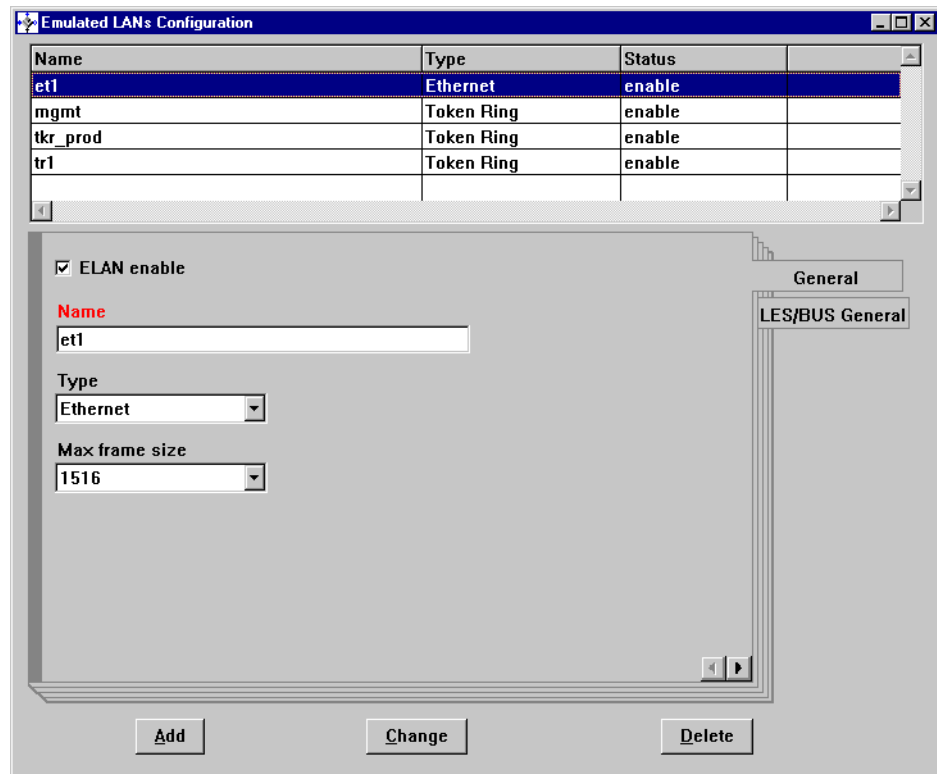


Figure 304. General Emulated LAN Configuration

Select the **LES/BUS General** tab.

Select the ATM device number. In our case **0**.

Select ESI **820000000001** from the pull-down and set the selector byte to **02**.

Set the ELAN identifier to **1**.

Now click **Add** to save the settings.

Continue adding the definitions for all the ELANs.

| Name     | Type       | Status |
|----------|------------|--------|
| et1      | Ethernet   | enable |
| mgmt     | Token Ring | enable |
| tkr_prod | Token Ring | enable |
| tr1      | Token Ring | enable |

☒ LES/BUS Instance enable

ATM Device:

LES/BUS End System Identifier:

LES/BUS Selector (hex):

ELAN Identifier:

LANE ATM addresses

Figure 305. LES/BUS General Emulated LAN Configuration

Select **LES/BUS** -> **local LES/BUS**.

We are going to configure the LES/BUS that provides control for an ELAN.

In the **General** window, we can define the general function of LES/BUS. To enable the Broadcast Control Manager (BCM), you must change the BUS mode operation to **System**.

Figure 305 shows the parameters for ELAN et1. Set the BUS mode to **System** and accept the other defaults as shown.



The screenshot shows the 'Local LES/BUS Configuration' window. At the top is a table listing interfaces and their configurations. Below the table are various configuration fields and checkboxes. On the right side, there is a vertical stack of tabs, with 'General' currently selected.

| Name     | Type       | Status |
|----------|------------|--------|
| et1      | Ethernet   | enable |
| mgmt     | Token Ring | enable |
| tkr_prod | Token Ring | enable |
| tr1      | Token Ring | enable |

Control Timeout:

Max Frame Age:

Address Resolution Response Destination:

☒ Partition Address Resolution Request Forwarding Domain

☒ Partition Unicast Frame Domain

☐ Enable Security (LECS Validation of Joins)

BUS mode operation:

On the right, the tabs are: General, LUNI 2.0 Params, Traffic Params 1, Traffic Params 2, Packet Tracing, BCM General 1, BCM General 2, BCM Static Target, and Redundancy.

Figure 306. Local LES/BUS General Parameters for the ELAN et1

Now select the **BCM General 1** tab.

Enable the IP and IPX broadcast managers. Accept the other defaults.

Broadcast management is an enhancement of the BUS function in LAN emulation. With this function the BCM caches client addresses. In many cases the BUS is then able to convert broadcast frames to unicast frames and send these frames to just one client. This can reduce the amount of broadcast traffic in the ATM network significantly.

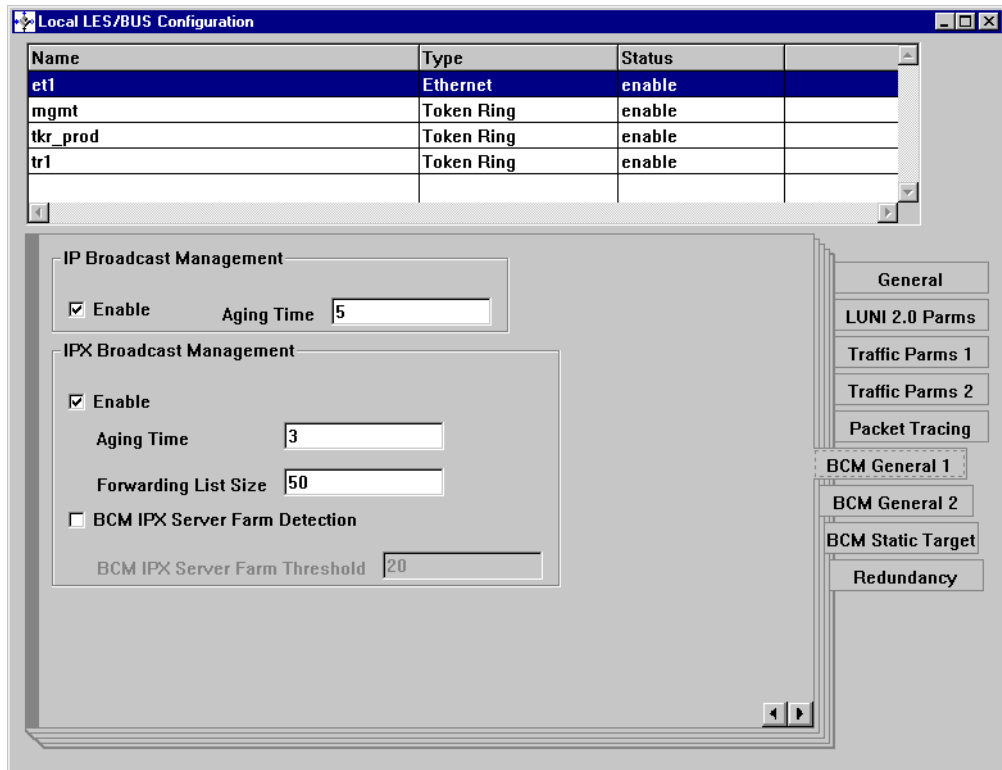


Figure 307. LES/BUS BCM General 1 Window

Now select the **BCM General 2** tab and enable NetBIOS broadcast manager.

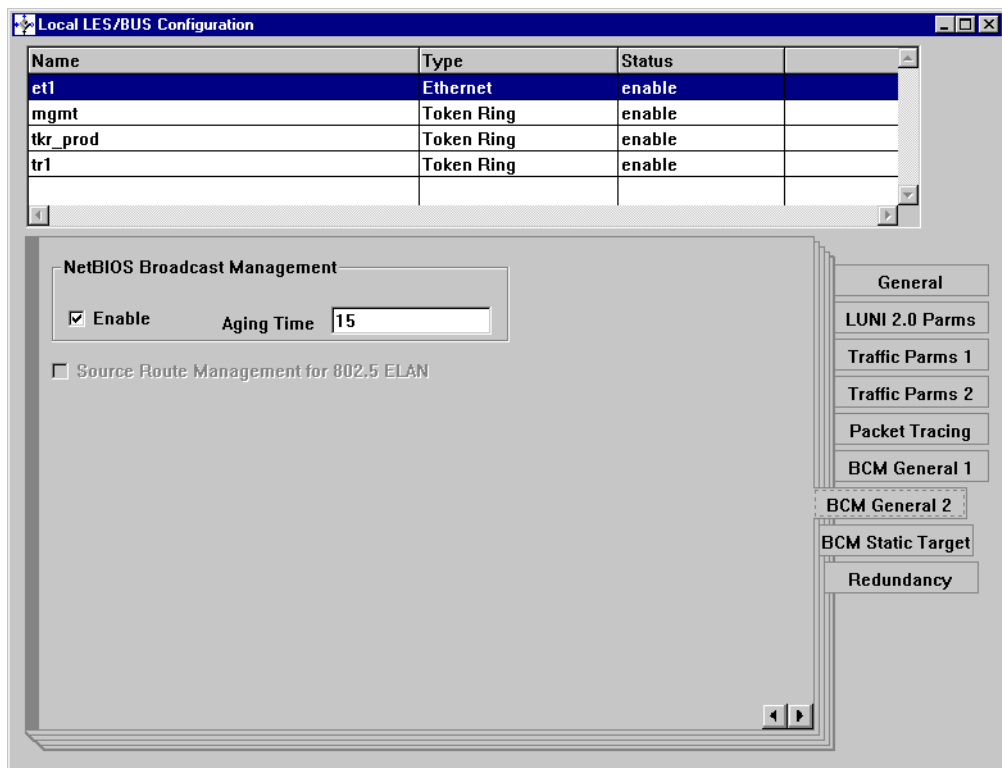


Figure 308. LES/BUS BCM General 2 Window

First click **LES/BUS redundancy protocol support**. Then enter the ATM address in full of the partner LES/BUS pair in the network. In our case, this is the backup LES/BUS pair in MSS2. Now set the role this MSS is performing. As this is MSS1 select **Primary**.

The screenshot shows the "Local LES/BUS Configuration" window. At the top, there's a title bar with standard Windows controls. Below it is a table with three columns: Name, Type, and Status.

| Name     | Type       | Status |
|----------|------------|--------|
| etl      | Ethernet   | enable |
| mgmt     | Token Ring | enable |
| tkr_prod | Token Ring | enable |
| trl      | Token Ring | enable |

Below the table, there are several configuration options:

- ☒ LES/BUS redundancy protocol support
- ATM address of partner LES/BUS: 39999999999900001111022182100000000202
- Redundancy protocol role: Primary LES/BUS (selected from a dropdown)
- ☒ LES/BUS Peer Redundancy at Primary LES/BUS

On the right side, there's a vertical stack of tabs or sections:

- General
- LUNI 2.0 Parms
- Traffic Parms 1
- Traffic Parms 2
- Packet Tracing
- BCM General 1
- BCM General 2
- BCM Static Target
- Redundancy (highlighted with a dashed border)

We have only one policy value selected to join an ELAN, the ELAN name. The next screen shows the configuration for ELAN et1.

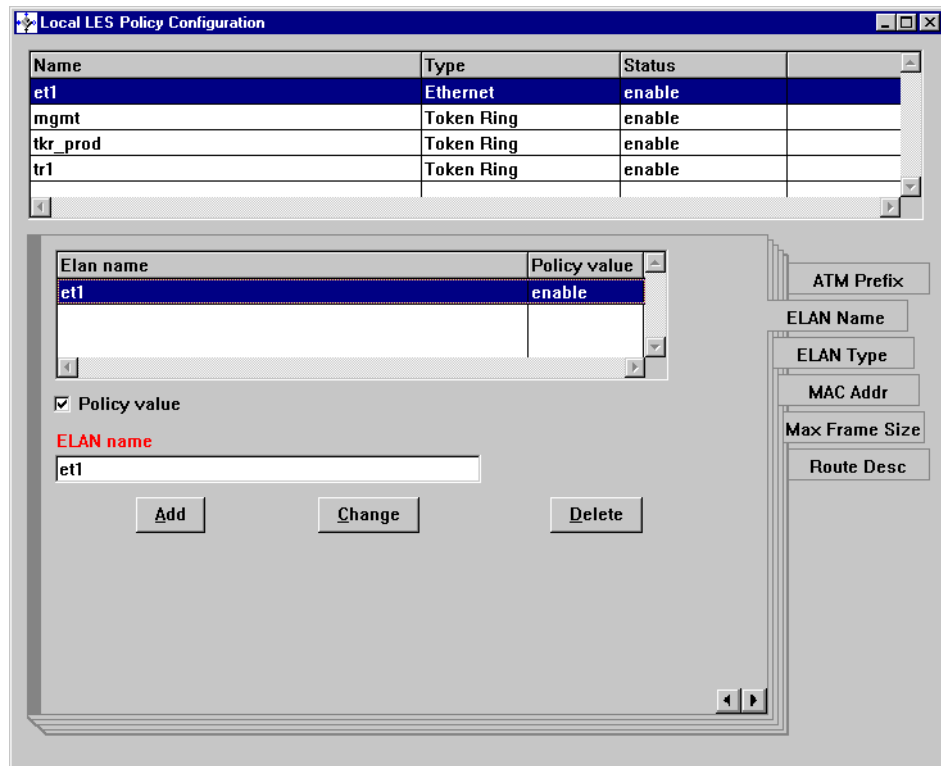


Figure 310. ELAN Name Policy Window for ELAN et1

### 8.7.3 LEC Configuration for MSS1

Select **LEC interfaces** under **LAN Emulation** from the Navigation Window. The LEC interfaces general window is displayed.

Select ATM device **0**, select the ESI shown from the pull-down and set a selector byte. We have chosen to use the 1x range of selectors for our clients and have given 10 to the first ELAN et1.

Set a MAC address. We are using a locally administered MAC address of 400082100110. We have used the format 4000xxxxyyzz where:

- xxxx is the device type (8210 here).
- yy is the number of the box:
  - 01 for mss1
  - 02 for mss2
  - Dx for the redundant default gateways
- zz is the same as the selector byte

Whatever you enter, stick to a defined scheme. It makes identifying the device from its MAC address much easier.

ATM forum is the default. Leave this.

| Interface | MAC          | Name     | Type       | Device | ESI          | Selector |
|-----------|--------------|----------|------------|--------|--------------|----------|
| 2         | 400082100110 | et1      | Ethernet   | 0      | 821000000001 | 10       |
| 3         | 400082100111 | tr1      | Token Ring | 0      | 821000000001 | 11       |
| 4         | 400082100112 | mgmt     | Token Ring | 0      | 821000000001 | 12       |
| 5         | 400082100113 | tkr_prod | Token Ring | 0      | 821000000001 | 13       |

Architecture: ATM Forum

ATM device: 0

LEC ESI: 821000000001

ATM LEC address selector (hex): 10 Generate

LEC local unicast MAC address: 400082100110

List LANE ATM addresses

Add Change Delete

General  
C7-C18  
C20-C28  
C33-C39  
ELAN  
Servers  
Misc  
QoS  
ILEC Gen  
ILEC Cache  
ILEC LES

Figure 311. LEC Interfaces General Window Showing Client for ELAN et1

Select the **ELAN** tab.

Choose the ELAN name **et1**, select the ELAN type, in our case **Ethernet** and set the max fame size.

(This window was captured after entering all our clients to show the range of selectors, MAC addresses, etc.)

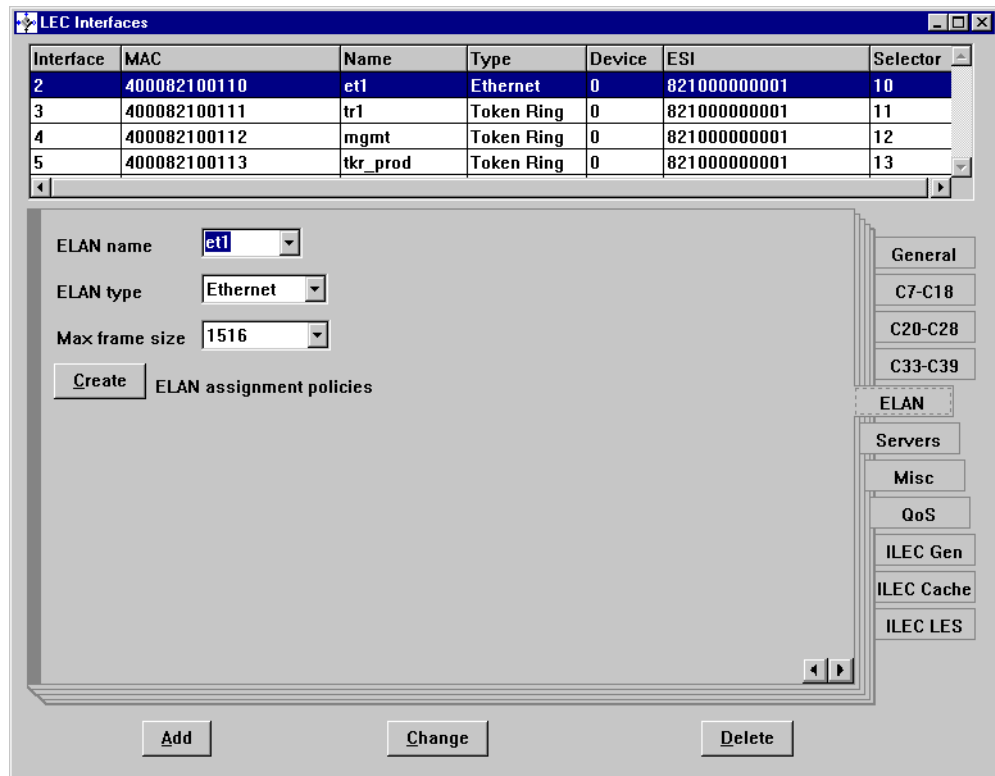


Figure 312. LEC Interfaces ELANs

Select the **Servers** tab. If you are using redundant LES/BUS pairs all clients *must* join via the LECS in order to be able to re-register with the backup LES/BUS pair if the primary fails. Ensure LECS AutoConfiguration is checked.

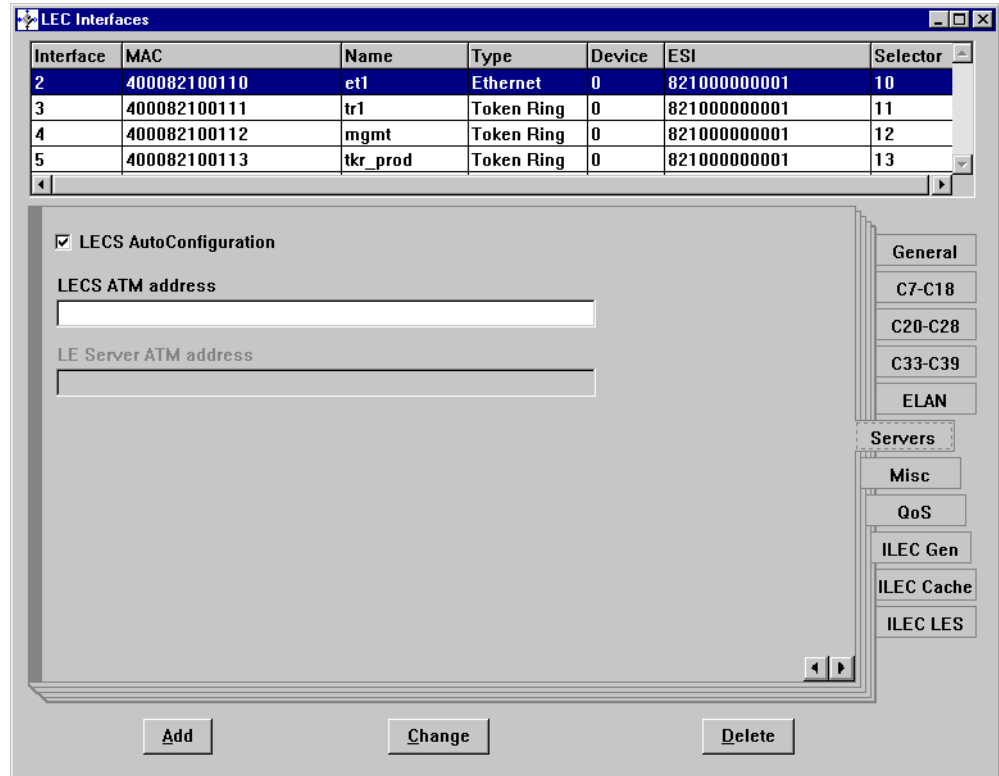


Figure 313. LEC Interfaces Server Window

Select the **Misc** tab. Check the **Persistent Data Direct VCC mode** box.

This will keep the data direct VCC up even if the LES/BUS pair fails and the client has to register with the backup LES/BUS. Data transfer should not be disrupted while this happens. This is also called the enhanced mode. For a full description of this refer to *Layer 3 Switching Using MSS and MSS Release 2.2 Enhancements*, SG24-5311.

Leave the other parameters at the defaults.

| Interface | MAC          | Name     | Type       | Device | ESI          | Selector |
|-----------|--------------|----------|------------|--------|--------------|----------|
| 2         | 400082100110 | et1      | Ethernet   | 0      | 821000000001 | 10       |
| 3         | 400082100111 | tr1      | Token Ring | 0      | 821000000001 | 11       |
| 4         | 400082100112 | mgmt     | Token Ring | 0      | 821000000001 | 12       |
| 5         | 400082100113 | tkr_prod | Token Ring | 0      | 821000000001 | 13       |

LE ARP cache size: 5000  
 LE ARP queue depth: 5  
 Best effort peak cell rate (Kbps): 155000  
☒ Persistent Data Direct VCC mode  
 Reconnect time out (sec): 30  
☐ Packet trace

Add Change Delete

Figure 314. LEC Interfaces Misc Window

This is the last parameter to set so click **Add** to add the LEC.

All other parameters behind the tabs are left at their defaults.

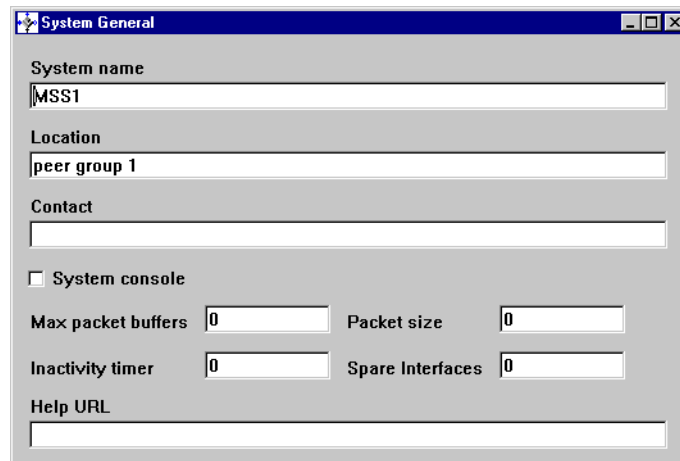
You can now go on and configure the remaining clients.

#### 8.7.4 System

At the System General window specify a name for this MSS server. We used MSS1. This appears as the command-line prompt and makes it easy to identify to which MSS you are connected.

We also set a location name of peer group 1.





**System General**

System name  
MSS1

Location  
peer group 1

Contact

☐ System console

Max packet buffers 0 Packet size 0

Inactivity timer 0 Spare Interfaces 0

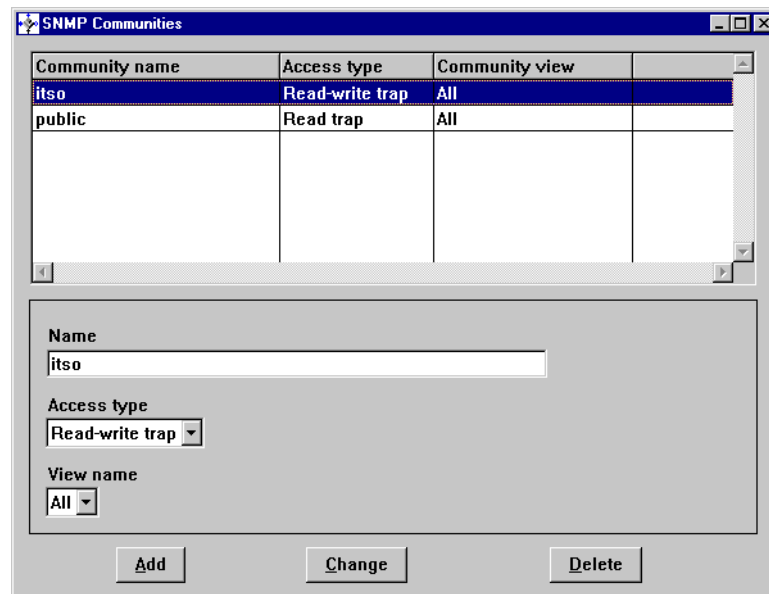
Help URL

Figure 315. System General Window

### 8.7.5 SNMP Configuration

Select **system** -> **snmp config** -> **communities** -> **general** from the Navigation Window.

The **public** community with read trap access is defined by default. We will add a new community of **itso** with Read-write trap access.



| Community name | Access type     | Community view |
|----------------|-----------------|----------------|
| itso           | Read-write trap | All            |
| public         | Read trap       | All            |

Name  
itso

Access type  
Read-write trap

View name  
All

Add Change Delete

Figure 316. Add Community

Add **itso** to the name field, select **Read-write trap** from the Access type pull-down menu and click **Add**.

Select **system** -> **snmp config** -> **communities** -> **details** from the Navigation Window.

This is where you can add the addresses of workstations/servers where you want the traps sent. We have entered the address of our network management

RS/6000 on our Classical IP network. It is important to note on this window how to get to the lower part of the window. You must click where the arrow points on the box marked Addresses. The configuration program has been rewritten with the 2.2 release of code and these "hidden" parts of the windows are new.

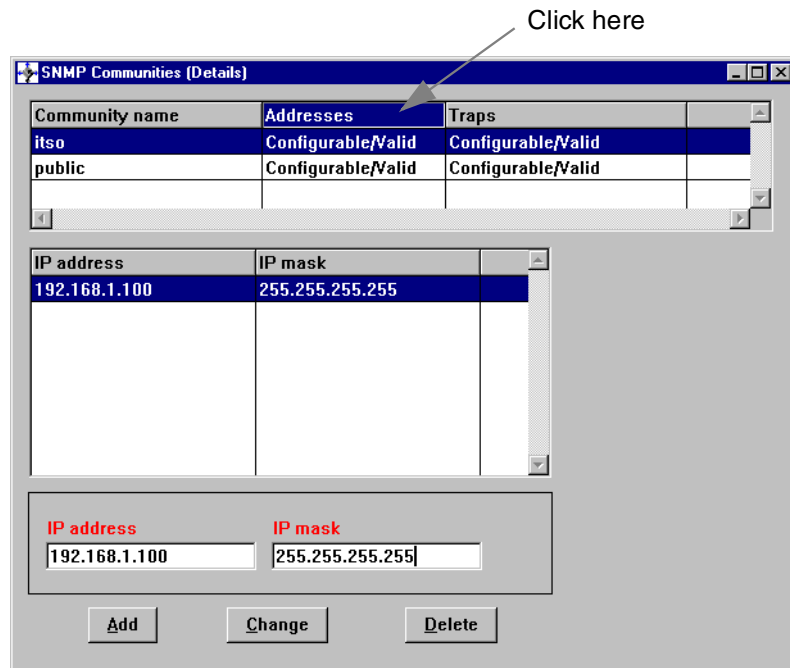


Figure 317. Add IP Address of Server

Enter 192.168.1.100 as the IP address of the server and 255.255.255.255 as its subnet mask, then click **Add**.

Select **system** -> **snmp config** -> **communities** -> **details** from the Navigation Window.

Click the box with the word **Traps** to display the lower part of the screen.

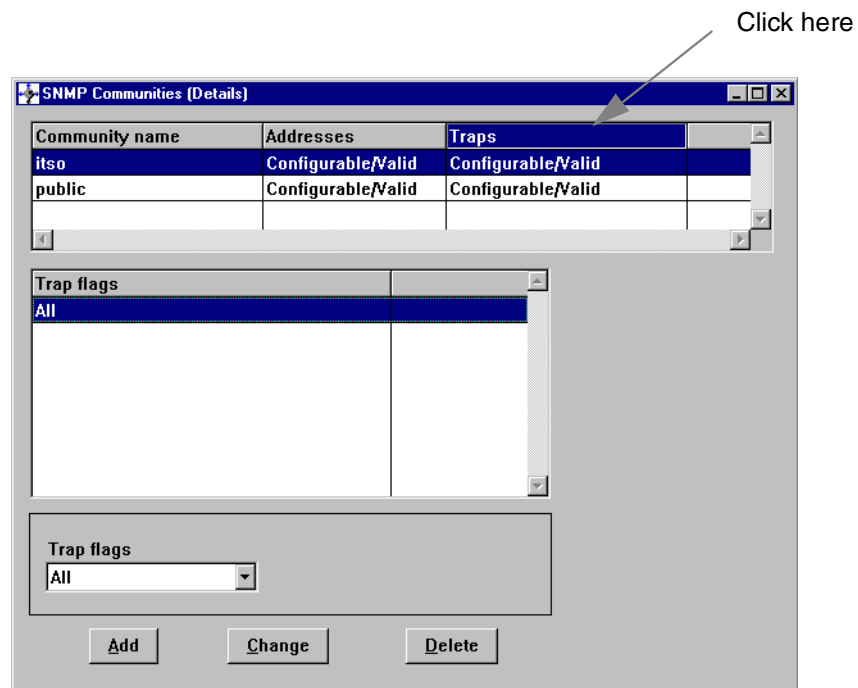


Figure 318. Change Trap Flags to All

Select the **itso** community. Change the trap flags to **All** and click **Change**.

## 8.7.6 IP Configuration

We are now going to configure the IP parameters on this MSS. From the Navigation Window select **Protocols -> IP -> IP Interfaces**.

### 8.7.6.1 Classical IP

Add the Classical IP address for interface 0 and its subnet mask and click **Add**.

The screenshot shows the 'IP Interfaces' configuration window. It contains a table with the following data:

| Interface | Type (Slot/Port) | Number of addresses |
|-----------|------------------|---------------------|
| 0         | ATM              | 1                   |
| 1         | NHRP-ATM 0       | 0                   |
| 2         | LEC-Ethernet     | 3                   |
| 3         | LEC-Token Ring   | 5                   |

Below the table is a section for configuring the selected interface (0). It includes the following fields:

| IP address  | Subnet mask   | Redirect |
|-------------|---------------|----------|
| 192.168.1.1 | 255.255.255.0 | enable   |

Below this table is a detailed configuration section for the selected interface (0):

IP address: 192.168.1.1  
Subnet mask: 255.255.255.0  
MTU:   
☒ ICMP redirects

At the bottom of the window are three buttons: Add, Change, and Delete.

Figure 319. IP Configuration for the Interfaces

### 8.7.6.2 LAN Emulation Client

The screenshot shows the 'IP Interfaces' configuration window. It contains two tables and a configuration section at the bottom.

| Interface | Type [Slot/Port] | Number of addresses |
|-----------|------------------|---------------------|
| 0         | ATM              | 1                   |
| 1         | NHRP-ATM 0       | 0                   |
| 2         | LEC-Ethernet     | 3                   |
| 3         | LEC-Token Ring   | 5                   |

| IP address | Subnet mask   | Redirect |
|------------|---------------|----------|
| 10.1.1.2   | 255.255.255.0 | enable   |
| 10.1.2.2   | 255.255.255.0 | enable   |
| 10.1.3.2   | 255.255.255.0 | enable   |

**IP address** 10.1.1.2  
**Subnet mask** 255.255.255.0  
**MTU**   
☒ ICMP redirects

**Add** **Change** **Delete**

Figure 320. Set IP Address for LEC on et1

To add an IP address to client interfaces highlight the interface. Add the IP address and subnet mask in the lower part of the window and click **Add**. This example shows a client for interface 2, the ELAN et1.

The IP addresses for the other clients are added in the same way.

In our configuration we have more than one IP subnet on each of the et1 and tr1 clients. The figure shows the et1 client with the three IP addresses we have defined for the three subnets active on this ELAN. Just keep on adding addresses until you have entered them all. Then go on to the next client.

### 8.7.6.3 Default Gateway

To configure the redundant default gateway for each LEC, from the Navigation Window select **Protocols -> IP -> Redundant Gateway Interfaces**.

| Interface | LEC name       | Number of gateways |
|-----------|----------------|--------------------|
| 2         | LEC-Ethernet   | 3                  |
| 3         | LEC-Token Ring | 5                  |
| 4         | LEC-Token Ring | 1                  |
| 5         | LEC-Token Ring | 0                  |

| IP address | IP mask       | MAC address  | MAC role | Gate |
|------------|---------------|--------------|----------|------|
| 10.1.1.1   | 255.255.255.0 | 40008210D110 | Primary  | Red  |
| 10.1.2.1   | 255.255.255.0 | 40008210D210 | Primary  | Red  |
| 10.1.3.1   | 255.255.255.0 | 40008210D310 | Primary  | Red  |

Gateway Parameters

IP address: 10.1.1.1 IP mask: 255.255.255.0

MAC address: 40008210D110 MAC address role: Primary

IP gateway type: Redundant-only

Add Change Delete

Figure 321. Configure Redundant Gateway Interface

Here we are setting the redundant default gateway for the client on the ELAN et1. As this ELAN has three IP subnets active we need three default gateway definitions, one for each subnet. The window shows 10.1.1.1 with its subnet mask and MAC address of 40008210D110 being added; 10.1.1.1 is the default gateway for the 10.1.1.X subnet. The other addresses are added in the same way. An identical set of addresses will be repeated in MSS2, which has the backup redundant default gateway for this ELAN.

### 8.7.7 CIP Configuration

To configure CIP, from the Navigation Window select **Protocols -> IP -> Classical IP Over ATM -> General**.

The Classical IP over ATM window is displayed:

| IP address  | Interface number | Interface name (Slot/Port) |
|-------------|------------------|----------------------------|
| 192.168.1.1 | 0                | ATM                        |
|             |                  |                            |

☒ Client is also an ARP Server

Address

Address

Add Change Delete Select Primary

ARP Server  
Refresh  
Re-registration  
Client Addr

Figure 322. Configure CIP ARP Server

MSS1 is our ARP server. Check **Client is also an ARP Server**.

Now select the **Client Addr** tab.

| IP address  | Interface number | Interface name (Slot/Port) |
|-------------|------------------|----------------------------|
| 192.168.1.1 | 0                | ATM                        |

ESI: 821000000001

☐ Runtime generated selector

Assigned selector (hex): 0A [Generate]

[List] RFC 1483 ATM addresses

ARP Server  
Refresh  
Re-registration  
Client Addr

Figure 323. Configure CIP Client Address

Select the ESI from the pull-down menu and set a selector. We chose **0A** to be the ARP server.

This completed our Classical IP definitions.

### 8.7.8 IPX Configuration

From the Navigation Window select **Protocols -> IPX -> General**.

To configure IPX, we need to enable the IPX protocol and add the network numbers for IPX routing.

Check **IPX** to enable the IPX protocol.



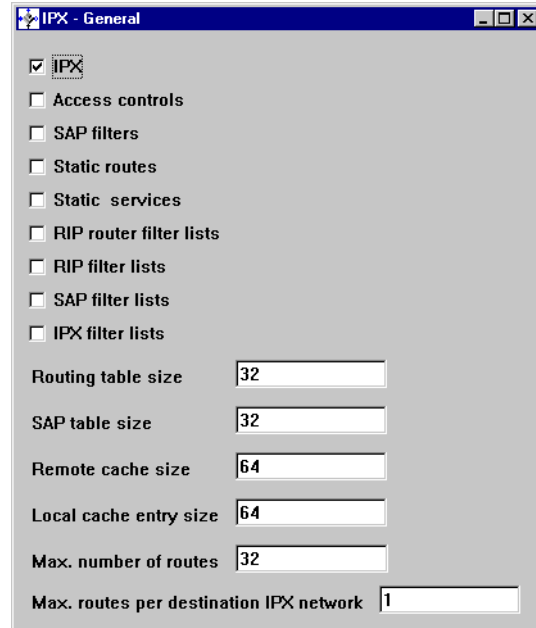


Figure 324. Enabling the IPX Protocol from the IPX-General Screen

From the Navigation Window select **Protocols -> IPX -> Interfaces**.

At the window shown in Figure 325 we will define the IPX circuit number. Click the word **Configure** to display the lower part of the window. Select the interface for the ELAN on which you wish to configure the IPX protocol. Add the circuit number and click **Add**.

Highlight the next interface on which you need to configure IPX. Continue until you have added the circuit number to all the interfaces on which you need IPX.

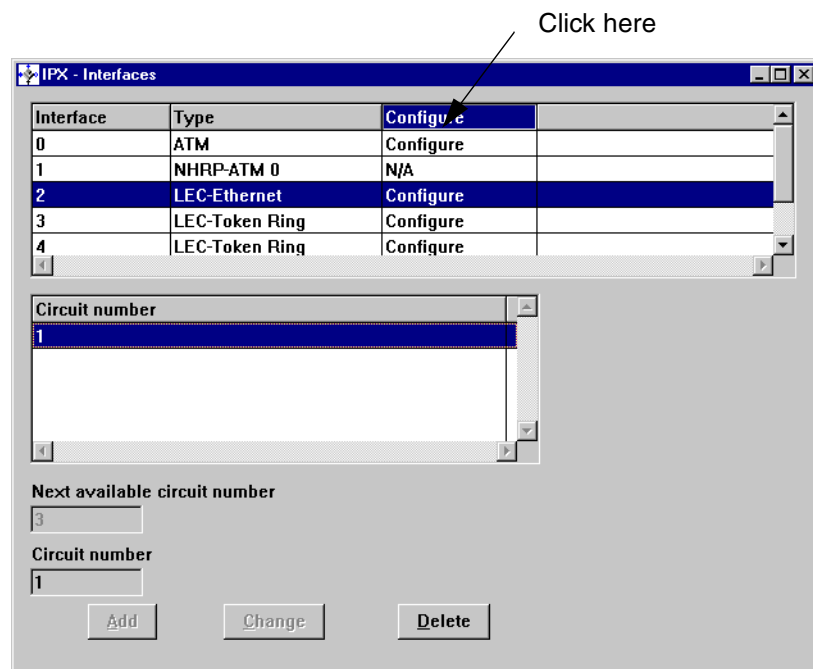


Figure 325. IPX Interfaces Window

Select **Circuits** from the Navigation Window to configure the IPX network numbers.

Select the appropriate circuit and click the word **Configure** at the top of the scrolling windows. Add the IPX network number in the appropriate field and select the framing type IPX is using on this interface. We have selected **Ethernet 802.3** selected as this is the circuit for the ELAN et1.

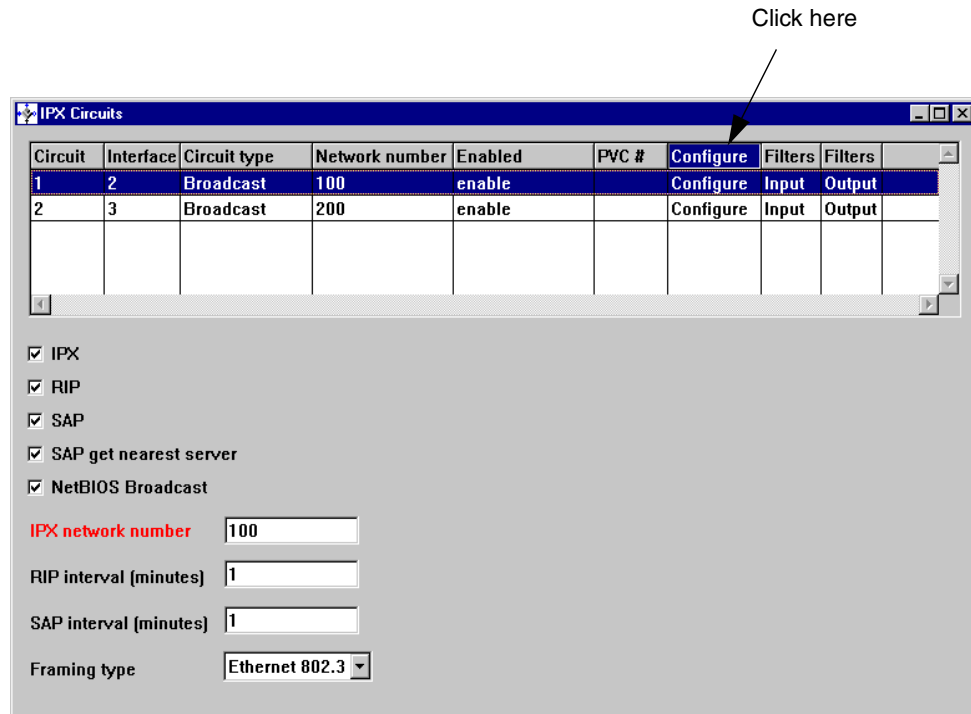


Figure 326. Configuring the IPX Network Number and Framing Type

From here you can go to another window that will let you enable and add filters. Click the word **Filters** at the top of the window. The bottom half changes to the window shown Figure 327. This is where you add filters. None are defined in our configuration.

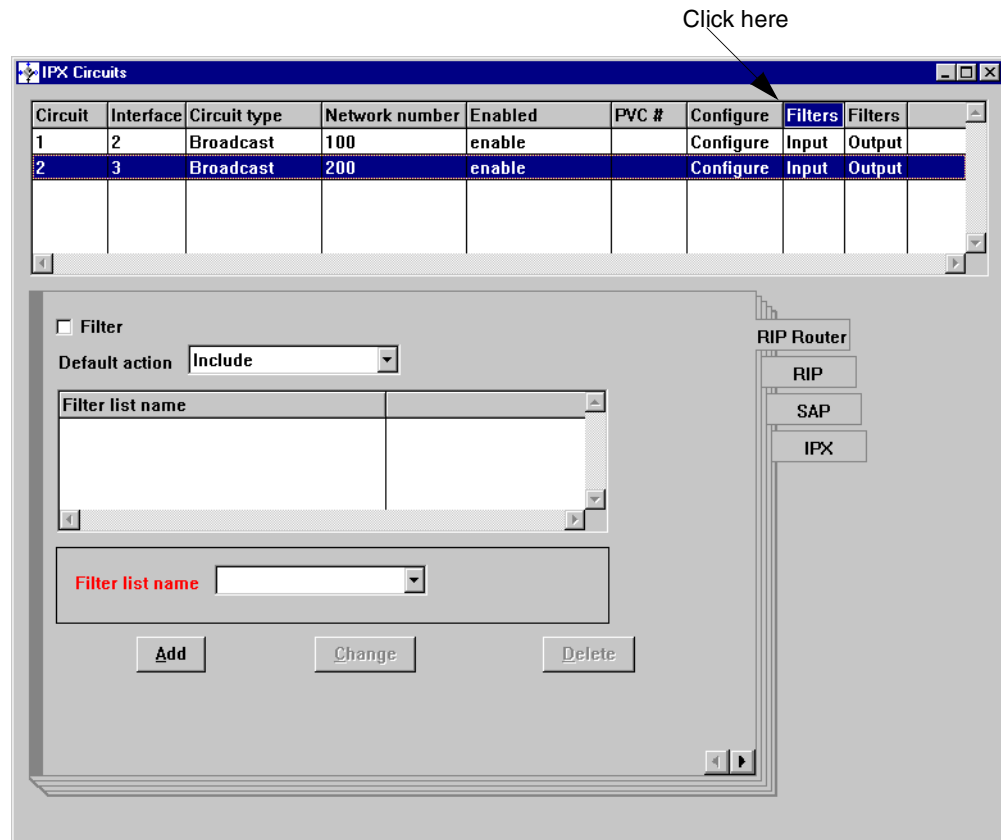


Figure 327. Adding IPX Filters to the Network

### 8.7.9 Bridge Configuration

We will now configure bridging between the et1 and tr1 ELANs. Transparent bridging is configured on the Ethernet ELAN et1 and source-route transparent bridging on the token-ring ELAN tr1.

Spanning tree will be enabled; to try and split the workload between the MSS servers we will configure the MSS2 bridge with a higher priority than MSS1.

Bridging is selected from the Navigation Window under **Protocols** then **Bridging**. Select the **General** window.

Check **Bridging** to enable the function globally.

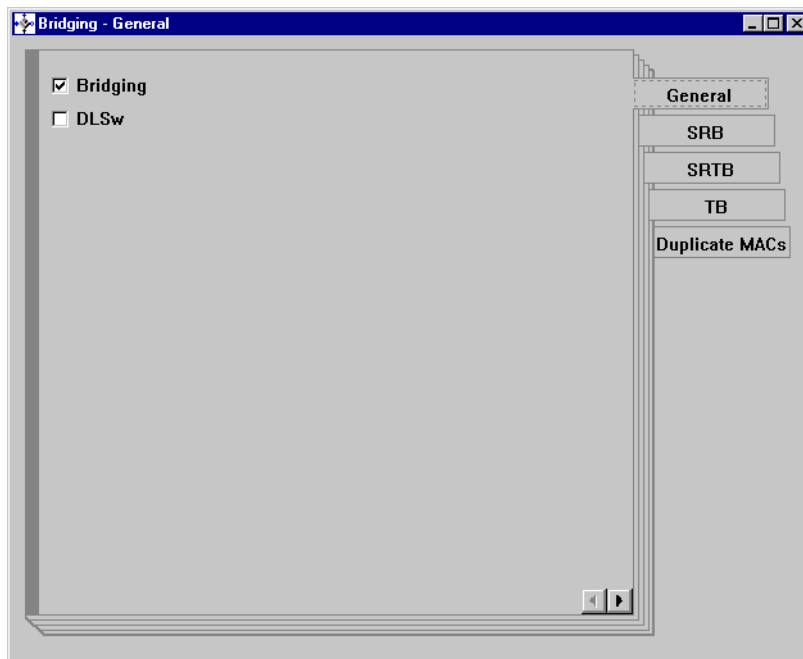


Figure 328. Bridging - General Window

Now select the **SRB** tab.

Set the bridge number to **1**. Although not strictly needed when only bridging two interfaces, we have defined an internal segment number of **AAA**.

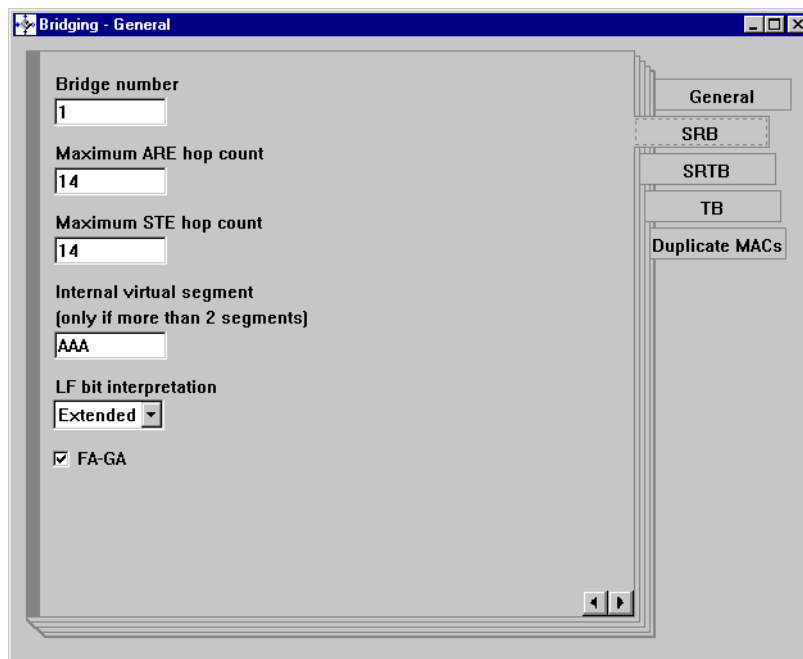


Figure 329. Selecting the SRB Parameters for Bridging

Leave the other parameters at the defaults and select the **SRTB** tab.

We have defined a TB virtual segment of **E1E**, and a maximum frame size of **1470**. The other parameters are the defaults.

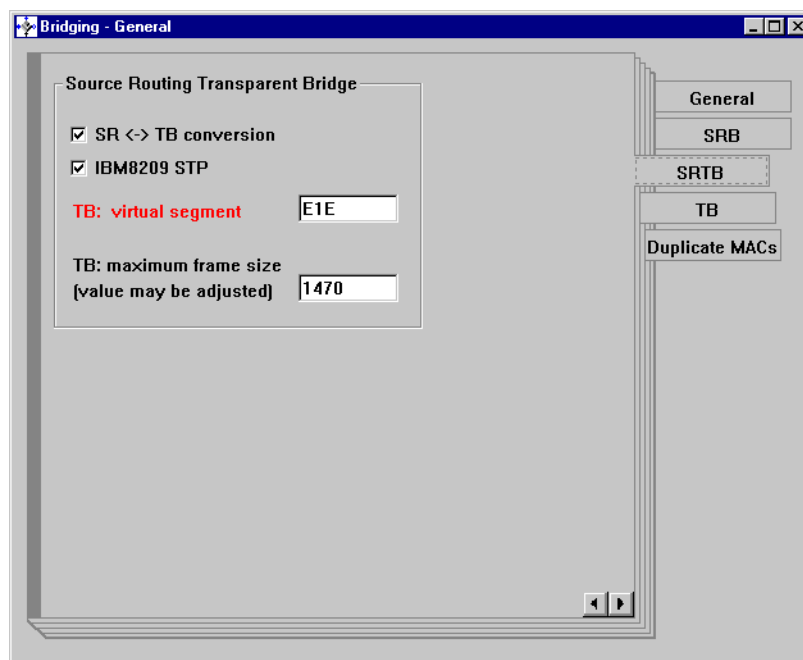


Figure 330. SRTB Parameters for Bridging

Now select the **TB** tab.

The recommendation is to set the filtering database size to 1024 entries, times the number of bridge ports. We have bridging defined on two ports so we have set this to 2048. The other parameters are the defaults. If you have the bridge ports already defined, click **Recommend** and the configurator should work this out for you.

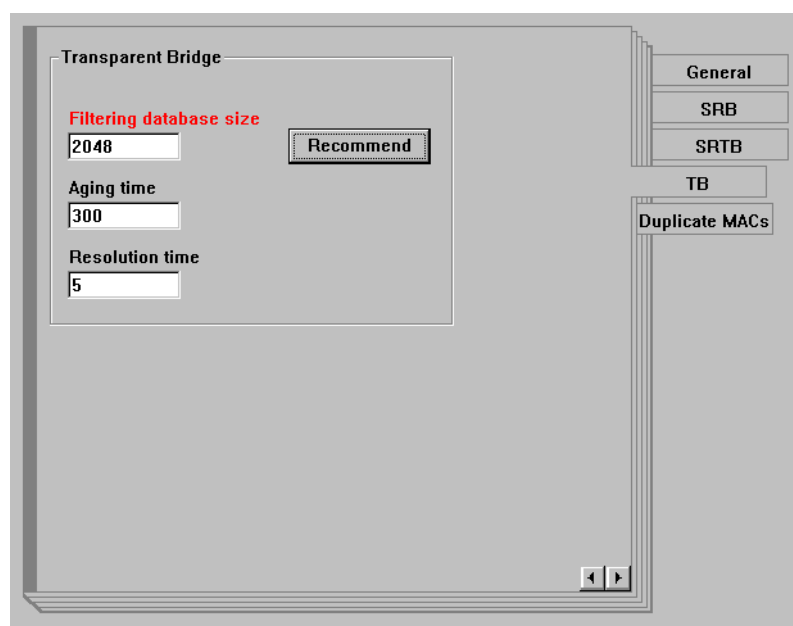


Figure 331. Setting Transparent Bridge Parameters

Now select **Protocols -> Bridging -> Interfaces**.

You must enable each interface you want to participate in bridging by clicking the Bridging port. The figure below shows bridging enabled on interfaces 2 and 3. These are the et1 and tr1 ELAN clients. Highlight the **Interface** then check **Bridging port** in the bottom part of the window.

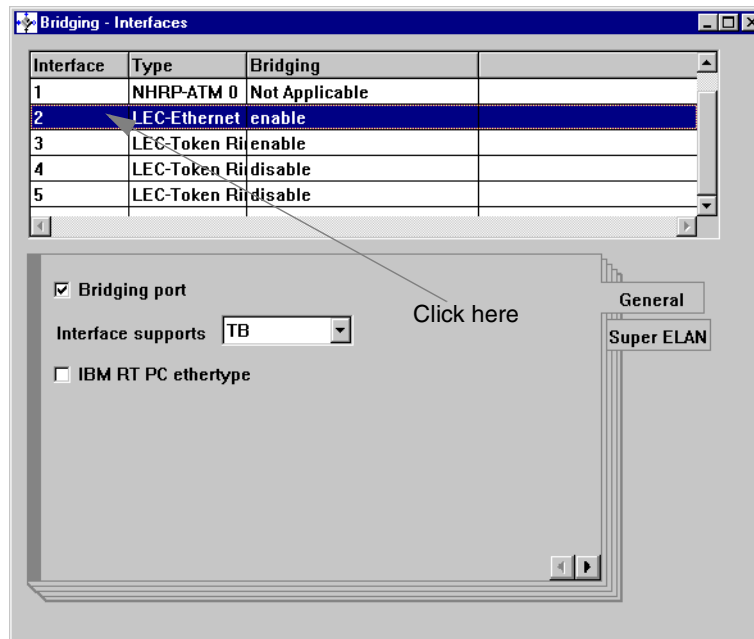


Figure 332. Bridging Interfaces Window - Transparent Bridging

The lower part of the window for token-ring interfaces is different, as shown in Figure 333. Highlighting Interface 3 will bring this up.

Check **Bridging port**.

Set the token-ring segment number to which this interface attaches to. In our case **A11**.

Set SRT from the pull-down in the Interface supports field. (This enables the port for source-route transparent bridging.)

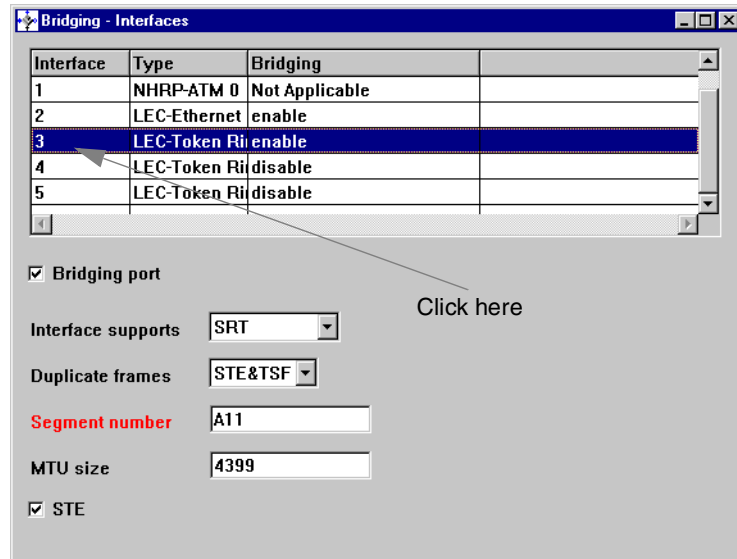


Figure 333. Bridging Interface Window - Source-Route Bridging

Now select **Bridging -> Spanning tree protocol -> General**. We will now configure the spanning tree parameters.

This window is shown in Figure 334 on page 307. We have set the bridge address to **A** in both the transparent and source-route bridging fields. The bridge priority field for this bridge is set to **200**. The lower the number the higher the priority. (MSS2 has a value of 100 configured, which will make it the root bridge.)

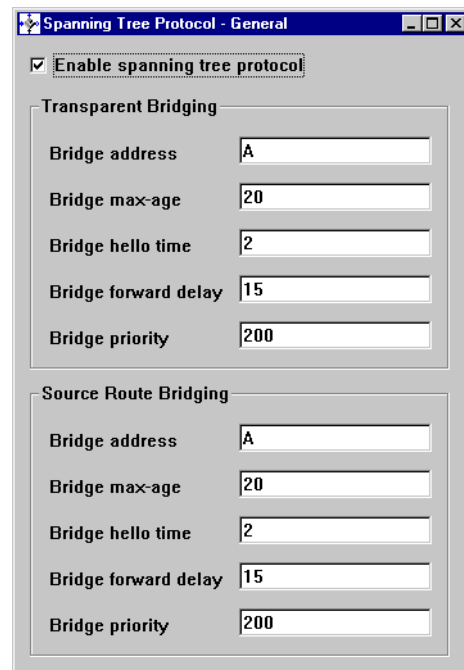


Figure 334. Spanning Tree General Screen

Now select **Bridging -> Spanning Tree Protocol -> The Spanning Tree Protocol Interfaces** window as shown in Figure 335 will appear.

You must enable the interfaces on which you want the spanning tree protocol active.

To enable or disable the protocol on an interface, click in the box under the STP heading for the particular interface you want. The window below shows Interface 2. The protocol can be enabled or disabled from here.

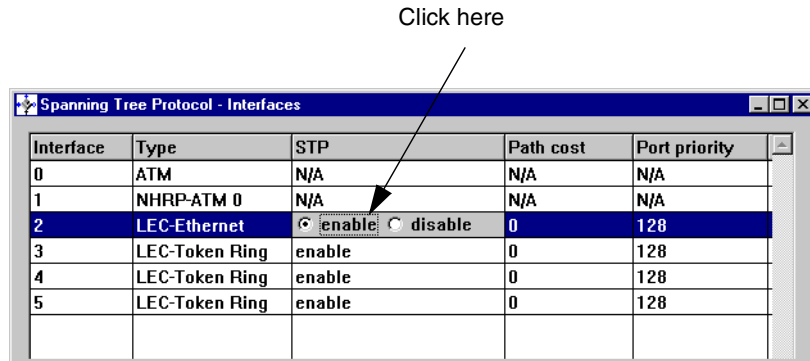


Figure 335. Spanning Tree Protocol - Interfaces

### 8.7.10 MPOA Configuration

MPOA (Multi protocol over ATM) provides a shortcut VCC between the clients on different ELANs even though they may be different LAN types, for example, layer-3 switching. The MSS server at Release 2.1 and above includes an MPOA server. Release 2.2 added IPX support to MPOA. By default this is enabled. If you have clients that support MPOA the shortcut between the clients will happen automatically.

The following window shows the MPOA general window with the default parameters. We did not change any of these parameters.

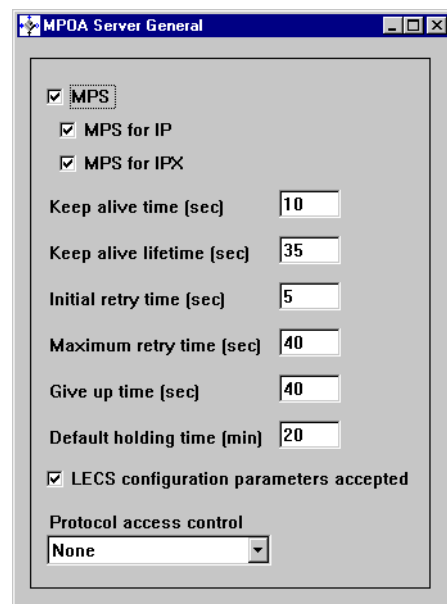


Figure 336. MPOA General Window



Now select the **MPOA Server Interfaces** window.

Select **Interface 0**, then configure the ESI from the pull-down menu. Configure a selector byte. We chose **14** in our configuration. Accept the other defaults. This window is shown in Figure 337.

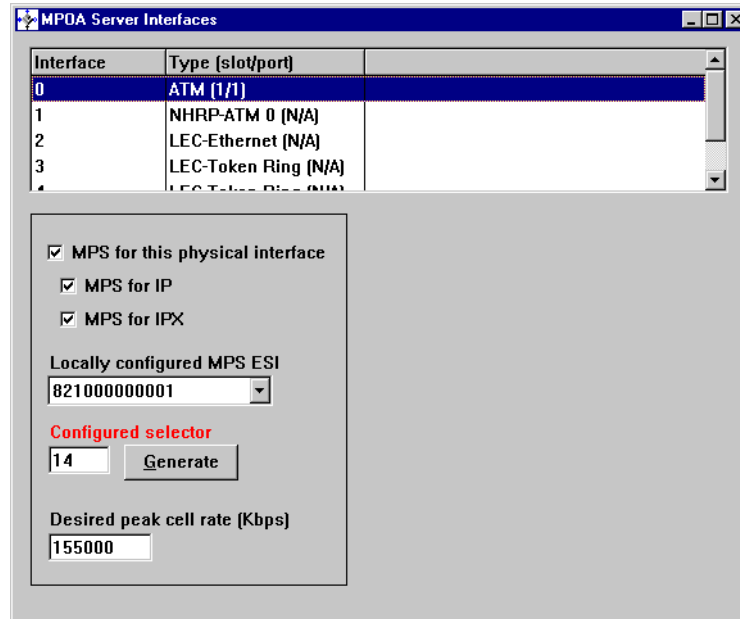


Figure 337. MPOA Interface Configuration Window

By default all interfaces are enabled. If you do not want MPOA to be active on an interface you can deconfigure it. Figure 338 shows the options for an emulated LAN interface, in this case Interface 2, the ELAN et1. In our network MPOA was active on the et1 and tr1 ELANs but disabled on the mgmt ELAN.

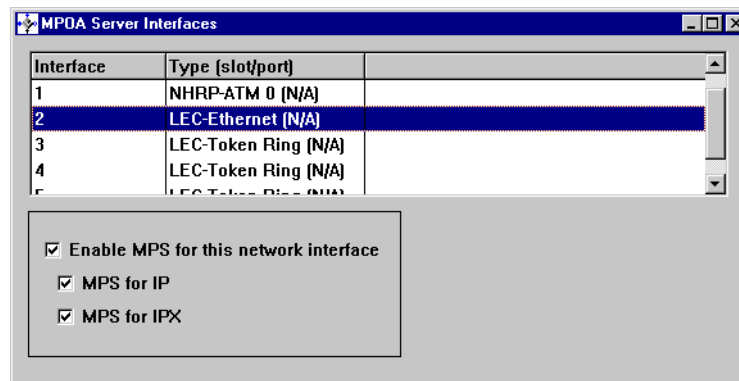


Figure 338. MPOA Interfaces Window.

## 8.8 MSS2 Configuration

In this section we are not going to show the complete configuration for MSS2. We will only show the differences from the configuration on MSS1. The majority of the configuration is the same.

### 8.8.1 Interface Configuration

MSS2 configuration starts by creating an ATM device and assigning an ESI number to the interface. Figure 339 is the Device Interfaces window with the **ESI** tab selected. The only difference here is the ESI of 821000000002 for MSS2.

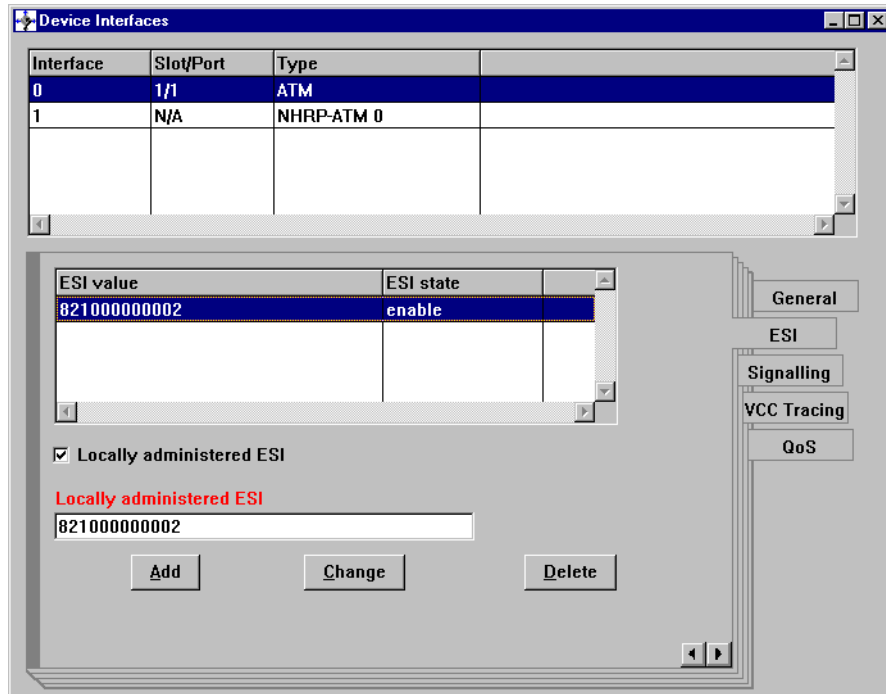


Figure 339. Assigning an ESI Number in MSS2

### 8.8.2 LECS Configuration

The next window is the LECS General. Again the only difference here from MSS1 is the ESI for MSS2. All other parameters are the same including the selector byte.

As you go through these configuration windows you will see we have tried to keep the addressing structure the same across both MSS servers.

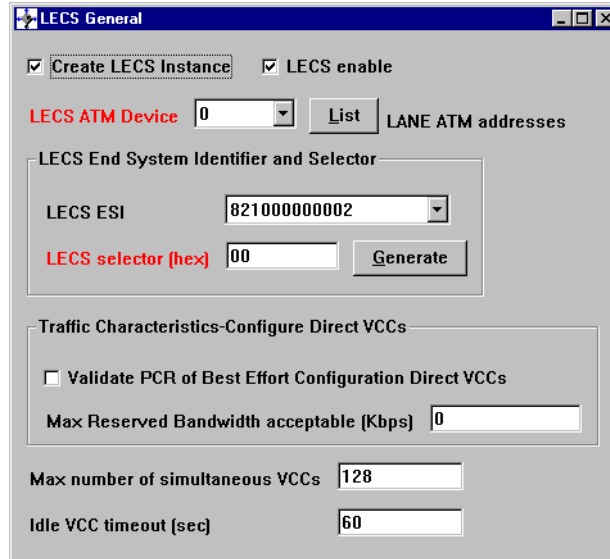


Figure 340. LECS General Window for MSS2

In MSS2 we have defined the LECS to accept database synchronization from MSS1. Figure 341 on page 311 is the LECS database synchronization screen which shows this.

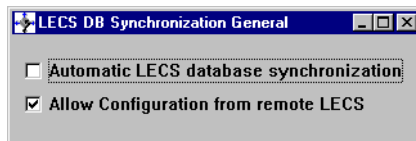


Figure 341. LECS DB Synchronization General

### 8.8.3 ELANs

The next window shows the ELAN definitions. The only difference here is the ESI for MSS2. Everything else is the same, including the selector byte.

The ELAN shown in the screen is et1.

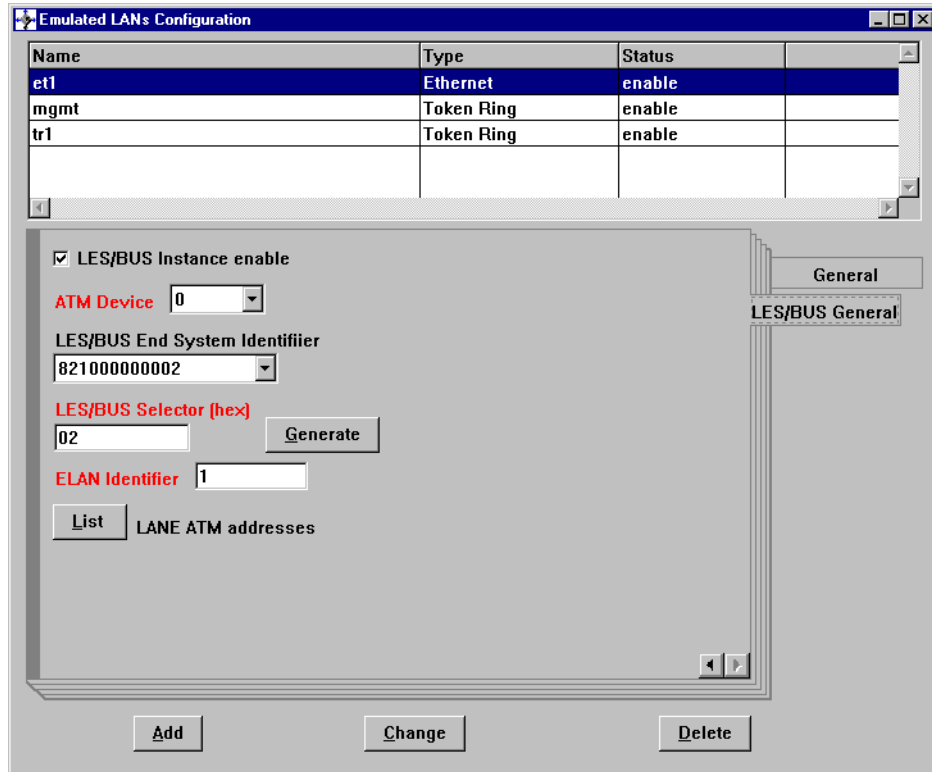


Figure 342. Local ELAN General in MSS2

#### 8.8.4 LES/BUS Definitions

The LES/BUS creation procedure is exactly the same as for MSS1. On the redundancy screen we need to define the ATM address of the partner LES/BUS. In our case this is the primary LES/BUS in MSS1. Figure 343 shows the definition for ELAN et1. The address is the address of the primary LES/BUS in MSS1. The redundancy protocol role is set to **backup** as this is the role MSS2 plays.



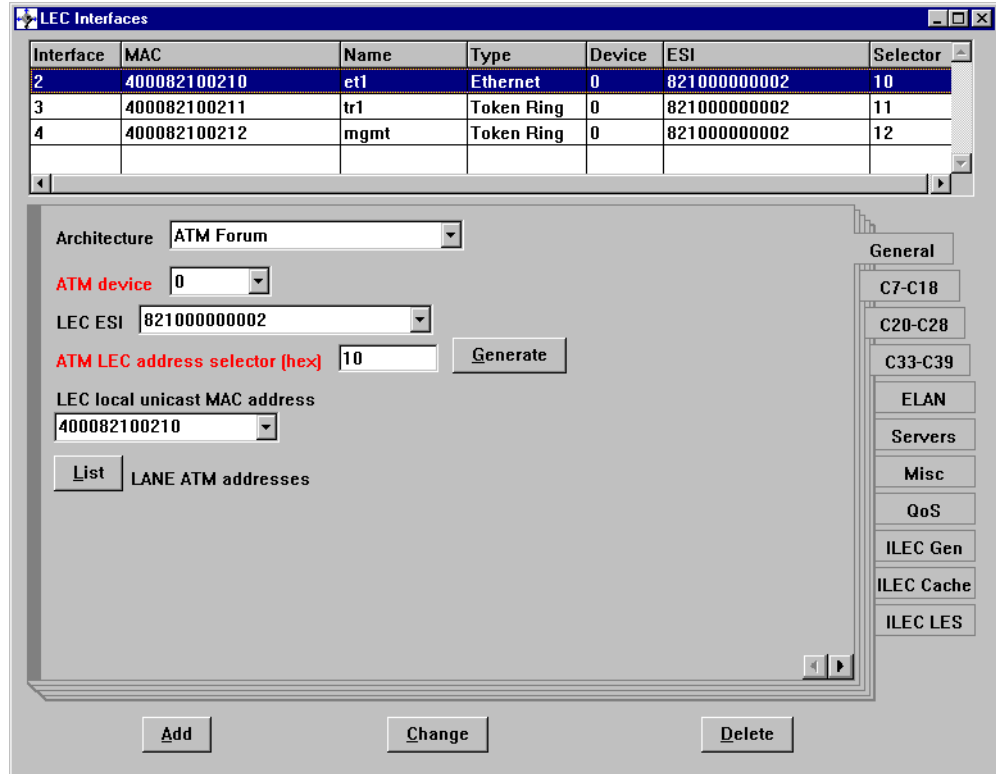


Figure 344. LEC Interface in MSS2

## 8.8.6 System

Set a different system name for MSS2. This will show in the command-line prompt. The location is also different. The following window shows the System General.

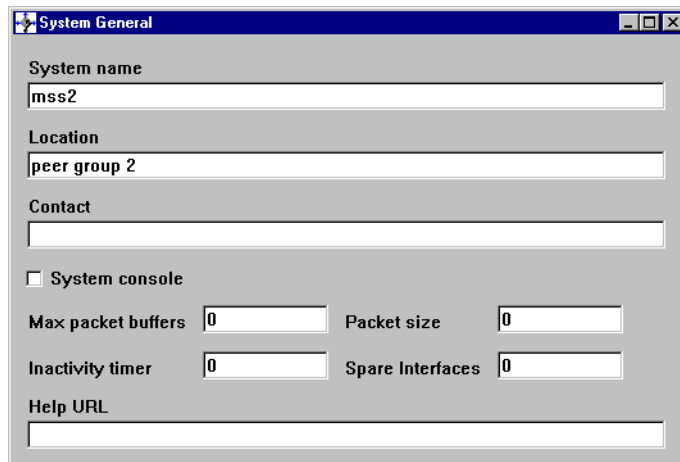


Figure 345. System General in MSS2

## 8.8.7 IP

Figure 346 is the IP interfaces window showing interface 0. Here we set the IP address for MSS2 to join Classical IP. This address is 192.168.1.2.

| Interface | Type (Slot/Port) | Number of addresses |
|-----------|------------------|---------------------|
| 0         | ATM              | 1                   |
| 1         | NHRP-ATM 0       | 0                   |
| 2         | LEC-Ethernet     | 3                   |
| 3         | LEC-Token Ring   | 5                   |

| IP address  | Subnet mask   | Redirect |
|-------------|---------------|----------|
| 192.168.1.2 | 255.255.255.0 | enable   |

**IP address**   
**Subnet mask**   
**MTU**   
☒ ICMP redirects

Figure 346. CIP Address in MSS2

The next window displays the IP parameters for the ELAN et1. The IP address for this interface is 10.1.1.3. The MAC address for this interface was set previously. The client IP addresses for the other ELANs are set in the same way.

| Interface | Type (Slot/Port) | Number of addresses |
|-----------|------------------|---------------------|
| 0         | ATM              | 1                   |
| 1         | NHRP-ATM 0       | 0                   |
| 2         | LEC-Ethernet     | 3                   |
| 3         | LEC-Token Ring   | 5                   |

| IP address | Subnet mask   | Redirect |
|------------|---------------|----------|
| 10.1.1.3   | 255.255.255.0 | enable   |
| 10.1.2.3   | 255.255.255.0 | enable   |
| 10.1.3.3   | 255.255.255.0 | enable   |

**IP address**   
**Subnet mask**   
**MTU**   
☒ ICMP redirects

Figure 347. Ethernet LEC's IP Address in MSS2

To support the redundant default gateway function the same definitions are required in the Redundant-Distributed IP Gateways window on MSS2 as was defined in MSS1. The only difference is the MAC address role. As MSS2 is the **Backup** for MSS1 we need to set the MAC address role accordingly. The following screen shows this.

| Interface | LEC name       | Number of gateways |
|-----------|----------------|--------------------|
| 2         | LEC-Ethernet   | 3                  |
| 3         | LEC-Token Ring | 5                  |
| 4         | LEC-Token Ring | 1                  |

| IP address | IP mask       | MAC address  | MAC role | Gate |
|------------|---------------|--------------|----------|------|
| 10.1.1.1   | 255.255.255.0 | 40008210D110 | Backup   | Red  |
| 10.1.2.1   | 255.255.255.0 | 40008210D210 | Backup   | Red  |
| 10.1.3.1   | 255.255.255.0 | 40008210D310 | Backup   | Red  |

**Gateway Parameters**

IP address: 10.1.1.1    IP mask: 255.255.255.0

MAC address: 40008210D110    MAC address role: Backup

IP gateway type: Redundant-only

Add    Change    Delete

Figure 348. Redundant-Distributed IP Gateway in MSS2

### 8.8.8 Classical IP

MSS2 will not have an ARP server function, just a client. The differences in the CIP configuration are shown in the next two windows.

First shown is the Classical IP over ATM general window. Do *not* check the Client is also an ARP Server box. In the Address box type the address of the ARP server as shown in Figure 349. (The ARP server is in MSS1.)



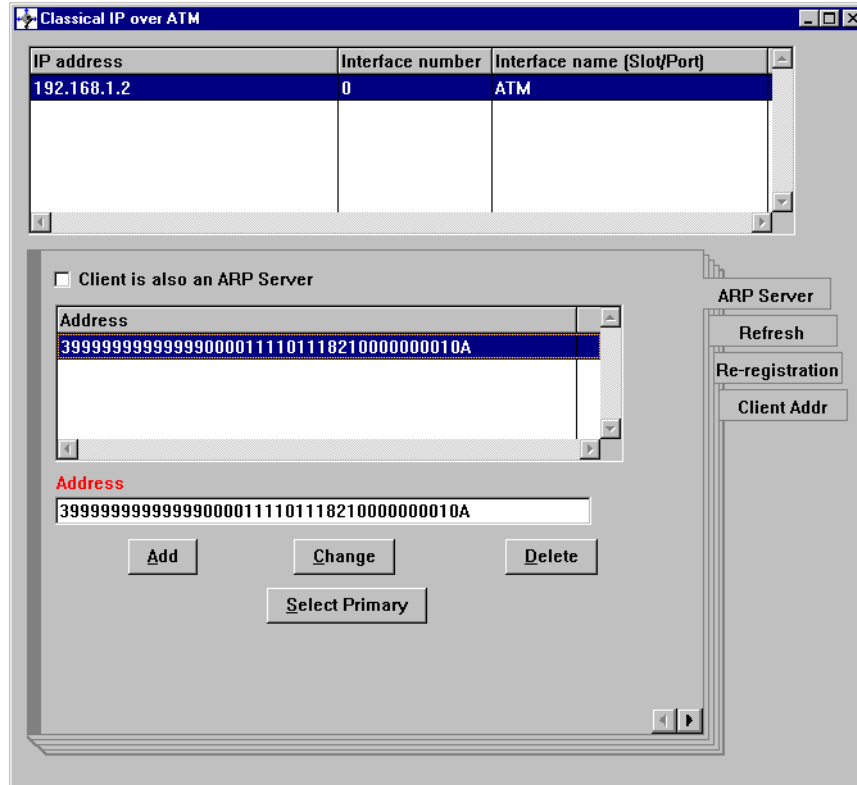


Figure 349. Classical IP over ATM in MSS2

Now select the **Client Addr** tab.

The ESI and selector bytes have to be defined here for the CIP client in MSS2.

The ESI is the one we have defined for MSS2 and the selector is **0A**.

This is shown in Figure 350.

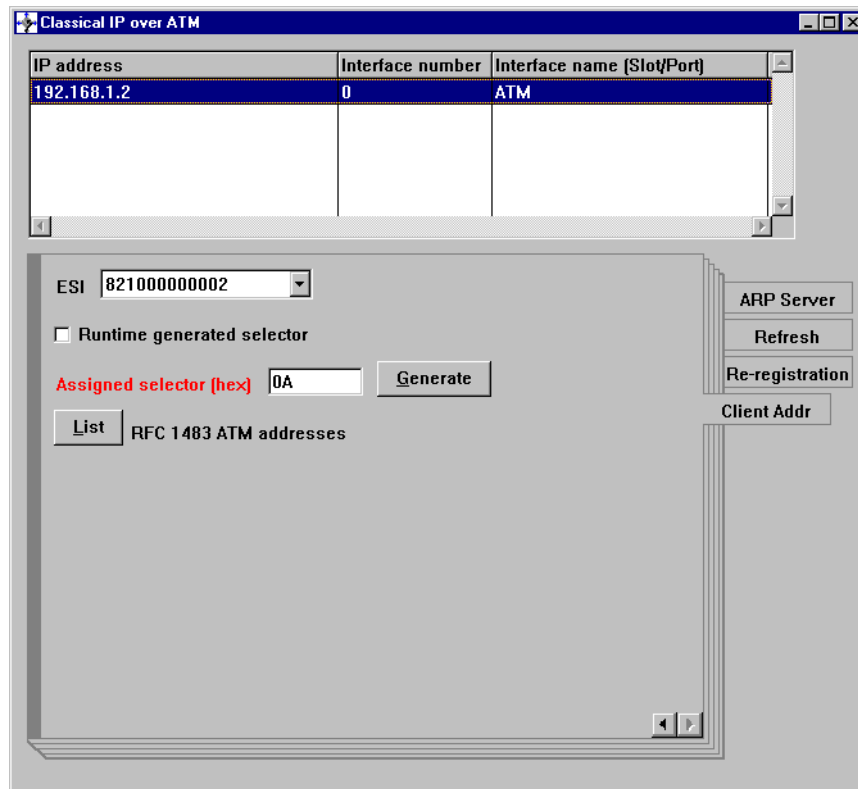


Figure 350. Client Address of CIP in MSS2

### 8.8.9 Bridging

We will now show the windows with the different bridging parameters set.

At the **Bridging - General** -> **SRB** window MSS2 has a bridge number of 2. The internal virtual LAN segment (although not strictly required with only two bridging interfaces) is set to **ABB**. This is shown in Figure 351.

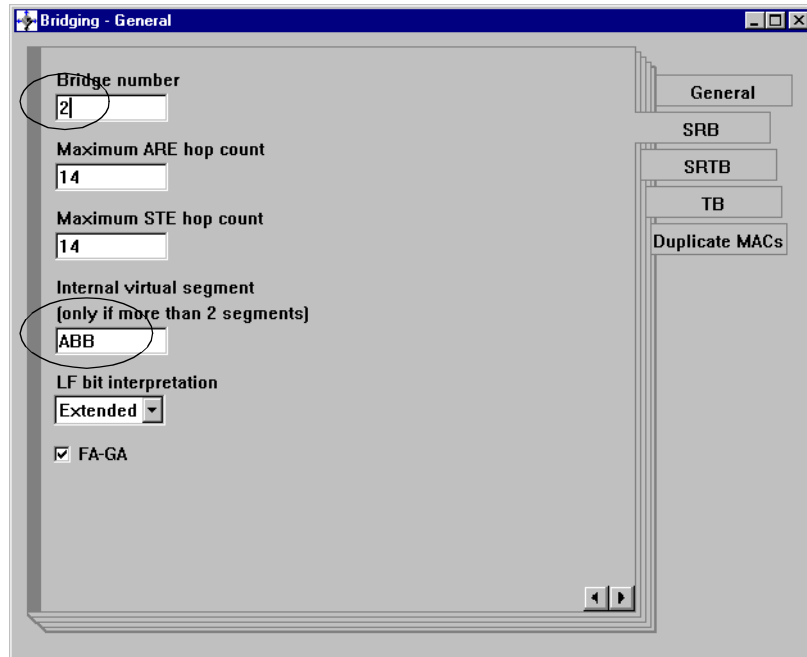


Figure 351. Source Route Bridge in MSS2

Select the **SRTB** tab.

The Source Routing Transparent Bridge will use a different TB: virtual segment number **E2E**.

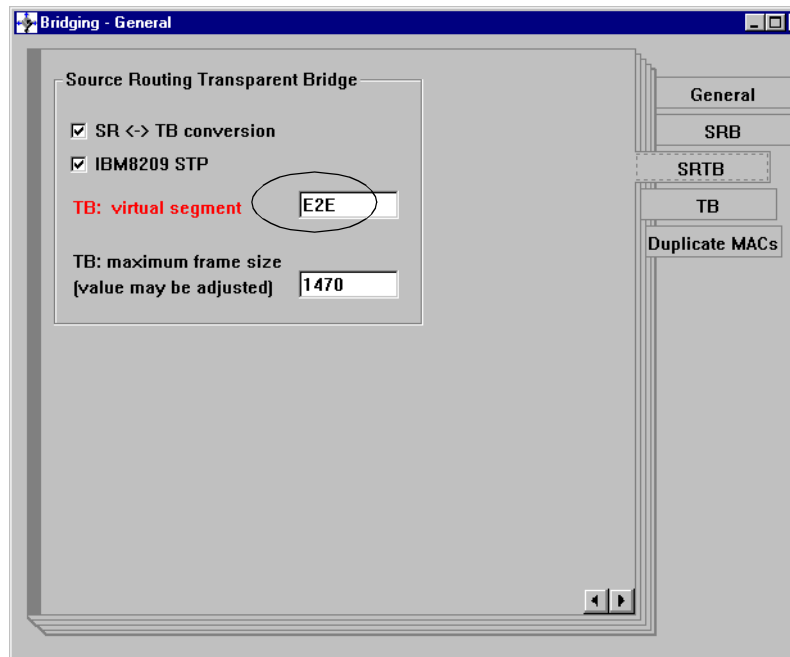


Figure 352. Source Routing Transparent Bridge in MSS2

At the Spanning Tree Protocol - General window we have given the bridge address a different value. Also the bridge priority is set to **100** for both transparent

bridging and source route bridging. This will give MSS2 a higher priority and hence make it the root bridge. Figure 353 shows this:

**Spanning Tree Protocol - General**

☒ Enable spanning tree protocol

**Transparent Bridging**

Bridge address: B

Bridge max-age: 20

Bridge hello time: 2

Bridge forward delay: 15

Bridge priority: 100

**Source Route Bridging**

Bridge address: B

Bridge max-age: 20

Bridge hello time: 2

Bridge forward delay: 15

Bridge priority: 100

Figure 353. Spanning Tree Protocol - General Window in MSS2

### 8.8.10 MPOA

The only difference with the MPOA definitions between the two MSS servers is at the MPOA Server Interface window. Here the ESI value is the one given to MSS2. Figure 354 shows this:

**MPOA Server Interfaces**

| Interface | Type (slot/port)     |  |
|-----------|----------------------|--|
| 0         | ATM (1/1)            |  |
| 1         | NHRP-ATM 0 (N/A)     |  |
| 2         | LEC-Ethernet (N/A)   |  |
| 3         | LEC-Token Ring (N/A) |  |
| 4         | LEC-Token Ring (N/A) |  |

☒ MPS for this physical interface

☒ MPS for IP

☒ MPS for IPX

Locally configured MPS ESI: 82100000002

Configured selector: 14

Generate

Desired peak cell rate (Kbps): 155000

Figure 354. MPOA Server Interfaces in MSS2

## 8.9 MSS Command Line Displays

MSS command line interface allows you to type in commands and queries. To access the MSS command line interface you must either have a terminal emulator directly attached to the MSS or you must be able to telnet to the MSS via your network.

### 8.9.1 Displaying the Status of LES/BUS Pairs

To display the status of a LES/BUS pair, type `Talk 5 -> Network 0 -> lan-emulation services -> summary`. A list of all the ELANS configured will be shown with their status and how many clients are registered with each.

The next two screens show the summary of the ELANs on both MSS1 and MSS2. First, the display of the screen on MSS1:

[illegible]

Figure 355. Summary of the ELANs on MSS1

## – Notes

- 1 Three Proxy LECs have joined the ELAN et1.
- 2 Nine NonProxy LECs have joined the ELAN mgmt.

Next is a summary for MSS2.

```
mss2 LE-SERVICES+SUMMARY
ELAN Type (E=Ethernet/802.3, T=Token Ring/802.5)
| Interface #
| | LES-BUS State (UP=Up, RE=Redun. ID=Idle, ND=Net Down, ER=Error/Down,
| | | **=Other; Work with specific LES-BUS to see actual state)
ELAN Name #LECs #LECs Last LES/BUS	
Proxy NonProxy State Change	

E 0 RE et1 (Redundant) 00.00.00.58
T 0 RE mgmt (Redundant) 00.00.00.58
T 0 RE tr1 (Redundant) 00.00.00.58
```

Figure 356. Summary of the ELANs on MSS2

|                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Note</b>                                                                                                                                                                                                                      |
| Notice the third column from the left, LES-BUS State. On MSS1 this is UP showing this MSS has the ELAN active whereas MSS2 shows RE. It is the redundant ELAN waiting to take over if a failure occurs with the primary in MSS1. |

Notice the third column from the left, LES-BUS State. On MSS1 this is UP showing this MSS has the ELAN active whereas MSS2 shows RE. It is the redundant ELAN waiting to take over if a failure occurs with the primary in MSS1.

You can display a complete list of the running ELANs by selecting each and creating a list. This is shown in Figure 354 on page 320 and Figure 355 on page 321 for ELAN et1. From the previous position in the menu, type `Work et1 -> list`.

```

MSSI EXISTING LES-BUS 'et1'+LIST
ELAN Name: et1
ELAN Type: Ethernet
ATM Device number: 0
of Proxy LEC's: 3
of Non-Proxy LEC's: 0
LES ATM Address: 399999999999900001111011182100000000102

-Status-
LES-BUS State: OPERATIONAL
Able to accept new LEC's: YES
Enhanced Redundancy VCC State: OPERATIONAL 1
Major Reason LES-BUS was last Down: none
Minor Reason LES-BUS was last Down: none
LES-BUS State last changed at: 00.00.00.63 (System Up Time)
LES-LEC Status Table changed at: 03.09.12.51 (System Up Time)
BUS-LEC Status Table changed at: 03.09.13.50 (System Up Time)
UNI Version: 3.1
IP BCM: ACTIVE
IPX BCM: ACTIVE
NetBIOS BCM: ACTIVE
IPX BCM Active Forwarding List Size: 2

-Current Configuration-
LES-BUS Enabled/Disabled: Enabled
ATM Device number: 0
End System Identifier (ESI): 82.10.00.00.00.01
Selector Byte: 0x02
ELAN Type: (S2) Ethernet
Max Frame Size: (S3) 1516
Control Timeout: (S4) 120
Max Frame Age: (S5) 1
ELAN Identifier: (S7) 1
Mcast Send Disconnect Timeout: (S9) 60
LECID Range Minimum: 0x0001
LECID Range Maximum: 0xFEFF
Validate Best Effort Peak Cell Rate (PCR): No
Control Distribute VCC Traffic Type: Best Effort VCC
Control Distribute VCC PCR in Kbps: 155000
Control Direct VCC Max Reserved Bandwidth: 0
Multicast Forward VCC Traffic Type: Best Effort VCC
Multicast Forward VCC PCR in Kbps: 155000
Multicast Send VCC MAX Reserved Bandwidth: 0

-LES-BUS Options-
BUS Mode: System
Security (LECS Validation of Joins): Disabled
Partition LE ARP REQUEST Forwarding Domain: Yes
LE_ARP RESPONSE Destination: One client
Partition Unicast Frame Domain: Yes
Redundancy: Enabled 2
Peer Redundancy: Enabled 3
Redundancy Role: Primary LES-BUS 4
ATM address of Backup LES-BUS: 399999999999900001111022182100000000202 5
ATM address trace filter value: 00
ATM address trace filter mask: FF

```

```

-BUS Monitor Configuration-
Monitor Host Usage of BUS: Disabled
Top Hosts to Record: 10
Seconds in each sample interval: 10
Seconds between sample intervals: 1800
Frame sampling rate: 1 out of 10

-Broadcast Manager Configuration-
IP BCM: Enabled 6
IPX BCM: Enabled
NetBIOS BCM: Enabled
BCM IP Cache Aging Time: 5
BCM IPX Cache Aging Time: 3
BCM NetBIOS Cache Aging Time: 15
BCM IPX Maximum Forwarding List: 50
BCM IPX Server Farm Detection: Disabled
BCM IPX Server Farm Threshold: 20
No BCM IPX Static Entries defined

-Bus Filter Configuration-
Bus Filter Enabled: Disabled
Bus Filter's Preferred List EXCLUDE LIST
Bus Filter's Default Action EXCLUDE

-Bus Police Configuration-
Bus Police Enabled: Disabled
Bus Police Filter Duration TEMPORARY
Bus Police Threshold (packets/sec) 50

```

Figure 357 (Part 2 of 2). Operational LES/BUS Pair for ELAN et1

Notes:

- 1** This shows the redundancy is up and operational for elan et1.
- 2** Configured to enable the Redundancy.
- 3** Peer redundancy is enabled to prevent a second disruption in the network when the primary LES/BUS pair becomes operational and there are more clients registered with the backup LES/BUS.
- 4** MSS1 configured to Primary LES/BUS
- 5** The ATM address of backup LES/BUS. It is the Redundancy partner.
- 6** Enabled the BCM for IP protocol. We can enable the BCM per protocol.

To see what clients have joined the ELAN et1, type `show lec`. The following screen shows that three clients that have joined the ELAN.



| LEC-LES and LEC-BUS State (UP=Up, ID=Idle, --. --. |       |      |       |      |      |       |       |  |  |
|----------------------------------------------------|-------|------|-------|------|------|-------|-------|--|--|
| **=Other; Show specific LEC to see actual)         |       |      |       |      |      |       |       |  |  |
|                                                    |       | LEC  | State | #ATM | #Reg | #Lmd  |       |  |  |
| LEC Primary ATM Address                            | Proxy | ID   | LES   | BUS  | Adrs | MACs  | MACs  |  |  |
| -----                                              | -     | ---- | --    | --   | ---- | ----- | ----- |  |  |
| 3999999999999999000011110111821000000000110        | Y     | 0001 | UP    | UP   | 1    | 4     | 0     |  |  |
| 39999999999999999000011110221821000000000210       | Y     | 0002 | UP    | UP   | 1    | 1     | 0     |  |  |
| 399999999999999990000111102230020DA71CE9102        | Y     | 0003 | UP    | UP   | 1    | 1     | 0     |  |  |

Use the `SHOW REGISTERED-MAC` command to display a list of registered MAC addresses in the ELAN.

```

MSS1 EXISTING LES-BUS 'et1'+SHOW REGISTERED-MAC
Number of Registered MAC's to display: 6

Registered
MAC Address Registering ATM Address Type LEC # BCM

400082100110 399999999999900001111011182100000000110 R 0001 1
400082100210 399999999999900001111022182100000000210 R 0002 1
0020DA71CE9F 39999999999990000111102230020DA71CE9102 R 0003 0
40008210D110 399999999999900001111011182100000000110 R 0001 1
40008210D210 399999999999900001111011182100000000110 R 0001 1
40008210D310 399999999999900001111011182100000000110 R 0001 1.

```

```

MSS1 ASRT>LIST BRIDGE
Bridge ID (prio/add): 200/00-00-00-00-00-0A 1
Bridge state: Enabled
UB-Encapsulation: Disabled
Bridge type: ASRT
Number of ports: 2
STP Participation: IEEE802.1d and IBM-8209 2

Port Interface State MAC Address Modes MSDU Segment Flags
1 Eth /0 Up 40-00-82-10-01-10 T 1516 RD
2 TKR /0 Up 02-00-41-08-80-88 SRT 4544 All RD

Flags: RE = IBMRT PC behavior Enabled, RD = IBMRT PC behavior Disabled

SR bridge number: 1
SR virtual segment: AAA (1:N SRB Not Active)
Adaptive segment: ELE

```

Figure 360. Bridge Status for MSS1

#### Notes:

- 1 This shows that the bridge priority for MSS1 is 200.
- 2 802.1d and 8209 are the defaults.

Figure 361 shows the bridge port status for MSS1. Note the transparent bridge port is in blocking state. MSS2 is the root bridge and will have this port in forwarding state.

```

MSS1 ASRT>LIST PORT
Port Id (dec) : 128: 1, (hex): 80-01
Port State : Blocking 1
STP Participation: Enabled
Port Supports : Transparent Bridging Only
Assoc Interface #/name : 2/Eth/0
+++++
Port Id (dec) : 128: 2, (hex): 80-02
Port State : Forwarding
STP Participation: Enabled
Port Supports : Transparent and Source Route Bridging
SRB: Segment Number: 0xA11 MTU: 4399 STE Forwarding: Auto
Duplicate Frames Allowed: STE: Yes, TSF: Yes
Assoc Interface #/name : 3/TKR/0

```

Figure 361. List Port Command for the Bridge in MSS1

#### Note:

- 1 The bridge port of ELAN et1 is in blocking state. At this time, MSS2 has its equivalent port in forwarding state.

To look at the state of the spanning tree in the MSS1 bridge type the `LIST SPANNING-TREE-PROTOCOL STATE` command.

```

MSS1 ASRT>LIST SPANNING-TREE-PROTOCOL STATE
802.1d Spanning Tree State:
 Designated root (prio/add): 100/00-00-00-00-00-0B 1
 Root cost: 62
 Root port: 2 (TKR /0)
 Current (root) maximum age: 20 seconds
 Current (root) hello time: 2 seconds
 Current (root) Forward delay: 15 seconds
 Topology change detected: FALSE
 Topology change: FALSE

 Port Interface State
 --- -
 1 Eth /0 Blocking
 2 TKR /0 Forwarding

```

Figure 362. List Spanning Tree Protocol State Command for MSS1

**Note:**

1 The root bridge has a priority of 100 (MSS2).

To display how the bridge spanning tree in MSS1 is configured, type the `LIST SPANNING-TREE-PROTOCOL CONFIGURATION` command as shown below:

```

MSS1 ASRT>LIST SPANNING-TREE-PROTOCOL CONFIGURATION
802.1d Spanning Tree Configuration:

 Bridge ID (prio/add): 200/00-00-00-00-00-0A
 Bridge state: Enabled
 Maximum age: 20 seconds
 Hello time: 2 seconds
 Forward delay: 15 seconds
 Hold time: 1 seconds
 Filtering age: 300 seconds
 Filtering resolution: 5 seconds

 Port Interface Priority Cost State
 --- -
 1 Eth /0 128 100 Enabled
 2 TKR /0 128 62 Enabled

```

Figure 363. Configured Spanning Tree for MSS1 Bridge

### 8.9.2.2 MSS2 Bridge Displays

The `LIST BRIDGE` command for MSS2 is shown in Figure 364.

```

mss2 ASRT>LIST BRIDGE
Bridge ID (prio/add): 100/00-00-00-00-00-0B 1
Bridge state: Enabled
UB-Encapsulation: Disabled
Bridge type: ASRT
Number of ports: 2
STP Participation: IEEE802.1d and IBM-8209

Port Interface State MAC Address Modes MSDU Segment Flags
1 Eth /0 Up 40-00-82-10-02-10 T 1516 RD
2 TKR /0 Up 02-00-41-08-40-88 SRT 4544 All RD

Flags: RE = IBMRT PC behavior Enabled, RD = IBMRT PC behavior Disabled

SR bridge number: 2
SR virtual segment: ABB (1:N SRB Not Active)
Adaptive segment: E2E

```

Figure 364. List Bridge Command for MSS2

**Note:**

**1** This bridge has a priority of 100 and will become the root bridge.

The `LIST PORT` command shows the state of the ports on the MSS2 bridge. The transparent bridge port on this bridge is in forwarding state because MSS2 is the root bridge.

```

mss2 ASRT>LIST PORT
Port Id (dec) : 128: 1, (hex): 80-01
Port State : Forwarding
STP Participation: Enabled
Port Supports : Transparent Bridging Only
Assoc Interface #/name : 2/Eth/0
+++++
Port Id (dec) : 128: 2, (hex): 80-02
Port State : Forwarding
STP Participation: Enabled
Port Supports : Transparent and Source Route Bridging
SRB: Segment Number: 0xA11 MTU: 4399 STE Forwarding: Auto
Duplicate Frames Allowed: STE: Yes, TSF: Yes
Assoc Interface #/name : 3/TKR/0

```

Figure 365. List Port Command for the MSS2 Bridge

The `LIST SPANNING-TREE-PROTOCOL STATE` command for MSS2 shows this bridge is the root with a priority of 100.

```

mss2 ASRT>LIST SPANNING-TREE-PROTOCOL STATE
802.1d Spanning Tree State:
 Designated root (prio/add): 100/00-00-00-00-00-0B
 Root cost: 0
 Root port: Self
 Current (root) maximum age: 20 seconds
 Current (root) hello time: 2 seconds
 Current (root) Forward delay: 15 seconds
 Topology change detected: FALSE
 Topology change: FALSE

 Port Interface State
 1 Eth /0 Forwarding
 2 TKR /0 Forwarding.

```

Figure 366. List Spanning Tree Protocol State Command for MSS2 Bridge

### 8.9.3 MPOA Displays

To display the MPOA status, type `Talk 5 -> protocol mpoa -> mps` and use the commands shown in Figure 367 through Figure 371.

The following screen shows the current configuration status:

```

MSS1 MPS Config Parameters >DISPLAY

State of Box Level MPS: IP and IPX ENABLED
Accept Config from LECS: YES

Keep-Alive Time: 10 (sec)
Keep-Alive Lifetime: 35 (sec)
Initial Retry Time: 5 (sec)
Maximum Retry Time: 40 (sec)
Giveup Time: 40 (sec)
Holding Time: 20 (min)
Protocol access controls are not used
No Exclude list for IP
No Exclude list for IPX
No disallowed router-to-router shortcuts for IP
No disallowed router-to-router shortcuts for IPX

Interface: 0 MPS IP and IPX ENABLED
ESI: 82.10.00.00.00.01 SELECTOR: 14
Desired PCR: 155000 (Kbps) Line Speed: 155 (Mbps)

NET 0: MPS IP and IPX ENABLED NET 2: MPS IP and IPX ENABLED NET
3: MPS IP and IPX ENABLED
NET 4: MPS IP and IPX DISABLED NET 5: MPS IP and IPX ENABLED

```

Figure 367. MPS Configuration

The `DISCOVERY` command lists all the neighbor MPSs and MPCs in the network.

```

MSS1 MPS >DISCOVERY
 DISCOVERY TABLE
Net Type Age MAC Addr/RD ATM Address

2 MPS 117 400082100210 399999999999900001111022182100000000214
3 MPS 9317 400082100211 399999999999900001111022182100000000214
3 MPC 61 A12C 399999999999900001111011382700000000120
3 MPC 242 A13D 399999999999900001111022382700000000220

```

Figure 368. Discovery Command

To display the status of the control VCCs, type the `CONTROL-VCCs` command. Control VCCs are used between MPOA entities to exchange MPOA control information.

```

MSS1 MPS >CONTROL-VCCs
 MPS Control VCCs
VPI VCI Net RefCnt MpcCnt Remote ATM Address

0 87 0 1 1 399999999999900001111011382700000000120
0 99 0 2 1 399999999999900001111022382700000000220

```

Figure 369. Control VCCs Command

To view the cache information that an MPOA server has saved for a particular shortcut, type the command `IMPOSITION-CACHE LIST`. You can see detailed information using the command `IMPOSITION-CACHE ENTRY`.

```

MSS1 MPS >IMPOSITION-CACHE LIST

Total Cache Entries = 2
MPOA Imposition Cache Entries
=====
CacId Destination Address NextHop Address State Htime Prot

2 10.2.1.99 10.2.1.99 Act 2369 IP
1 10.2.2.101 10.2.2.101 Act 2369 IP

```

Figure 370. Imposition-Cache List Command

The `SERVER-PURGE-CACHE-IP` command displays the purge cache maintained by the MPS for both the ingress and egress functions. This cache is an IP-specific list.

```

MSS1 MPS >SERVER-PURGE-CACHE-IP
 SERVER PURGE CACHE
Dest. IP Pf NextHop IP Age Client IP/ATM

10.2.1.0 24 10.2.1.99 1143 399999999999900001111011382700000000120
10.2.1.99 32 10.2.1.99 1143 399999999999900001111011382700000000120
10.2.2.0 24 10.2.2.101 1143 399999999999900001111022382700000000220
10.2.2.101 32 10.2.2.101 1143 399999999999900001111022382700000000220

```

Figure 371. Serve-Purge-Cache-IP Command

## 8.9.4 IP Protocol Displays

Type the `REDUNDANT` command under the IP protocol to display the redundant default IP gateways configured for each interface.

```
MSS1 IP>REDUNDANT
Redundant Default IP Gateways for each interface:
 inf 2 10.1.1.1 255.255.255.0 40.00.82.10.D1.10 primary active 1
 inf 2 10.1.2.1 255.255.255.0 40.00.82.10.D2.10 primary active
 inf 2 10.1.3.1 255.255.255.0 40.00.82.10.D3.10 primary active
 inf 3 10.2.1.1 255.255.255.0 40.00.82.10.D1.11 primary active
 inf 3 10.2.2.1 255.255.255.0 40.00.82.10.D2.11 primary active
 inf 3 10.2.3.1 255.255.255.0 40.00.82.10.D3.11 primary active
 inf 3 10.2.4.1 255.255.255.0 40.00.82.10.D4.11 primary active
 inf 3 10.2.5.1 255.255.255.0 40.00.82.10.D5.11 primary active
 inf 4 10.3.1.1 255.255.255.0 40.00.82.10.D1.12 primary active
```

Figure 372. Redundant Default Gateway Command

### Note:

- 1** Because MSS1 acts as the primary gateway, the status is primary and active. The MSS2 will be backup and standby.





---

## Chapter 9. Web Interfaces

This chapter describes some of the features provided by the 8265 and MSS Web interfaces. We tried to find features which are more easily displayed or accessed via the Web interface. We do not show the complete configuration using the Web interface.

To use the Web interface you need a device that has an operational Web browser installed. From this device you must have TCP/IP connectivity to the box you want to manage. To use the Web interface, you must first configure the device for basic TCP/IP connectivity.

When you use Web interfaces you mostly navigate through different windows as if you were surfing the Internet. You may be asked to input data by typing it in the window.

---

### 9.1 Web Interface for 8265 Control Point Integrated Web Server

The 8265 has an integrated Web server that has the following features:

- Graphical topology display application to provide an exact image of the topology seen by the PNNI node.
- Graphical view of the 8265 chassis, ATM modules, and ATM interfaces, with easy navigation.
- Telnet link to the control point.
- Direct navigation to integrated Web servers on attached devices.
- Basic configuration functions (isolate and connect modules, enable and disable ATM interfaces).
- Debugging facilities (traces, error log, dump and cleared table)
- Basic Show functions.

In this section, we show some examples using the Web interface of the 8265.

#### 9.1.1 Enabling Web Interface in IBM 8265

First you need to configure TCP/IP on your 8265. This is described in 7.3.1.1, “Configuring 8265\_hub11” on page 223.

The community table defines which IP addresses can access the integrated Web server on the 8265.

To create a Web-access entry in the community table, use the `set community` command.

```
8265hub_11> set community webmgr 10.2.1.50 http_enable
```

*Figure 373. Set Community for Web Access*

Now the Web interface has been activated to respond to requests coming from IP address 10.2.1.50, which is the device where the Web browser is running.

### 9.1.2 Logging on to the 8265

We access 8265\_hub11 using a Web browser on the PC.

1. Enter `http://` followed by the IP address of 8265\_hub11. In our case it was `http://10.3.1.11`.
2. Enter a User Name and Password for logon to 8265\_hub11.

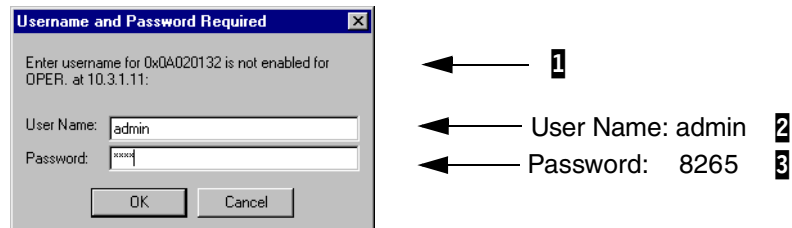


Figure 374. Log On to the 8265\_hub11

#### Notes:

- 1 0x0A020132 means 10.2.1.50 is the IP address of the PC using the Web browser.
- 2 The User Name is always `admin`.
- 3 The password is the current administrator password.

3. The initial window shows the module, port and power supply as shown in Figure 375.

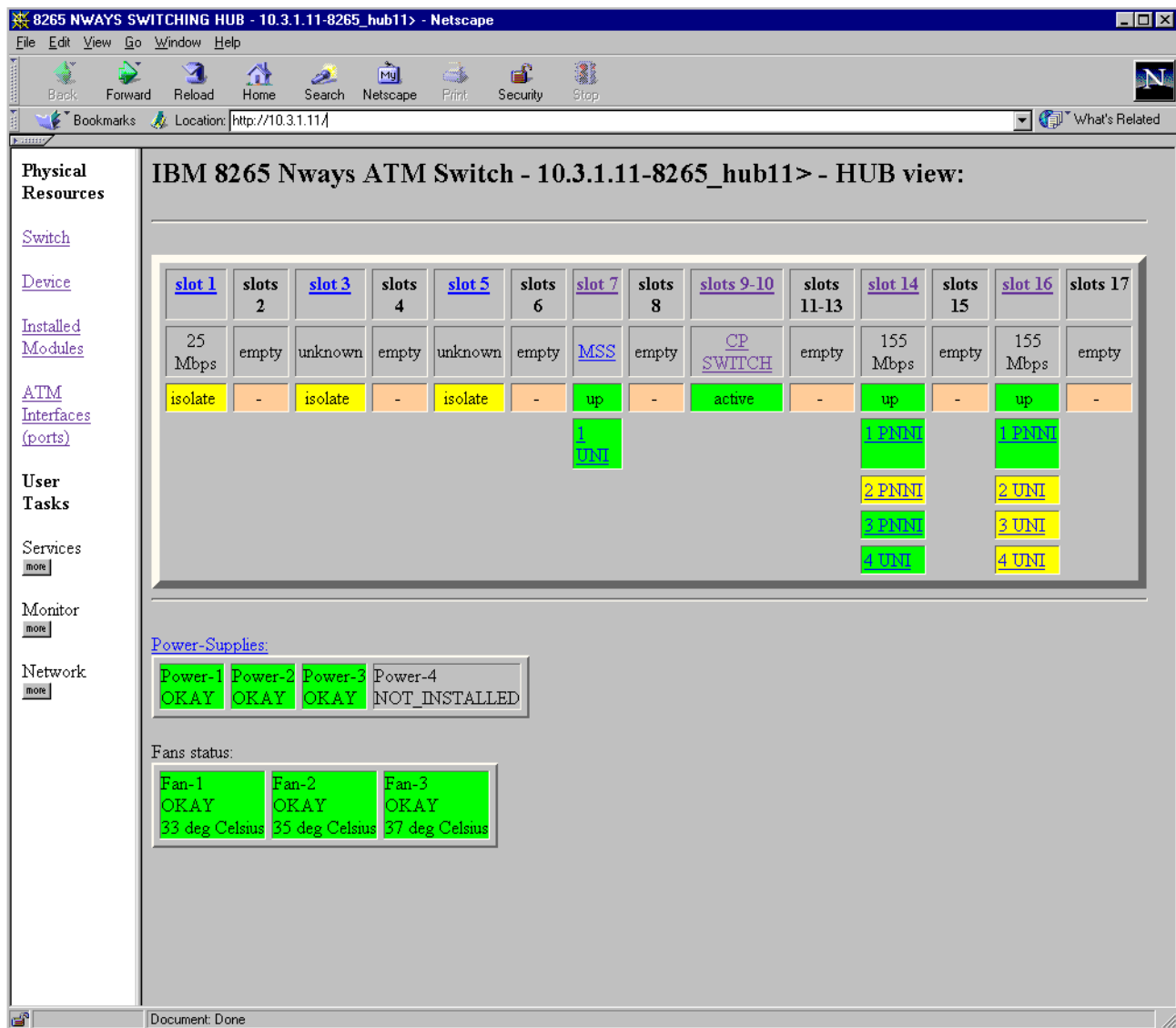


Figure 375. Initial Window for 8265\_hub11

## 9.1.3 Some Examples

### 9.1.3.1 Device Information

Select a slot where you have some connections. In this scenario we selected **slot 14** from Figure 375 on page 335.

This brings up a screen with data similar to the `show module 14` and `show port 14.all` commands.

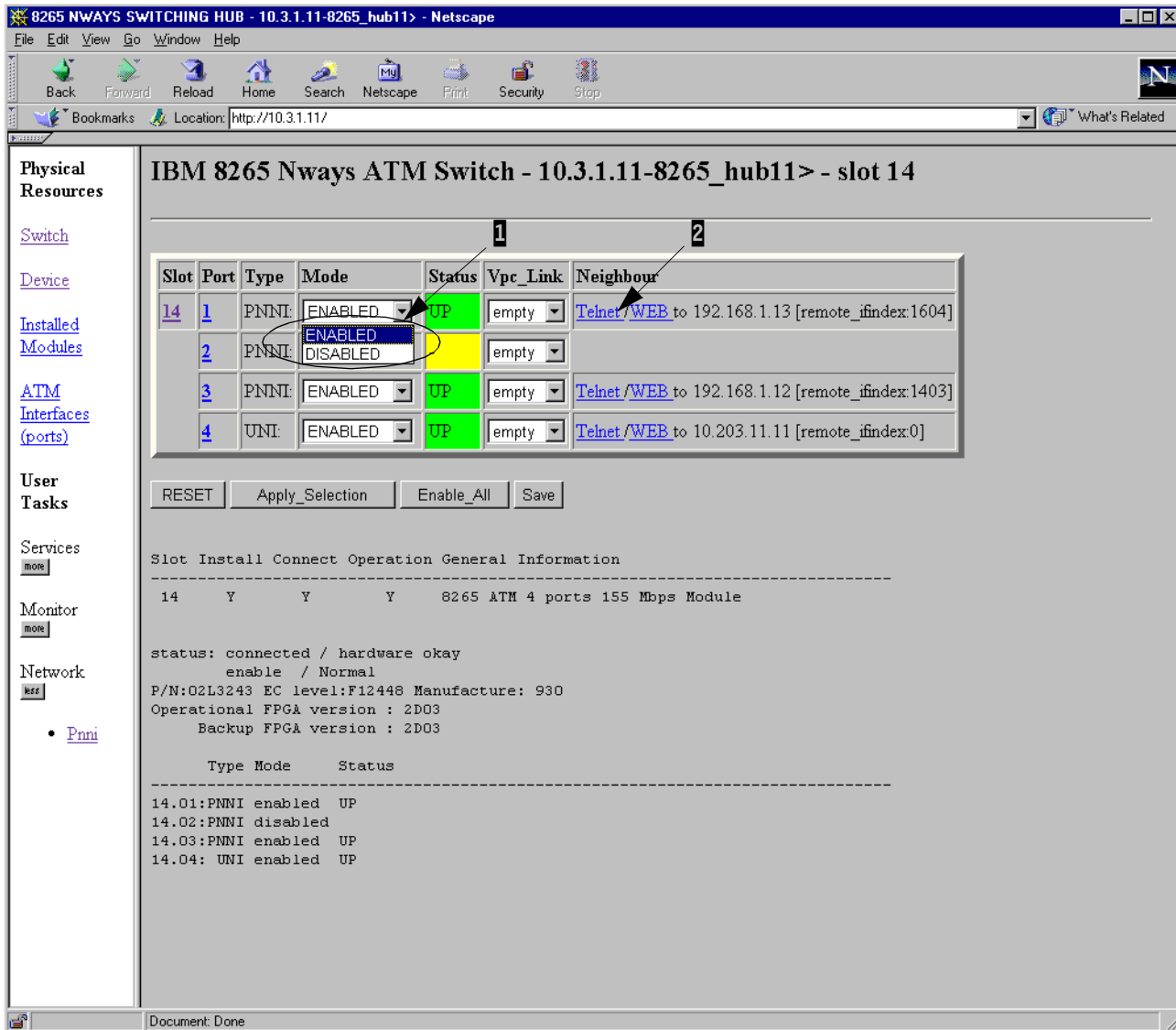


Figure 376. Show Slot 14 on 8265\_hub11

#### Notes:

- 1 You can set the mode of a port by selecting enable/disable from the pull-down menu. Port mode does not change before you press the `Apply_Selection` button.
- 2 You can telnet or access other devices from these links.

Other options can be found on the left pane of the window under Services, Monitor and Network. Clicking the *more* button under each expands the display to show the options. The trace option is shown in Figure 377.

### 9.1.3.2 Trace in Services

We found out that taking different traces was easier with the Web interface. To take a trace follow these steps:

1. Select **Trace** from Services on the left pane.
2. Check specified trace type and components.
3. Click **Apply** to start the trace with specified options.

The screenshot displays the web interface for the IBM 8265 Nways ATM Switch. The left sidebar contains navigation links for Physical Resources, User Tasks, Services, Monitor, and Network. The main content area is titled "IBM 8265 Nways ATM Switch - 10.3.1.11-8265\_hub11> - Traces". It features a "MAIN" section with checkboxes for "main\_trace" and "engineering". Below this is a "Components" table with checkboxes for various components like base, lec, les, bus, pnni\_messages, pnni\_neighbor, pnni\_path\_selection, pnni\_base, connections, saal, rfc\_1577, pvc, atm, snmp, signaling\_messages, box\_services, and web. There are buttons for "Apply", "set\_all", "reset\_all", and "Cancel". Below the components is a "Filters" section with a dropdown menu set to "No Filters", and buttons for "Delete", "Add", "Slot", "Port", and "Vpc". At the bottom, there is a "Clear", "Reload", and "Format" button. A status bar at the bottom of the main area says "Wait until the document is done before using Format button." The bottom pane shows a log of trace data, including timestamps, source IP addresses, and message details.

Figure 377. Trace on 8265hub\_11

### 9.1.3.3 PNNI Display under Network Button

The 8265\_hub11 is peer group leader within peer group 1. Select **PNNI** from Network on the left pane. The PNNI network is shown in Figure 378:

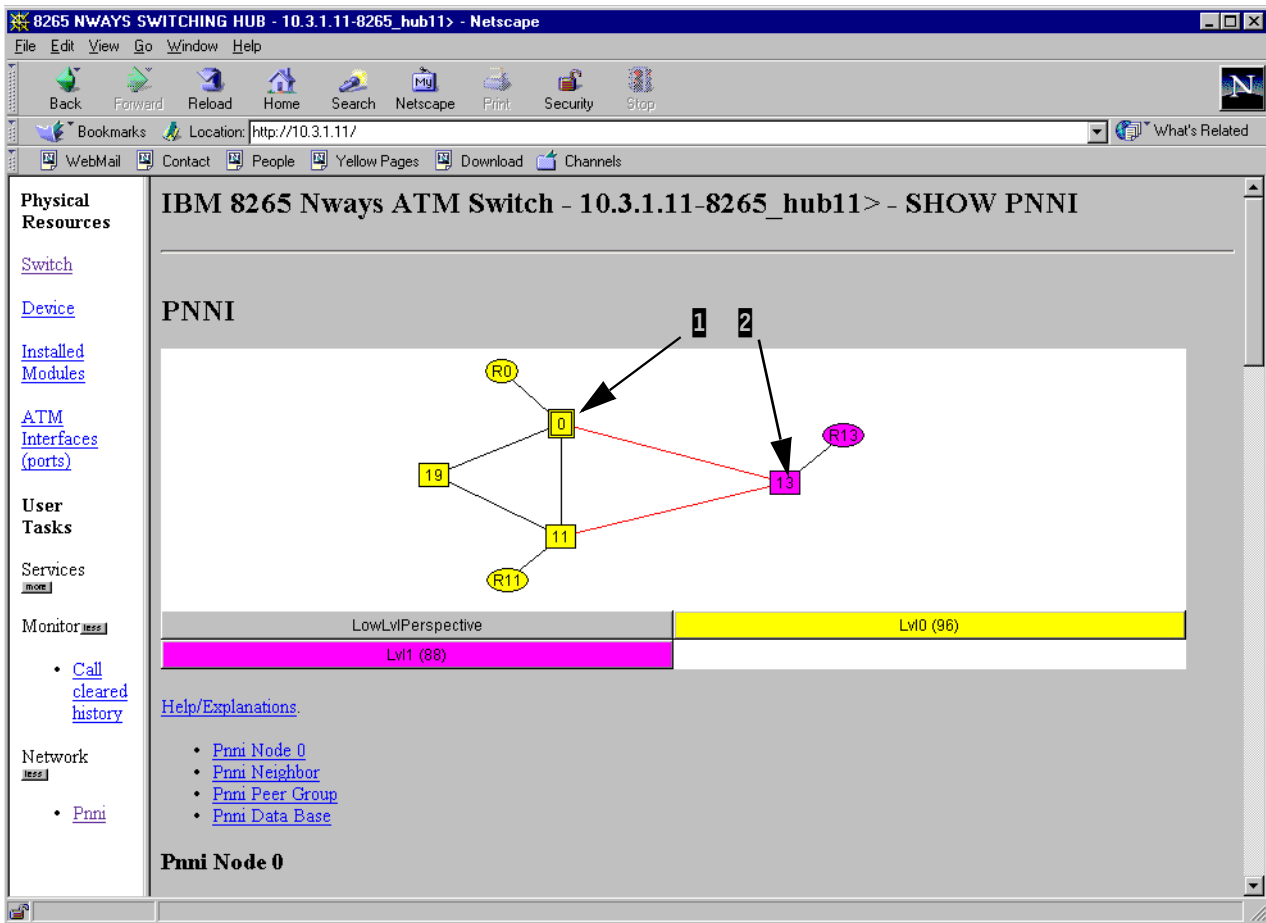


Figure 378. PNNI Network on 8265\_hub11

#### Notes:

- 1** This number *is not* the HUB number. The number displayed is the vertex number (see "Vertex Numbers" on page 339). The node is hub11. It is the peer group leader within this peer group.
- 2** A purple square means this node is another peer group leader outside this peer group. It has been given the vertex number 13. From Figure 380 we can see that it is hub23. Hub23 is not a border node in the other peer group but is the peer group leader. See Figure 381

A fast way of seeing which nodes are displayed is to click a specified node with the right mouse button. See Figure 379.

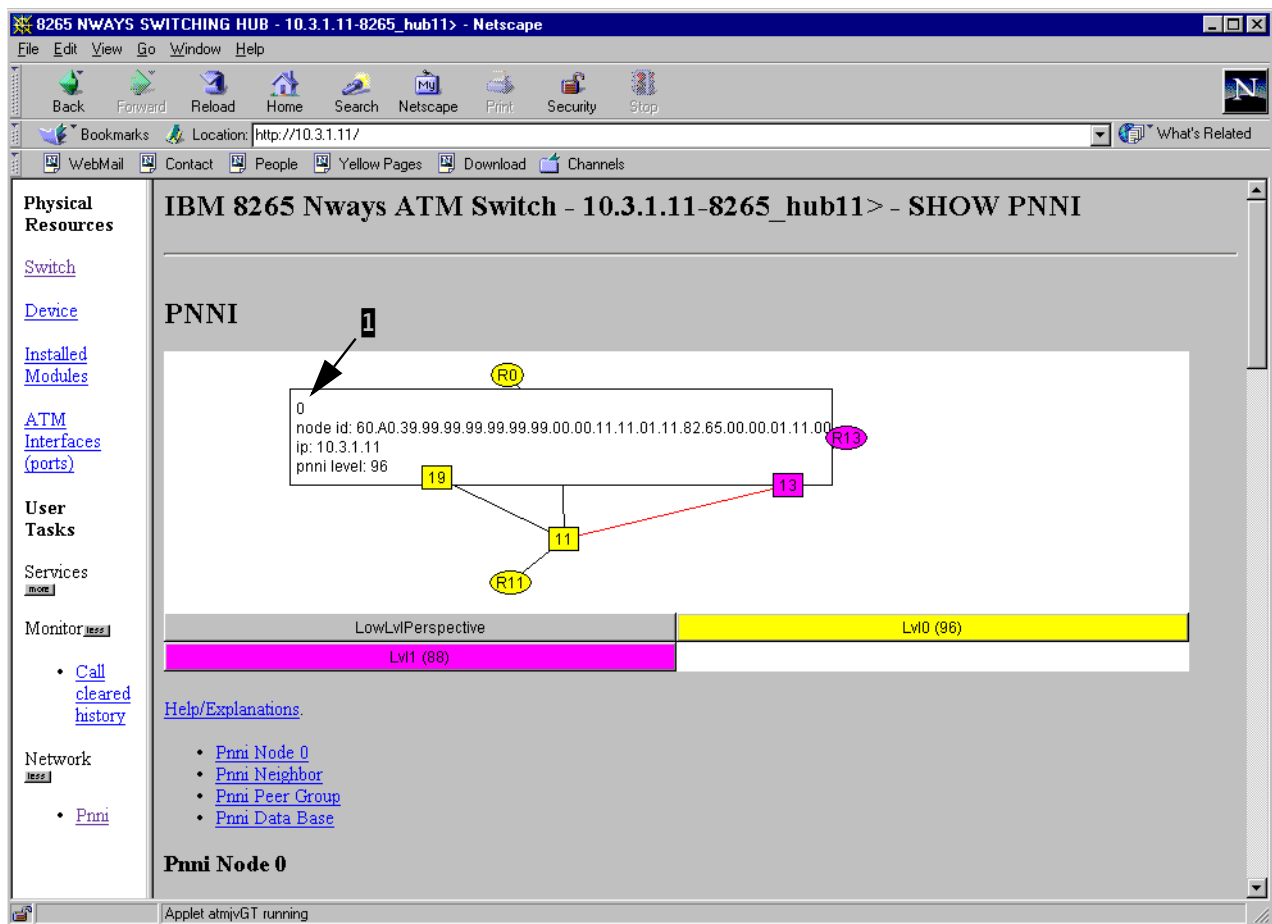


Figure 379. PNNI Network with Address Information on 8265\_hub11

#### Note:

- 1** Information on vertex 0. The ATM address of the node is 39.99.99.99.99.99.00.00.11.11.01.11.82.65.00.00.01.11.00. The IP address is 10.3.1.11. The PNNI level is 96.

#### Vertex Numbers

A vertex number is an arbitrary number given to all other PNNI nodes internally by an 8265. Vertex is an internal object of the PNNI database and it's mapped to a node (an ATM switch). Each PNNI ATM node has its own set of vertexes with a local numbering scheme. Vertex 0 is always the local node whose PNNI database is displayed. To display vertex numbers select **Pnni Data Base**. This brings you to the PNNI database shown in Figure 380. Here you can see the vertex numbers assigned to the ATM addresses.

| PTSEid<br>(HEX) | TYPE | LIFE | GRP | VERTX | ORIGIN | ORIGIN NODEid<br>(1ST BYTE -> LEVEL ID OF NODE'S PEER GROUP) |
|-----------------|------|------|-----|-------|--------|--------------------------------------------------------------|
| 1               | nig  | 2416 | 1   | 1     |        | 58.60.399999999999999900001110100.826500000111.00            |
| b               | ir   | 2819 | 1   | 1     |        | 58.60.399999999999999900001110100.826500000111.00            |
| 9               | ir   | 2915 | 1   | 1     |        | 58.60.399999999999999900001110100.826500000111.00            |
| 7               | hl   | 2307 | 1   | 1     |        | 58.60.399999999999999900001110100.826500000111.00            |
| c               | ir   | 2685 | 1   | 1     |        | 58.60.399999999999999900001110100.826500000111.00            |
| 1               | nig  | 2789 | 1   | 13    |        | 58.60.399999999999999900001110200.826500000223.00            |
| 8               | ir   | 2898 | 1   | 13    |        | 58.60.399999999999999900001110200.826500000223.00            |
| b               | hl   | 3199 | 1   | 13    |        | 58.60.399999999999999900001110200.826500000223.00            |
| 4               | ir   | 3096 | 1   | 13    |        | 58.60.399999999999999900001110200.826500000223.00            |
| 6               | ir   | 3403 | 1   | 13    |        | 58.60.399999999999999900001110200.826500000223.00            |
| 1               | nig  | 3274 | 1   | 0     |        | 60.a0.399999999999999900001110111.826500000111.00            |
| d               | hl   | 3581 | 1   | 0     |        | 60.a0.399999999999999900001110111.826500000111.00            |
| a               | ir   | 3536 | 1   | 0     |        | 60.a0.399999999999999900001110111.826500000111.00            |
| 8               | ir   | 3530 | 1   | 0     |        | 60.a0.399999999999999900001110111.826500000111.00            |
| 3               | ul   | 2352 | 1   | 0     |        | 60.a0.399999999999999900001110111.826500000111.00            |
| 6               | er   | 2307 | 1   | 0     |        | 60.a0.399999999999999900001110111.826500000111.00            |
| 5               | er   | 2147 | 1   | 0     |        | 60.a0.399999999999999900001110111.826500000111.00            |
| 4               | hl   | 1891 | 1   | 0     |        | 60.a0.399999999999999900001110111.826500000111.00            |
| 2               | ir   | 2813 | 1   | 0     |        | 60.a0.399999999999999900001110111.826500000111.00            |
| 1               | nig  | 3430 | 1   | 19    |        | 60.a0.399999999999999900001110113.826500000113.00            |
| 9               | hl   | 3529 | 1   | 19    |        | 60.a0.399999999999999900001110113.826500000113.00            |
| 8               | hl   | 3083 | 1   | 19    |        | 60.a0.399999999999999900001110113.826500000113.00            |
| 2               | ir   | 3182 | 1   | 19    |        | 60.a0.399999999999999900001110113.826500000113.00            |
| 1               | nig  | 3412 | 1   | 11    |        | 60.a0.399999999999999900001110112.826500000112.00            |
| 7               | hl   | 3156 | 1   | 11    |        | 60.a0.399999999999999900001110112.826500000112.00            |
| 3               | ul   | 3105 | 1   | 11    |        | 60.a0.399999999999999900001110112.826500000112.00            |
| 6               | er   | 3259 | 1   | 11    |        | 60.a0.399999999999999900001110112.826500000112.00            |
| 5               | er   | 2331 | 1   | 11    |        | 60.a0.399999999999999900001110112.826500000112.00            |
| 4               | hl   | 3566 | 1   | 11    |        | 60.a0.399999999999999900001110112.826500000112.00            |
| 2               | ir   | 3259 | 1   | 11    |        | 60.a0.399999999999999900001110112.826500000112.00            |

Figure 380. PNNI Data Base

8265\_hub23 is peer group leader within peer group 2. Access the 8265\_hub23 in the same way as the 8265\_hub11 described in 9.1.2, “Logging on to the 8265” on page 334.

If we now take a look at the PNNI displays from this side, we can see another view of the same PNNI network. This is shown in Figure 381 on page 341.



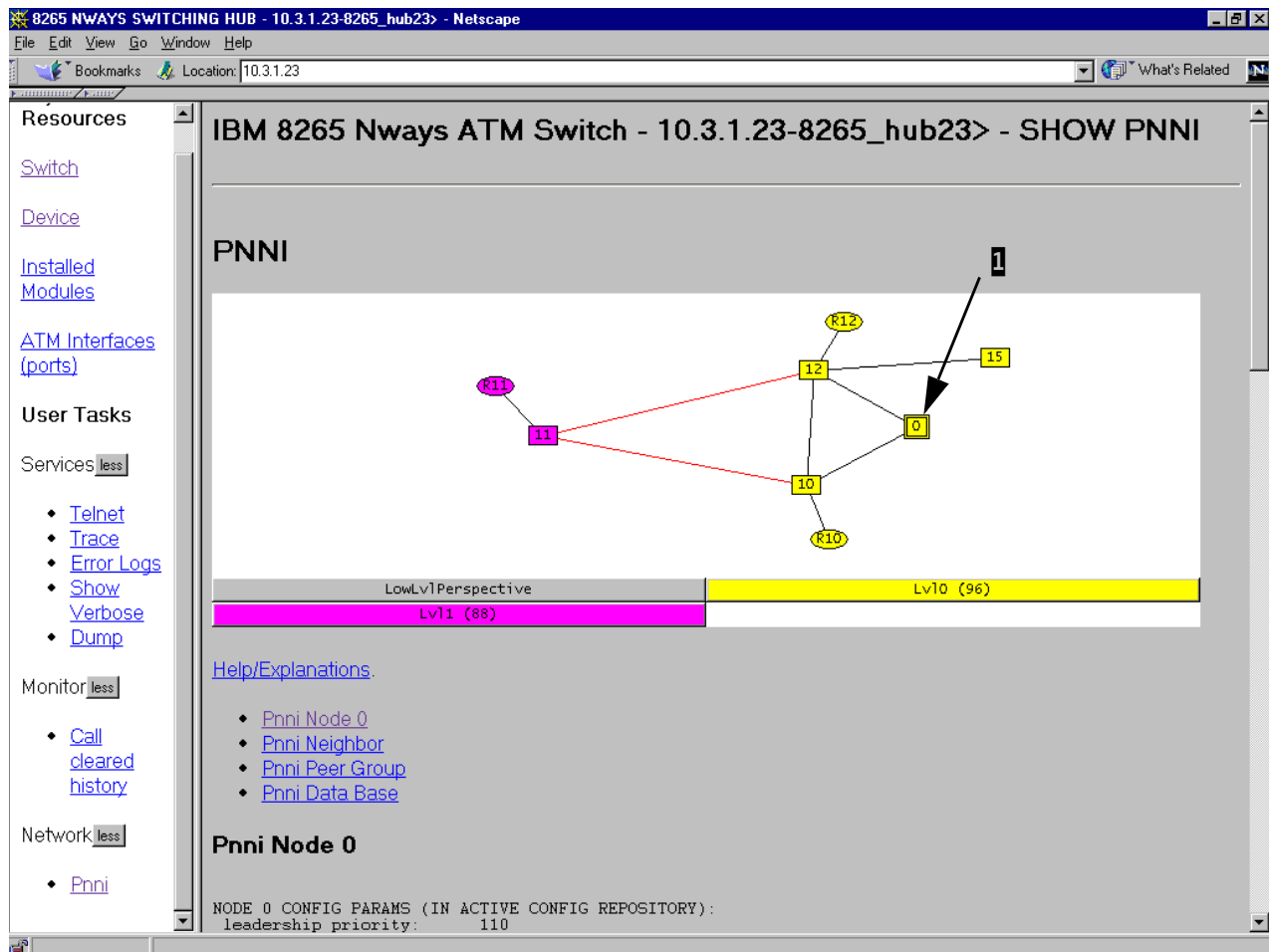


Figure 381. PNNI Network on 8265\_hub23

**Note:**

- 1** Vertex 0 is the hub23. This node is peer group leader within this peer group.

## 9.2 Web Interface for MSS Server

The MSS server has a Web server that has the following features:

- Graphical view of the MSS server.
- Operator console functions the same as Talk 5 for a command-line interface.
- Gateway configuration functions the same as Talk 6 for a command-line interface.
- Event logging system console functions the same as Talk 2 for a command-line interface.
- Help functions.

We will now show some examples of using the Web interface on the MSS Server.

### 9.2.1 Access to the MSS

To use the Web interface you need a device that has an operational Web browser installed. From this device you must have a TCP/IP connectivity to the box you want to manage. To use the Web interface, you must first configure the device for basic TCP/IP connectivity.

We access MSS1 using a Web browser on PC.

1. Enter `http://` followed by the IP address of MSS (MSS1: `http://10.3.1.2`).
2. The initial window is shown (Figure 382).

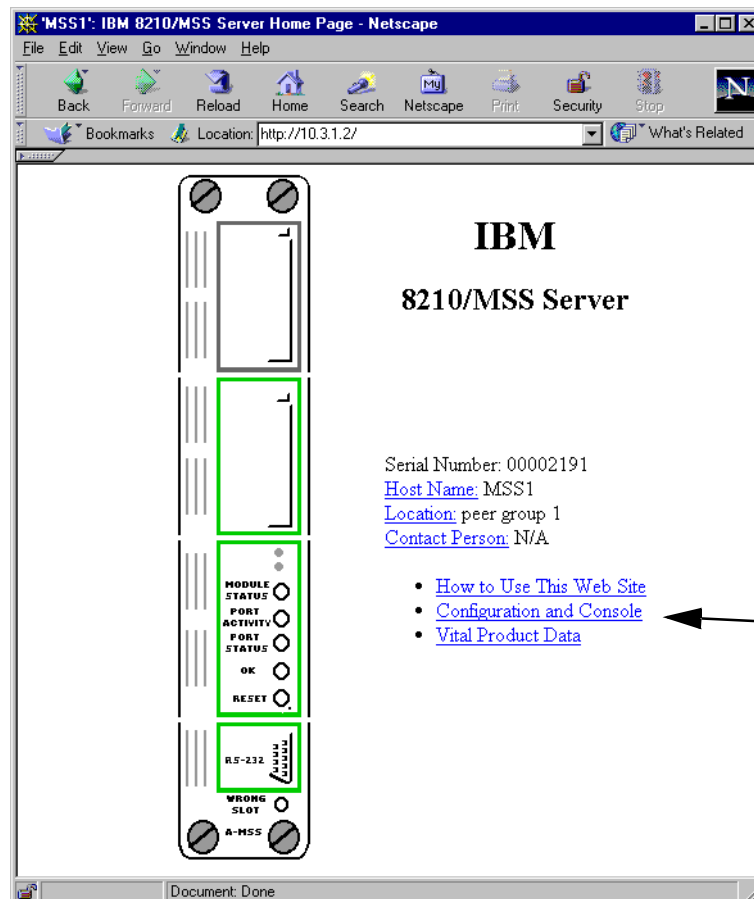


Figure 382. Initial Window on MSS1

**Note:**

- 1** Follow Configuration and Console link.

3. The Configuration and Console window is shown in Figure 383.

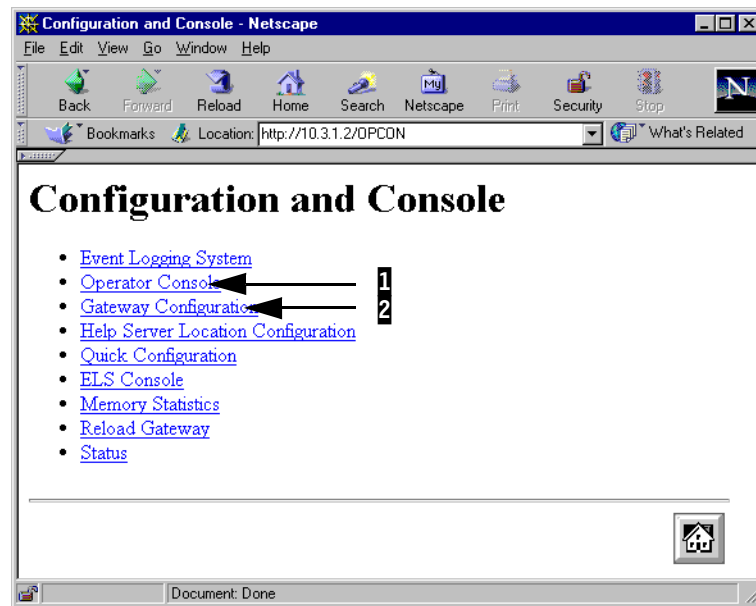


Figure 383. Configuration and Console Screen

**Notes:**

- 1** Operator Console is the same as Talk 5 for a command line-interface. This is shown in Figure 384 on page 344.
- 2** Gateway Configuration is the same as Talk 6 for a command-line interface.

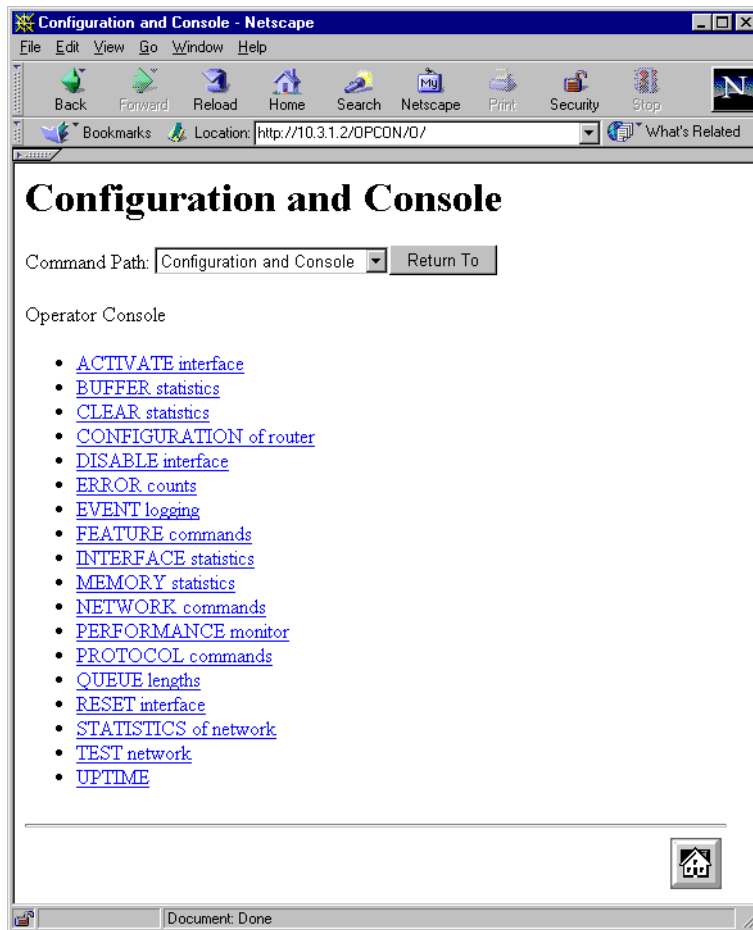


Figure 384. Operator Console Window





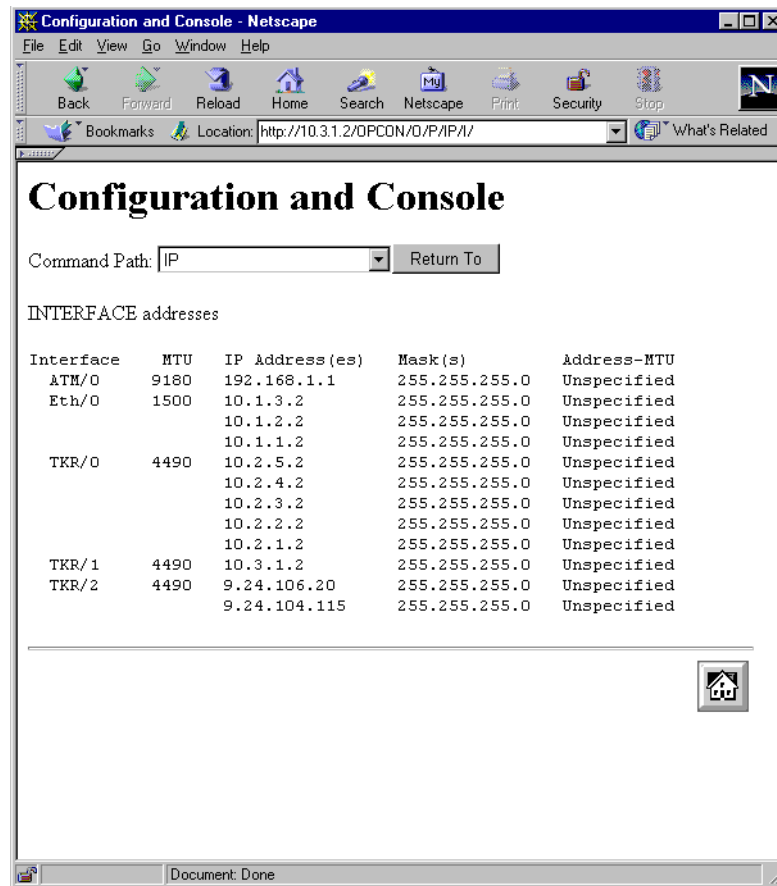


Figure 387. Show IP Addresses on MSS1





---

## Chapter 10. ATM Proxy Clients Configuration Examples

We are now going to show the configuration of a number of clients and attach them to our ATM network. Instead of our 8265 network we will use two 8260s we used to show the migration process from Version 2 code to PNNI Version 3 code. This should not be a problem as everything we are going to demonstrate can be done with these switches. In general, the proxy configuration should not be dependent of the backbone configuration. The logical network configuration will be exactly the same as we have used in the PNNI configuration examples. This is shown in Chapter 8, "MSS Configuration" on page 273. We will have the same two user ELANs, one Ethernet (et1) and the other token-ring (tr1) and our clients will join these.

We are going to show the configuration for the following clients:

**8271-712:** The 8271 switch is now based on new hardware and we are going to show the configuration of this with its ATM UFC. See 10.1, "Configuring the 8271-712" on page 351.

**8274-GRS:** See 10.2, "8274 Routeswitch Configuration" on page 357.

**8270-800:** We will show the configuration of this token-ring switch together with the MSS client blade we have installed. The MSS client includes the MPOA client and we will demonstrate how shortcuts can be created with other clients in our network (the 8371 Ethernet switch and the 2216 router running an NHRP client). With MPOA, or layer-3 switching in the ATM world, the LAN types do not need to be the same. Hence our examples will show shortcuts between clients on token-ring and Ethernet ELANs as described in 10.3, "8270 and 2216 Configurations with MPOA and NHRP" on page 369.

Typically in a lot of networks today where switches are used customers have more than one IP subnet in a physical LAN. Workstation traffic from one subnet to another has to be routed through a router. In the ATM world this would mean routing through an MSS server. With the implementation of MSS client, local MPOA shortcuts can be created within the 8270 switch without the traffic being passed to and from the router function in the MSS. We will show this.

**2216-400:** We will show the configuration of this routeswitch with an NHRP client in 10.3, "8270 and 2216 Configurations with MPOA and NHRP" on page 369.

**8371-A16:** This Ethernet switch includes an MPOA client. We will show how to configure this switch and the shortcuts that are created in 10.5, "8371" on page 408.

**S/390 OSA-2:** We will show the configuration of an OSA-2 adapter. Our 9672 has an ATM OSA card and we will show how to configure two LAN emulation clients in the OSA-2 in 10.6, "OSA-2 ATM Adapter" on page 429.

For clarity, diagrams of our physical network and logical network follow.

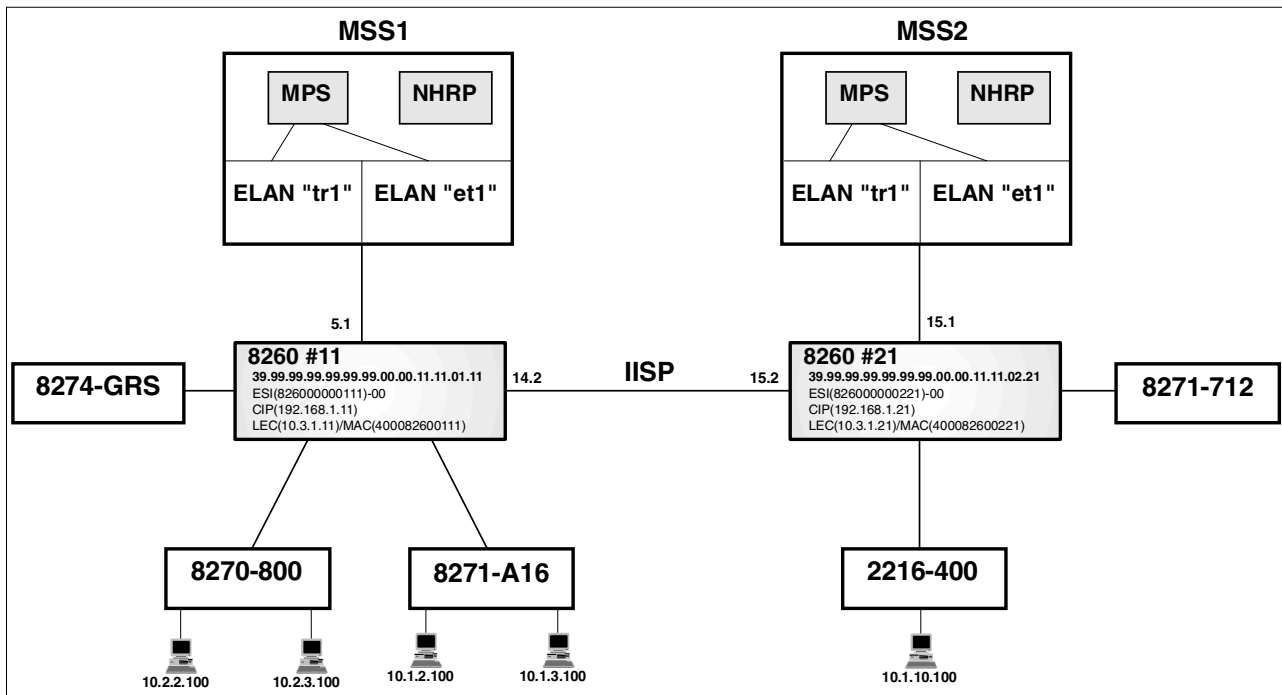


Figure 388. Physical Network

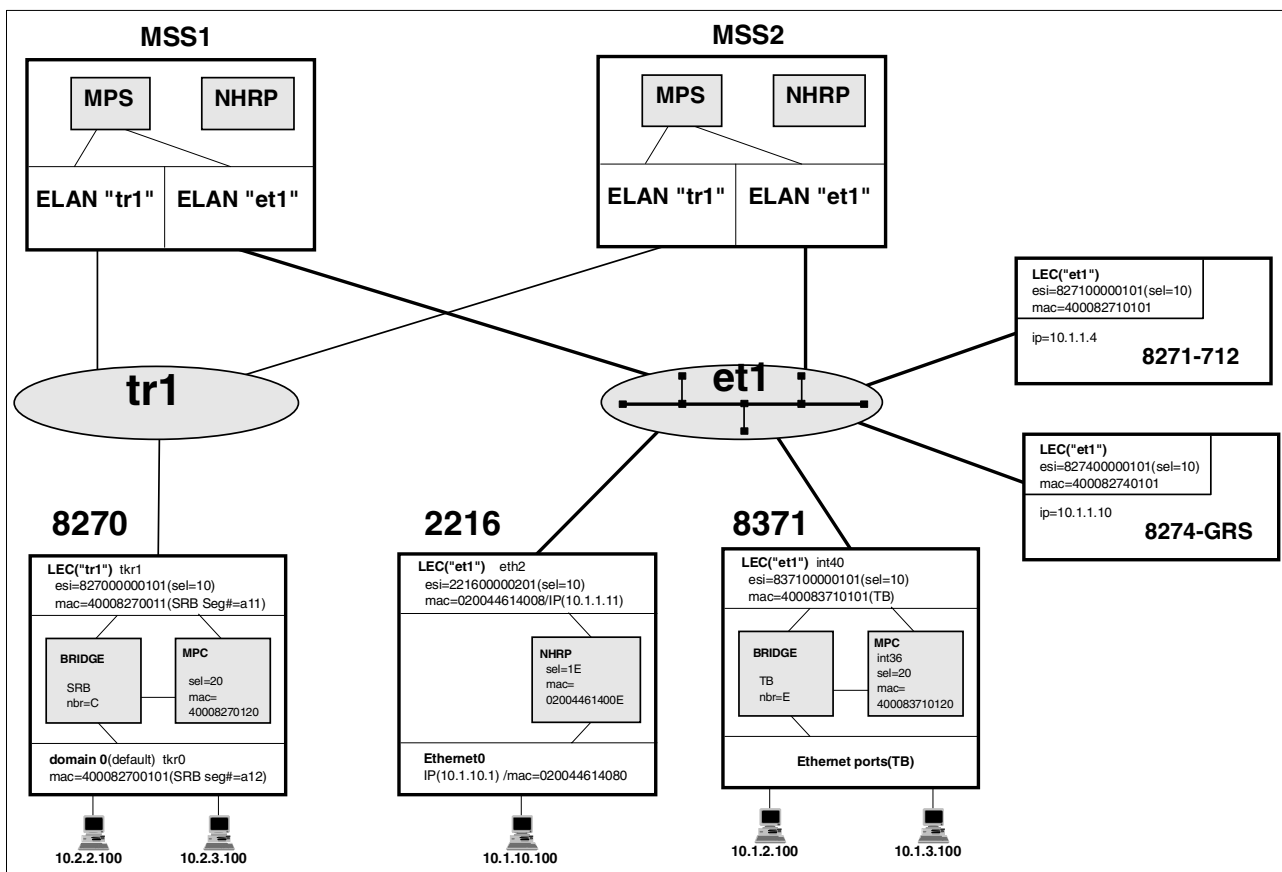


Figure 389. Logical Network

## 10.1 Configuring the 8271-712

We are going to leave the base switch in its default configuration. This has all ports in the default domain. We will set a management IP address and configure the ATM UFC with one LAN emulation client.

First log on to the 8271 switch. The main menu is shown in Figure 390 on page 351.

```
IBM 8271 Nways Switch Main Menu

 SWITCH MANAGEMENT
 USER ACCESS LEVELS
 STATUS
 MANAGEMENT SETUP
 SOFTWARE UPGRADE
 INITIALIZE
 RESET
 REMOTE POLL
 ATM CONFIGURATION

 LOGOFF
```

Figure 390. 8271 Main Menu

In the SWITCH MANAGEMENT menu, we can configure Port, Unit and VLAN. Figure 391 shows the VLAN status. We will use just one VLAN, which is the default.

```
IBM 8271 Nways Switch VLAN Setup

 Port Type VLAN Membership

 1
 2
 3
 4
 5
 6
 7
 8
 9
 10
 11
 12
 13 ATM 1

 Port ID: 1 VLAN ID: [1]

 APPLY CANCEL
```

Figure 391. Switch VLAN Setup Screen

**Note:**

- 1** All switch ports including ATM are assigned to VLAN1.

Before configuring the ATM UFC, we need to perform the 8271 management configuration. The IP address is 10.1.1.4, and the default gateway will be 10.1.1.1. The rest of the configuration is left at the default values shown in Figure 392:

IBM 8271 Nways Switch Management Setup

MAC Address:08004E359355

Power On Self Test Type:Normal

Device IP Address: [10.1.1.4]SLIP Address: [0.0.0.0]

Device SubNet Mask: [255.255.255.0]SLIP SubNet Mask: [0.0.0.0]

Default Router: [10.1.1.1]

BOOTP Select:Disabled

| IPX Network | Node           | Status   | Data Link Protocol |
|-------------|----------------|----------|--------------------|
| [00000000]  | : 08004e359355 | Disabled | Ethernet_802.3     |
| [00000000]  | : 08004e359355 | Disabled | Ethernet_802.2     |
| [00000000]  | : 08004e359355 | Disabled | Ethernet_II        |
| [00000000]  | : 08004e359355 | Disabled | Ethernet_SNAP      |

OKSETUP TRAPS  CONSOLE PORT  CANCEL

Figure 392. 8271 Management Setup

Now we will configure the ATM LEC interface. From the Switch main menu (Figure 390) select **ATM CONFIGURATION**. The Figure 393 is displayed. After configuring the ATM module choose **ATM LEC SETUP** to set up the ATM LEC.

IBM 8271 Nways Switch ATM Module Configuration

Changing the configuration displayed on this screen will cause the device to be reset and may result in a loss of communication. Please refer to the manual before editing any of the fields on this screen.

|                    |                         |          |
|--------------------|-------------------------|----------|
| ATM Mode:          | LAN Emulation Version 1 |          |
| Signalling:        | uni3.1                  | <b>1</b> |
| SONET/SDH:         | SONET STS-3c            |          |
| Max VPI Bits(0-4): | [1 ]                    | <b>2</b> |
| Max VCI Bits:      | 10                      |          |
| ILMI VCC:          | [0 ] [16 ]              | <b>3</b> |

ATM Module Version Information:

|                              |       |          |
|------------------------------|-------|----------|
| Hardware Version:            | 1.00  |          |
| Upgradable Software Version: | 1.07D | <b>4</b> |
| Boot Software Version:       | 1.00  |          |

OK
**ATM LEC SETUP**
CANCEL

Figure 393. ATM Module Configuration Screen

**Notes:**

- 1** Signalling UNI version (we will use UNI3.1).
- 2** VPI/VCI bit (leave at the default value).
- 3** This switch will use the ILMI function. Leave the default value.
- 4** The ATM UFC's software version (the latest code can be obtained from the IBM networking Web site, <http://www.networking.ibm.com>).

By selecting **ATM LEC SETUP**, Figure 394 on page 354 is displayed. We can define the ATM LEC in this screen. We have defined the LEC to join the ELAN et1 by using the LECS.

To activate the changes made click **APPLY**.

IBM 8271 Nways Switch ATM LEC Setup

Select APPLY after configuring the LEC parameters for each VLAN.  
Selecting another VLAN will discard any edits that have not been saved using APPLY

Select the VLAN to be configured: [1 ] **1**

Is this VLAN to be connected to an ELAN? Yes **2**

Is the LES Address to be entered manually  
or obtained from the LECS? LECS **3**

Enter the name of the ELAN  
that this VLAN is to join: [et1 ] **4**

**APPLY** CANCEL

Figure 394. ATM LEC Setup

**Notes:**

- 1** The ATM LEC will attach to the default VLAN1 as shown in Figure 391 on page 351.
- 2** Connect the VLAN to the ELAN.
- 3** You can define either the LES's ATM address, or the LEC will obtain the LES address from the LECS. We have set LECS.
- 4** The name of ELAN that the LEC will join is et1.

You can verify the status of the ATM connection as follows. Choose **SWITCH MANAGEMENT** from the main menu shown in Figure 390 on page 351. This brings you to Figure 395:

IBM 8271 Nways Switch Management

Management Level: Port

Port ID (default 1): [13]

Enter port number:1..12(10/100BASE-TX), 13(Module).

**STATS** RESILIENCE SETUP CANCEL

Figure 395. Switch Management Screen

Select port **13** and then **STATS**. The ATM port statistics menu is displayed as shown in Figure 396.

IBM 8271 Nways Switch ATM Port Statistics

Port ID: 13

Transmit Bandwidth Used: 0%

Receive Bandwidth Used: 0%

Receive Errors: 0%

AAL5 Layer:

|                     |        |                     |          |
|---------------------|--------|---------------------|----------|
| Frames Received:    | 104513 | Octets Received:    | 28030013 |
| Frames Transmitted: | 51205  | Octets Transmitted: | 2419803  |
| Errored Frames:     | 0      | Discarded Frames:   | 0        |

ATM Layer:

|                    |        |                   |   |
|--------------------|--------|-------------------|---|
| Cells Received:    | 770258 | Errored Cells:    | 0 |
| Cells Transmitted: | 88288  | Bad VCC Received: | 0 |

CLEAR SCREEN COUNTERS **LEC** PHYSICAL CANCEL

Figure 396. Nways Switch ATM Port Status

Select **LEC** from this screen. Figure 397 is displayed:

IBM 8271 Nways Switch ATM VLAN LEC Status

Port ID:13

Select the VLAN to be monitored in the field below:

VLAN:[1 ]

LEC State:Active1

LEC ELAN Name:et12

LEC ATM Address:39999999999999000011110221:08004e359355:003

Last LEC Failure Reason:None

LEC Operation at Failure:None

Frames Received:63408Octets Received:30295440

Frames Transmitted:14198Octets Transmitted:1104529

CLEAR SCREEN COUNTERSCANCEL

Figure 397. ATM LEC Status

Notes:

- 1 The LEC status is shown as active.
- 2 The LEC ELAN name is et1.
- 3 This shows the full ATM address of this LEC. The first 13 bytes are obtained from the ATM switch. The next 6 bytes are the ESI and on the 8271 it is the burned-in MAC address. The last byte, the selector, is automatically assigned to 00.

If the LEC is not active and you have verified the configuration, try resetting the 8271 switch. Also verify the LEC status in MSS.

Attention

The spanning tree protocol may not be supported over ATM. Read the 8271 microcode release notes. If you try and create a redundant link with the ATM UFC, a network loop may occur.



## 10.2 8274 Routeswitch Configuration

Using a terminal program with the command-line interface, we log into the 8274 with the default logon ID `admin` with password `switch` as shown in Figure 398:

```
Welcome to the IBM Corporation Gigabit RouteSwitch! Version 3.4.4
login : admin
password:

IBM Corporation Gigabit RouteSwitch - Copyright (c) 1994, 1995, 1996, 1997, 1998
, 1999

 System Name: no-name
 Command Main Menu

 File Manage system files
 Summary Display summary info for VLANs, bridge, interfaces, etc.
 VLAN VLAN management
 Networking Configure/view network parameters such as routing, etc.
 Interface View or configure the physical interface parameters
 Security Configure system security parameters
 System View/set system-specific parameters
 Services View/set service parameters
 Switch Enter Any to Any Switching Menu
 Help Help on specific commands
 Diag Display diagnostic level commands
 Exit/Logout Log out of this session
 ? Display the current menu contents
```

Figure 398. Log In to the 8274 Switch

### 10.2.1 System Configuration

Once logged in to the 8274, basic system information may be changed. Type `syscfg` at the command prompt as shown in Figure 399:

```
/ % syscfg

System Contact : Unset
System Name : no-name
System Location : Unset
System Description : DESCRIPTION NOT SET.
Duplicate MAC Aging Timer : 0 (not configured)
Change any of the above {Y/N}? (N) : y
System Contact (Unset) : ITSO
System Name (no-name) : ibm8274
System Location (Unset) : LAB
System Description (DESCRIPTION NOT SET.) : 8274 GRS
Duplicate Mac Aging Timer (0) :
```

Figure 399. Change the Basic System Information

Then we can change the system prompt by typing `chpr` at the command prompt as shown in Figure 400 on page 358.

```

/ %chpr

Currently the prompt format is:

$Menu-Path %

Example prompt format: Yields a prompt like
===== =====
$Menu-Path > /Print/Mibs >
$SysName -> Marketing 1 ->
% %
wxyz : wxyz :

New prompt format: ITSO_GRS1$Menu-Path>

ITSO_GRS1/>

```

Figure 400. Change the System Prompt

## 10.2.2 ATM Port Configuration

To view ATM port information, use the `vap` command as shown in Figure 401:

```

ITSO_GRS1/>vap 5/2

 ATM Port Table

Slot Port ATM Port Description Conn Tran Media UNI Max VCI
=====
5 2 ATM PORT PVC STS3c Multi Pri 1023 10

Slot Port Loopback Cfg Tx Clk Source
=====
5 2 NoLoop LocalTiming

Slot Port ATM Network Prefix End System Sig Sig IIMI IIMI IIMI
=====
5 2 N/A N/A N/A N/A N/A N/A N/A

 Status

Slot Port Tx Seg Sz Rx Seg Sz Tx Buff Sz Rx Buff Sz Oper SSCOP IIMI
=====
5 2 131072 131072 4600 4600 Enb(PVC) Down Down

```

Figure 401. View ATM Port Configuration

### Note:

**1** Display the ATM port 5/2 as PVC.

The ATM port configuration is changed to SVC using the `map` command as shown in Figure 402.

ITSO\_GRS1/>map 5/2

Slot 5 Port 2 Configuration

|                                                                |            |
|----------------------------------------------------------------|------------|
| 1) Description (30 chars max)                                  | : ATM PORT |
| 2) Conn Type { PVC(1), SVC(2) }                                | : PVC      |
| 3) Max VCCs (1-1023)                                           | : 1023     |
| 4) Max VCI bits (1..10)                                        | : 10       |
| 5) UNI Type                                                    | : Private  |
| 6) Tx SAR Buffer Size ( 131072 )                               | : 131072   |
| 7) Rx SAR Buffer Size ( 131072 )                               | : 131072   |
| 8) Tx Frame Buffer Size (1800-8192)                            | : 4600     |
| 9) Rx Frame Buffer Size (1800-8192)                            | : 4600     |
| 10) Pl Scramble { (False(1),True(2)) }                         | : True     |
| 11) Timing Mode { (Loop(1),Local(2)) }                         | : Local    |
| 12) Loopback Config { NoLoop(1), DiagLoop(2),<br>LineLoop(3) } | : NoLoop   |
| 13) Phy media { SONET(1),SDH(2) }                              | : SONET    |

Enter (option=value/save/cancel) : 2=2

**1**

Slot 5 Port 2 Configuration

|                                                                |                |
|----------------------------------------------------------------|----------------|
| 1) Description (30 chars max)                                  | : ATM PORT     |
| 2) Conn Type { PVC(1), SVC(2) }                                | : SVC          |
| 30) Sig version { 3.0(1) 3.1(2) }                              | : 3.0          |
| 31) Signaling VCI (0..1023)                                    | : 5            |
| 32) ILMI Enable { (False(1),True(2)) }                         | : True         |
| 33) ESI (12 hex-chars)                                         | : 0020dac778d1 |
| 34) ILMI VCI (0..1023)                                         | : 16           |
| 35) ILMI Polling { (Off(1),On(2)) }                            | : Off          |
| 3) Max VCCs (1-1023)                                           | : 1023         |
| 4) Max VCI bits (1..10)                                        | : 10           |
| 5) UNI Type                                                    | : Private      |
| 6) Tx SAR Buffer Size ( 131072 )                               | : 131072       |
| 7) Rx SAR Buffer Size ( 131072 )                               | : 131072       |
| 8) Tx Frame Buffer Size (1800-8192)                            | : 4600         |
| 9) Rx Frame Buffer Size (1800-8192)                            | : 4600         |
| 10) Pl Scramble { (False(1),True(2)) }                         | : True         |
| 11) Timing Mode { (Loop(1),Local(2)) }                         | : Local        |
| 12) Loopback Config { NoLoop(1), DiagLoop(2),<br>LineLoop(3) } | : NoLoop       |
| 13) Phy media { SONET(1),SDH(2) }                              | : SONET        |

Figure 402(Part 1 of 2). Modify the 8274 ATM Port Configuration to SVC

```

Enter (option=value/save/cancel) : 33=827400000001 2

Slot 5 Port 2 Configuration

1) Description (30 chars max) : ATM PORT
2) Conn Type { PVC(1), SVC(2) } : SVC

30) Sig version { 3.0(1) 3.1(2) } : 3.0
31) Signaling VCI (0..1023) : 5
32) ILM I Enable { (False(1),True(2)) } : True
33) ESI (12 hex-chars) : 827400000001 2
34) ILM I VCI (0..1023) : 16
35) ILM I Polling { (Off(1),On(2)) } : Off

3) Max VCCs (1-1023) : 1023
4) Max VCI bits (1..10) : 10
5) UNI Type : Private
6) Tx SAR Buffer Size (131072) : 131072
7) Rx SAR Buffer Size (131072) : 131072
8) Tx Frame Buffer Size (1800-8192) : 4600
9) Rx Frame Buffer Size (1800-8192) : 4600
10) Pl Scramble { (False(1),True(2)) } : True
11) Timing Mode { (Loop(1),Local(2)) } : Local
12) Loopback Config { NoLoop(1), DiagLoop(2),
 LineLoop(3) } : NoLoop
13) Phy media { SONET(1),SDH(2)} : SONET

Enter (option=value/save/cancel) : save

Reset all services on slot 5 port 2 (n)? : y
Resetting port, please wait... 3

```

Modify the 8274 ATM Port Configuration to SVC

**Notes:**

- 1 Change the connection type to SVC.
- 2 Change the burned-in ESI address to a locally administered address of 827400000001.
- 3 Reset the port.

To view ATM port information, type `vap` at the command prompt as shown in Figure 403 on page 361. The 13-byte ATM network prefix is displayed. This address was learned from the 8265 ATM switch 8265\_HUB1 to which this 8274 is physically connected.

[illegible]

*Figure 403. View ATM Port Information*

### 10.2.3 Create a LANE Service

Figure 404 on page 362 shows how to create a LANE service. We use the `cas` command set to create a LANE service.

ITSO\_GRS1/>**cas 5/2**

Slot 5 Port 2 Service 1 Configuration

- 1) Description (30 chars max) : PTOP Bridging Service 1
- 2) Service type { LANE client(1),  
Trunking (4),  
Classical IP(5),  
PTOP Bridging(6),  
VLAN cluster(7) } : PTOP Bridging **1**
- 10) Encaps Type { Private(1),  
RFC1483(2) } : Private
- 3) Connection Type { PVC(1),  
SVC(2) } : PVC
- 4) PTOP Group : 1
- 5) PTOP connection : none
- 6) Admin Status { disable(1),  
enable(2) } : Enable
- 7) BandWidth Group (1-8) : 1

Enter (option=value/save/cancel) : **2=1** **1**

Slot 5 Port 2 Service 1 Configuration

- 1) Description (30 chars max) : LAN Emulation Service 1
- 2) Service type { LANE client(1),  
Trunking (4),  
Classical IP(5),  
PTOP Bridging(6),  
VLAN cluster(7) } : LAN Emulation **2**
- 21) LAN type { 802.3 (1),  
802.5 (2) } : 802.3
- 22) Change LANE Cfg { NO (1),  
YES (2) } : NO
- 3) Connection Type { PVC(1),  
SVC(2) } : SVC
- 30) SEL for the ATM address : 01
- 4) LAN Emulated Group : 1
- 5) LECS Address (40-char-hex) : 470079000000000000000000000000A03E00000100 **2**
- 6) Admin Status { disable(1),  
enable(2) } : Enable
- 7) BandWidth Group (1-8) : 1

Figure 404 (Part 1 of 3). Create a LANE Service on Port 5/2

```

Enter (option=value/save/cancel) : 22=2 3

Slot 5 Port 2 Service 1 LANE Configuration Parameters

1) Proxy { NO (1), YES (2) } : YES
2) Max Frame Size { 1516 (1), 4544 (2)
 9234 (3), 18190 (4) } : 1516
3) Use translation options{NO (1), YES (2) : Yes (use Swch menu to set)
4) Use Fwd Delay time { NO (1), YES (2) } : NO
5) Use LE Cfg Server (LECS){ NO (1), YES (2)}: YES
6) Use Default LECS address { NO(1), YES (2)}: YES
7) Control Time-out (in seconds) : 10
8) Max Unknown Frame Count : 10
9) Max Unknown Frame Time (in seconds) : 1
10) VCC Time-out Period (in minutes) : 20
11) Max Retry Count : 2
12) Aging Time (in seconds) : 300
13) Expectd LE_ARP Resp Time (in seconds) : 1
14) Flush Time-out (in seconds) : 4
15) Path Switching Delay (in seconds) : 6
16) ELAN name (32 chars max) : 4

Enter (option=value/save/cancel) : 16=et1 4

Slot 5 Port 2 Service 1 LANE Configuration Parameters

1) Proxy { NO (1), YES (2) } : YES
2) Max Frame Size { 1516 (1), 4544 (2)
 9234 (3), 18190 (4) } : 1516
3) Use translation options{NO (1), YES (2) : Yes (use Swch menu to set)
4) Use Fwd Delay time { NO (1), YES (2) } : NO
5) Use LE Cfg Server (LECS){ NO (1), YES (2)}: YES
6) Use Default LECS address { NO(1), YES (2)}: YES
7) Control Time-out (in seconds) : 10
8) Max Unknown Frame Count : 10
9) Max Unknown Frame Time (in seconds) : 1
10) VCC Time-out Period (in minutes) : 20
11) Max Retry Count : 2
12) Aging Time (in seconds) : 300
13) Expectd LE_ARP Resp Time (in seconds) : 1
14) Flush Time-out (in seconds) : 4
15) Path Switching Delay (in seconds) : 6
16) ELAN name (32 chars max) : et1 4

Enter (option=value/save/cancel) : save

Saving new LANE Configuration values

```

Figure 404 (Part 2 of 3). Create a LANE Service on Port 5/2

```

Slot 5 Port 2 Service 1 Configuration

1) Description (30 chars max) : LAN Emulation Service 1
2) Service type { LANE client(1),
 Trunking (4),
 Classical IP(5),
 PTOP Bridging(6),
 VLAN cluster(7) } : LAN Emulation
21) LAN type { 802.3 (1),
 802.5 (2) } : 802.3
22) Change LANE Cfg { NO (1),
 YES (2) } : NO
3) Connection Type { PVC(1),
 SVC(2) } : SVC
30) SEL for the ATM address : 01
4) LAN Emulated Group : 1
5) LECS Address (40-char-hex) : 4700790000000000000000000000A03E00000100
6) Admin Status { disable(1),
 enable(2) } : Enable
7) BandWidth Group (1-8) : 1

Enter (option=value/save/cancel) : save
Creating service, please wait...
Enabling service...

```

Figure 404 (Part 3 of 3). Create a LANE Service on Port 5/2

#### Notes:

- 1** Modify the service type of LAN Emulation.
- 2** The default LECS address is the ATM well known address. The other option is to configure the ATM address of the LECS directly.
- 3** Modify the LANE configuration.
- 4** Add an ELAN name. This will be used by the LECS to respond with a LES/BUS ATM address as well as by the LES/BUS during the join process.

To view the services defined on the 8274, the `vas` command is entered at the command prompt. Figure 405 on page 365 displays the services.

Slot 5 Port 2 Service 1 is configured for LAN Emulation.



```
ITSO_GRS1/>vas

 ATM Services

Slot Port Serv Service Service
==== =====
5 2 1 LAN Emulation Service 1 802.3 LEC
5 2 2 PTOP Bridging Service 2 PTOP Priv

 ATM Services

Slot Port Serv VC Oper
==== =====
5 2 1 SVC LANE Op. 01 1 87 88 89 90
5 2 2 PVC Enabled N/A 1 100

FDDI Services do not exist!
```

Figure 405. View ATM Services

The connection to the LES/BUS function on the MSS is successful, as indicated by the Oper Status of LANE Op. and the dynamically allocated Conn VCI's of 87, 88, 89, 90.

10.2.4 Create a VLAN

A new VLAN will be created as it is not recommended to use the default VLAN for application data traffic.

The new VLAN will be created with the following attributes:

- 1. VLAN number 2 - part of Group 1
- 2. Network address rule
  - Protocol IP:10.1.1.0
- 3. Port address rule
  - ATM port 5/2 using the LANE service
  - Gigabit Ethernet port 7/1, 7/2
- 4. Virtual IP router arm - 10.1.1.10
- 5. Default RIP - Silent
- 6. Default framing type - Ethernet II

```

ITSO GRS1/>cratvl
Enter the VLAN Group id for this VLAN (1) : 1
Enter the VLAN Id for this VLAN (2) : 2
Enter the new VLAN's description: VLAN2
Enter the Admin status for this vlan [(e)nable/(d)isable] (d): e
Select rule type:
 1. Port Rule
 2. MAC Address Rule
 3. Protocol Rule
 4. Network Address Rule
 5. User Defined Rule
 6. Binding Rule
 7. DHCP PORT Rule
 8. DHCP MAC Rule
Enter rule type (1): 4 1

Set Rule Admin Status to [(e)nable/(d)isable] (d): e

Select the Network Protocol:
 1. IP
 2. IPX
Enter protocol type: 1 2
Enter the IP Address: 10.1.1.0
Enter the IP Mask (255.0.0.0): 255.255.255.0
Configure more rules for this vlan [y/n] (n): y

Select rule type:
 1. Port Rule
 2. MAC Address Rule
 3. Protocol Rule
 4. Network Address Rule
 5. User Defined Rule
 6. Binding Rule
 7. DHCP PORT Rule
 8. DHCP MAC Rule
Enter rule type (1): 1. 3

Set Rule Admin Status to [(e)nable/(d)isable] (d): e
Enter the list of ports in Slot/Interface format: 5/2 3
Configure more rules for this vlan [y/n] (n): y

Select rule type:
 1. Port Rule
 2. MAC Address Rule
 3. Protocol Rule
 4. Network Address Rule
 5. User Defined Rule
 6. Binding Rule
 7. DHCP PORT Rule
 8. DHCP MAC Rule
Enter rule type (1): 1 3

Set Rule Admin Status to [(e)nable/(d)isable] (d): e

Enter the list of ports in Slot/Interface format: 7/1-2 3

Configure more rules for this vlan [y/n] (n): n
VLAN 1: 2 created successfully

```

Figure 406(Part 1 of 2). Create a VLAN

```

Enable IP? (y): y 4
IP Address : 10.1.1.10 4
IP Subnet Mask (0xff000000) : 0xffffffff
IP Broadcast Address (10.1.1.255) :
Description (30 chars max) : IP Virtual router
Disable routing? (n) :
Enable NHRP? (n) :
IP RIP mode {Deaf(d),
 Silent(s),
 Active(a),
 Inactive(i)} (s) :
Default framing type {Ethernet II(e),
 fddi(f),
 token ring(t),
 Ethernet 802.3(8),
 source route token ring(s)} (e) :

Created router port for vlan 1: 2

Enable IPX? (y): y 5
IPX Network : 100 5
Description (30 chars max) : IPX Virtual router
IPX Delay in ticks (0) :
IPX RIP and SAP mode {RIP and SAP active(a),
 RIP only active(r),
 RIP and SAP inactive(i)} (a) :
Default router framing type for: {
Ethernet Media:
 Ethernet II(0),
 Ethernet 802.3 LLC(1),
 Ethernet 802.3 SNAP(2),
 Novell Ethernet 802.3 raw(3),
FDDI Media:
 fddi SNAP(4),
 source route fddi SNAP(5),
 fddi LLC(6),
 source route fddi LLC(7),
Token Ring Media:
 token ring SNAP(8),
 source route token ring SNAP(9),
 token ring LLC(a),
 source route token ring LLC(b)} (0) :

```

Figure 406(Part 2 of 2). Create a VLAN

#### Notes:

- 1** Create a rule type as Network Address Rule for VLAN2.
- 2** Select IP protocol for Network Address Rule. The IP address is 10.1.1.0 and IP mask is 255.255.255.0.
- 3** Create another rule type as Port Rule for VLAN2. Interfaces 5/2, 7/1 and 7/2 are assigned to this VLAN.
- 4** Enable IP as IP address is 10.1.1.10.
- 5** Enable IPX as IPX network address is 100.

Figure 407 displays the status of the VLAN followed by the Virtual Interface VLAN Membership.

```

ITSO_GRS1/>atv1
VLAN VLAN VLAN
Group:Id Description Admin Operational
Status Status

1: 2 VLAN2 Enabled Active

ITSO_GRS1/>viv1
Virtual Interface VLAN Membership
Slot/Intf/Service/Instance Group Member of VLAN#

1 /1 /Rtr /1 1 1
1 /1 /Rtr /2 1 2
4 /1 /Brg /1 1 1
:
:
:
:
4 /32 /Brg /1 1 1
5 /2 /Brg /1 1 1 2
5 /2 /Lne /1 1 1 2
7 /1 /Brg /1 1 1 2
7 /2 /Brg /1 1 1 2

```

Figure 407. View VLANs and Assignments

#### Notes:

- 1** Virtual IP router arm is a member of VLAN 2.
- 2** LANE service on interface 5/2 and Gigabit Ethernet ports on interfaces 7/1-7/2 are assigned to VLAN 2.

For the default VLAN 1 we disable IP for the following reasons (Figure 408 on page 369):

- The 8274 will not manage via the default VLAN but rather by the VLANs that will be created.
- Since there are no policies configurable for the default VLAN 1, all broadcast and unicast traffic to unknown destinations are flooded out of all ports within the group.
- Save IP address space since every virtual router port has to have its own IP subnet.
- The default VLAN should not be used for communication at all.

```

ITSO_GRS1/>>modv1 1
Current values associated with GROUP 1.1 are as follows:

1) GROUP Number - 1:1
2) Description - Default GROUP (#1)
IP parameters:
3) IP enabled - Y
4) IP Network Address - 192.168.10.1
5) IP Subnet Mask - 255.255.255.0
6) IP Broadcast Address - 192.168.10.255
7) Router Description - GROUP #1.0 IP router vport
8) RIP Mode - Silent
 {Active(a), Inactive(i), Deaf(d), Silent(s)}
9) Routing disabled - N
10) NHRP enabled - N
11) Default Framing - Ethernet II
 {Ethernet II(e), Ethernet 802.3(8), fddi(f),
 token ring(t), source route token ring(s)}
IPX parameters:
12) IPX enabled - N

(save/quit/cancel)
: 3=n
: save

```

Figure 408. Disable the Virtual Router for the Default VLAN

### 10.2.5 Connectivity between the 8274 and the MSS

To verify that we have connectivity between the 8274 and the MSS, we type `ping 10.1.1.1` from a command prompt as shown in Figure 409:

```

ITSO_GRS1/>>ping 10.1.1.1
Count (0 for infinite) (1) : 5
Size (64) :
Timeout (1) :
Ping starting, hit <RETURN> to stop
PING 10.1.1.1: 64 data bytes

[0]

----10.1.1.1 PING Statistics----
5 packets transmitted, 5 packets received, 0% packet loss

```

Figure 409. Verify IP Connectivity

## 10.3 8270 and 2216 Configurations with MPOA and NHRP

In this section we are going to configure an 8270-800 token-ring switch domain and the MSS client UFC we have installed. This will join the ELAN tr1.

We will then configure the 2216 switch with an Ethernet LAN and a 155 MMF ATM LIC. The ATM LIC will join the et1 Ethernet ELAN and will be configured with an NHRP client.

We will have workstations on the LANs behind each switch and will show the shortcuts that are created between these MPOA and NHRP clients bypassing the router function in the MSS.

The following diagram shows what we are going to do. This is a small part of the overall logical diagram shown in Figure 389 on page 350.

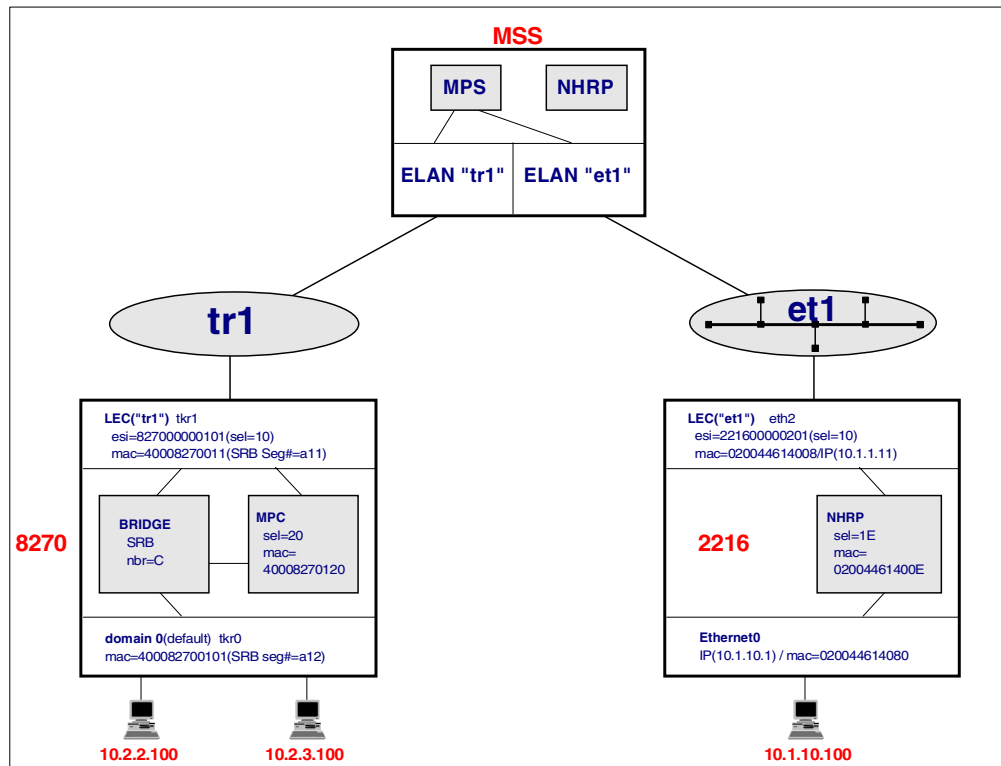


Figure 410. Logical Overview of the 8270 and 2216 Connectivity

### 10.3.1 8270 Configuration

In our 8270 configuration we will configure the base switch with a single domain and configure the MSS client with an MPOA client to join the ELAN tr1. This will give it the ability to create shortcuts where these are allowed.

You will need to install an MSS Client Configuration Program to your workstation. You can get it from <http://www.networking.ibm.com> support pages.

#### 10.3.1.1 Add Physical Interface

The MSS client is configured the same as an MSS. The configuration tool only contains sections for the parameters that apply to the MSS client but will be familiar to anyone who has used the MSS configuration tool before.

To configure an MSS client, select **New configuration** from the menu bar, then **MSS client** -> **ATM**. The Navigation Window shown in Figure 411 is displayed.

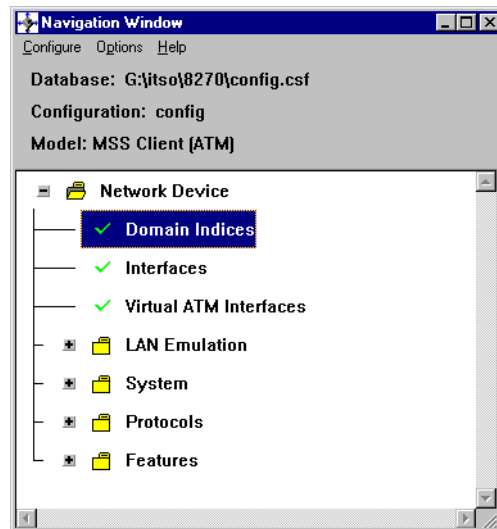


Figure 411. Navigation Windows

We will add a token-ring interface to attach the MSS client to the base unit domain. This is shown in Figure 412. Here we are adding one client as all the base token-ring ports are in the default domain. If you have created more than one domain a separate interface is needed for each domain. The ATM interface already exists on the window because we selected ATM type as MSS client.

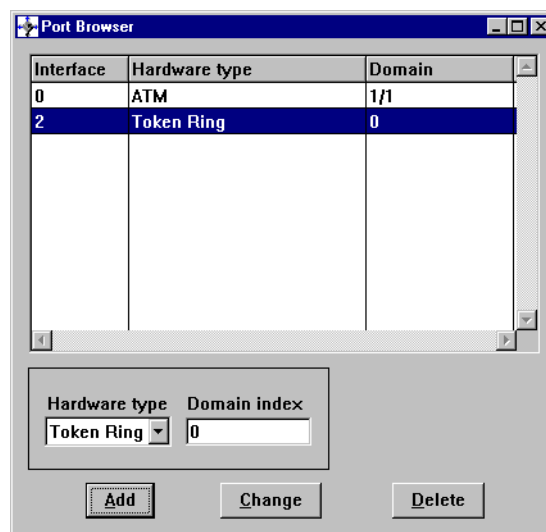


Figure 412. Add Token-Ring Interface

Next we will configure the interfaces. The interfaces window is shown in Figure 413. We will configure the ATM interface first.

In the General tab, use the default values.

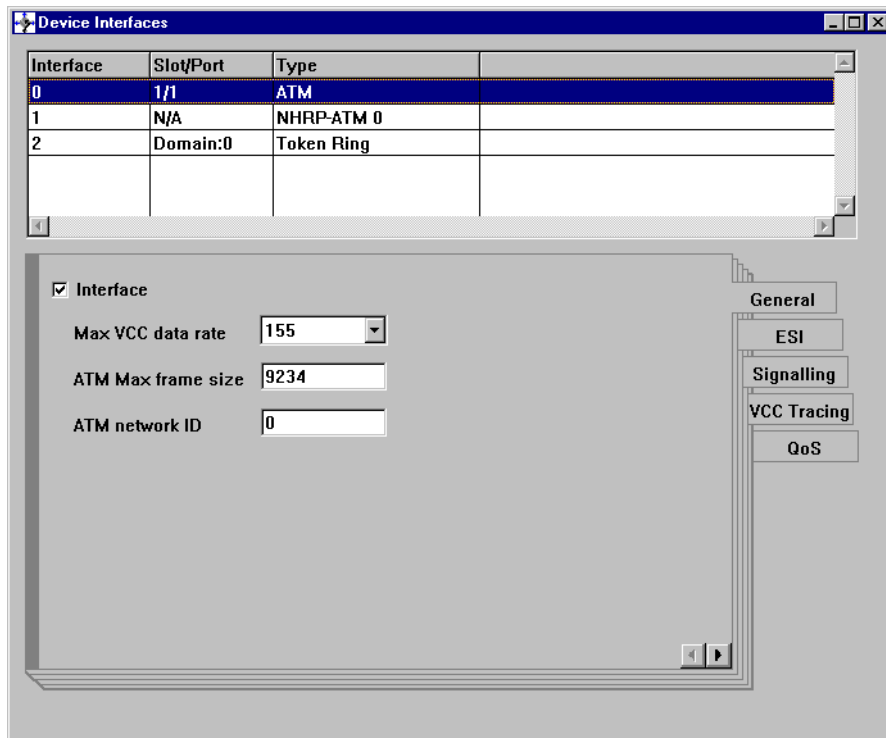


Figure 413. Device Interfaces: General

In the ESI tab we type the Locally administered ESI to the value 827000000101 as shown in Figure 414.

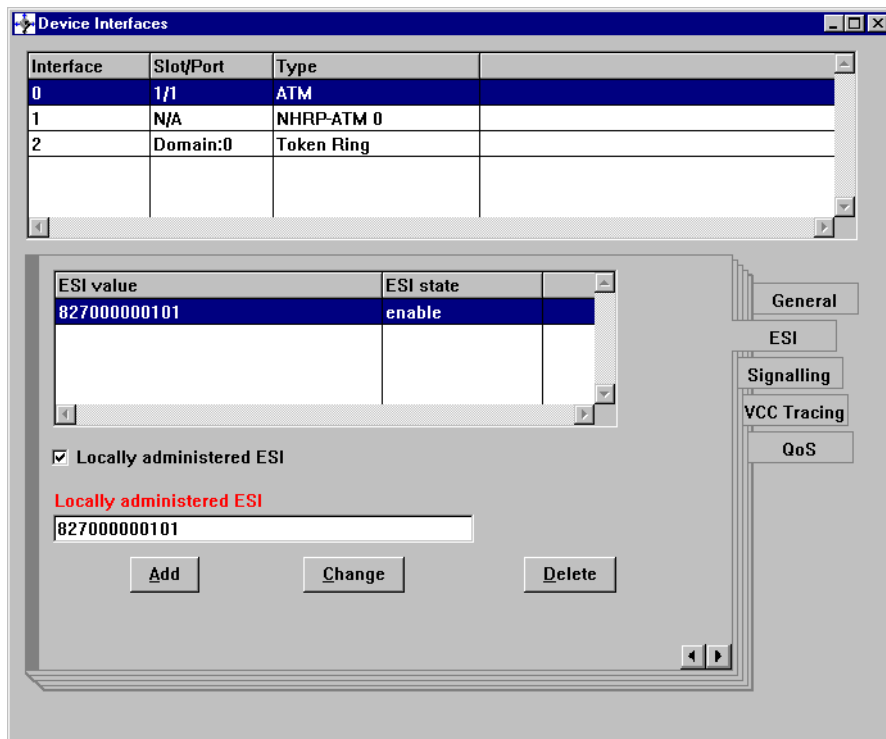


Figure 414. Assign ESI Number



In the **Signalling** tab change the signalling protocol to **UNI 3.1**. In our ATM network, all signalling protocols used are UNI 3.1. Leave the other parameters at their defaults. This is shown in Figure 415:

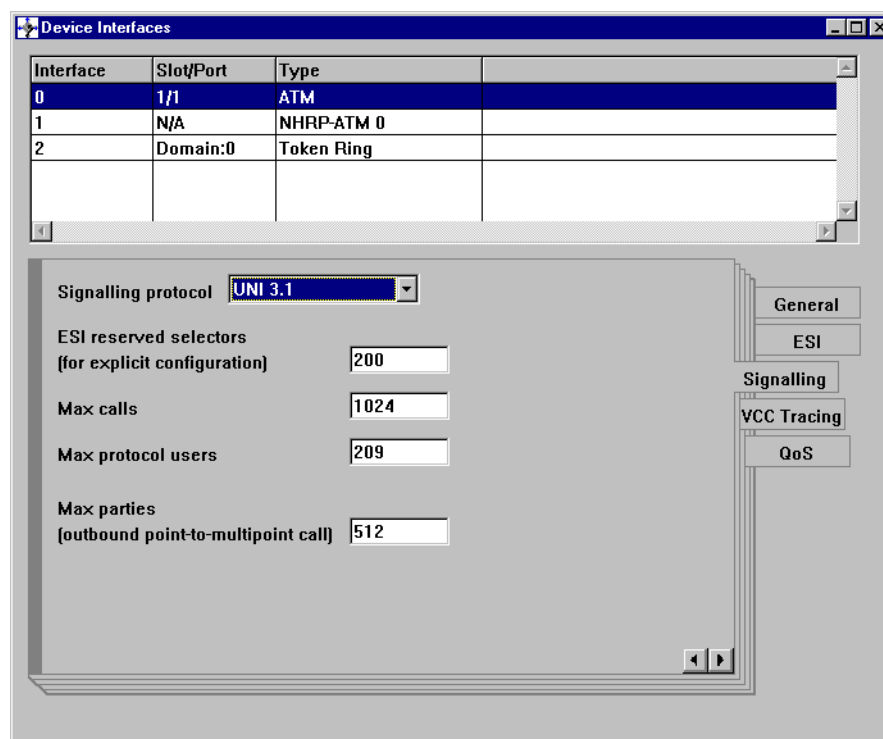


Figure 415. Signalling Protocol

Select the Token Ring domain. We will assign a locally administered address on the token-ring interface. We assigned the address 400082700101 in accordance with our addressing table shown in Table 11 on page 276. Assigning the MAC is shown in Figure 416:

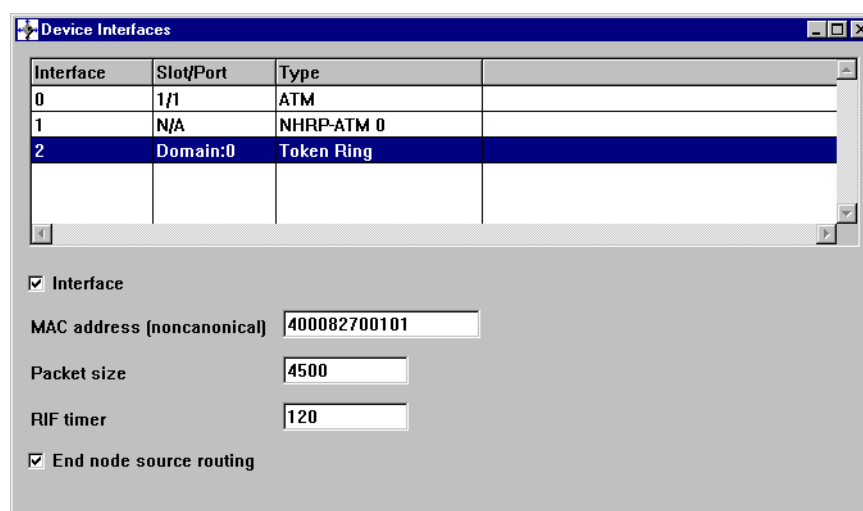


Figure 416. Assign MAC Address on the Token Ring Interface

### 10.3.1.2 Configuring LEC Interface

To configure the LEC interface, select LEC interfaces under LAN Emulation in the Navigation Window. From the General tab, you can set LEC information. Set the ESI to the one shown and the selector to 10. The locally administered MAC address is set to 400082700110. Figure 417 also shows ATM device and ATM LEC address selector (hex) text in red because these fields are required fields. The General tab is also shown in red because the referred page contains required fields.

The screenshot shows the 'LEC Interfaces' configuration window. At the top is a table with columns: Interface, MAC, Name, Type, Device, ESI, and Selector. Below the table are configuration fields for the 'General' tab. The 'Architecture' is set to 'ATM Forum'. The 'ATM device' field is set to '0' and is highlighted in red. The 'LEC ESI' field is set to '827000000101'. The 'ATM LEC address selector (hex)' field is set to '10' and is highlighted in red. A 'Generate' button is next to this field. The 'LEC local unicast MAC address' field is set to '400082700110'. Below this is a 'List' button and the text 'LANE ATM addresses'. On the right side, there is a vertical navigation pane with tabs: General (highlighted in red), C7-C18, C20-C28, C33-C39, ELAN, Servers, Misc, and QoS. At the bottom of the window are three buttons: Add, Change, and Delete.

| Interface | MAC | Name | Type | Device | ESI | Selector |
|-----------|-----|------|------|--------|-----|----------|
|-----------|-----|------|------|--------|-----|----------|

Architecture: ATM Forum

ATM device: 0

LEC ESI: 827000000101

ATM LEC address selector (hex): 10 [Generate]

LEC local unicast MAC address: 400082700110

[List] LANE ATM addresses

Navigation tabs: General, C7-C18, C20-C28, C33-C39, ELAN, Servers, Misc, QoS

[Add] [Change] [Delete]

Figure 417. Configuring LEC

Next select the **ELAN** tab and set the ELAN name to tr1 as shown in Figure 418.

The screenshot shows the 'LEC Interfaces' window. At the top is a table with columns: Interface, MAC, Name, Type, Device, ESI, and Selector. Below the table are three input fields: 'ELAN name' with the value 'tr1', 'ELAN type' with a dropdown menu showing 'Token Ring', and 'Max frame size' with a dropdown menu showing '4544'. On the right side, there is a vertical stack of tabs: General, C7-C18, C20-C28, C33-C39, ELAN (selected), Servers, Misc, and QoS. At the bottom of the window are three buttons: Add, Change, and Delete.

| Interface | MAC | Name | Type | Device | ESI | Selector |
|-----------|-----|------|------|--------|-----|----------|
|           |     |      |      |        |     |          |

ELAN name:

ELAN type:

Max frame size:

General  
C7-C18  
C20-C28  
C33-C39  
**ELAN**  
Servers  
Misc  
QoS

Add Change Delete

Figure 418. Configuring the ELAN

Select the **Servers** tab. Ensure that LECS AutoConfiguration is checked as shown in Figure 419.

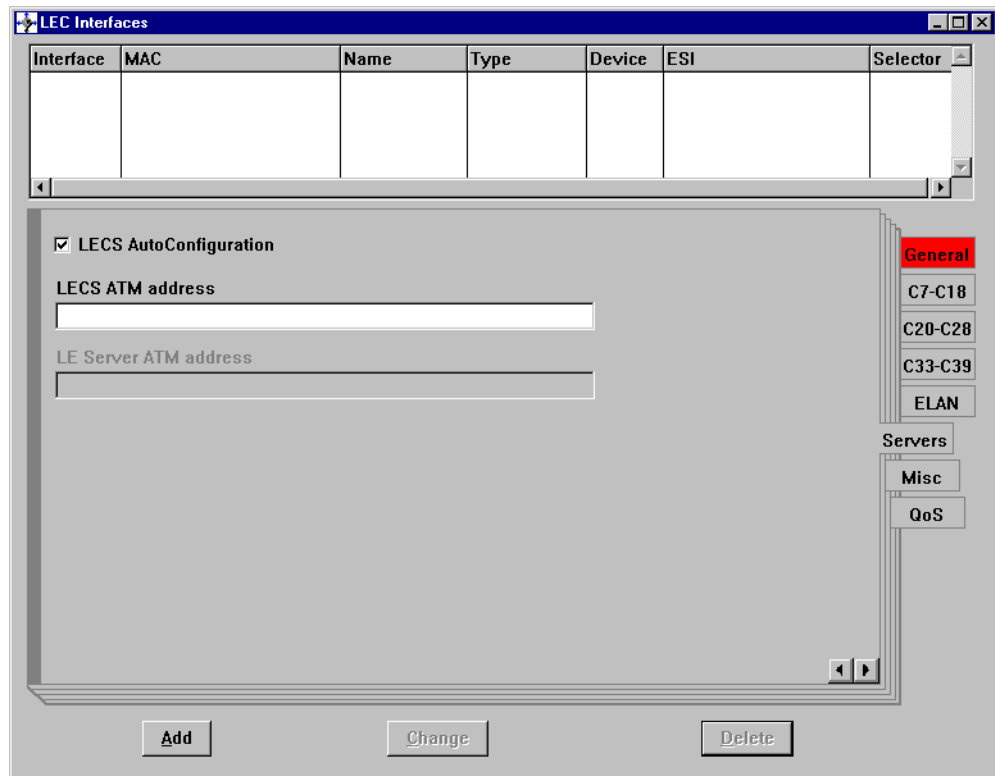


Figure 419. Configuring Servers

Select the **Misc** tab as shown in Figure 420.

Check the persistent data direct VCC mode. By enabling the Persistent data direct VCC mode, we can prevent the LEC from dropping connections to clients for the time period shown if the LES/bus pair fails and the LEC rejoins the backup LES/BUS.

Leave the other parameters at the defaults.

| Interface | MAC          | Name | Type       | Device | ESI          | Selector |
|-----------|--------------|------|------------|--------|--------------|----------|
| 3         | 400082700110 | tr1  | Token Ring | 0      | 827000000101 | 10       |

LE ARP cache size:   
 LE ARP queue depth:   
 Best effort peak cell rate (Kbps):   
☒ Persistent Data Direct VCC mode  
 Reconnect time out (sec):   
☐ Packet trace

Add Change Delete

Figure 420. Configuring Persistent Data Direct VCC Mode

### 10.3.1.3 Configuring System

In the System General window in Figure 421 we typed 8270#1 in the System name field and ITSO in the Location field.

System name:   
 Location:   
 Contact:   
☐ System console  
 Max packet buffers:  Packet size:   
 Inactivity timer:  Spare Interfaces:   
 Help URL:

Figure 421. Configuring System General

In the MSS client we have not configured any IP addresses on interfaces so we are going to configure TCP/IP Host Services to enable management access to the client from the network. There are two ways to access MSS client. From the network using the IP address defined in TCP/IP Host Services or from the base 8270 unit by selecting the **Non-Token-ring Port**. The base unit has a

management IP address which should be different from the one defined in the MSS client.

Enter the IP address and default gateway as shown in Figure 422:

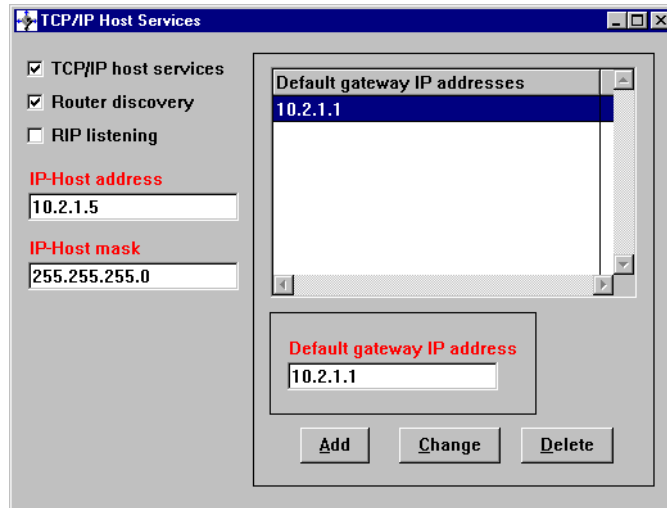


Figure 422. TCP/IP Host Services

#### 10.3.1.4 Configuring SNMP

We are going to configure a community name of itso and Read-write trap access.

To configure community, select **community** under the SNMP config in the Navigation Window.

Enter the details as shown in Figure 423 and click **Add**.

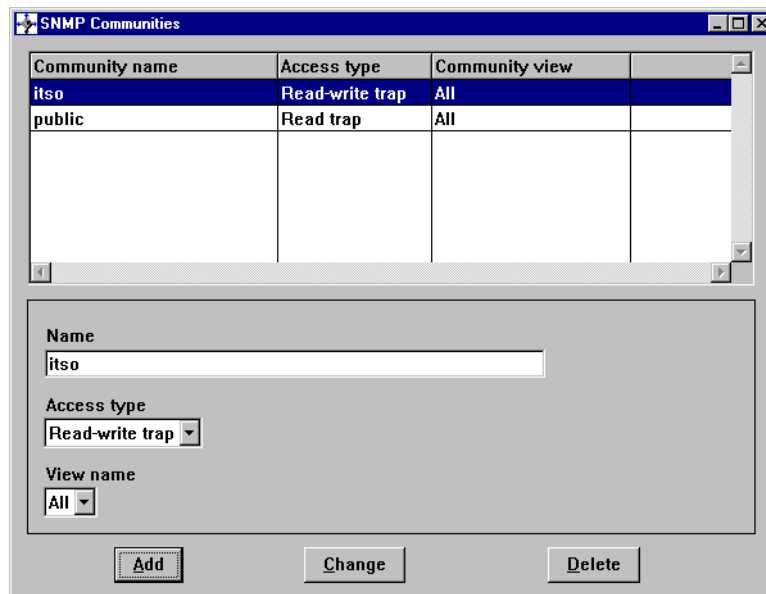


Figure 423. Add Community

To configure the server IP address which receives the traps, click the word **Addresses** at the top of Figure 424 on page 379. Add the IP address of the server and click **Add**.

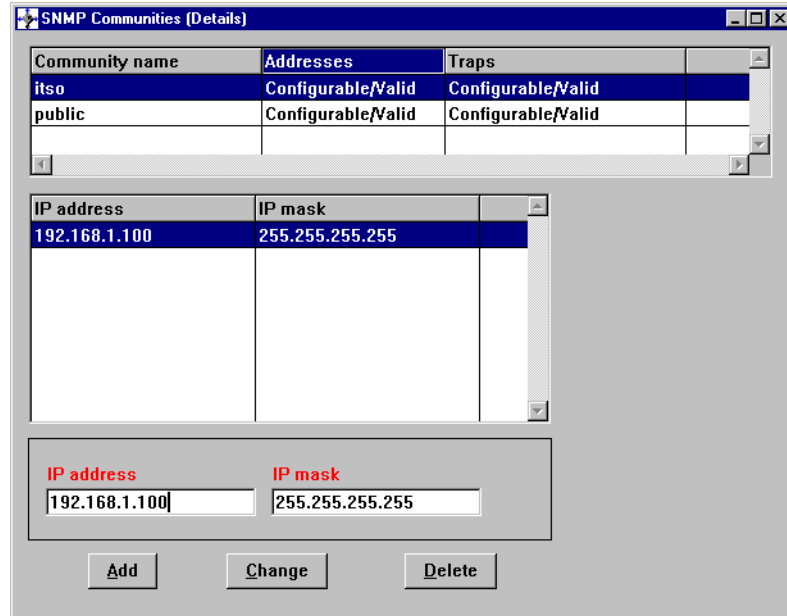


Figure 424. SNMP Communities (Details): Addresses

To configure the trap flags, click the word **Traps**. Select **All** from the pull-down menu and click **Add** as shown in Figure 425.

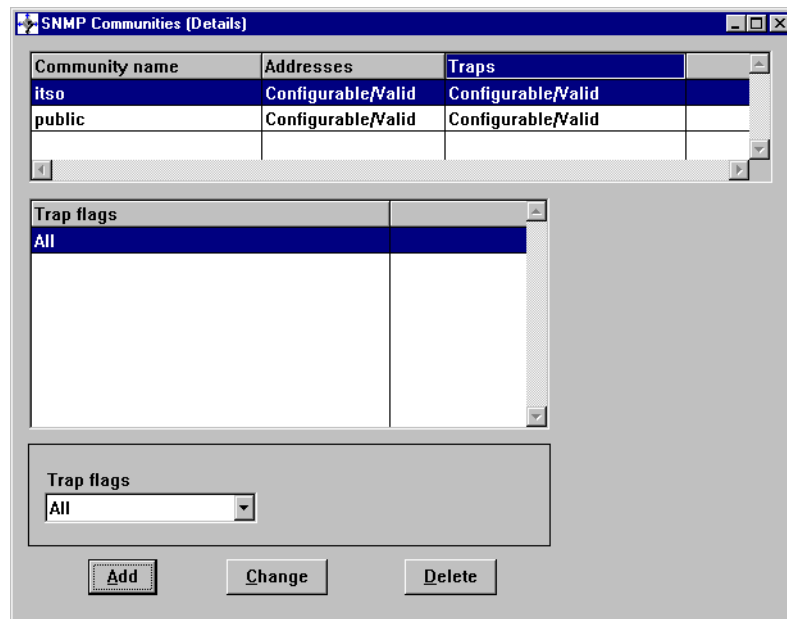


Figure 425. SNMP Communities (Details): Traps

### 10.3.1.5 Configuring MPOA Client

To configure the MPOA client, select the **MPOA client** under **Protocols** in the Navigation Window. This brings you to Figure 426 on page 380. The MPOA client is enabled by default, but we need to change some of the default parameters such as the ESI number.

At the General tab, leave the status for MPOA enabled. Set the ESI to the value shown from the pull-down menu and set the selector to 20. We have selected **Perform fragmentation** as the fragmentation mode because we will be switching to Ethernet clients.

| Enable | Device | ESI          | Selector |
|--------|--------|--------------|----------|
| enable | 0      | 827000000101 | 20       |

☒ MPOA client  
☒ MPC for IP  
☒ MPC for IPX

MPC End System Identifier and Selector  
 ESI: 827000000101  
 Selector (hex): 20 Generate

Fragmentation mode: Perform fragmentation  
☒ LECS configuration parameters accepted

Add Change Delete

Figure 426. Configuring MPOA Client

Select the **Shortcuts** tab shown in Figure 427 on page 381. This shows that MPOA shortcuts will be set up when the frame rate exceeds 10 frames per second. We left this at the default. Some of the effects of this can be seen later when we show examples of windows where shortcuts have been set up.

We have set a locally administered MAC address of 400082700120.



| Enable | Device | ESI          | Selector |
|--------|--------|--------------|----------|
| enable | 0      | 827000000101 | 20       |

Shortcut setup frame parms

Count: 10

Time: 1

☒ LANE Shortcuts

Source MAC address origin: Locally admin MAC Addr

Locally administered MAC address: 400082700120

Buttons: Add, Change, Delete

Navigation: General, Shortcuts, Timers, Traffic Parms

Figure 427. Configuring MPOA Client Shortcuts

By default the MPOA client and the NHRP client are enabled. We have configured the MPOA client. For reference the NHRP general and interface windows are shown in Figure 428 on page 381 and Figure 429 on page 382.

☒ NHRP

Options

Holding time (minutes): 20

Attempt shortcuts: Yes

Data-rate threshold (pps): 10

Server purge cache size: 10000

Registrations cache size: 10000

Resolution cache size: 10000

☒ Shortcuts to Classical IP clients

IP access control: None

Navigation: General, Extensions

Figure 428. NHRP General

The following window shows the NHRP Interface. Box level defaults are left enabled.

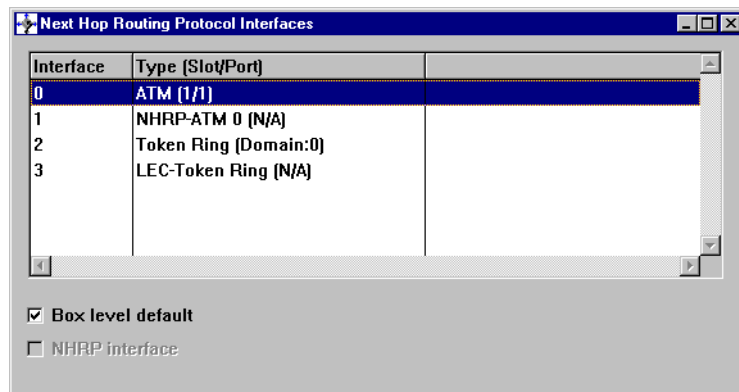


Figure 429. NHRP Interface

### 10.3.1.6 Configuring Bridging

Now we will configure bridging. The interface between the MPOA client and the switch domains in the base unit is through a source-route bridge. Bridging must be enabled and a source-route bridge set up between the MPOA client and each switch domain. We have only one switch domain, which is why we have only one token-ring bridge port.

Select the **General** tab under Bridging in the Navigation Window. Check Bridging as shown in Figure 430.

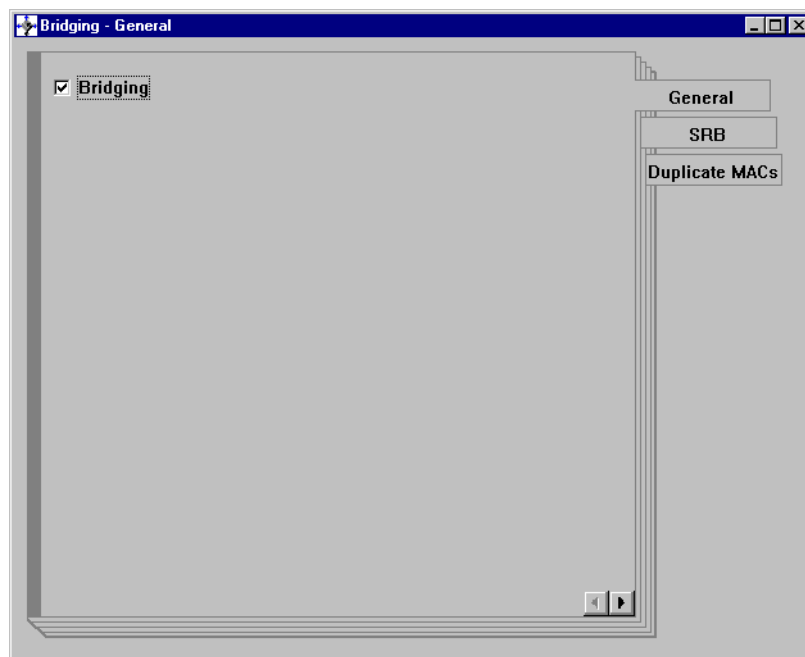


Figure 430. Enabling Bridging

SRB is the only bridge type available. Select the **SRB** tab and set the bridge number shown in Figure 431 on page 383. We have typed c. The bridge number must be unique among bridges that attach to the same segment.

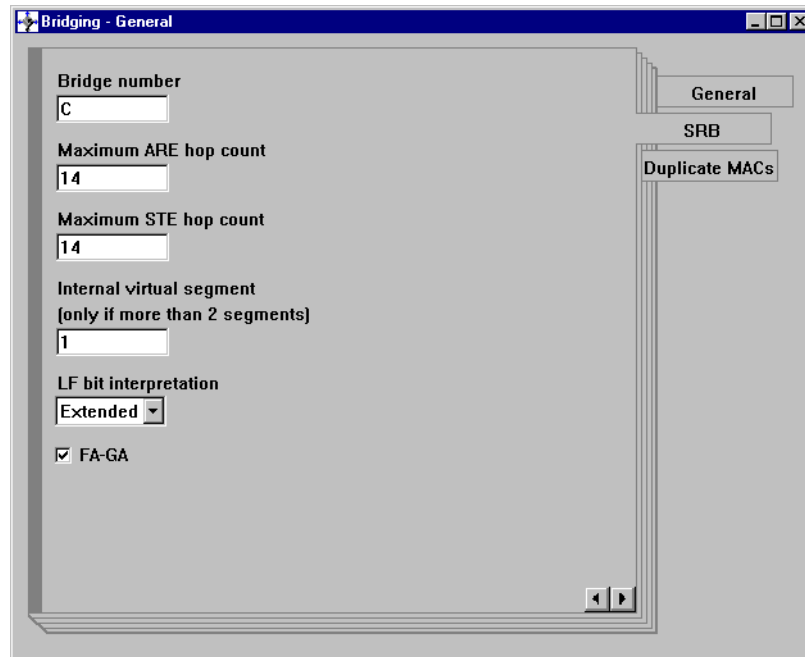


Figure 431. Configuring Source-Route Bridging

Now we will configure the bridge interfaces. Select **Interfaces** under **Bridging** in the Navigation Window. The bridge interfaces that can be configured are the token-ring interfaces and the LEC-token-ring interface, numbers 2 and 3 in our case. These are shown starting from Figure 432 on page 384.

Highlight the Token Ring interface. Check **Bridging port** so this interface participates in the bridge. The 8270 only supports source-route bridging so select **SRB** from the Interface supports field. We have typed a segment number of **A12** to this interface which should match the segment number of the switch base ports.

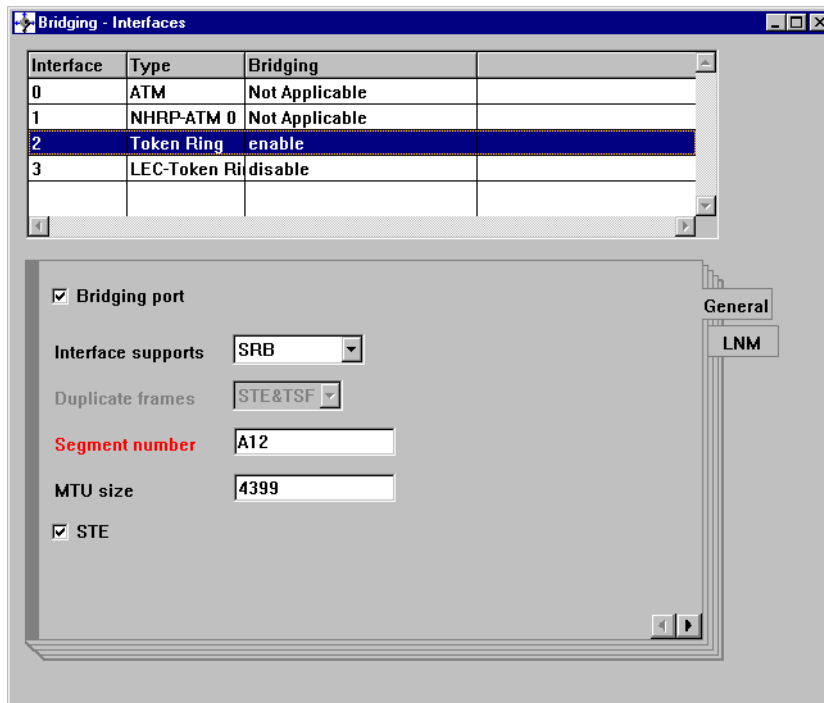


Figure 432. Configuring Bridge in Token Ring Interface

After configuring the token ring interface, highlight the **LEC-Token Ring**. Configure this in the same way but use a segment number by typing `a11`. This is the segment number for ELAN tr1 from the MSS point of view.

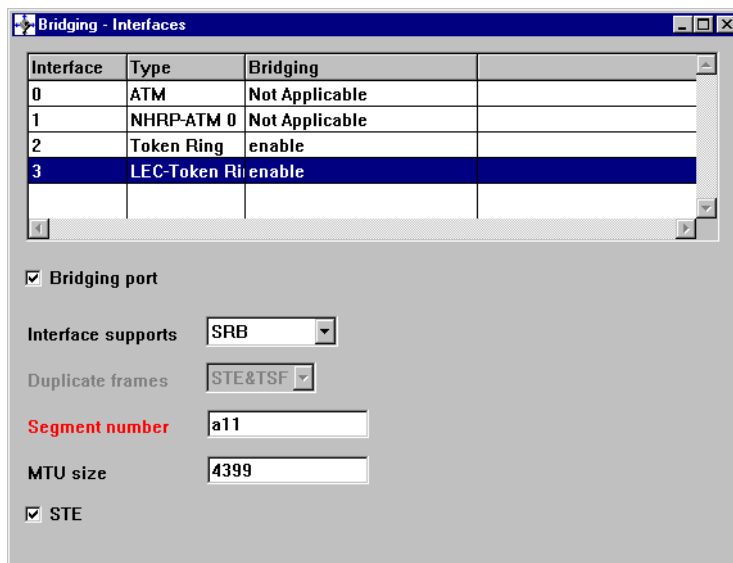


Figure 433. Configuring Bridge in LEC-Token Ring Interface

To configure spanning tree, select the **Spanning tree** protocol under **Bridging** in the Navigation Window.

In default, enable the spanning tree. You can assign the bridge address which will be used as the bridge MAC address as shown in Figure 434 on page 385.

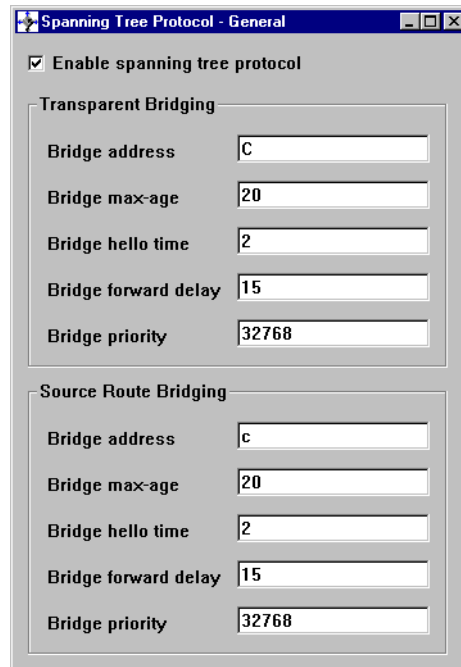


Figure 434. Spanning Tree Protocol - General

### 10.3.2 Configuring 2216

We will configure the 2216-400 LEC and NHRP client. NHRP shortcuts will be set up in the 8270 in our example. The 2216 configuration program is available from the IBM networking site <http://www.networking.ibm.com> and can be found on the 2216 code download pages.

Figure 435 on page 386 shows the 2216 Navigation Window.

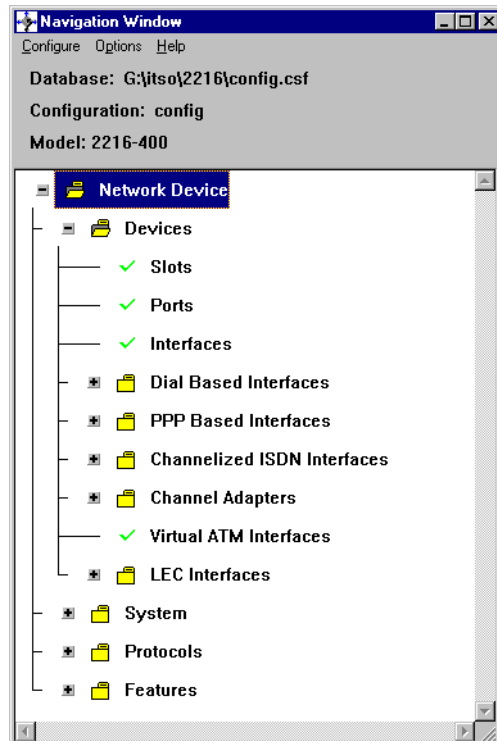


Figure 435. Navigation Window

### 10.3.2.1 Configuring Device

First we will add the adapters in their slots. After clicking **Slots**, the Slot Browser window shown in Figure 436 will appear. We have our ATM adapter in slot 4 and a two-port Ethernet adapter in slot 5. We are only using Ethernet port 1.

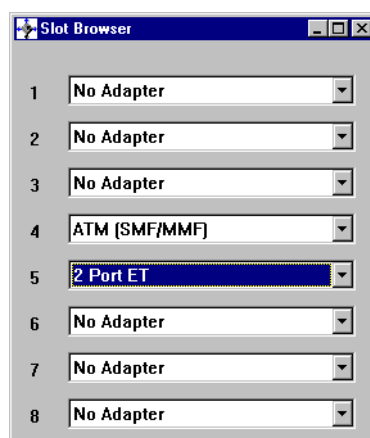


Figure 436. Slot Browser

Next we will configure the interfaces we have just added. This is basically similar to the MSS and MSS client so it will only be briefly described here.

To configure the ATM interface, select the **ESI** tab, assign the locally administered address 221600000201 and click **Add**. This is shown in Figure 437 on page 387.

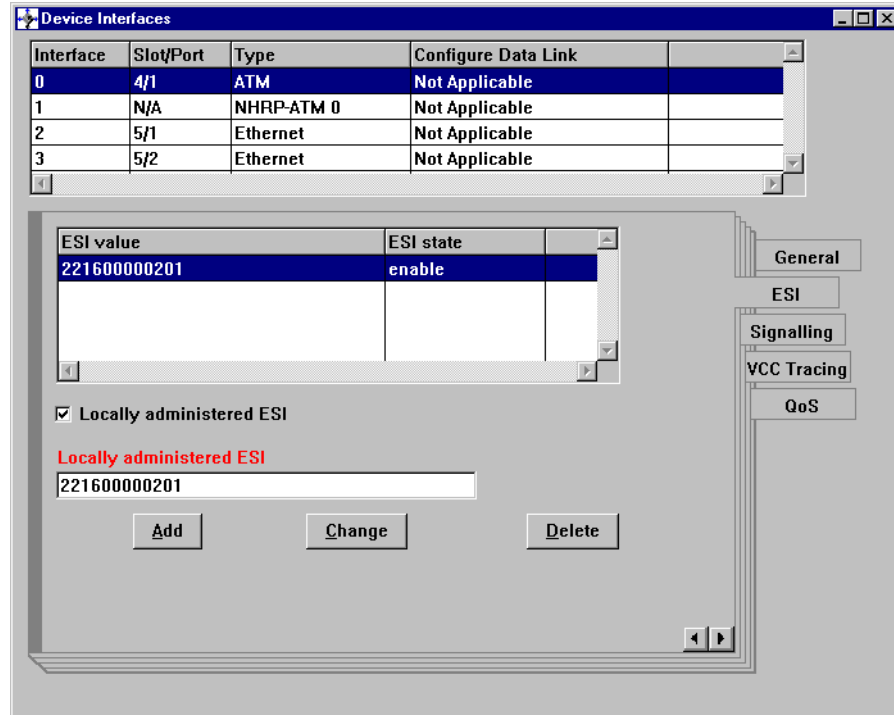


Figure 437. Configuring ESI

Select **Signalling**. Change the signalling protocol to UNI 3.1 as shown in Figure 438:

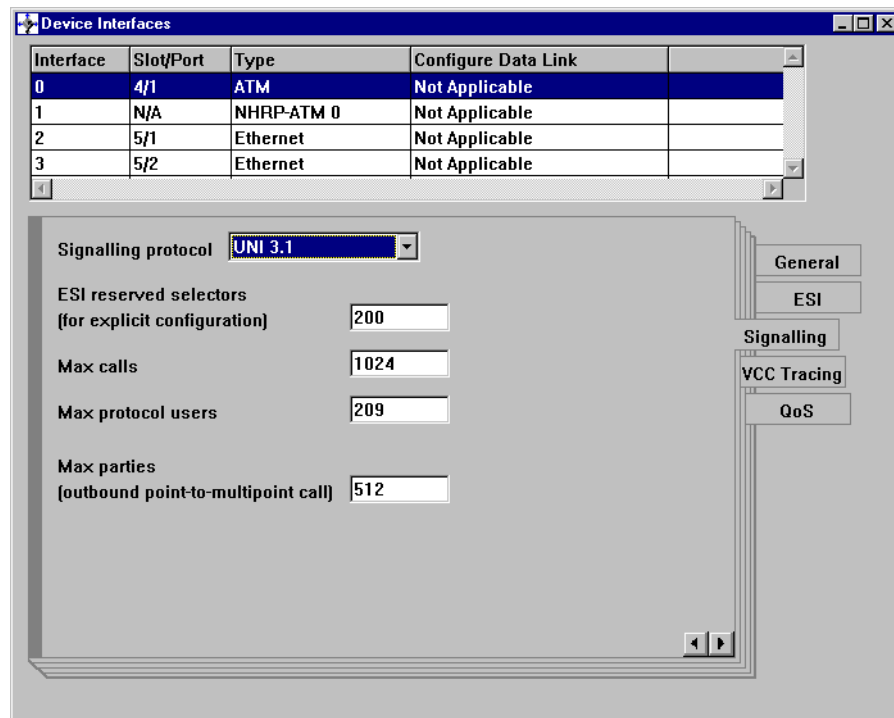


Figure 438. Configuring Signalling

To configure the NHRP interface select the **NHRP-ATM 0** interface. We have changed the parameters as follows.

Select 221600000201 with a selector of 1E from the LSI ESI drop-down list as shown in Figure 439:

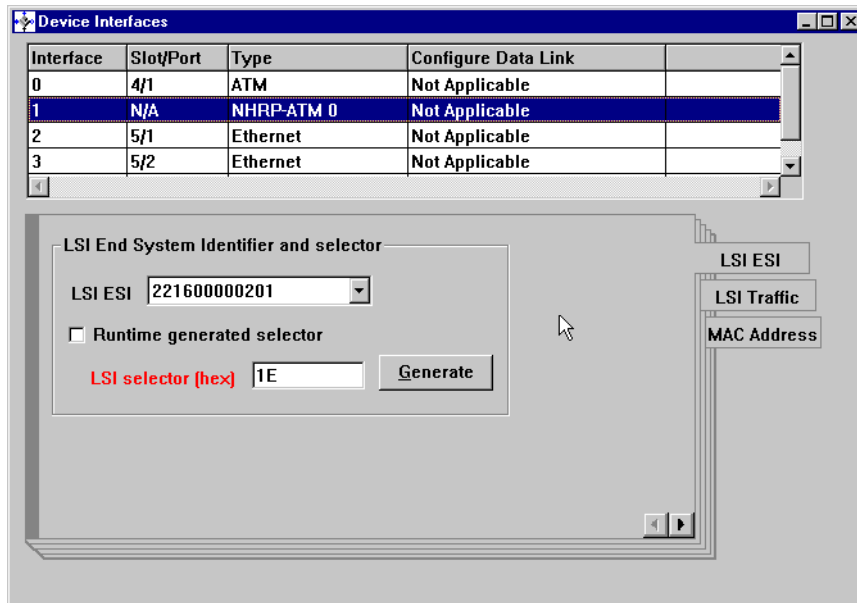


Figure 439. Configuring NHRP Interface

Select the **MAC Address** tab and assign a locally administered MAC address, in this case, 02004468400E (in non-canonical form, this is 400022160201) as shown in Figure 440.

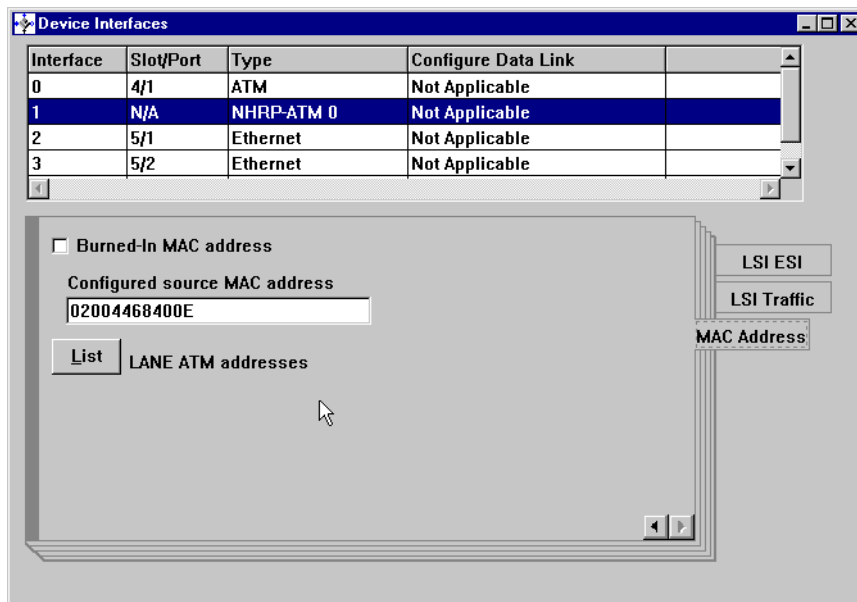


Figure 440. Setting the MAC Address

Select the first **Ethernet** interface. We are using an RJ45 cable to attach to a hub and want Ethernet framing. We have set a MAC address of 020044684080 as shown in Figure 441:



| Interface | Slot/Port | Type       | Configure Data Link |
|-----------|-----------|------------|---------------------|
| 0         | 4/1       | ATM        | Not Applicable      |
| 1         | N/A       | NHRP-ATM 0 | Not Applicable      |
| 2         | 5/1       | Ethernet   | Not Applicable      |
| 3         | 5/2       | Ethernet   | Not Applicable      |

☒ Interface  
 Connector type:   
 IP encapsulation:   
 MAC address (canonical):

Figure 441. Configuring Ethernet Interface

### 10.3.2.2 Configuring LEC

The ESI and selector byte are configured under the General tab. The MAC address assigned is 020044684008 or 400022160210 in non-canonical format, as shown in Figure 442:

| Interface | MAC | Name | Type | Device | ESI | Selector |
|-----------|-----|------|------|--------|-----|----------|
|           |     |      |      |        |     |          |

ATM device:   
 LEC End System Identifier and selector:  
 LEC ESI:   
 ATM LEC address selector (hex):    
 LEC local unicast MAC address:  
  
 LANE ATM addresses

General  
 C7-C18  
 C20-C28  
 ELAN  
 Servers  
 Misc  
 Qos-1  
 Qos-2

Figure 442. Configuring LEC

Select the **ELAN** tab (Figure 443 on page 390). The 2216 will join ELAN et1 so enter the ELAN name, `et1` in the ELAN name field.

| Interface | MAC | Name | Type | Device | ESI | Selector |
|-----------|-----|------|------|--------|-----|----------|
|           |     |      |      |        |     |          |

ELAN name:   
 ELAN type:   
 Max frame size:

Add Change Delete

Figure 443. Configuring ELAN

### 10.3.2.3 Configuring System

The system information is configured in the System General window shown in Figure 444. Define the system name and the location.

System name:   
 Location:   
 Contact:

☐ System console

Max packet buffers:     Packet size:   
 Inactivity timer:     Spare interfaces:   
 Logging level:   
 Logging disposition:

Figure 444. System General

### 10.3.2.4 Configuring IP

Select **IP** under **Protocols** from the Navigation Window.

We will configure the IP address in the Ethernet interface. The IP address of the LEC-Ethernet will be in the same subnet as ELAN et1. The Ethernet interface has a subnet of its own.

To configure the IP address on the Ethernet interface, highlight the Ethernet interface and enter the IP address as 10.1.10.1 with subnet mask 255.255.255.0 and click **Add** as shown in Figure 445:

The screenshot shows the 'IP Interfaces' configuration window. It contains two tables and several input fields.

| Interface | Type (Slot/Port) | Number of addresses |
|-----------|------------------|---------------------|
| 0         | ATM              | 0                   |
| 1         | NHRP-ATM 0       | 0                   |
| 2         | Ethernet         | 1                   |
| 3         | Ethernet         | 0                   |
| 4         | LEC-Ethernet     | 1                   |

| IP address | Subnet mask   | Redirects | Awareness | Primary |
|------------|---------------|-----------|-----------|---------|
| 10.1.10.1  | 255.255.255.0 | enable    | disable   | enable  |

Below the tables, there are input fields for 'IP address' (10.1.10.1), 'Subnet mask' (255.255.255.0), and 'MTU'. There are also checkboxes for 'Dynamic address', 'Primary IP address' (checked), 'ICMP redirects' (checked), and 'Next hop awareness'.

At the bottom, there are three buttons: 'Add', 'Change', and 'Delete'.

Figure 445. Adding LAN IP Address in the Ethernet Interface

We will assign IP address 10.1.1.11 to the LEC interface. Type the IP address and subnet mask and click **Add**.

The IP Interfaces window displays a table of interfaces. Interface 4, LEC-Ethernet, has 1 address. Below the table, the configuration for the selected interface is shown:

| Interface | Type (Slot/Port) | Number of addresses |
|-----------|------------------|---------------------|
| 0         | ATM              | 0                   |
| 1         | NHRP-ATM 0       | 0                   |
| 2         | Ethernet         | 1                   |
| 3         | Ethernet         | 0                   |
| 4         | LEC-Ethernet     | 1                   |

| IP address | Subnet mask   | Redirects | Awareness | Primary |
|------------|---------------|-----------|-----------|---------|
| 10.1.1.11  | 255.255.255.0 | enable    | disable   | enable  |

IP address: 10.1.1.11  
 Subnet mask: 255.255.255.0  
 MTU:   
☐ Dynamic address  
☒ Primary IP address  
☒ ICMP redirects  
☐ Next hop awareness

Buttons: Add, Change, Delete

Figure 446. Adding an IP Address in the LEC Interface

The 2216 is a router. To communicate with other IP subnets through the MSS a default route is required in our configuration. We will add a default static route to the 2216. This is shown in Figure 447.

The Static Routes window displays a table of static routes. The first route is a default route to 0.0.0.0 with a next hop of 10.1.1.1 and a cost of 1.

| Destination network | Destination mask | Address 1 | Cost 1 | Address |
|---------------------|------------------|-----------|--------|---------|
| 0.0.0.0             | 0.0.0.0          | 10.1.1.1  | 1      |         |

Destination network: 0.0.0.0  
 Destination mask: 0.0.0.0  
 Next hop address 1: 10.1.1.1, Cost 1: 1  
 Next hop address 2: , Cost 2: 1  
 Next hop address 3: , Cost 3: 1  
 Next hop address 4: , Cost 4: 1

Buttons: Add, Change, Delete

Figure 447. Adding Static Router

Add the destination network by typing 0.0.0.0 with mask 0.0.0.0 and next hop router 10.1.1.1, which is the MSS interface. Click **Add**.

### 10.3.2.5 Configuring NHRP

The NHRP configuration is the default. It is shown here for reference so you can see what parameters are defined. See Figure 448:

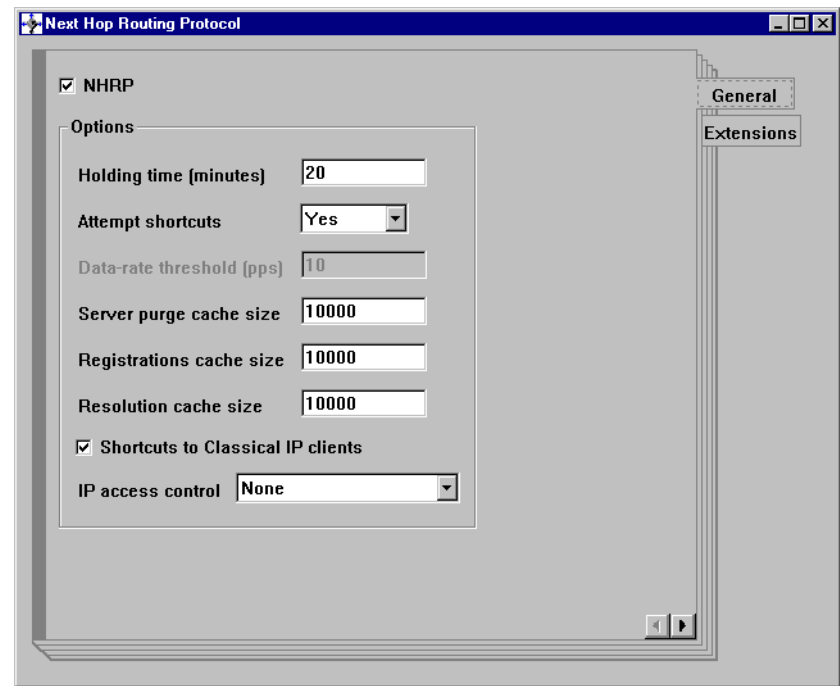


Figure 448. NHRP General

The NHRP Interfaces window is shown in Figure 449. There, Box level defaults is checked.

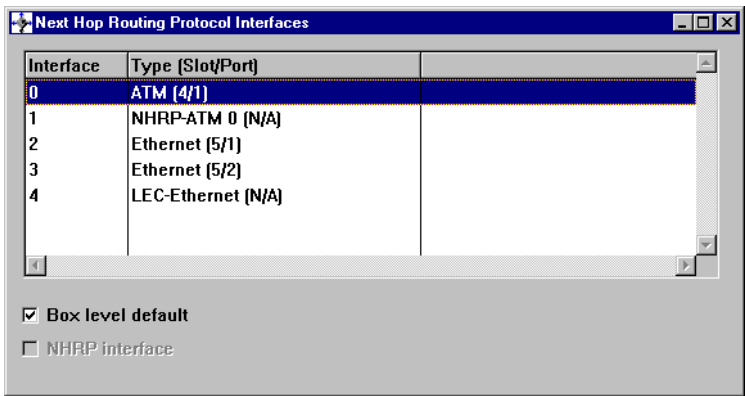


Figure 449. NHRP Interfaces

## 10.4 Monitoring Connectivity between 8270 and 2216 Using MPOA/NHRP

In our network we are now going to establish connectivity between a workstation attached to the 8270 switch and one on the Ethernet LAN connected to the 2216 router. The following screens are taken from the MPOA client in the 8270, the MPOA server in the MSS and the NHRP client in the 2216. The 2216 does not have an MPOA client, just an NHRP client, but this can be used to establish a

shortcut with an MPOA client in the 8270. The following screens show when the shortcuts are established.

#### 10.4.1 Shortcuts with NHRP Enabled on 2216 and MPOA on 8270

Figure 450 shows the shortcut flow.

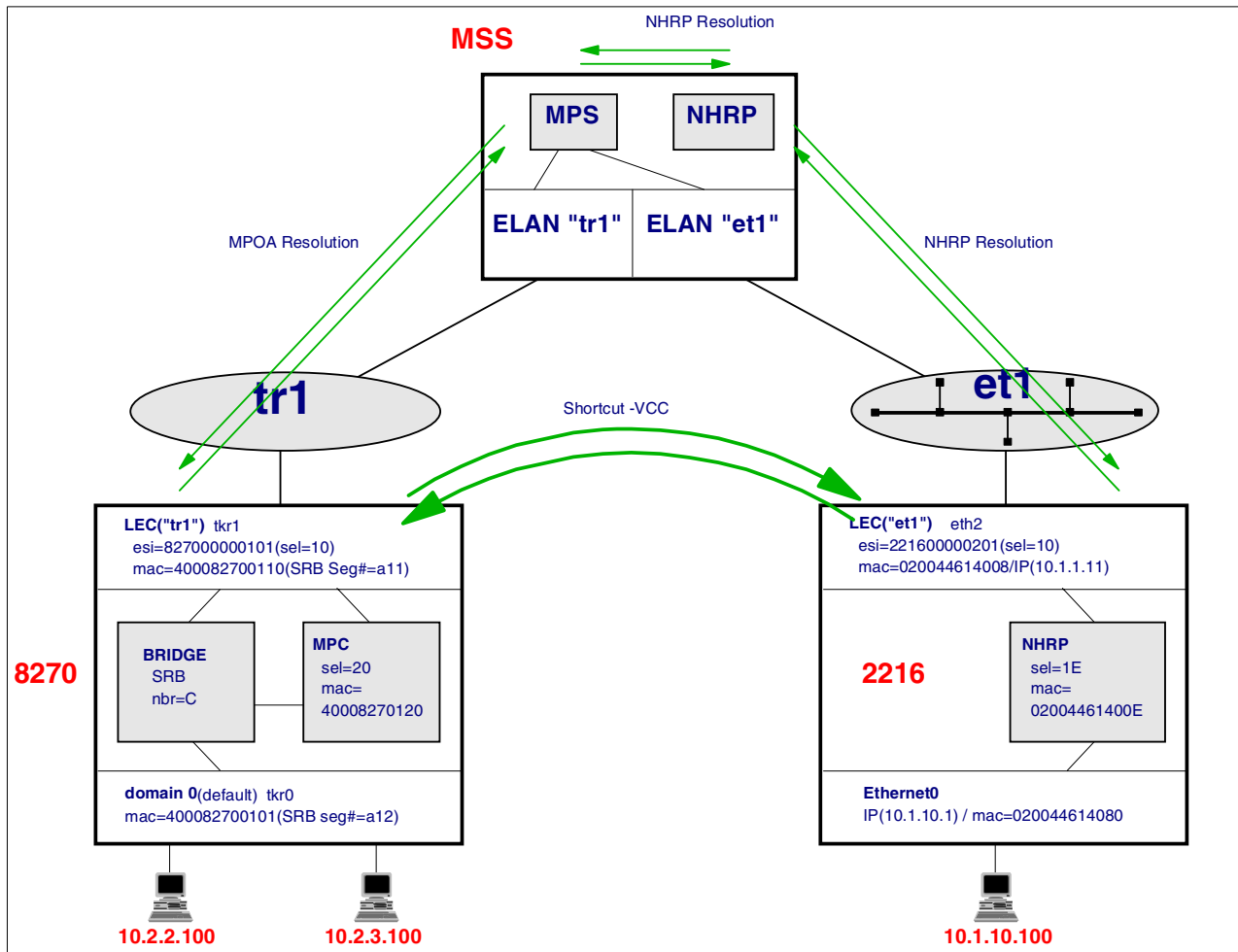


Figure 450. Logical Diagram of MPOA and NHRP Interoperability

##### 10.4.1.1 Monitoring from the MPOA/NHRP Server in the MSS

A control VCC will be established between the MPOA client in the 8270 and the MPOA server in the MSS. Control VCCs will also be established between the NHRP client in the 2216 and the NHRP server in the MSS.

The MSS screen shown in Figure 451 on page 395 shows the connections from the MPOA server to other MPOA servers and clients in the network. To display this type the following commands:

```
Talk 5 -> Protocol MPOA -> MPS -> DISCOVERY
```

```

MSS1 MPS >DISCOVERY
 DISCOVERY TABLE
Net Type Age MAC Addr/RD ATM Address

3 MPS 3310 400082100211 399999999999900001111022182100000000214
3 MPC 1005 400082700110 399999999999900001111011182700000010120
3 MPC 7015 400082700210 399999999999900001111022182700000020120
3 MPC 164 A12C 399999999999900001111011182700000010120
3 MPC 224 A13D 399999999999900001111022182700000020120

```

Figure 451. The DISCOVERY Command

The first entry shows that the MPOA server in MSS1 knows about the second MPOA server in MSS2. The remaining entries are for the MPOA clients. As can be seen we had two 8270 MSS clients in our network.

The control VCC relationship between MPS and MPCs is shown in Figure 452. Issue the command `CONTROL-VCCs`. We have a control VCC to each of our 8270s. The selector byte of 20 was defined for the control VCC.

```

MSS1 MPS >CONTROL-VCCs
 MPS Control VCCs
VPI VCI Net RefCnt MpcCnt Remote ATM Address

0 703 0 7 2 399999999999900001111011182700000010120
0 676 0 3 2 399999999999900001111022182700000020120

```

Figure 452. The CONTROL-VCCs Command

#### 10.4.1.2 Monitoring Connections from the 8270 MSS Client

The 8270 MSS client includes the MPOA client. Figure 453 on page 395 shows the MPOA servers this MPOA client knows about.

To display this type the following commands: `Talk 5-> Protocol MPOA-> MPC-> Neighbor-> LIST`

```

8270#1 MPC MPS>LIST
 List of Neighbor MPSs for MPOA Client (interface 0):
 =====
1) Control ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14 1

 3 MAC Address(es) Learnt For This MPS:

 1) MAC Addr: x40.00.82.10.D2.11 Associated LEC Intf #: 3
 2) MAC Addr: x40.00.82.10.01.11 Associated LEC Intf #: 3
 3) MAC Addr: x40.00.82.10.D1.11 Associated LEC Intf #: 3

```

Figure 453. Show List of Neighbor MPSs

#### Note:

**1** ATM address of MPS. The selector byte defined in the MSS for the MPOA server is 14.

We can display a list of the VCCs that have been established to and from this MPOA client. From **Protocol MPOA** select **MPC-> VCC-> LIST**.

This is shown in Figure 454.

```
8270#1 MPC VCC>LIST
 SVCs For MPC On ATM Interface 0 (total 4):
 =====
1) VPI/VCI 0/804 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.01.14 1
2) VPI/VCI 0/809 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.01.11 2
3) VPI/VCI 0/814 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.02.21.22.16.00.00.02.01.10 3
4) VPI/VCI 0/815 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.02.21.22.16.00.00.02.01.1E 4
```

Figure 454. Show List of VCCs

**Notes:**

- 1** The control VCC between this MPOA client and the MPOA server.
- 2** This is the VCC to the tr1 LEC in the MSS.
- 3** This is a VCC to the LEC in the 2216.
- 4** This is a VCC to the NHRP client in the 2216.

To see a detailed display of a single VCC issue the command **LIST-VCC** and enter the VPI and VCI values when prompted. Two examples follow showing detailed displays of the last two VCCs in the previous screen.



```

8270#1 MPC VCC>LIST-VCC
VPI, Range 0..255 [0]?
VCI, Range 0..65535 [0]? 814

VPI/VCI: 0/814 State: OPERATIONAL Calling Party: TRUE 1
Hold Down Cause: N/A Cause Code: N/A Fwd/Bak SDU:1516/1516
Remote ATM Addr: 39.99.99.99.99.99.00.00.11.11.02.21.22.16.00.00.02.01.10
Conn Type: P2P VCC Type: B. EFFORT Encaps. Type: ETH-LANE 2
H/W Path Valid: FALSE Ref. Frame Cnt: 6167
Frames Tx/Rx: 18584/1 Bytes Tx/Rx: 17105820/6

(Direct) Shortcut Routes Using This VCC:

1) Address/Mask: 10.1.10.100/255.255.255.255 State: RESOLVED 3
2) Address/Mask: 10.1.1.11/255.255.255.255 State: RESOLVED

8270#1 MPC VCC>LIST-VCC
VPI, Range 0..255 [0]?
VCI, Range 0..65535 [0]? 815

VPI/VCI: 0/815 State: OPERATIONAL Calling Party: FALSE 4
Hold Down Cause: N/A Cause Code: N/A Fwd/Bak SDU:4544/4544
Remote ATM Addr: 39.99.99.99.99.99.00.00.11.11.02.21.22.16.00.00.02.01.1E
Conn Type: P2P VCC Type: B. EFFORT Encaps. Type: TR-LANE 5
H/W Path Valid: TRUE Ref. Frame Cnt: 9596
Frames Tx/Rx: 0/13932 Bytes Tx/Rx: ?/?

(Direct) Shortcut Routes Using This VCC:

```

Figure 455. Show the VCC Details

#### Notes:

- 1** This VCC is a connection to the 2216 as shown in the ATM address. The Calling Party field shows TRUE, which means this end (the 8270) established this connection. This is the shortcut VCC established by the MPOA client to the 2216 LEC.
- 2** This shows the type of encapsulation being used for the connection. The client is on an Ethernet LAN (IP address in **3**). Hence the 8270 is using Ethernet LANE encapsulation.
- 3** 10.1.10.100 is the IP address of the workstation on the Ethernet LAN attached to the 2216. A state of RESOLVED means a shortcut has been established for this connection.
- 4** At the second VCC the Calling Party field is shown as FALSE. This VCC was established by the other end. As seen from the ATM address this is a connection from the NHRP client in the 2216 to the 8270 switch.
- 5** The encapsulation type for this connection is TR-LANE. The NHRP client in the 2216 is forwarding frames across this shortcut VCC in the format required for the 8270 to put them directly onto its switch ports.

The MPC-> INGRESS-> LIST command shows the connections that this MPOA client has established to other clients. When configuring MPOA you specify in one of the parameters how many frames per second have to flow before a shortcut is established. The default is 10. Figure 456 on page 398 shows this client has a number of connections to other clients. Some of these have shortcuts established and others have not. A shortcut state of FLOW DETECTION means the client

knows about the connection but the flow of traffic has not reached the level necessary for it to establish a shortcut. A shortcut state of RESOLVED means the client has established a shortcut to this device. In our testing we issued PINGs to these addresses. One per second is under the shortcut threshold of 10. Hence at that time a shortcut was not established. We then used FTP to transfer a file. This exceeded the 10-second threshold and the shortcut was established. You have the option of defining in the configuration how many frames per second have to flow before the MPOA client will try and establish a shortcut.

The 10.1.10.100 is the Ethernet-attached station, which is behind the 2216. We can see its state is resolved.

```
8270#1 MPC INGRESS>LIST
IP-Ingress Cache For MPC on ATM Interface 0
=====

Ingress Cache Entries for Direct Host Routes:

1) Protocol Address: 10.2.1.5 Shortcut State: FLOW DETECTION
2) Protocol Address: 10.1.1.11 Shortcut State: RESOLVED
3) Protocol Address: 9.170.3.240 Shortcut State: FLOW DETECTION 1
4) Protocol Address: 10.2.1.1 Shortcut State: FLOW DETECTION
5) Protocol Address: 10.1.10.100 Shortcut State: RESOLVED 2
6) Protocol Address: 10.2.2.1 Shortcut State: RESOLVED
7) Protocol Address: 10.3.1.21 Shortcut State: RESOLVED
8) Protocol Address: 10.3.1.11 Shortcut State: RESOLVED

Ingress Cache Entries for Direct Network Routes:

Ingress Cache Entries for Derived Host Routes:

```

Figure 456. Show List of Ingress Cache Entries

#### Notes:

- 1 Here the 8270 has sensed traffic to this address, but the flow rate is below the threshold necessary to establish a shortcut.
- 2 IP address 10.1.10.100 is our target station on the Ethernet LAN attached to the 2216. This has a shortcut established as can be seen from the resolved state.

To display detailed information about a particular connection use the `LIST-ENTRY` command. Enter the IP address when prompted as shown in Figure 457:

```

8270#1 MPC INGRESS>LIST-ENTRIES
Destination Protocol Address [0.0.0.0]? 10.1.10.100
Destination Protocol Address Mask [255.255.255.255]?

Host Route Entries matching 10.1.10.100/255.255.255.255

Direct Host Routes :

1) Address: 10.1.10.100 Shortcut State: RESOLVED 1
 Hold Down Cause: N/A CIE Code: xC
 Dest ATM: 39.99.99.99.99.99.99.99.00.00.11.11.02.21.22.16.00.00.02.01.10
 Frames Sent To MPS: 288 Frames Sent Over Shortcut: 1170
 Remaining Age (mins:secs): 17:46 Last Request ID: x7
 Destn MTU: 1500 Encaps. Type: ETH-DIX-IP-LANE 2
 LANE Encaps. Hdr: x00000200446840084000827001200800
 Tag Value: N/A
 Shortcut VCC (VPI/VCI): 0/ 814 Local Shortcut ? : FALSE 3
 MPS: 39.99.99.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14

Derived Host Routes :

Network Route Entries matching 10.1.10.100/255.255.255.255

None found!

```

Figure 457. Show the Details of Ingress Cache Entry

#### Notes:

- 1** A shortcut to this address has been established. The IP address of 10.1.10.100 is resolved.
- 2** The encapsulation type being used on this connection is Ethernet-DIX-IP-LANE.
- 3** It is possible to create local shortcuts within the 8270 switch between workstations on different IP subnetworks without the traffic being routed through the MSS router function. (There is more on this later.) This connection is across the ATM network to a 2216, hence the Local Shortcut status is FALSE.

To display the status of the connections being received by the 8270 MPOA client use the MPC EGRESS displays.

Figure 458 on page 400 shows the MPC -> EGRESS -> LIST command which shows a list of the connections to this MPOA client. It shows we have one connection going to workstation 10.2.2.100 attached to an 8270 token-ring switch port.

```

8270#1 MPC EGRESS>LIST
 Egress Cache For MPC on ATM Interface 0
 =====

 Egress Cache Entries w/ MPOA-Tag Encapsulation:

 Egress Cache Entries w/ Native 1483 Encapsulation (Host Routes):

1) Protocol Address/Mask: 10.2.2.100/255.255.255.255 State: ACTIVE

 Egress Cache Entries w/ Native 1483 Encapsulation (Netwk Routes):

```

Figure 458. Show List of Egress Cache Entries

To display detailed information about this entry use the `LIST-ENTRIES` command. Enter the IP address when prompted. Figure 459 shows this:

```

8270#1 MPC EGRESS>LIST-ENTRIES
Destination Protocol Address [0.0.0.0]? 10.2.2.100
Destination Protocol Address Mask [255.255.255.255]?

 Egress Cache Entries matching 10.2.2.100/255.255.255.255 :

1) Address/Mask: 10.2.2.100/255.255.255.255 Entry Type: 1483 (HOST, DIRECT)
 LEC #: 3 Cache ID: x30 State: ACTIVE
 MPS: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.01.14
 Source: 39.99.99.99.99.99.00.00.11.11.02.21.22.16.00.00.02.01.1E 1
 Remaining Age (mins:secs): 36:28
 Recvd Octets: N/A
 Recvd Frames Forwarded: N/A
 Recvd Frames Discarded: N/A
 Tag Value: N/A Local Shortcut: FALSE 2
 DLL Header: x00404000560e0101c0008210011106b0a12ca110aaaa030000000800
 LANE Extensions in last Imposition reply: Formats 7, 11, 13

```

Figure 459. Show the Details of Egress Cache Entry

#### Notes:

- 1 This shows the source ATM address of the connection, which is the 2216 NHRP client.
- 2 This is not a local shortcut between workstations attached to this 8270 switch.

#### 10.4.1.3 Monitoring Shortcuts from the 2216

We can display a list of what shortcuts the 2216 has established.

Type `Talk 5-> Protocol NHRP-> CACHE LIST` to see a list of the entries the 2216 knows about. This is shown in Figure 460 on page 401. We have one entry to workstation 10.2.2.100, which is attached to our 8270 switch.

```

Total Cache Entries = 1, Active Entries = 1
NHRP Resolution Cache Entries
=====
Dest Address NextHop Address State Htime MTU Net

10.2.2.100 10.2.2.100 Act 585 4490 1
=====

```

To display detailed information about entries in the cache list use the `cache entry` command as shown in Figure 461. The display for address 10.2.2.100 is shown:

```
2216 NHRP>cache entry
Enter destination address [0.0.0.0]? 10.2.2.100
Destination: 10.2.2.100
NextHop: 10.2.2.100
ATM Address: 3999999999999999000011111011182700000010120
State: Act
Net: 1
HoldingTime: 562 seconds
MTU size: 4490
Flags: 0x00420000
```

**Note:**

To display the shortcut-VCC status, issue the command `lane_shortcut` from the NHRP interface. You can see the MAC address of 10.2.2.100 and VPI/VCI information as shown in Figure 462:

```
2216 NHRP>lane_shortcut all

LANE Shortcut Interface #: 1, ATM Network Interface #: 0
=====
Next Hop Prot @ Dest Mac @ VPI/VCI

10.2.2.100 40-00-56-0E-01-01 0/132

Current MTU being used: 4490
```

#### 10.4.1.4 Statistics Report in MSS1 with Both MPOA and NHRP Enabled

ATM Proxy Clients Configuration Examples 401

| MSS1 +STATISTICS |           |         |     |           |     |          |       |
|------------------|-----------|---------|-----|-----------|-----|----------|-------|
| Net              | Interface | Unicast |     | Multicast |     | Bytes    | Bytes |
|                  |           | Pkts    | Rcv | Pkts      | Rcv | Received | Trans |
| 0                | ATM/0     |         | 10  |           | 0   | 566      | 479   |
| 1                | NHRPL/0   |         | 0   |           | 0   | 0        | 0     |
| 2                | Eth/0     |         | 4   |           | 1   | 310      | 250   |
| 3                | TKR/0     |         | 0   |           | 1   | 54       | 0     |
| 4                | TKR/1     |         | 0   |           | 0   | 0        | 0     |
| 5                | TKR/2     |         | 0   |           | 0   | 0        | 0     |

| MSS1 +STATISTICS |           |         |     |           |     |          |       |
|------------------|-----------|---------|-----|-----------|-----|----------|-------|
| Net              | Interface | Unicast |     | Multicast |     | Bytes    | Bytes |
|                  |           | Pkts    | Rcv | Pkts      | Rcv | Received | Trans |
| 0                | ATM/0     |         | 472 |           | 0   | 30488    | 581   |
| 1                | NHRPL/0   |         | 0   |           | 0   | 0        | 0     |
| 2                | Eth/0     |         | 40  |           | 43  | 6112     | 52    |
| 3                | TKR/0     |         | 46  |           | 65  | 8398     | 51    |
| 4                | TKR/1     |         | 0   |           | 0   | 0        | 0     |
| 5                | TKR/2     |         | 0   |           | 2   | 108      | 2     |

Figure 463. Show Statistics on MSS1 When MPOA and NHRP Are Enabled

#### 10.4.1.5 Statistics Report in MSS1 with MPOA and NHRP Disabled

We repeated the previous test with MPOA and NHRP disabled. The statistics in Figure 464 show us this file is being transferred through the MSS router. The byte count on the ATM interface has increased; so has the received count on the Ethernet interface and the transmit count on the token-ring interface.

| MSS1 +STATISTICS |           |         |     |           |     |          |       |
|------------------|-----------|---------|-----|-----------|-----|----------|-------|
| Net              | Interface | Unicast |     | Multicast |     | Bytes    | Bytes |
|                  |           | Pkts    | Rcv | Pkts      | Rcv | Received | Trans |
| 0                | ATM/0     |         | 5   |           | 0   | 324      | 3     |
| 1                | NHRPL/0   |         | 0   |           | 0   | 0        | 0     |
| 2                | Eth/0     |         | 0   |           | 0   | 0        | 0     |
| 3                | TKR/0     |         | 5   |           | 0   | 324      | 3     |
| 4                | TKR/1     |         | 0   |           | 0   | 0        | 0     |
| 5                | TKR/2     |         | 0   |           | 0   | 0        | 0     |

| MSS1 +STATISTICS |           |         |       |           |     |          |       |
|------------------|-----------|---------|-------|-----------|-----|----------|-------|
| Net              | Interface | Unicast |       | Multicast |     | Bytes    | Bytes |
|                  |           | Pkts    | Rcv   | Pkts      | Rcv | Received | Trans |
| 0                | ATM/0     |         | 13859 |           | 0   | 13618339 | 13956 |
| 1                | NHRPL/0   |         | 0     |           | 0   | 0        | 0     |
| 2                | Eth/0     |         | 8943  |           | 38  | 12678715 | 4565  |
| 3                | TKR/0     |         | 4578  |           | 57  | 325146   | 8968  |
| 4                | TKR/1     |         | 0     |           | 0   | 0        | 0     |
| 5                | TKR/2     |         | 0     |           | 0   | 0        | 0     |

Figure 464. Show Statistics on MSS1, MPOA and NHRP Disabled

### 10.4.2 8270 Local Shortcut

In our network we have more than one IP subnet attached to our 8270 switch (10.2.1.x, 10.2.2.x, 10.2.3.x, etc, all with a subnet mask of 255.255.255.0). Normally traffic from workstations on one subnet would have to route through the MSS router to get to workstations on a different subnet even though they are physically attached to the same 8270 switch. The MPOA client implementation allows for local shortcuts to be established within the same switch. This means

once the traffic flow exceeds the predefined flow count (10 frames per second by default) a shortcut can be created within the same 8270 switch. Data is then switched between workstations in the 8270 and not sent to the MSS router only to be routed back to the same edge switch. This reduces ATM network traffic.

In our example we have two clients, 10.2.2.100 and 10.2.3.100, on the same switch but in different subnets. When a file is transferred between them a local shortcut is created bypassing the MSS router. The following screens show this.

First, a diagram of the local shortcut in Figure 465:

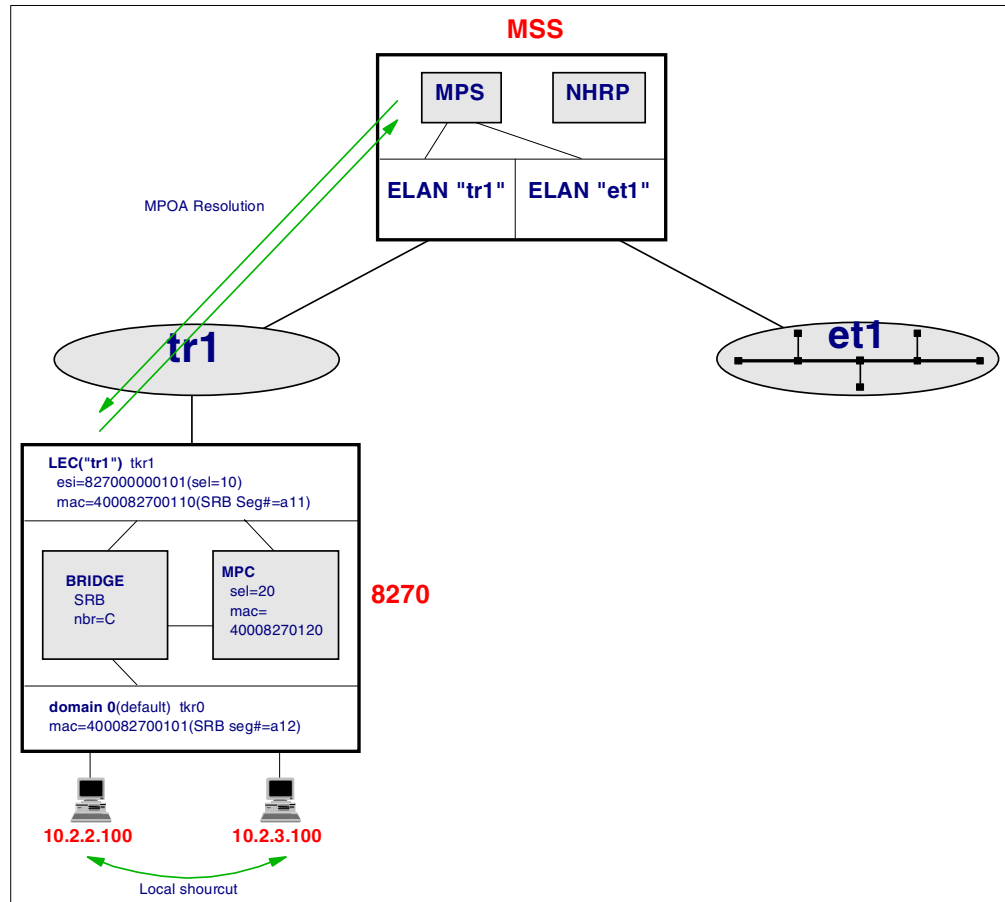


Figure 465. Local Shortcut within the Same 8270 Switch

Figure 466 on page 404 shows the MPOA control VCC and data direct VCC with the MSS LEC.

```

8270#1 MPC >VCCs

MPOA Client VCC Console
=====
8270#1 MPC VCC>LIST
 SVCs For MPC On ATM Interface 0 (total 2):
 =====
1) VPI/VCI 0/907 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14
2) VPI/VCI 0/908 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.11

```

Figure 466. Show List of VCCs

Figure 467 on page 405 shows the result of typing the MPC -> INGRESS commands.

The first is an MPC INGRESS LIST command that shows our two attached workstations in resolved state. That is, a shortcut has been created for both of them.

The second and third are MPC INGRESS LIST-ENTRIES commands for these two addresses. They show the destination ATM address is the same in both cases and a local shortcut has been established (the local shortcut is TRUE).



```

8270#1 MPC INGRESS>LIST
IP-Ingress Cache For MPC on ATM Interface 0
=====
Ingress Cache Entries for Direct Host Routes:

1) Protocol Address: 10.2.3.100 Shortcut State: RESOLVED 1
2) Protocol Address: 9.24.104.108 Shortcut State: HOLD DOWN
3) Protocol Address: 10.2.1.1 Shortcut State: RESOLVED
4) Protocol Address: 10.2.1.5 Shortcut State: RESOLVED
5) Protocol Address: 10.2.2.100 Shortcut State: RESOLVED 1
6) Protocol Address: 100.121.107.96 Shortcut State: HOLD DOWN
7) Protocol Address: 100.2.2.10 Shortcut State: HOLD DOWN

Ingress Cache Entries for Direct Network Routes:

Ingress Cache Entries for Derived Host Routes:

8270#1 MPC INGRESS>LIST-ENTRIES
Destination Protocol Address [0.0.0.0]? 10.2.3.100
Destination Protocol Address Mask [255.255.255.255]?
Host Route Entries matching 10.2.3.100/255.255.255.255

Direct Host Routes :
1) Address: 10.2.3.100 Shortcut State: RESOLVED
Hold Down Cause: N/A CIE Code: x0
Dest ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.01.20 2
Frames Sent To MPS: 2 Frames Sent Over Shortcut: 9195
Remaining Age (mins:secs): 16:4 Last Request ID: x1
Destn MTU: 4490 Encaps. Type: TR-SNAP-IP-LANE
LANE Encaps. Hdr: x00000040400038212763c0008210011106b0a12ca110
Tag Value: N/A
Shortcut VCC (VPI/VCI): 0/ 0 Local Shortcut ?: TRUE 3
MPS: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14

Derived Host Routes :
Network Route Entries matching 10.2.3.100/255.255.255.255

None found!

8270#1 MPC INGRESS>LIST-ENTRIES
Destination Protocol Address [0.0.0.0]? 10.2.2.100
Destination Protocol Address Mask [255.255.255.255]?
Host Route Entries matching 10.2.2.100/255.255.255.255

Direct Host Routes :
1) Address: 10.2.2.100 Shortcut State: RESOLVED
Hold Down Cause: N/A CIE Code: x0
Dest ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.01.20 2
Frames Sent To MPS: 1 Frames Sent Over Shortcut: 8994
Remaining Age (mins:secs): 17:6 Last Request ID: x5
Destn MTU: 4490 Encaps. Type: TR-SNAP-IP-LANE
LANE Encaps. Hdr: x00000040400099990020c0008210011106b0a12ca110
Tag Value: N/A
Shortcut VCC (VPI/VCI): 0/ 0 Local Shortcut ?: TRUE 3
MPS: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14

Derived Host Routes :
Network Route Entries matching 10.2.2.100/255.255.255.255

None found!

```

Figure 467. Show List of Ingress Cache Entries

### Notes:

- 1** IP addresses 10.2.2.100 and 10.2.3.100 are resolved. This means the MPOA client has created a shortcut to these addresses.
- 2** The MPOA client discovered the ATM address of the partner client is the MPOA client itself. It created the shortcut within itself. The partner client's ATM address is the same as the 8270 box ATM address.
- 3** The local shortcut status is TRUE for both entries. This means the shortcut between these workstations is within the same switch.

The MPC EGRESS displays in Figure 468 show the same information.

```
8270#1 MPC EGRESS>LIST
 Egress Cache For MPC on ATM Interface 0
 =====
 Egress Cache Entries w/ MPOA-Tag Encapsulation:

 Egress Cache Entries w/ Native 1483 Encapsulation (Host Routes):

 1) Protocol Address/Mask: 10.2.2.100 /255.255.255.255 State: ACTIVE
 2) Protocol Address/Mask: 10.2.1.5 /255.255.255.255 State: ACTIVE
 3) Protocol Address/Mask: 10.2.3.100 /255.255.255.255 State: ACTIVE
 Egress Cache Entries w/ Native 1483 Encapsulation (Netwk Routes):

8270#1 MPC EGRESS>LIST-ENTRIES 10.2.3.100
Destination Protocol Address Mask [255.255.255.255]?
 Egress Cache Entries matching 10.2.3.100/255.255.255.255 :
 1) Address/Mask: 10.2.3.100/255.255.255.255 Entry Type: 1483 (HOST, DIRECT)
 LEC #: 3 Cache ID: x5C State: ACTIVE
 MPS: 39.99.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.01.14
 Source: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.01.20
 Remaining Age (mins:secs): 35:4
 Recvd Octets: N/A
 Recvd Frames Forwarded: N/A
 Recvd Frames Discarded: N/A
 Tag Value: N/A Local Shortcut: TRUE
 DLL Header: x0040400038212763c0008210011106b0a12ca110aaaa030000000800
 LANE Extensions in last Imposition reply: Formats 7, 11, 13, 17

8270#1 MPC EGRESS>LIST-ENTRIES 10.2.2.100
Destination Protocol Address Mask [255.255.255.255]?
 Egress Cache Entries matching 10.2.2.100/255.255.255.255 :
 1) Address/Mask: 10.2.2.100/255.255.255.255 Entry Type: 1483 (HOST, DIRECT)
 LEC #: 3 Cache ID: x57 State: ACTIVE
 MPS: 39.99.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.01.14
 Source: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.01.20
 Remaining Age (mins:secs): 36:22
 Recvd Octets: N/A
 Recvd Frames Forwarded: N/A
 Recvd Frames Discarded: N/A
 Tag Value: N/A Local Shortcut: TRUE
 DLL Header: x0040400099990020c0008210011106b0a12ca110aaaa030000000800
 LANE Extensions in last Imposition reply: Formats 7, 11, 13, 17
```

Figure 468. Show List of Egress Cache Entries

#### 10.4.2.1 Statistics Report in MSS1 with Local MPOA Shortcut

We repeated the previous test, this time displaying the statistics in the MSS with and without the MPOA client enabled in the 8270. The first screen, Figure 469,

shows the MSS statistics with the MPOA client enabled. The displays were taken before and after transferring a 12 MB file.

| MSS1 +STATISTICS |           |                     |                       |                   |                  |                |
|------------------|-----------|---------------------|-----------------------|-------------------|------------------|----------------|
| Net              | Interface | Unicast<br>Pkts Rcv | Multicast<br>Pkts Rcv | Bytes<br>Received | Packets<br>Trans | Bytes<br>Trans |
| 0                | ATM/0     | 19                  | 0                     | 1427              | 22               | 1800           |
| 1                | NHRPL/0   | 0                   | 0                     | 0                 | 0                | 0              |
| 2                | Eth/0     | 1                   | 1                     | 170               | 1                | 62             |
| 3                | TKR/0     | 8                   | 2                     | 749               | 6                | 416            |
| 4                | TKR/1     | 0                   | 0                     | 0                 | 0                | 0              |
| 5                | TKR/2     | 0                   | 0                     | 0                 | 0                | 0              |

| MSS1 +STATISTICS |           |                     |                       |                   |                  |                |
|------------------|-----------|---------------------|-----------------------|-------------------|------------------|----------------|
| Net              | Interface | Unicast<br>Pkts Rcv | Multicast<br>Pkts Rcv | Bytes<br>Received | Packets<br>Trans | Bytes<br>Trans |
| 0                | ATM/0     | 425                 | 0                     | 28388             | 516              | 39729          |
| 1                | NHRPL/0   | 0                   | 0                     | 0                 | 0                | 0              |
| 2                | Eth/0     | 19                  | 39                    | 4470              | 38               | 2356           |
| 3                | TKR/0     | 59                  | 59                    | 8864              | 56               | 3996           |
| 4                | TKR/1     | 0                   | 0                     | 0                 | 0                | 0              |
| 5                | TKR/2     | 0                   | 1                     | 54                | 1                | 54             |

Figure 469. Show Statistics on MSS1 with MPOA Client

#### 10.4.2.2 Statistics Report in MSS1 with No Local Shortcut

The 12 MB file was then transferred with the MPOA client disabled. Now the route is to and from the MSS router. Again the statistics were taken before and then after transferring the file as shown in Figure 470:

| MMSS1 +STATISTICS |           |                     |                       |                   |                  |                |
|-------------------|-----------|---------------------|-----------------------|-------------------|------------------|----------------|
| Net               | Interface | Unicast<br>Pkts Rcv | Multicast<br>Pkts Rcv | Bytes<br>Received | Packets<br>Trans | Bytes<br>Trans |
| 0                 | ATM/0     | 42                  | 0                     | 2433              | 45               | 3152           |
| 1                 | NHRPL/0   | 0                   | 0                     | 0                 | 0                | 0              |
| 2                 | Eth/0     | 1                   | 3                     | 295               | 3                | 187            |
| 3                 | TKR/0     | 11                  | 4                     | 1120              | 9                | 642            |
| 4                 | TKR/1     | 0                   | 0                     | 0                 | 0                | 0              |
| 5                 | TKR/2     | 0                   | 0                     | 0                 | 0                | 0              |

| MSS1 +STATISTICS |           |                     |                       |                   |                  |                |
|------------------|-----------|---------------------|-----------------------|-------------------|------------------|----------------|
| Net              | Interface | Unicast<br>Pkts Rcv | Multicast<br>Pkts Rcv | Bytes<br>Received | Packets<br>Trans | Bytes<br>Trans |
| 0                | ATM/0     | 14089               | 0                     | 13156503          | 14246            | 13177073       |
| 1                | NHRPL/0   | 0                   | 0                     | 0                 | 0                | 0              |
| 2                | Eth/0     | 34                  | 72                    | 8092              | 72               | 4466           |
| 3                | TKR/0     | 13409               | 114                   | 13122074          | 13411            | 13113417       |
| 4                | TKR/1     | 0                   | 1                     | 54                | 1                | 54             |
| 5                | TKR/2     | 0                   | 0                     | 0                 | 0                | 0              |

Figure 470. Show Statistics on MSS1

## 10.5 8371

We are going to configure an 8371 with an MPOA client. The basic configuration is very similar to the MSS but you can only use the command-line or Web interface. There is no configuration tool for the IBM 8371.

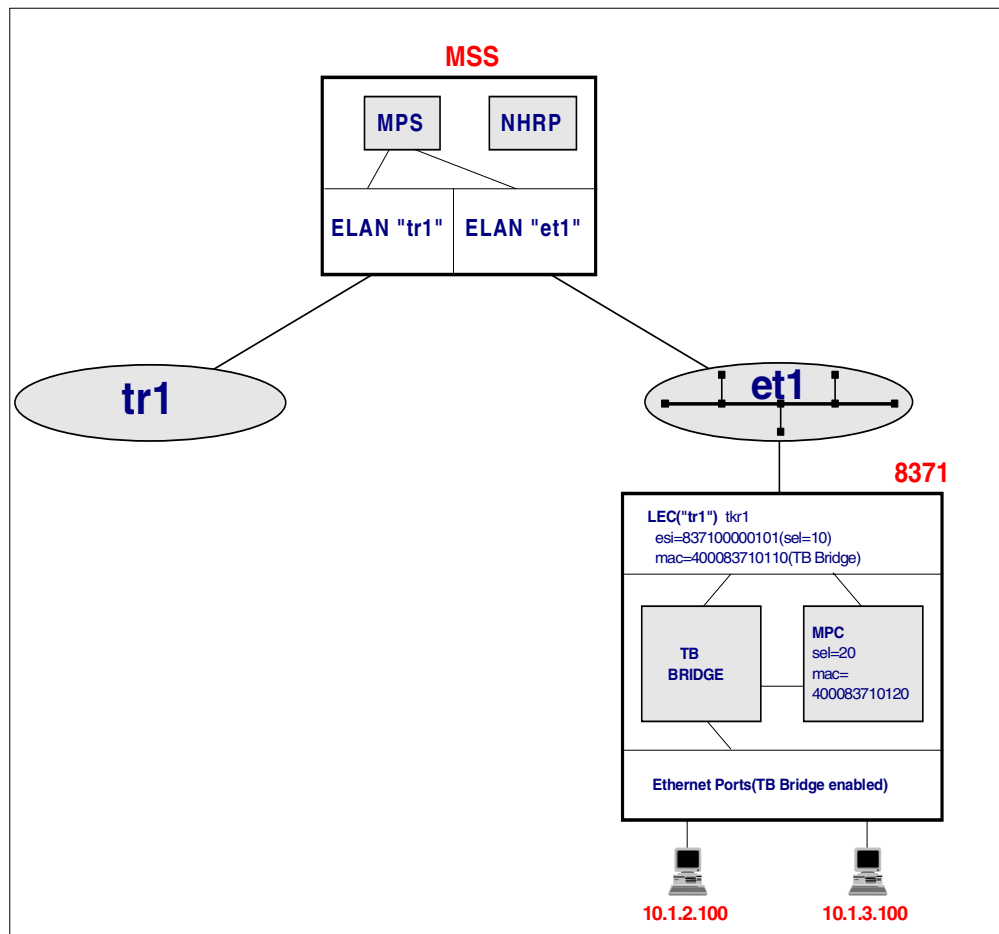


Figure 471. Logical View of the 8371 Attached to the Network

### 10.5.1 Configuring the 8371 As an MPOA Client

#### 10.5.1.1 ATM Port Configuration

We used slot 2 for the UFC which has port 1 assigned to network 38. The LEC is assigned to network 40. We will use the command-line interface to configure the 8371.

Type `Talk 6-> network 38-> interface` at the command-line interface.

Set the ESI by typing the `Add ESI` command. Select value **837100000101** from the list. The UNI version is set to 3.1.

```

ATM Interface Config>ADD ESI
ESI in 00.00.00.00.00.00 form []? 83.71.00.00.01.01 1
ATM Interface Config>LIST ESIs

 ESI Enabled

00.00.00.00.00.00 NO
83.71.00.00.01.01 YES

ATM Interface Config>SET UNI-VERSION
UNI version [3.0, 3.1, AUTO, NONE] []? 3.1 2

ATM Interface Config>LIST CONFIGURATION

 ATM Configuration

Interface (net) number = 38
Maximum VCC data rate Mbps = 155
Maximum frame size = 1664
Maximum number of callers = 209
Maximum number of calls = 1024
Maximum number of parties to a multipoint call = 512
Maximum number of Selectors that can be configured = 200
UNI Version = UNI 3.1 2
Packet trace = OFF
ATM Network ID = 0

```

Figure 472. ATM Configuration

#### Notes:

- 1** Set the ESI by typing 837100000101.
- 2** Change UNI version to 3.1.

#### 10.5.1.2 LEC Configuration

Type Talk 6-> network 38 from the command-line interface.

We use the `ASSIGN-LEC` command to assign a LEC to network 38. The first available is network 40.

```

ATM Config>ASSIGN-LEC
select LEC to assign [40]?
Note: this lecs esi has been reset to its burned in value.
If you wish to associate it with the new atm esi, you must do so manually

```

Figure 473. Assigning LEC As Network 40 on Network 38

Type Talk 6-> network 40 from the command-line interface.

Then we configure the LEC.

We will set the ELAN name by typing `et1`, the selector to 10, and the MAC address to 400083710110 for this LEC.



- 3** The selector is set by typing 10.
- 4** The locally administered MAC address is set by typing 400083710110.

We will now enable the interfaces we have just configured.

Type Talk 6 from the command-line interface.

```
Config>ENABLE INTERFACE 38
Interface enabled successfully

Config>ENABLE INTERFACE 40
Interface enabled successfully
```

Figure 475. Enabling Interfaces for Networks 38 and 40

Next we will configure MPOA.

### 10.5.1.3 MPOA Configuration

Type Talk 6-> protocol MPOA-> MPC-> 38 -> config from the command-line interface.

We will set the selector byte by typing 20 and the MAC address to 400083710120 for the MPOA client.

We will also enable IPX. IP is enabled by default.

#### Note

If the configuration has been cleared you may need to Add interface 38 before configuring it.

To do so, type the following commands:

```
Talk 6 -> Protocol MPOA -> MPC -> 38 -> ADD
```

This will add the interface. You can now continue configuring it.

```

MPC/38 Configuration>SET SELECTOR
Selector Byte (in hex) [2]? 20
MPC/38 Configuration>SET ESI
[1] Burned in ESI
[2] 83.71.00.00.01.01
ESI: [1]? 2

MPC/38 Configuration>SET SHORTCUTS
Enable LANE Shortcuts? [Yes]?

Choices for Source MAC Address for LANE Shortcuts:
[1] Burned in ESI
[2] Locally Configured MAC Address
[3] MAC Address from the Resolution Reply

MAC Address Type for LANE Shortcuts: [1]? 2
MAC Address for LANE Shortcuts: [00.00.00.00.00.00]? 40.00.83.71.01.20
MPC/38 Configuration>SET IPX-PROTOCOL
Enable IPX (Yes/No):? [No]: yes
MPC/38 Configuration>LIST

MPC Configuration

STATUS: ENABLED
Shortcut Setup Frame Count: 10 (frames)
Shortcut Setup Frame Time: 1 (sec)
Initial Retry Time: 5 (sec)
Maximum Retry Time: 40 (sec)
Hold Down Time: 160 (sec)
VCC Timeout Period: 20 (min)
Accept Config From LECS: Yes
Fragmentation Mode: Maximize Shortcut Usage

Interface: 38
ESI: 83.71.00.00.01.01
Selector: 0x20
Desired PCR: 155000 (kbps)
Maximum Reserved Bandwidth: 155000 (kbps)
Line Rate: 155 (Mbps)
Enable LANE Shortcuts: TRUE
Source MAC Address for Shortcuts: Locally Configured
 40.00.83.71.01.20

IP-Protocol: ENABLED
IPX-Protocol: ENABLED

```

Figure 476. Configuring MPOA

#### Notes:

- 1** Setting the selector to 20.
- 2** Setting the ESI to 837100000101.
- 3** Setting the MAC address to 400083710120.
- 4** Enabling shortcuts for IPX.

#### 10.5.1.4 TCP/IP Host Service Configuration

We cannot configure an IP address on the interface so we are going to configure TCP/IP Host services to enable management access to the 8371.

Type Talk 6-> protocol hst from the command-line interface.



```
TCP/IP-Host config>SET IP-HOST
IP-Host address [10.1.2.4]? 10.1.1.5 1
Address mask [255.0.0.0]? 255.255.255.0
IP-Host address set.

TCP/IP-Host config>ADD DEFAULT-GATEWAY
Default-Gateway address [0.0.0.0]? 10.1.1.1 2
```

Figure 477. Configuring IP Host Service

**Notes:**

- 1** Set the TCP/IP host address by typing 10.1.1.5.
- 2** Set the default gateway address by typing 10.1.1.1.

### 10.5.1.5 Bridge Configuration

Because all Ethernet ports and LECs are configured as bridge ports by default there is no bridge configuration to be done. The bridge configuration is shown here for reference only.

Type Talk 6-> protocol asrt from the command-line interface.

**Note**

If the configuration has been cleared you will need to enable the bridge.

To do so, type the following commands:

```
Talk 6 -> Protocol ASRT -> Enable Bridge
```

```

ASRT config>LIST BRIDGE

Source Routing Transparent Bridge Configuration
=====

Bridge: Enabled Bridge Behavior: STB 1
+-----+-----+
| SPANNING TREE PROTOCOL INFORMATION |
+-----+-----+
Bridge Address: Default Bridge Priority: 32768/0x8000
SRB Bridge Address: Default SRB Bridge Priority: 32768/0x8000
STP Participation: IEEE802.1d 2
+-----+-----+
| TRANSLATION INFORMATION |
+-----+-----+
FA<=>GA Conversion: Enabled UB-Encapsulation: Disabled
DLS for the bridge: Disabled
+-----+-----+
| PORT INFORMATION |
+-----+-----+
Number of ports added: 56
Port: 1 Interface: 0 Behavior: STB Only STP: Enabled
Port: 2 Interface: 1 Behavior: STB Only STP: Enabled
|
(Note:- some lines have been removed here)
|
Port: 33 Interface: 40 Behavior: STB Only STP: Enabled
Port: 34 Interface: 41 Behavior: STB Only STP: Enabled
|
(Note:- some lines have been removed here)
|

```

Figure 478. Show Bridge Configuration

#### Notes:

- 1 The bridge is enabled by default.
- 2 Spanning tree participation (IEEE 802.1d) is enabled by default.

```

ASRT config>LIST PORT
Port ID (dec) : 128:01, (hex): 80-01
Port State : Enabled
STP Participation: Enabled
Port Supports : Transparent Bridging Only
Assoc Interface : 0
Path Cost : 0
Source Address Learning : ENABLED
+++++
Port ID (dec) : 128:02, (hex): 80-02
Port State : Enabled
STP Participation: Enabled
Port Supports : Transparent Bridging Only
Assoc Interface : 1
Path Cost : 0
Source Address Learning : ENABLED
+++++
|
(Note:- some lines have been removed from here.)
|
Port ID (dec) : 128:33, (hex): 80-21
Port State : Enabled
STP Participation: Enabled
Port Supports : Transparent Bridging Only
Assoc Interface : 40
Path Cost : 0
Source Address Learning : ENABLED
+++++
Port ID (dec) : 128:34, (hex): 80-22
Port State : Enabled
STP Participation: Enabled
Port Supports : Transparent Bridging Only
Assoc Interface : 41
Path Cost : 0
Source Address Learning : ENABLED
+++++
|
(Note:- some lines have been removed from here)

```

Figure 479. Showing the Bridge Port Configuration

**Note:**

- 1** All ports are enabled for transparent bridging by default.

## 10.5.2 Web Interface for the 8371

The 8371 has a Web server that has the following features:

- Graphical view of the 8371
- Operator console functions the same as Talk 5
- Gateway configuration functions the same as Talk 6
- Event logging system console functions the same as Talk 2 in the command-line interface
- Help functions

In this section, we will show some examples of using the Web interface for the 8371.

### 10.5.2.1 Access the 8371 Using the Web Interface

1. Enter `http://` followed by the IP address of the 8371 (in our case 10.1.1.5).
2. The initial Web screen is shown in Figure 480:

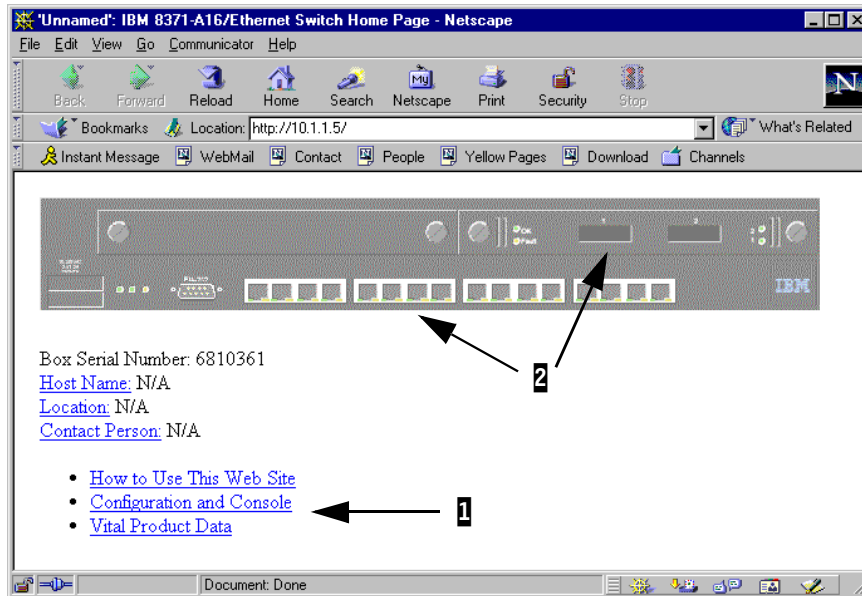


Figure 480. Initial Web Window on the 8371

#### Notes:

- 1 Select **Configuration and Console** from here.
- 2 Click a port to show the status of that port.

Click **Configuration and Console**. You are taken to the window shown in Figure 481:

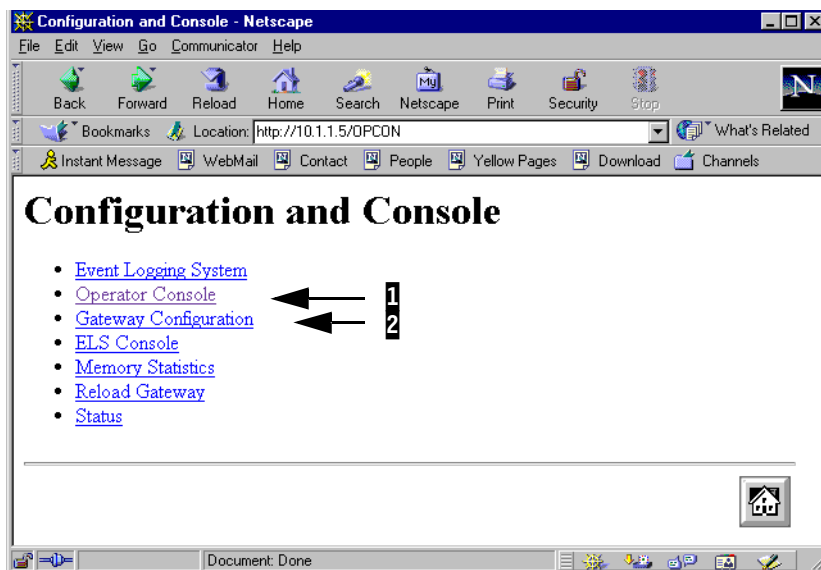


Figure 481. Configuration and Console Window

#### Notes:

- 1 Operator Console has Talk 5 interface.
- 2 Gateway Configuration has Talk 6 interface.

The Operator Console Window is shown in Figure 482:

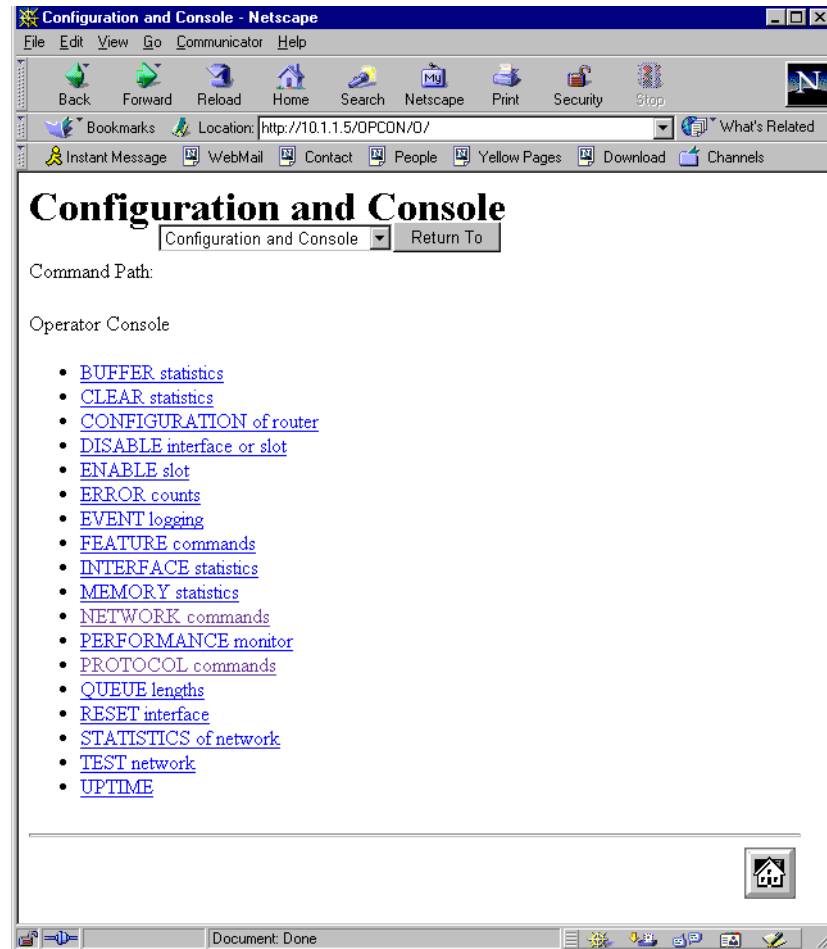


Figure 482. Operator Console Window

The window shown in Figure 483 on page 418 is an example what you get when you click an Ethernet port to show its status. An Ethernet port is shown in Figure 480:

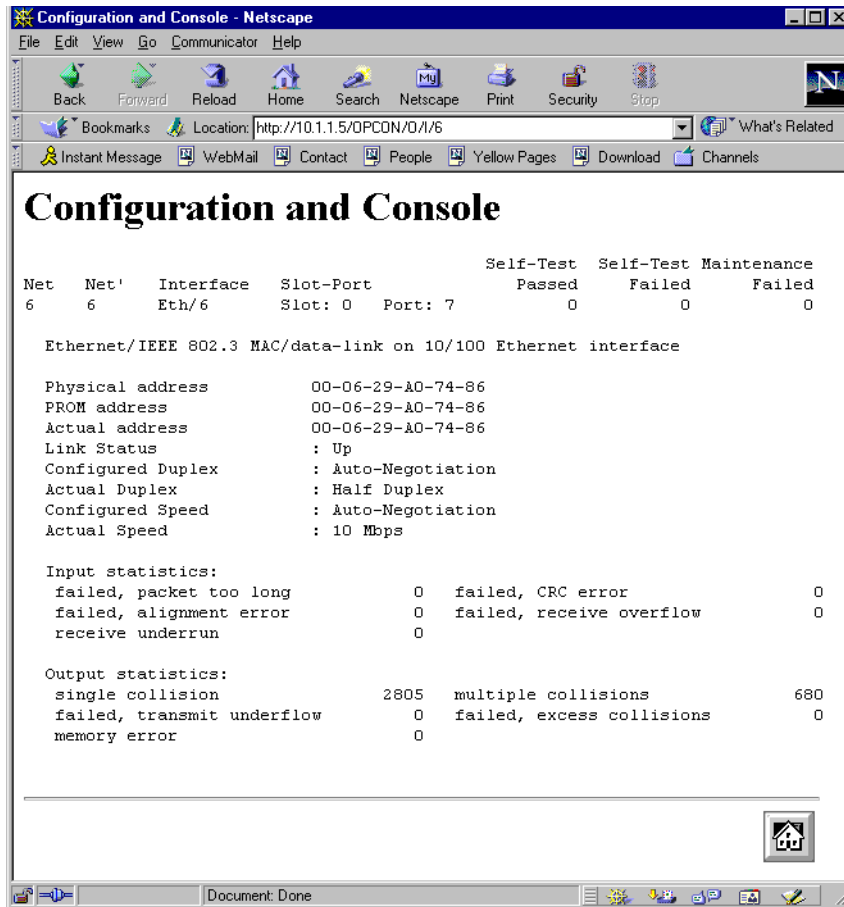


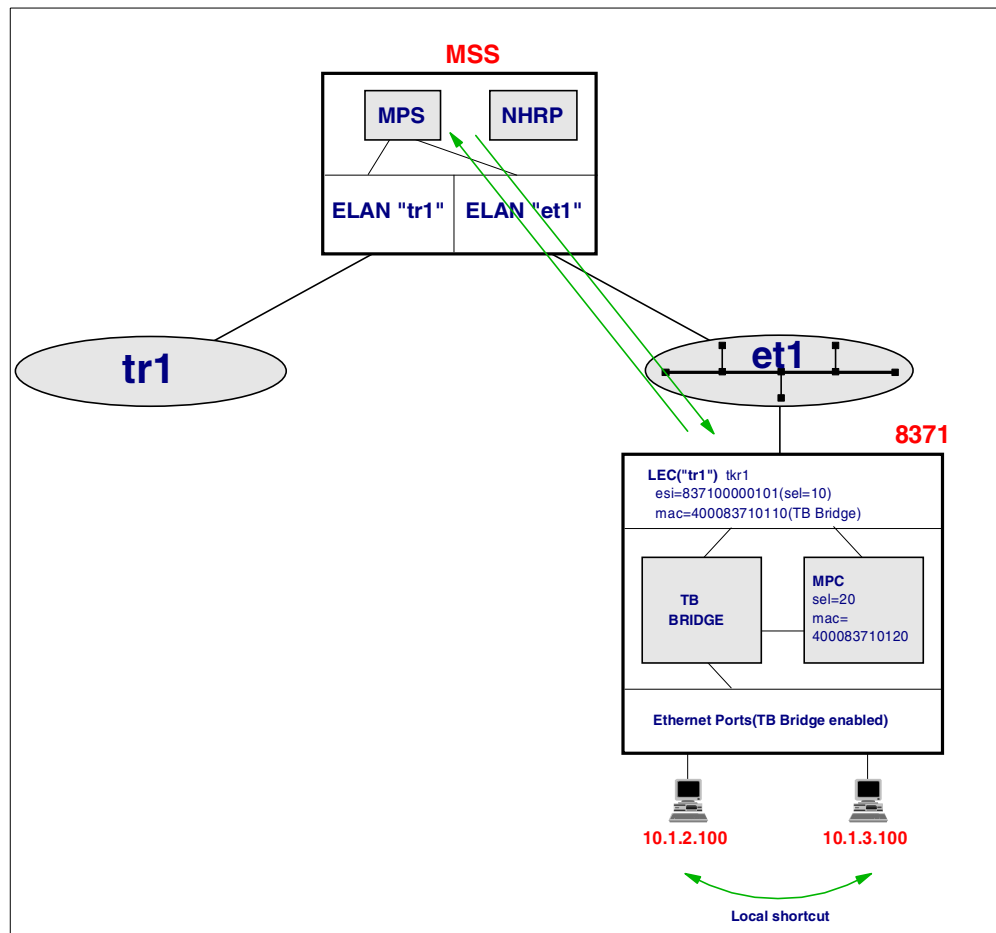
Figure 483. Show Ethernet Port (Port 7) on 8371

### 10.5.3 8371 Local MPOA Shortcut

We are going to connect two workstations to 8371 ports that have IP addresses in different subnets. These workstation addresses are 10.1.2.100 and 10.1.3.100 and would normally require a router to route between the subnets. With the 8371 MPOA client we can create a local shortcut between the Ethernet ports so that user data bypasses the MSS router.

After connecting the workstations a file transfer was performed between them.

A diagram of the configuration is shown in Figure 484:



### 10.5.3.1 Monitoring on MSS

To see this type: Talk 5 -> Protocol MPOA -> MPS -> Discovery as shown in Figure 485:

| MSS1 MPS >DISCOVERY |      |      |              |                                            |  |
|---------------------|------|------|--------------|--------------------------------------------|--|
| DISCOVERY TABLE     |      |      |              |                                            |  |
| Net                 | Type | Age  | MAC Addr/RD  | ATM Address                                |  |
| 2                   | MPC  | 1974 | 0004ACEBEA20 | 3999999999999999000011110111000629A074A602 |  |
| 2                   | MPC  | 32   | 000629A07486 | 399999999999999900001111011183710000010120 |  |
| 2                   | MPC  | 1943 | 000629A07489 | 3999999999999999000011110111000629A074A602 |  |
| 2                   | MPC  | 7697 | 0200C18E8080 | 3999999999999999000011110111000629A074A602 |  |
| 2                   | MPC  | 1936 | 08005A394D9E | 3999999999999999000011110111000629A074A602 |  |
| 3                   | MPS  | 2985 | 400882100211 | 399999999999999900001111022182100000000214 |  |
| 3                   | MPC  | 276  | A12C         | 399999999999999900001111011182700000010120 |  |

**Note:**

### 10.5.3.2 Monitoring the MPOA Connections on the 8371

To display what VCCs the 8371 has established type Talk 5 -> Protocol MPOA -> MPC -> 38 -> VCC -> LIST as shown in Figure 486:

```
MPC/38 VCC>LIST
 SVCs For MPC On ATM Interface 38 (total 2):
 =====
1) VPI/VCI 0/406 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14
2) VPI/VCI 0/407 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.01.20.
```

Figure 486. Show List of VCCs

To see what workstation addresses have created shortcuts look at the ingress list by typing Talk 5 -> Protocol MPOA -> MPC -> 38 -> Ingress as shown in Figure 487:



```

MPC/38 INGRESS>LIST
IP-Ingress Cache For MPC on ATM Interface 38
=====
Ingress Cache Entries for Direct Host Routes:

1) IP Address: 10.1.3.100 State: RESOLVED 1
2) IP Address: 10.1.2.100 State: RESOLVED 1
3) IP Address: 100.121.107.96 State: FLOW DETECTION
4) IP Address: 100.2.1.10 State: FLOW DETECTION
Ingress Cache Entries for Direct Network Routes:

Ingress Cache Entries for Derived Host Routes:

MPC/38 INGRESS>LIST-ENTRIES
Destination Protocol Address [0.0.0.0]? 10.1.3.100
Destination Protocol Address Mask [255.255.255.255]?
Host Route Entries matching 10.1.3.100/255.255.255

Direct Host Routes :
1) Address: 10.1.3.100 Shortcut State: RESOLVED
Hold Down Cause: N/A CIE Code: x0
Dest ATM: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20
Remaining Age (mins:secs): 17:44 Last Request ID: x2
Destn MTU: 1500 Encaps. Type: TAGGED 3
LANE Encaps. Hdr: xN/A
Tag Value: x2
Shortcut VCC (VPI/VCI): 0/ 0 Local Shortcut ?: TRUE 2
MPS: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14
Derived Host Routes :
Network Route Entries matching 10.1.3.100/255.255.255

None found!

MPC/38 INGRESS>LIST-ENTRIES
Destination Protocol Address [0.0.0.0]? 10.1.2.100
Destination Protocol Address Mask [255.255.255.255]?
Host Route Entries matching 10.1.2.100/255.255.255

Direct Host Routes :
1) Address: 10.1.2.100 Shortcut State: RESOLVED
Hold Down Cause: N/A CIE Code: x0
Dest ATM: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20
Remaining Age (mins:secs): 17:33 Last Request ID: x1
Destn MTU: 1500 Encaps. Type: TAGGED 3
LANE Encaps. Hdr: xN/A
Tag Value: x1
Shortcut VCC (VPI/VCI): 0/ 0 Local Shortcut ?: TRUE 2
MPS: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14
Derived Host Routes :
Network Route Entries matching 10.1.2.100/255.255.255

None found!.
```

Figure 487. Show List of Ingress Entries

**Note:**

- 1** IP addresses 10.1.3.100 and 10.1.2.100 are resolved. A shortcut has been created between them.
- 2** As both workstations are on the same 8371 a local shortcut has been created.

- 3** The encapsulation type is LLC Tagged. This is the method preferred by the 8371.

The Egress display shows the same status information for the two stations.

```
MPC/38 EGRESS>LIST
 Egress Cache For MPC on ATM Interface 38
 =====
 Egress Cache Entries w/ MPOA-Tag Encapsulation:

 1) IP Address/Mask: 10.1.3.100 /255.255.255.255 State: ACTIVE
 2) IP Address/Mask: 10.1.2.100 /255.255.255.255 State: ACTIVE
 Egress Cache Entries w/ Native 1483 Encapsulation (Host Routes):

 1) IP Address/Mask: 10.1.1.5 /255.255.255.255 State: ACTIVE
 Egress Cache Entries w/ Native 1483 Encapsulation (Netwk Routes):

MPC/38 EGRESS>LIST-ENTRIES 10.1.3.100
Destination Protocol Address Mask [255.255.255.255]?
 Egress Cache Entries matching 10.1.3.100/255.255.255.255 :
 1) Address/Mask: 10.1.3.100/255.255.255.255 Type: TAG
 LEC #: 40 Cache ID: x66 State: ACTIVE
 MPS: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.01.14
 Source: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20
 Remaining Age (mins:secs): 37:16
 Tag Value: x2 Local Shortcut: TRUE
 DLL Header: x08005a394d9e4000821001100800
 LANE Extensions in last Imposition reply: None

MPC/38 EGRESS>LIST-ENTRIES 10.1.2.100
Destination Protocol Address Mask [255.255.255.255]?
 Egress Cache Entries matching 10.1.2.100/255.255.255.255 :
 1) Address/Mask: 10.1.2.100/255.255.255.255 Type: TAG
 LEC #: 40 Cache ID: x65 State: ACTIVE
 MPS: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.01.14
 Source: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20
 Remaining Age (mins:secs): 37:10
 Tag Value: x1 Local Shortcut: TRUE
 DLL Header: x0004acebea204000821001100800
 LANE Extensions in last Imposition reply: None.
```

Figure 488. Show List of Egress Entries

#### 10.5.4 Connectivity between 8270 and 8371 Using MPOA

We will now show MPOA connectivity between our 8371 attached to the ELAN et1 and an 8270 attached to the ELAN tr1. The configuration of our 8371 is the same as that just used for the local shortcut example. The 8270 has the same configuration as that used in 10.3, “8270 and 2216 Configurations with MPOA and NHRP” on page 369.

To create the shortcut we will transfer our 12 MB file between a workstation attached to our 8371 and a token-ring workstation attached to our 8270.

A logical network diagram is shown in Figure 489:



```

MSS1 MPS >CONTROL-VCCs
 MPS Control VCCs
VPI VCI Net RefCnt MpcCnt Remote ATM Address

0 754 0 13 1 399999999999900001111011182700000010120
0 298 0 6 2 399999999999900001111011183710000010120

```

Figure 491. The CONTROL-VCCs Command

### 10.5.4.2 Monitoring the Connections from the 8371

The following screen shows the three displays from the 8371:

```

MPC/38 VCC>LIST
 SVCs For MPC On ATM Interface 38 (total 3):
 =====
1) VPI/VCI 0/456 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.01.14
2) VPI/VCI 0/459 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.20
3) VPI/VCI 0/460 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.20

MPC/38 VCC>LIST-VCC
VPI, Range 0..255 [0]?
VCI, Range 0..65535 [0]? 459
VPI/VCI: 0/459 State: OPERATIONAL Calling Party: FALSE 1
Hold Down Cause: N/A Cause Code: N/A Fwd/Bak SDU:1536/1536
Remote ATM Addr: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.20
Conn Type: P2P VCC Type: B. EFFORT Encaps. Type: LLC 1483 2
Ref. Frame Cnt: 0
Frames Tx/Rx: 0/9504
(Direct) Shortcut Routes Using This VCC:

MPC/38 VCC>LIST-VCC
VPI, Range 0..255 [0]?
VCI, Range 0..65535 [0]? 460
VPI/VCI: 0/460 State: OPERATIONAL Calling Party: TRUE 3
Hold Down Cause: N/A Cause Code: N/A Fwd/Bak SDU:4544/4544
Remote ATM Addr: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.20
Conn Type: P2P VCC Type: B. EFFORT Encaps. Type: TR-LANE 4
Ref. Frame Cnt: 0
Frames Tx/Rx: 4433/0
(Direct) Shortcut Routes Using This VCC:

1) Address/Mask: 10.2.2.100/255.255.255.255 State: RESOLVED

```

Figure 492. Show List of VCCs

#### Notes:

- 1** Calling party: FALSE means this VCC was established from the other end, that is, the 8270.
- 2** The encapsulation type is LLC 1483. This is the format preferred by the 8371.
- 3** The calling Party is TRUE. The 8371 established the VCC to the 8270.
- 4** The encapsulation used is TR-LANE. This is the 8270's preferred encapsulation type.

The ingress connections for this client are shown in Figure 493 on page 425. First the `list` command is issued, then `list-entries 10.2.2.100`. The information displayed is similar to the previous display.

```

MPC/38 INGRESS>LIST
 IP-Ingress Cache For MPC on ATM Interface 38
 =====
 Ingress Cache Entries for Direct Host Routes:

1) IP Address: 10.2.2.100 State: RESOLVED
 Ingress Cache Entries for Direct Network Routes:

 Ingress Cache Entries for Derived Host Routes:

MPC/38 INGRESS>LIST-ENTRIES 10.2.2.100
Destination Protocol Address Mask [255.255.255.255]?
 Host Route Entries matching 10.2.2.100/255.255.255

 Direct Host Routes :
1) Address: 10.2.2.100 Shortcut State: RESOLVED
 Hold Down Cause: N/A CIE Code: x0
 Dest ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.70.00.00.01.01.20 1
 Remaining Age (mins:secs): 16:23 Last Request ID: x1
 Destn MTU: 4490 Encaps. Type: TR-SNAP-IP-LANE
 LANE Encaps. Hdr: x00000040400099990020c0008210011106b0a12ca110
 Tag Value: N/A
 Shortcut VCC (VPI/VCI): 0/ 460 Local Shortcut ?: FALSE 2
 MPS: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14
 Derived Host Routes :
 Network Route Entries matching 10.2.2.100/255.255.255

None found!.
```

Figure 493. Show List of Ingress Cache Entries

#### Notes:

- 1 The ATM address for IP workstation 10.2.2.100, that is, the 8270.
- 2 This is not a local shortcut, hence FALSE.

#### 10.5.4.3 Monitoring the Connections from the 8270

Looking at the same connections from the 8270 end we see the following.

First the VCCs. The first command below shows there are two VCCs to the 8371. A full display of each of them is shown in Figure 494:

```

8270#1 MPC VCC>LIST
 SVCs For MPC On ATM Interface 0 (total 4):
 =====
1) VPI/VCI 0/907 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14
2) VPI/VCI 0/908 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.11
3) VPI/VCI 0/922 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20
4) VPI/VCI 0/923 State: OPERATIONAL
 Remote ATM: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20

8270#1 MPC VCC>LIST-VCC
VPI, Range 0..255 [0]?
VCI, Range 0..65535 [0]? 922 1
VPI/VCI: 0/922 State: OPERATIONAL Calling Party: TRUE
Hold Down Cause: N/A Cause Code: N/A Fwd/Bak SDU:1536/1536
Remote ATM Addr: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20
Conn Type: P2P VCC Type: B. EFFORT Encaps. Type: LLC 1483
H/W Path Valid: FALSE Ref. Frame Cnt: 0
Frames Tx/Rx: 9450/0 Bytes Tx/Rx: 12672094/0
(Direct) Shortcut Routes Using This VCC:

1) Address/Mask: 10.1.2.100/255.255.255.255 State: RESOLVED
2) Address/Mask: 10.1.1.5/255.255.255.255 State: RESOLVED

8270#1 MPC VCC>LIST-VCC
VPI, Range 0..255 [0]?
VCI, Range 0..65535 [0]? 923 2
VPI/VCI: 0/923 State: OPERATIONAL Calling Party: FALSE
Hold Down Cause: N/A Cause Code: N/A Fwd/Bak SDU:4544/4544
Remote ATM Addr: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20
Conn Type: P2P VCC Type: B. EFFORT Encaps. Type: TR-LANE
H/W Path Valid: TRUE Ref. Frame Cnt: 0
Frames Tx/Rx: 0/4434 Bytes Tx/Rx: ?/?
(Direct) Shortcut Routes Using This VCC:

```

Figure 494. Show List of VCCs

#### Notes:

**1** This VCC is initiated by the 8270.

**2** This VCC is initiated by the 8371.

The ingress connections from this MPOA client are shown in Figure 495. The figure shows that the shortcut connection has been created to 10.1.2.100 (RESOLVED).

```

8270#1 MPC INGRESS>LIST
IP-Ingress Cache For MPC on ATM Interface 0
=====
Ingress Cache Entries for Direct Host Routes:

1) Protocol Address: 10.2.1.1 Shortcut State: RESOLVED
2) Protocol Address: 10.2.1.5 Shortcut State: RESOLVED
3) Protocol Address: 10.2.2.100 Shortcut State: RESOLVED
4) Protocol Address: 10.1.2.100 Shortcut State: RESOLVED 1
5) Protocol Address: 10.1.1.5 Shortcut State: RESOLVED
6) Protocol Address: 10.1.1.1 Shortcut State: HOLD DOWN
Ingress Cache Entries for Direct Network Routes:

Ingress Cache Entries for Derived Host Routes:

8270#1 MPC INGRESS>LIST-ENTRIES 10.1.2.100
Destination Protocol Address Mask [255.255.255.255]?
Host Route Entries matching 10.1.2.100/255.255.255

Direct Host Routes :
1) Address: 10.1.2.100 Shortcut State: RESOLVED
 Hold Down Cause: N/A CIE Code: x0
 Dest ATM: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20 2
 Frames Sent To MPS: 1 Frames Sent Over Shortcut: 9263
 Remaining Age (mins:secs): 10:31 Last Request ID: x163
 Destn MTU: 1500 Encaps. Type: TAGGED
 LANE Encaps. Hdr: xN/A
 Tag Value: x1
 Shortcut VCC (VPI/VCI): 0/ 922 Local Shortcut ?: FALSE
 MPS: 39.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.00.01.14
 Derived Host Routes :
 Network Route Entries matching 10.1.2.100/255.255.255

None found!

```

Figure 495. Show List of Ingress Cache Entries

#### Notes:

- 1 The shortcut connection to 10.1.2.100 has been created (RESOLVED).
- 2 The ATM address for IP address 10.1.2.100.

The egress connections from this client are shown in Figure 496 on page 428. This shows the connection from the 8371 to the 8270.

```

8270#1 MPC EGRESS>LIST
 Egress Cache For MPC on ATM Interface 0
 =====
 Egress Cache Entries w/ MPOA-Tag Encapsulation:

 Egress Cache Entries w/ Native 1483 Encapsulation (Host Routes):

 1) Protocol Address/Mask: 10.2.2.100 /255.255.255.255 State: ACTIVE
 2) Protocol Address/Mask: 10.2.1.5 /255.255.255.255 State: ACTIVE
 Egress Cache Entries w/ Native 1483 Encapsulation (Netwk Routes):

8270#1 MPC EGRESS>LIST-ENTRIES 10.2.2.100
Destination Protocol Address Mask [255.255.255.255]?
 Egress Cache Entries matching 10.2.2.100/255.255.255.255 :
 1) Address/Mask: 10.2.2.100/255.255.255.255 Entry Type: 1483 (HOST, DIRECT)
 LEC #: 3 Cache ID: x6E State: ACTIVE
 MPS: 39.99.99.99.99.99.99.00.00.11.11.01.11.82.10.00.00.01.14
 Source: 39.99.99.99.99.99.00.00.11.11.01.11.83.71.00.00.01.01.20
 Remaining Age (mins:secs): 37:10
 Recvd Octets: N/A
 Recvd Frames Forwarded: N/A
 Recvd Frames Discarded: N/A
 Tag Value: N/A Local Shortcut: FALSE
 DLL Header: x0040400099990020c0008210011106b0a12ca110aaaa0300000000800
 LANE Extensions in last Imposition reply: Formats 7, 11, 13, 17

```

Figure 496. Show List of Egress Cache Entries

#### 10.5.4.4 Statistics Report on MSS1 with MPOA Shortcut

A display of the statistics in MSS1 before and after transferring the 12 MB file is shown in Figure 497:

```

MSS1 +STATISTICS
Net Interface Unicast Multicast Bytes Packets Bytes
 Pkts Rcv Pkts Rcv Received Trans Trans
0 ATM/0 38 0 2822 45 3461
1 NHRPL/0 0 0 0 0 0
2 Eth/0 1 3 294 3 186
3 TKR/0 12 4 1223 6 382
4 TKR/1 0 0 0 0 0
5 TKR/2 0 1 54 1 54

MSS1 +STATISTICS
Net Interface Unicast Multicast Bytes Packets Bytes
 Pkts Rcv Pkts Rcv Received Trans Trans
0 ATM/0 665 0 47545 927 74351
1 NHRPL/0 0 0 0 0 0
2 Eth/0 82 54 14479 54 3348
3 TKR/0 74 83 11749 126 13501
4 TKR/1 0 1 54 1 54
5 TKR/2 1 4 270 5 270

```

Figure 497. Show Statistics on MSS1 with MPOA Enabled

#### 10.5.4.5 Statistics Display on MSS1 with No MPOA Shortcut

The displays in Figure 498 on page 429 were taken before and after a 12 MB file was transferred.



| MSS1 + <b>STATISTICS</b> |           |                     |                       |                   |                  |                |
|--------------------------|-----------|---------------------|-----------------------|-------------------|------------------|----------------|
| Net                      | Interface | Unicast<br>Pkts Rcv | Multicast<br>Pkts Rcv | Bytes<br>Received | Packets<br>Trans | Bytes<br>Trans |
| 0                        | ATM/0     | 30                  | 0                     | 1762              | 38               | 2866           |
| 1                        | NHRPL/0   | 0                   | 0                     | 0                 | 0                | 0              |
| 2                        | Eth/0     | 1                   | 2                     | 232               | 2                | 124            |
| 3                        | TKR/0     | 7                   | 3                     | 734               | 5                | 330            |
| 4                        | TKR/1     | 0                   | 0                     | 0                 | 0                | 0              |
| 5                        | TKR/2     | 0                   | 0                     | 0                 | 0                | 0              |

| MSS1 + <b>STATISTICS</b> |           |                     |                       |                   |                  |                |
|--------------------------|-----------|---------------------|-----------------------|-------------------|------------------|----------------|
| Net                      | Interface | Unicast<br>Pkts Rcv | Multicast<br>Pkts Rcv | Bytes<br>Received | Packets<br>Trans | Bytes<br>Trans |
| 0                        | ATM/0     | 13883               | 0                     | 13107680          | 14091            | 13039996       |
| 1                        | NHRPL/0   | 0                   | 0                     | 0                 | 0                | 0              |
| 2                        | Eth/0     | 4488                | 45                    | 282122            | 8973             | 12677484       |
| 3                        | TKR/0     | 8985                | 70                    | 12809026          | 4528             | 316879         |
| 4                        | TKR/1     | 0                   | 1                     | 54                | 1                | 54             |
| 5                        | TKR/2     | 0                   | 0                     | 0                 | 0                | 0              |

Figure 498. Show Statistics on MSS1 without MPOA Clients

## 10.6 OSA-2 ATM Adapter

We are now going to configure an OSA-2 ATM adapter in a 9672 with two LAN-emulation clients joining our network. How the OSA-2 will attach to the network is shown in Figure 499:

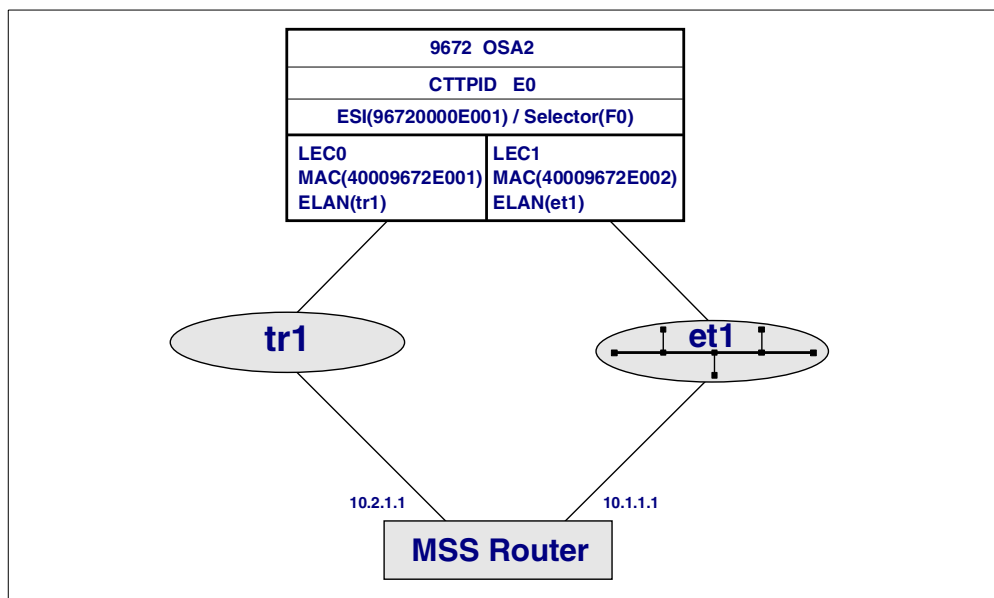


Figure 499. Logical Attachment of OSA to the Network

We will attach the OSA-2 to logical partition 4 (LP4) which is running an OS/390 system with a TCP/IP stack. The OSA/SF is also running in this partition. The OSA-2 is on CHPID E0. Address 20A0/1 will attach to LEC0 and 20A2/3 will attach to LEC1 as shown below. Address 20AF is used by the OSA/SF to connect to the OSA-2 card.

We are going to configure both LAN-emulation clients available with the ATM OSA-2 card. The aim here is to show how to configure both even though we did not use both of them in our moderately simple network design.

The aim here is to show how to configure the OSA-2. Detailed information about the OSA-2 is available in the following publications:

*Planning for the S/390 Open Systems Adapter (OSA-1, OSA-2) Feature, GC23-3870*

*OSA-2 Implementation Guide for OS/390, SG24-4470*

*Open Systems Adapter Support Facility User's Guide, SC28-1855*

Figure 500 shows how the system addresses are assigned:

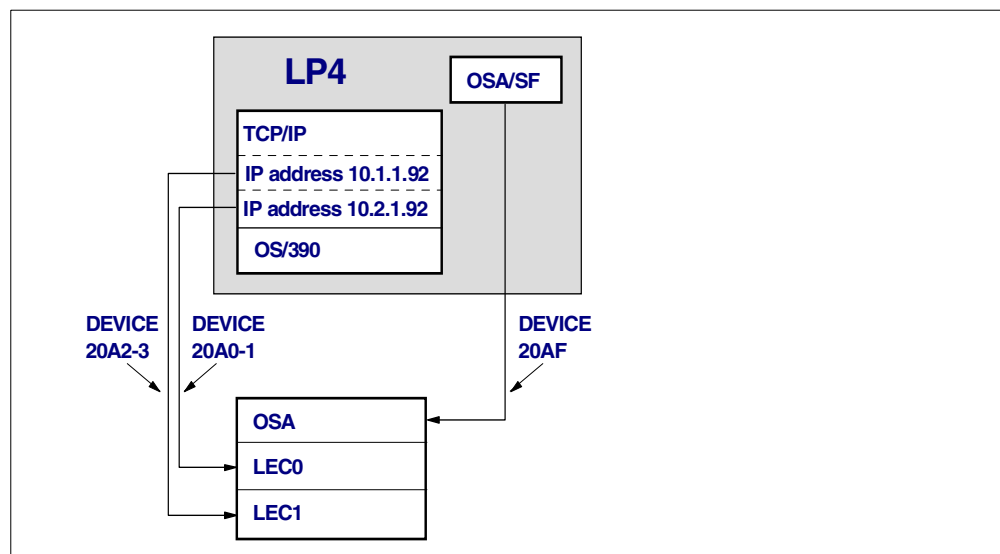


Figure 500. System Addresses in LP4

An overview of how the OSA/SF GUI running on a workstation connects to the OSA/SF application in the 9672 is shown in Figure 501 on page 431. The OSA-2 can be configured using the GUI or IOACMD from a TSO session.

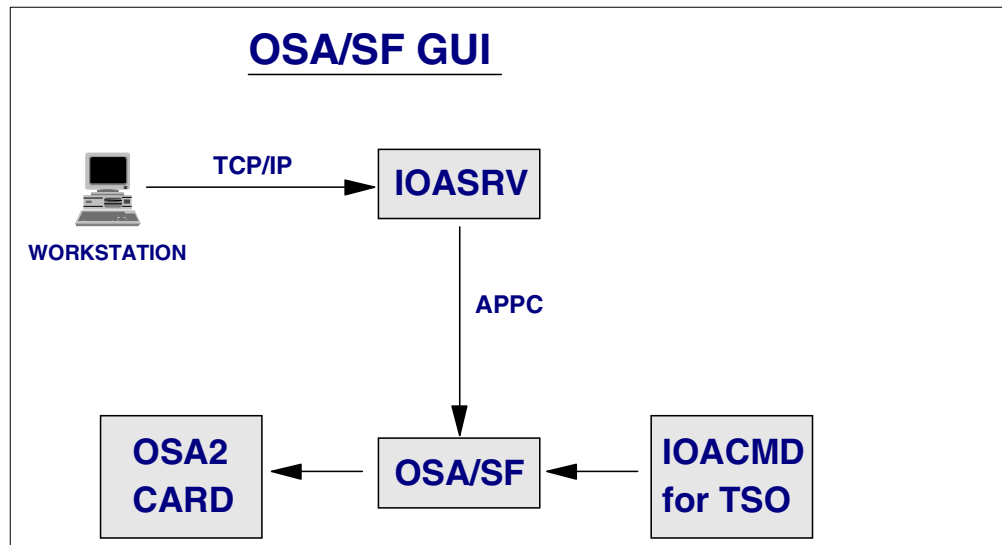


Figure 501. OSA/SF GUI Logistics

We are going to configure the OSA-2 using the OSA/SF GUI. The configuration program GUI comes with the OSA/SF code and has to be downloaded from the 9672 and installed on a workstation. This can be done using a terminal emulator or FTP provided you have access to the 9672. We already had a TCP/IP network with access to the 9672 so we used FTP to download the file. Detailed instructions on how to download and install the GUI can be found in *Open Systems Adapter Support Facility User's Guide*, SC28-1855.

Start the GUI on your workstation. The OSA/SF Hosts window is displayed. Your first step is to create an icon that has the connectivity information behind it to connect to the OSA/SF application in the 9672. From the Selected pull-down menu choose **create another**. We then selected **TCP/IP** because we already had a TCP/IP connection to the host. From the next screen define the connectivity information: IP address, Port number (default is 2000) and the name for this host.

Double-click the icon you have created to connect the OSA/SF application in the 9672. An example of this is shown in Figure 502:

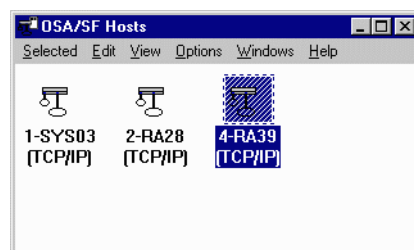


Figure 502. OSA/SF Hosts

This screen has three icons and can connect to the OSA/SF in three systems. We use TCP/IP to connect to the host in logical partition 4 which we have named RA39.

Once connected to the OSA/SF the first window displayed is the OSA CHPID Tree View in its collapsed form. To work with an OSA click the + sign to expand it.

This displays the ports available on the OSA-2 card and the channel device addresses. This is shown in Figure 503 where our CHPID E0 is shown expanded.

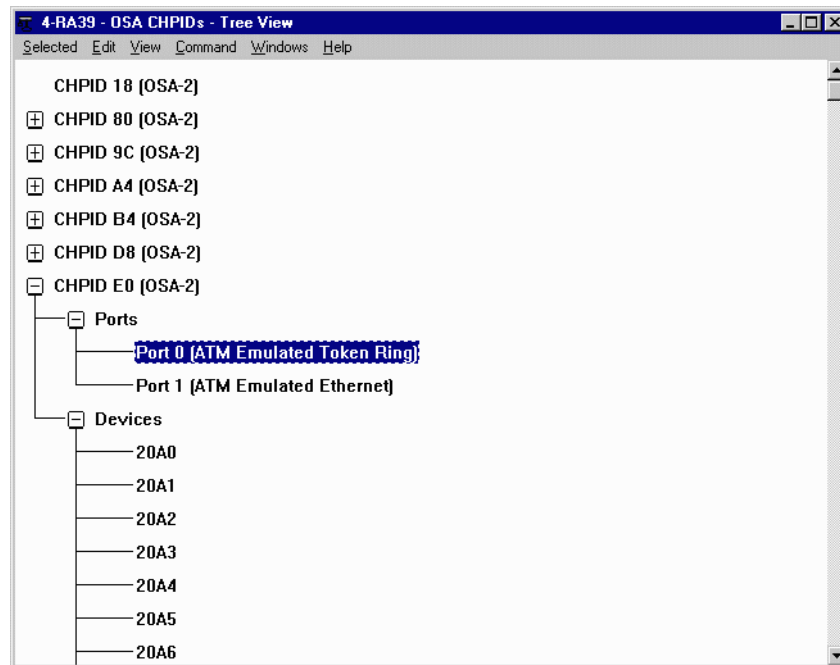


Figure 503. 4-RA39 - OSA CHPIDs - Tree View

Start the configuration by double-clicking **Port 0**. The resulting window for Port 0 is shown in Figure 504 on page 433. Start by configuring the ESI for the OSA-2 adapter.

On the Physical tab click **Set** for the Active MAC address (ESI).

#### Note

The ESI display has an error in Figure 504 on page 433. The displayed ESI should be *96.72.00.00.E0.01* instead of *9.72.00.00.E0.01*. This will be corrected in future release.

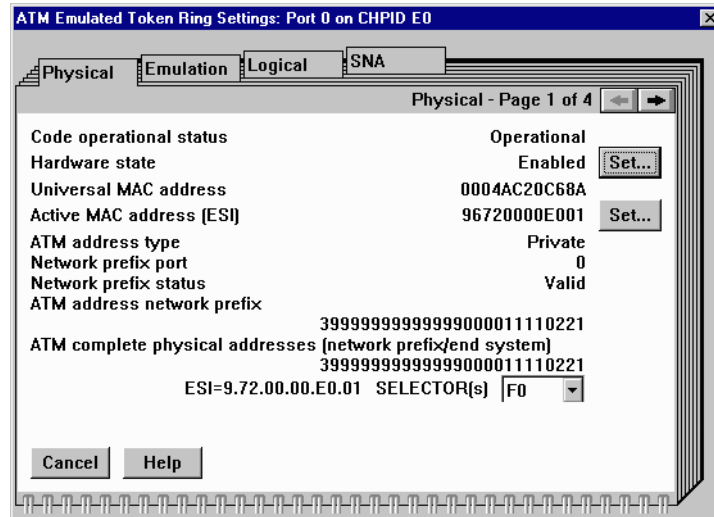


Figure 504. ATM Emulated Token Ring Settings: Port 0 on CHPID E0

The Set Active MAC Address (ESI) window is shown in Figure 505.

### Note

The ESI parameter is an ATM End System Identifier. It is not a MAC address. Make sure that the value you use is different from any other ATM device ESI value connecting to the same ATM switch.

We have specified an ESI of 96720000E001 in line with our existing scheme shown in Figure 11 on page 276. Click **Set** when you have finished. This sets the new value into the OSA-2 card. There is a prompt to re-enable the OSA-2 to make the change active. We did not do so at this stage as there is more configuration to do.

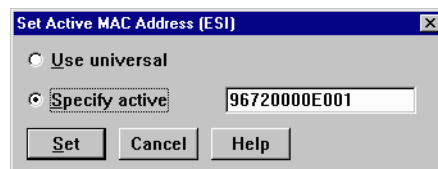


Figure 505. Set Active MAC Address (ESI)

You will be returned to the OSA CHPIDs Tree View window (Figure 506 on page 434).

Now highlight the CHPID (in our case E0) and from the Selected pull-down list choose **Configurations** -> **Config list**.

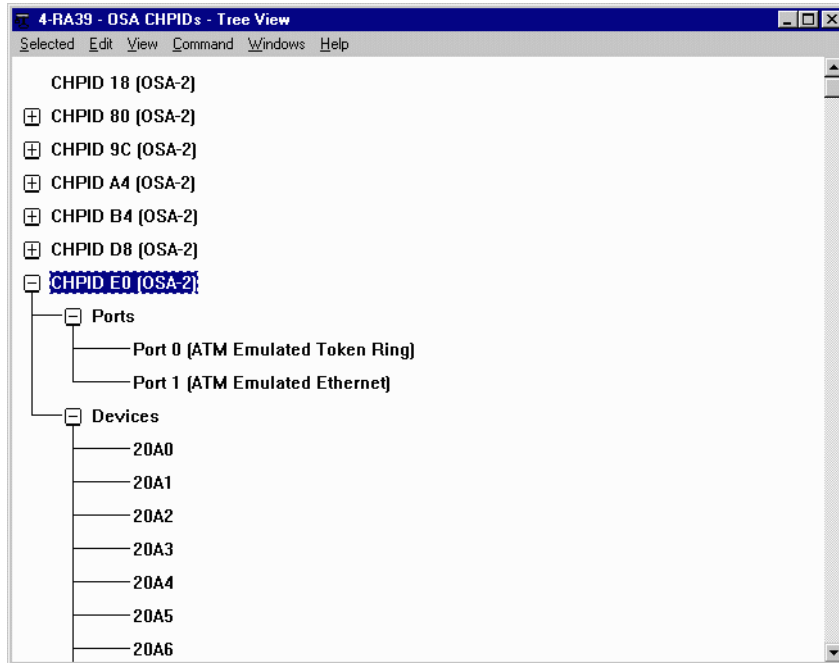


Figure 506. 4-RA39 - OSA CHPIDs - Tree View

The configuration list for CHPID E0 is displayed (Figure 507).

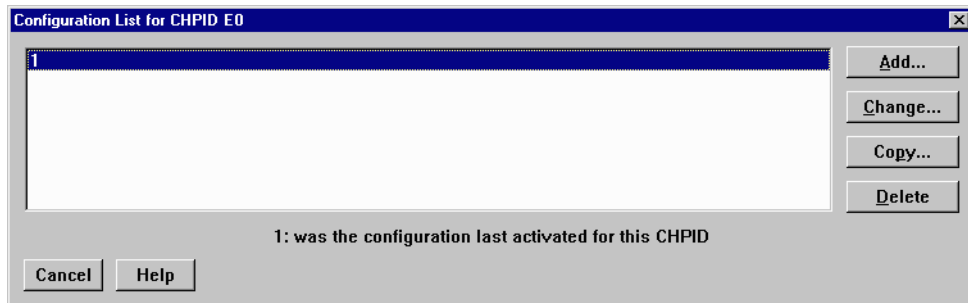


Figure 507. Configuration List for CHPID E0

The window shown contains configuration 1, which is the one we built and will describe. This window will be blank when you start so click **Add...** to bring up the first configuration window. This is shown in Figure 508:

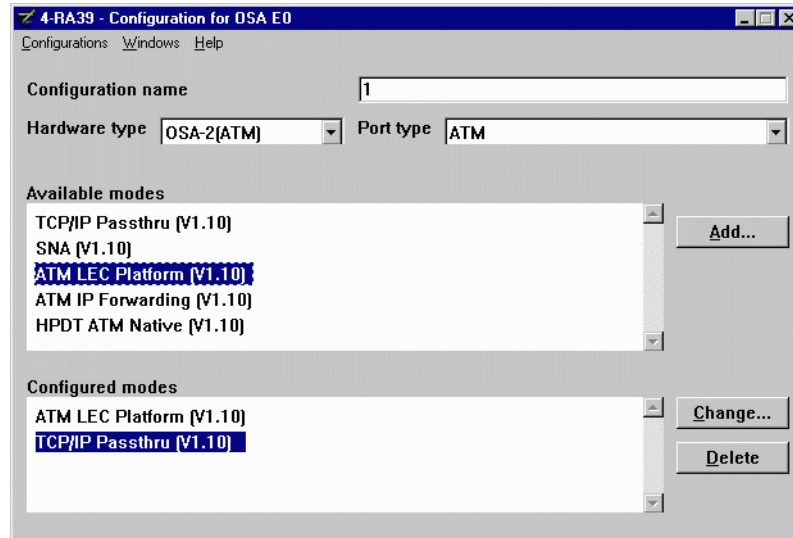


Figure 508. 4-RA39 - Configuration for OSA E0

Enter a name for the configuration you are going to create in the Configuration name field (See Figure 508).

We are going to create a configuration with two LAN-emulation clients so click **ATM LEC Platform** under the Available modes section and click **Add....** This will take you to the ATM LEC Platform Settings window as shown in Figure 509:

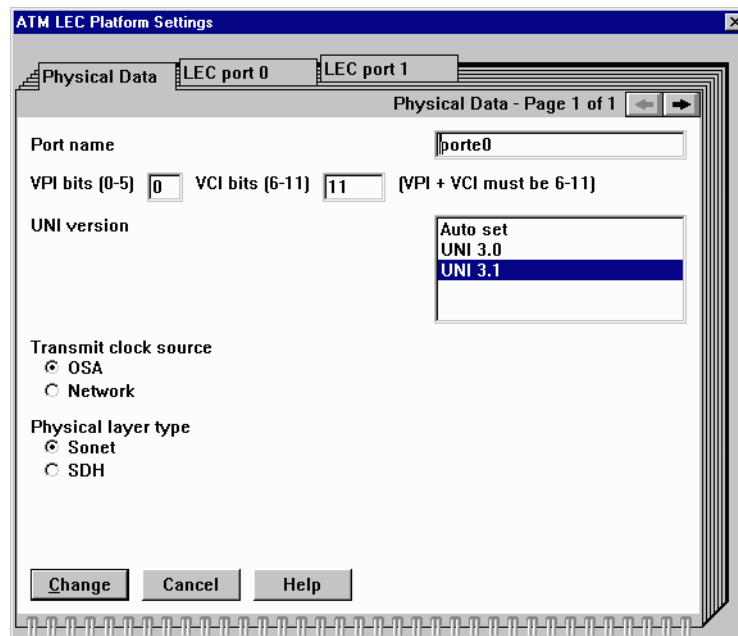


Figure 509. ATM LEC Platform Settings

There are three tabs here: A Physical Data tab with one page for the ATM port settings, UNI type, VPI/VCI bit ranges, etc; a LEC port 0 tab with three pages for setting the definitions for the first LAN-emulation client; a tab for LEC port 1, which contains the same three pages for the second client.

At the Physical Data page in Figure 509, click the UNI version to **UNI\_3.1**. To set a port name, we typed `porte0`. The other options are left at the defaults, that is, OSA transmit clock source, SONET is physical layer type and the maximum number of VPI and VCI bits are 0 and 11.

**Note**

The VPI/VCI value defined at the ATM switch must match or be a subset of the default values of the OSA adapter for the ILMI negotiation to succeed.

For your reference we show how our port 7.13 was configured in Figure 510:

```
8260_hub21> show port 7.13 verbose
 Type Mode Status

 7.13:UNI enabled UP

Signalling Version : Auto
> Oper Sig. Version : 3.1
ILMI status : UP
ILMI vci : 0.16
RB Bandwidth : unlimited
Signalling vci : 0.5
Administrative weight: 5040
VPI.VCI range : 15.1023 (4.10 bits)
Connector : SC DUPLEX
Media : multimode fiber
Port speed : 155000 kbps
Remote device is active

Frame format : SONET STS-3c
Scrambling mode : frame and cell
Clock mode : internal
```

*Figure 510. ATM Port Definition at the Switch*

Select the **LEC port 0** tab to configure the first LEC shown in Figure 511:



ATM LEC Platform Settings

Physical Data | LEC port 0 | LEC port 1

LEC port 0 (Implementation values) - Page 1 of 3

Use this port in the configuration ☒ Yes ☐ No

Local MAC address ☐ Use universal ☒ Specify local 40009672E001

LAN type Token Ring (16Mb)

Enhanced mode ☐ Yes ☒ No

Best effort peak rate (Mb/sec) 155.0

Max data frame size 4544

Change Cancel Help

Figure 511. ATM LEC Platform Settings: LEC Port 0 (Page 1 of 3)

This will be a token-ring LEC and will join the ELAN tr1. Ensure the Use this port in the configuration is set to **Yes**. Enter the MAC address in the local MAC address field (we are using 40009672E001), select the LAN type, Token Ring (16 Mb) in our case, and select the Max data frame size, **4544**.

Go to the Page 2 of 3 for LEC port 0 shown in Figure 512 (by clicking the arrow pointing to the right in the top right-hand corner of the window).

ATM LEC Platform Settings

Physical Data | LEC port 0 | LEC port 1

LEC port 0 (Architected values) - Page 2 of 3

Automatic configuration mode ☒ Automatic ☐ Manual

This port's remaining fields are settable, but have defaults. The exceptions are: 'LE Server ATM address' and 'Emulated LAN name', which **MUST** have values when Automatic cfg. mode is: manual. When Automatic cfg. mode is: auto, the fields are settable (except 'LE Server ATM address'), but some may be overridden by the LAN Emulation Configuration Server (LECS).

LE Server ATM address

Emulated LAN name tr1

Control timeout (seconds) 120

Maximum unknown frame count 5

Change Cancel Help

Figure 512. ATM LEC Platform Settings: LEC Port 0 (Page 2 of 3)

Leave the Automatic configuration mode checked. The client will then look for a LECS address from the ATM switch and go there for the LES/BUS address.

Enter the ELAN name `tr1` in the Emulated LAN name field. Leave the other parameters at the defaults.

Page 3 of 3 for the LEC contains control parameters and we left these at the defaults seen in Figure 513:

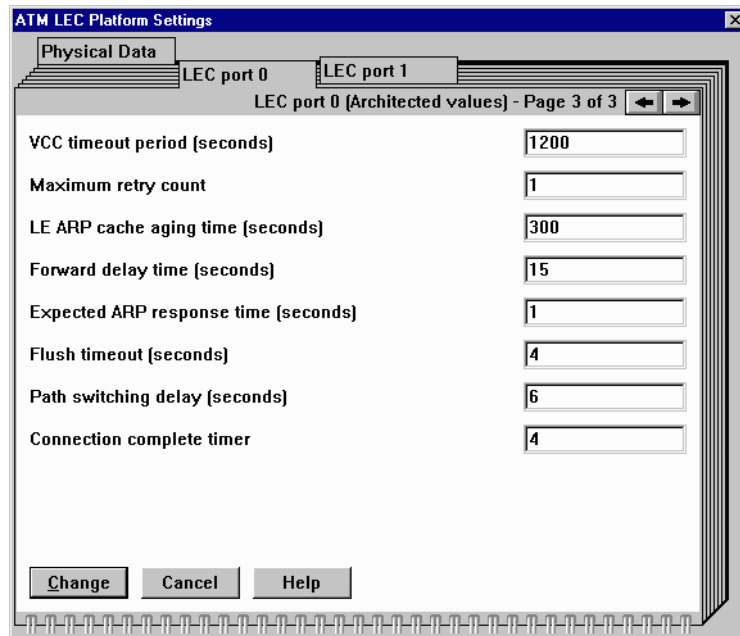


Figure 513. ATM LEC Platform Settings: LEC Port 0 (Page 3 of 3)

Now select the **LEC port 1** tab. The first window for the second LEC is displayed as shown in Figure 514 on page 439.

The configuration steps are the same as those just entered for LEC 0 apart from the addresses.

Enable this port by setting the Use this port in the configuration to **Yes**. Enter the MAC address (`02009672E002`) in the local MAC address field. As this is going to join an Ethernet ELAN the MAC address has to be in canonical format. Set the LAN type by selecting **Ethernet** and the maximum frame size by choosing **1516**. Leave the other parameters at the defaults.

ATM LEC Platform Settings

Physical Data | LEC port 0 | LEC port 1

LEC port 1 (Implementation values) - Page 1 of 3

Use this port in the configuration ☒ Yes ☐ No

Local MAC address ☐ Use universal ☒ Specify local 02009672E002

LAN type Ethernet

Enhanced mode ☐ Yes ☒ No

Best effort peak rate (Mb/sec) 155.0

Max data frame size 1516

Change Cancel Help

Figure 514. ATM LEC Platform Settings: LEC Port 1 (Page 1 of 3)

Now select Page 2 of 3 (Figure 515). Leave the Automatic configuration mode set to **Automatic** and enter the ELAN name, `et1` in the Emulated LAN name field. Leave the other parameters at the defaults.

ATM LEC Platform Settings

Physical Data | LEC port 0 | LEC port 1

LEC port 1 (Architected values) - Page 2 of 3

Automatic configuration mode ☒ Automatic ☐ Manual

This port's remaining fields are settable, but have defaults. The exceptions are: 'LE Server ATM address' and 'Emulated LAN name', which MUST have values when Automatic cfg. mode is: manual. When Automatic cfg. mode is: auto, the fields are settable (except 'LE Server ATM address'), but some may be overridden by the LAN Emulation Configuration Server (LECS).

LE Server ATM address

Emulated LAN name et1

Control timeout (seconds) 120

Maximum unknown frame count 5

Change Cancel Help

Figure 515. ATM LEC Platform Settings: LEC Port 1 (Page 2 of 3)

This completes the emulated LAN definitions for both clients.

Click **Change...** to save this window. You will be returned to the Configuration for OSA E0 window (Figure 516). Select **TCP/IP Passthru** from the Available modes list and click **Add...**

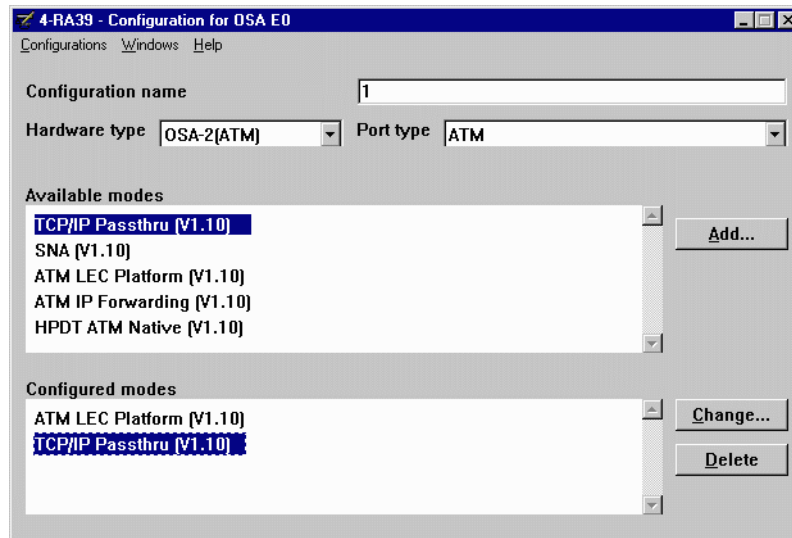


Figure 516. 4-RA39 - Configuration for OSA E0

The TCP/IP Passthru Settings window is displayed as shown in Figure 517. It shows the two sets of definitions for the two LECs we have defined.

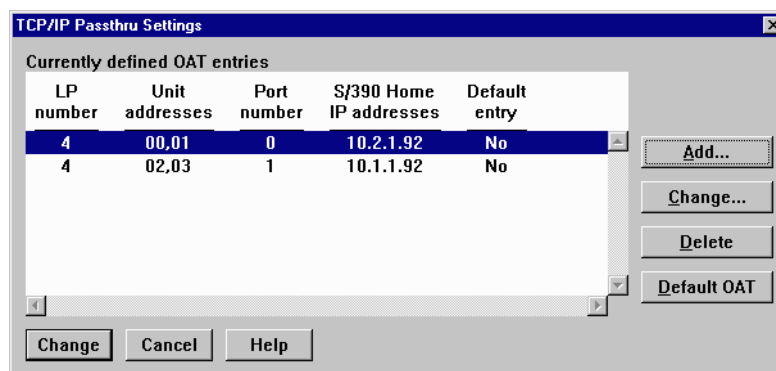


Figure 517. TCP/IP Passthru Settings

To enter these definitions click **Add...** from this window. The TCP/IP Passthru OAT Entry Definition window in Figure 518 on page 441 is displayed. Enter the LP number, Even unit address, and Port number (0 or 1) that this definition applies to.

The IP address of the host OS/390 system's TCP/IP stack this definition applies is entered in the Address field at the bottom of the window. After typing the address click **Add address** to add this address to the table. If you want more addresses continue until the last is entered. Then click **Change**.

TCP/IP Passthru OAT Entry Definition

LP number  Even unit address  Port

Default entry indicator

☐ Primary

☐ Secondary

☒ Not primary or secondary

S/390 Home  
IP address

10.2.1.92

Add address

Change address

Delete address

10.2.1.92

Change Cancel Help

Figure 518. TCP/IP Passthru OAT Entry Definition

Return to the TCP/IP Passthru Settings window (Figure 517 on page 440) and add the definitions for all the interfaces you need. We show two in this window as we have two LECs.

Click **Change** from Figure 517 on page 440 to return to the Configuration for OSA E0 window shown in Figure 516 on page 440.

The next step is to save this configuration. From the **Configurations** pull-down list select **Save**. This will save this file on the host Sys/390 system. Remember the workstation GUI interface is not the only way of configuring the OSA-2. It can also be configured using REXX from TSO.

#### Note

The following action is disruptive as it loads the configuration to the OSA-2 card and restarts the card. Stop all network traffic through the OSA-2 and vary the system devices (20A0 through 20A3 in our case) offline before proceeding.

The configuration we built can be activated from Figure 516. The OSA/SF address (20AF in our configuration) needs to be online to perform this load. First highlight the configuration. We used the TCP/IP Passthru. From the **Configurations** pull-down menu select **Activate** to complete the activation of the new configuration.

### 10.6.1 Verification of the OSA-2 ATM Connections

You can use the OSA/SF GUI windows to verify that the LECs have joined the ELANs. From the OSA CHPIDs Tree View window (Figure 519 on page 442) double-click the port item.

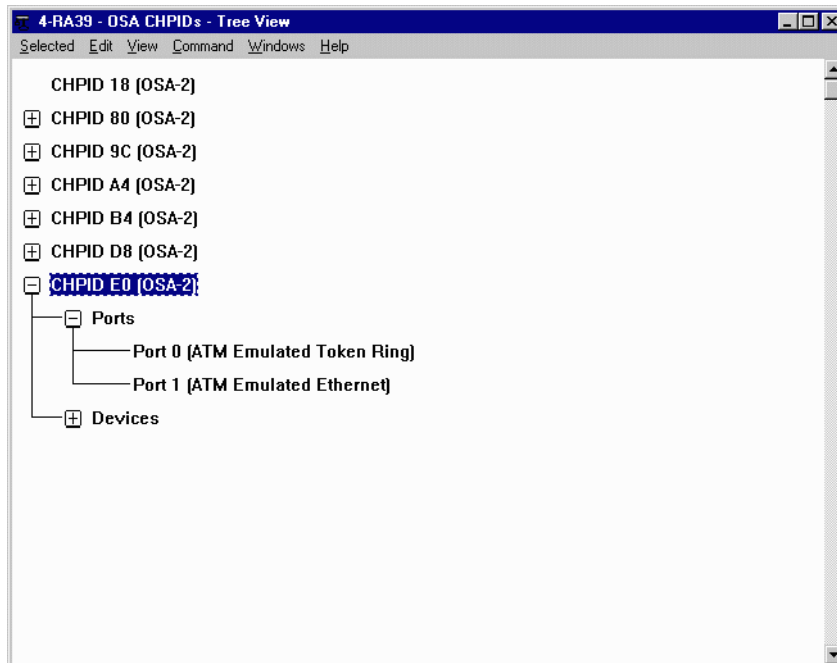


Figure 519. 4-RA39 - OSA CHPIDs - Tree View

The Emulated Token Ring Port Settings window is displayed for the port. You can see that the LEC has learned the first 13 bytes of the ATM address from the ATM switch. This is shown at the bottom of Figure 520:

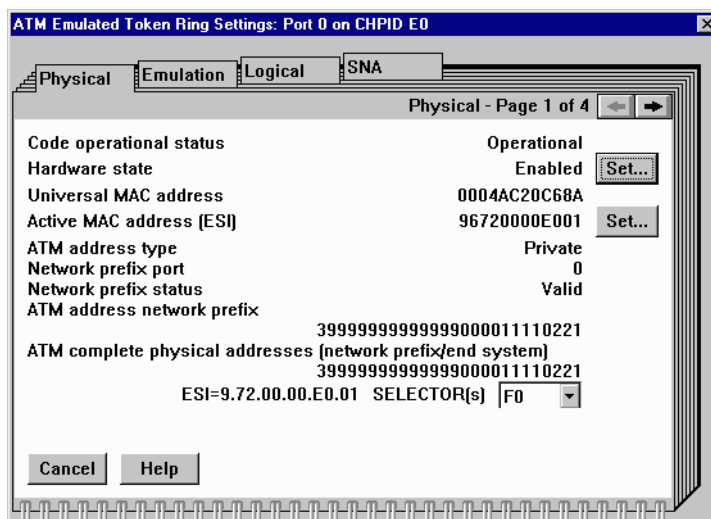


Figure 520. ATM Emulated Token Ring Settings: Port 0 on CHPID E0 (Physical)

Now select the **Emulation** tab and move to Page 2 of 9 shown in Figure 521 on page 443. The address of the LES this client has joined is displayed at the bottom of the window. The name of the emulated LAN you have configured plus the name of the LAN this client has actually joined are also displayed. In our case, it is tr1.

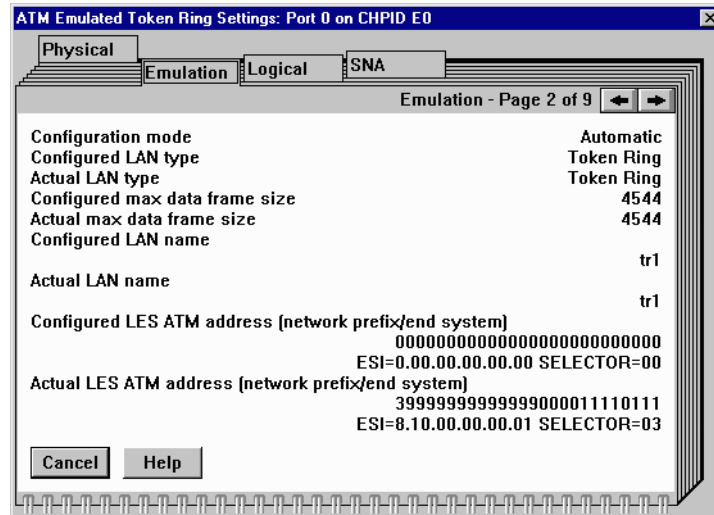


Figure 521. ATM Emulated Token Ring Settings: Port 0 on CHPID E0 (Emulation)

Go back to the OSA CHPIDs view (Figure 519 on page 442) and select **Port 1**. This is the second LEC that was set to join the ELAN et1. (Note there is no Physical tab on this port.) Select the second window under the Emulation tab as shown in Figure 522. Again you can see the ATM address of the LES this LEC is registered with. The ELAN name this client has joined is shown under Actual LAN name.

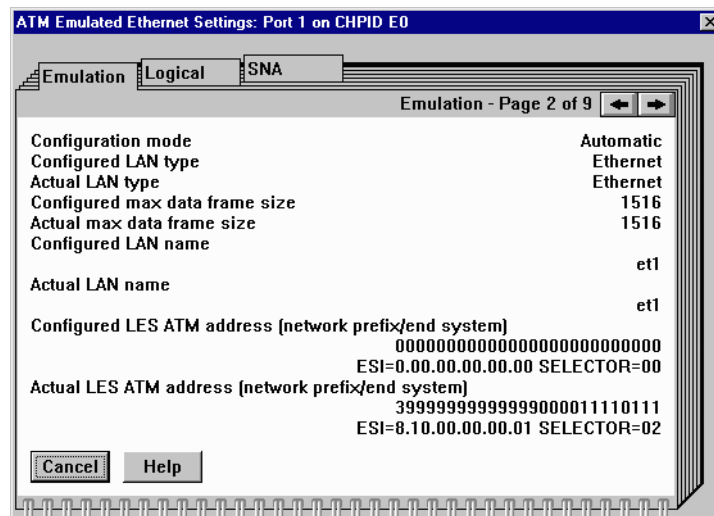


Figure 522. ATM Emulated Ethernet Settings: Port 1 on CHPID E0 (Emulation)

From MSS1 in our network you can see the status of the two OSA LECs. MSS1 is the primary LES/BUS pair for the ELANs and the IP default gateway.

The `Show LEC` command in T5 shows LEC0 in our OSA-2 has joined the ELAN tr1 (Figure 523 on page 444). The `Show Registered-MAC Address` command shows the MAC address we have defined for LEC0 in the OSA-2.

```

MSS1 *TALK 15
MSS1 +NETWORK 0
ATM Console
MSS1 ATM+LE-SERVICES
LE-Services Console
MSS1 LE-SERVICES+WORK
 (1) et1
 (2) mgmt
 (3) tkr_prod
 (4) trl

choice of LES/BUS [1]? 4
LE-Services Console for an existing LES-BUS Pair
MSS1 EXISTING LES-BUS 'trl'+SHOW LEC
Number of LEC's to display: 4

LEC-LES and LEC-BUS State (UP=Up, ID=Idle, --. --.
**=Other; Show specific LEC to see actual) v v

LEC Primary ATM Address Proxy LEC State #ATM #Reg #Lrmd
----- ----- - - - - - - -
3999999999999999999900001111022196720000E001F1 N 0001 UP UP 1 1 0
3999999999999999999900001111011182100000000111 Y 0002 UP UP 1 6 0
39999999999999999999000011110111827200000000180 Y 0003 UP UP 1 1 0
39999999999999999999000011110111827000000010110 Y 0004 UP UP 1 1 3
MSS1 EXISTING LES-BUS 'trl'+SHOW REGISTERED-MAC
Number of Registered MAC's to display: 9

Registered
MAC Address Registering ATM Address Type LEC # BCM
----- ----- - - - - -
400082700110 39999999999999999999000011110111827000000010110 R 0004 0
400082100111 3999999999999999999900001111011182100000000111 R 0002 2
0004AC28CE00 39999999999999999999000011110111827200000000180 R 0003 1
40008210D111 39999999999999999999000011110111821000000000111 R 0002 1
40008210D211 39999999999999999999000011110111821000000000111 R 0002 1
40008210D311 39999999999999999999000011110111821000000000111 R 0002 1
40008210D411 39999999999999999999000011110111821000000000111 R 0002 1
40008210D511 39999999999999999999000011110111821000000000111 R 0002 1
40009672E001 3999999999999999999900001111022196720000E001F1 R 0001 1
MSS1 EXISTING LES-BUS 'trl'+

```

Figure 523. MSS T 5 Output for tr1

The same is true for LEC1 which has joined the ELAN et1 shown in Figure 524 on page 445.



Figure 524. MSS T 5 Output for et1

ATM Proxy Clients Configuration Examples 445

```

MSS1 EXISTING LES-BUS 'et1'+EXIT
MSS1 LE-SERVICES+EXIT
MSS1 ATM+EXIT
MSS1 +
MSS1 +PROTOCOL IP
MSS1 IP>PING 10.2.1.92
PING 10.2.1.2 -> 10.2.1.92: 56 data bytes, ttl=64, every 1 sec.
56 data bytes from 10.2.1.92: icmp_seq=0. ttl=60. time=0. ms
56 data bytes from 10.2.1.92: icmp_seq=1. ttl=60. time=0. ms
56 data bytes from 10.2.1.92: icmp_seq=2. ttl=60. time=0. ms
56 data bytes from 10.2.1.92: icmp_seq=3. ttl=60. time=0. ms

----10.2.1.92 PING Statistics----
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms
MSS1 IP>PING 10.1.1.92
PING 10.1.1.2 -> 10.1.1.92: 56 data bytes, ttl=64, every 1 sec.
56 data bytes from 10.1.1.92: icmp_seq=0. ttl=60. time=10. ms
56 data bytes from 10.1.1.92: icmp_seq=1. ttl=60. time=0. ms
56 data bytes from 10.1.1.92: icmp_seq=2. ttl=60. time=0. ms
56 data bytes from 10.1.1.92: icmp_seq=3. ttl=60. time=0. ms

----10.1.1.92 PING Statistics----
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0/2/10 ms
MSS1 IP>

```

Figure 525. MSS Ping Capture

#### 10.6.1.1 Reference Information

For reference we are including the IOCDS definitions for CHPID E0. As can be seen in Figure 526 CHPID E0 is available to many partitions. We used only partition 4.

```

RESOURCE PARTITION=((A1,1) , (A10,A) , (A2,2) , (A3,3) , (A4,4) , (A5,5) *
, (A8,8) , (A9,9) , (C1,6) , (C2,7))
CHPID PATH=(E0) ,SHARED, *
PARTITION=((A1,A10,A2,A3,A4,A8,A9) , (A1,A10,A2,A3,A4,A8,A*
9,A5)) ,TYPE=OSA
CNTRLUNIT CUNUMBR=20A0 ,PATH=(E0) ,UNIT=OSA
IODEVICE ADDRESS=(20A0,015) ,UNITADD=00 ,CUNUMBR=(20A0) , *
STADET=Y ,UNIT=OSA
IODEVICE ADDRESS=20AF ,UNITADD=FE ,CUNUMBR=(20A0) ,STADET=Y,
UNIT=OSAD

```

Figure 526. IOCDS Definitions for CHPID E0

Some of the definitions from the TCPIP.PROFILE data set are included in Figure 527 on page 447 to show just what we had configured for the interfaces, the gateways to networks 10.2.x.x and 10.1.x.x, and the default gateway. This is only a small section of this data set but these definitions are shown to help the reader in understanding our configuration.

```

TCPCONFIG
 UNRESTRICTLowports
 TCPSENDBfrsize 16384 ; Range is 256-256K - Default is 16K
 TCPRCVBfrsize 16384 ; Range is 256-256K - Default is 16K
 SENDGARBAGE FALSE ; Packet contains no data
UDPCONFIG
 UNRESTRICTLowports
 UDPCHKsum ; Do checksum
 UDPSENDBfrsize 16384 ; Default is 16K
 UDPRCVBfrsize 16384 ; Default is 16K
IPCONFig
 VARSUBNETTING
; *****
; ATM OSA Definition LE
; *****
 DEVICE OSA20A0 LCS 20A0
 LINK OSAT20A0 IBMTR 0 OSA20A0

 DEVICE OSA20A2 LCS 20A2
 LINK OSAT20A2 ETHERor802.3 1 OSA20A2
; -----
HOME
 10.2.1.92 OSAT20A0
 10.1.1.92 OSAT20A2

GATEWAY
 10 = OSAT20A0 4000 0.255.255.0 0.2.1.0
 10 = OSAT20A2 1492 0.255.255.0 0.1.1.0
 10 10.2.1.1 OSAT20A0 4000 0.255.0.0 0.2.0.0
 10 10.1.1.1 OSAT20A2 1492 0.255.0.0 0.1.0.0
 DEFAULTINET 10.2.1.1 osat20a0 4000 0
; -----

START OSA20A0
START OSA20A2

```

Figure 527. Part of TCPIP.PROFILE



## Appendix A. Troubleshooting the ATM Environment

This section provides information on how to troubleshoot the 8260 and 8285 configurations. This section will show problems occurring with SSI and NNI connections, as well as settings for the LIS in CIP.

### A.1 Troubleshooting SSI Connections

To enable connectivity between switches, we configure an SSI connection between them. This is done using the `set port` command:

```
8285> set port 1.13 enable ssi 155000
```

When setting up your SSI parameters, make certain that you satisfy the following conditions:

1. The ATM network address (the first 11 bytes of the ATM address) for each switch is the same.
2. The ATM cluster number (11th byte of the ATM address) is the same on each switch.
3. The hub numbers (13th byte of the ATM address) are different.

A port can be reported as being not in service even though the port may be physically up, that is, receiving and transmitting properly. The reason may be that the port is misconfigured. If this happens, the 8285 will try to provide helpful error messages in the IX Status field returned by the `show port` command with the `verbose` option.

```
8285> show port 1.13 verbose
```

```
 Type Mode Status

1.13 : SSI enabled UP-NOT IN SERVICE

SSI Bandwidth : 155000 Kbps
Connector : SC DUPLEX
Media : Multimode fiber
Port speed : 155000 Kbps
Remote device is active
IX status : HUB numbers identical
Scrambling mode : frame and cell
Clock mode : internal
```

A list of some of these messages is given in Table 12:

Table 12. IX Status Messages and Causes

| IX Status Message        | Possible Causes                                              | Suggestions                                      |
|--------------------------|--------------------------------------------------------------|--------------------------------------------------|
| IX OK                    | Link is configured properly and active.                      | N/A.                                             |
| Attached to non-SSI port | Remote device is not configured to support the SSI protocol. | Disable the remote port, then enable it for SSI. |

| IX Status Message     | Possible Causes                                 | Suggestions                                                                                                                                                                 |
|-----------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hub numbers identical | Both switches have the same ATM network prefix. | Change the ATM address of one of the switches so that at least the hub number is different.                                                                                 |
| ACS mismatch          | Each switch has a different ATM cluster number. | Change the ATM address of one of the switches so that both have the same cluster number.<br>Set each end of the link to use NNI protocols if connecting different clusters. |

### A.1.1 Troubleshooting the CIP Network

There are relatively few entities in a CIP network that could cause problems. However, should you be unable to reach other CIP devices, the following items should be considered:

- Check the ARP server to see that you have registered with it. The procedure for doing so is described in Appendix A.1.1.1, “Checking ARP Server for Registration” on page 450.
- If so, check the IP parameters you configured on the 8285 to ensure that they are correct. Pay particular attention to your IP subnet and your IP subnet mask.
- If you are not registered with the ARP server, try the steps outlined in A.1.1.2, “Correcting ARP Registration” on page 451.

#### A.1.1.1 Checking ARP Server for Registration

If you are unable to ping the ARP server or any other IP device, check to see if the ARP server is properly registering your IP and ATM addresses.

For AIX ARP servers, this can be checked in two ways:

1. Using SMIT, the Systems Management Interface Tool
2. Using the fast path command `arp -t atm -a`

#### Checking ARP Registration via SMIT

To check ARP registration via SMIT, perform the following steps:

1. Log on to the server as root.
2. Issue the command `smit`.
3. Select the following menu items in sequence:
  - Communications Applications and Services
  - TCP/IP
  - Further Configuration
  - Network Interfaces
  - List SVCs over an ATM 100 Network or List SVCs over an ATM 155 Network depending on your interface

## Checking ARP Registration via Fast Path Command

To check ARP registration via the fast path command, perform the following steps:

1. Log on to the server as root.
2. Key in the command `arp -t atm -a`.

### A.1.1.2 Correcting ARP Registration

If the ARP server is not registering your 8285 CIP information but is registering other CIP devices, try reinitializing the 8285 CIP function by re-entering the `set device arp_server` command. This will force the 8285 to go through the CIP registration process again.

If you are still not able to register, check the ARP server address you keyed in and be sure that all 20 bytes of the address explicitly match the ARP server's address.

## A.1.2 Troubleshooting Your LANE Network

There are relatively few entries in a LANE network that could cause you problems. The following sections describe the typical items that should be considered:

- Check the Physical (ATM) Connection
- Check the LANE Registration
- Other Considerations

### A.1.3 Check the Physical (ATM) Connection

When you connect an ATM device to an IBM 8260 or 8285, you have to connect the physical cabling to the device and configure its ATM parameters. Then the device should be connected to the ATM network and you can check the status from the IBM 8260/85 console using the `show port` command.

Figure 528 on page 452 shows a sample console screen when the command is issued.

```
8285> show port 1.1 verbose 1
```

| Type                      | Mode                  | Status           |
|---------------------------|-----------------------|------------------|
| -----                     |                       |                  |
| 1.01:UNI                  | enabled               | UP-NO ACTIVITY 2 |
| Signalling Version        | : with IIMI           |                  |
| Flow Control              | : Off                 |                  |
| VPI.VCI range             | : 3.1023 (2.10 bits)  |                  |
| Connector                 | : RJ45                |                  |
| Media                     | : copper twisted pair |                  |
| Remote device is inactive | 2                     |                  |
| IX status                 | : IX KO 2             |                  |
| Port speed                | : 25600 kbps          |                  |

```
8285>
```

```
8285> show port 1.1 verbose 3
```

| Type                    | Mode                  | Status    |
|-------------------------|-----------------------|-----------|
| -----                   |                       |           |
| 1.01:UNI                | enabled               | UP-OKAY 4 |
| Signalling Version      | : with IIMI           |           |
| Flow Control            | : Off                 |           |
| VPI.VCI range           | : 3.1023 (2.10 bits)  |           |
| Connector               | : RJ45                |           |
| Media                   | : copper twisted pair |           |
| Remote device is active | 4                     |           |
| IX status               | : IX OK 4             |           |
| Port speed              | : 25600 Kbps          |           |

```
8285>
```

Figure 528. The Sample Console Screen to Check the Physical Connection

#### Notes:

- 1 This `show port` command was issued after the physical cabling had been connected but before the remote device was powered on.
- 2 You can get the status shown in several lines, but the main status is shown in the first line. UP-NO ACTIVITY means the physical cabling is done but no physical layer activity is detected.
- 3 This `show port` command was issued after the physical connection was up and the remote device was ready.
- 4 UP-OKAY means the remote device is attached to the ATM network.

The typical reasons an ATM device might be unable to make a physical connection are as follows:

- Cabling

If a fiber cable is used, check to see if each end of the cable is connected to the appropriate connector, transmit or receive. And if a copper cable is used, make sure that the cable type is correct, especially when you use a non-Forum compliant adapter or the connection is between ATM switches.

If the cable type is not correct, the status should be UP-NO ACTIVITY which means physical activity isn't detected on the port.



- ATM Connection Parameters

Check if the ATM connection parameters used in the switch and the device are matched, such as:

- Connection type (SVC/PVC)
- VPC/VCC number
- UNI Version (3.0/3.1/4.0)
- Service type (CBR/VBR/UBR/ABR)
- Required and available bandwidth if RB connection

If this information is mismatched, the status should be UP-NOT IN SERVICE which means physical activity is detected on the port but that the device cannot access the network.

When the physical layer connection is established, then the device requests to register with a LANE network. You can check the status from the IBM 8285 console using the `show lan_emul servers` and `show device` commands.

Figure 529 and Figure 530 show a sample console screen when the `show lan_emul servers` command is issued.

```
8285> show lan_emul servers 1 1

----- LAN Emulation Server 1 -----
Status : Running.
LAN type : Ethernet.
Actual ELAN name : "8285ETH4".
Desired ELAN name : "".
Actual max frame size : 1516.
Desired max frame size: 1516.
ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02
Max number of clients : 64.
Current number of operational clients : 1. 2
Local : 39.99.99.99.99.99.00.00.99.99.01.02
40.00.82.85.01.02.02 (port 0.0) OPERATIONAL NonProxy 3
8285>
```

Figure 529. The Sample Console Screen to Check the LANE Registration

**Notes:**

- 1** This `show lan_emul servers` command was issued after the server was up and the clients had requested to be registered.
- 2** The number of clients registered with the IBM 8285 integrated LES is shown on this line.
- 3** The clients registered with the IBM 8285 integrated LES are shown in these lines. This information only appears when you specify either of the servers using the server ID.

```

8285> show device 1
8285 Nways ATM Workgroup Switch
Name : 8285
Location :

For assistance contact :

Manufacture id: 53-
Part Number: 58G9605 EC Level: C38846
Serial Number: LAG050
Boot EEPROM version: v.1.4.0
Flash EEPROM version: v.1.4.0
Flash EEPROM backup version: v.1.0.0
Last Restart : 14:57:56 Thu 17 Oct 96 (Restart Count: 1)

A-8285

ATM address: 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00

> Subnet atm:
IP address: 192.168.21.85. Subnet mask: ff.ff.ff.00

> Subnet lan emulation Ethernet/802.3 2
Up 3
Name : "IBM_ETHERNET_LAN1" 3
MAC Address: 420082850001
IP address : 192.168.30.1. Subnet mask: FF.FF.FF.00
ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00
Config LES addr:39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02
Actual LES addr:39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02 3
BUS ATM address:39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.02 3
Config LECS add:none
Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
LEC Identifier: 1. Maximum Transmission Unit: 1492 3
> Subnet lan emulation token ring
up
Name : "8285TR4"
MAC Address: 420082850002
IP address : 0.0.0.0. Subnet mask: 00.00.00.00
ATM address : 39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.00
Config LES addr:39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.03
Actual LES addr:39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.03
BUS ATM address:39.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.01.02.03
Config LECS add:none
Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
LEC Identifier: 2. Maximum Transmission Unit: 4544

Default Gateway :

IP address: 0.0.0.0

ARP Server:

ATM address: 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00

Dynamic RAM size is 8 MB. Migration: off. Diagnostics: enabled.

8285>

```

Figure 530. The Sample Console Screen to Check the LANE Registration

### Notes:

- 1** This `show device` command was issued when the server was up and the clients had requested to be registered. This command can be used to check the status of each LEC on the IBM 8285, especially if they are registered with an external LES.
- 2** This line shows the ELAN type and Ethernet type of the LEC. The Ethernet/802.3 means the ELAN type is Ethernet and the Ethernet type is 802.3. Don't make the mistake of thinking that Ethernet/802.3 means that both DIX and 802.3 Ethernet types are supported. The LEC on the IBM 8285 can support either of them and the status should be Ethernet/DIX when the Ethernet type is DIX.
- 3** The appropriate values in these fields mean that the registration process has successfully completed because these values are returned by the LES.

The typical reasons a LEC might be unable to register with the LES are as follows:

- ATM switch connection  
If the LECs are attached to a different switch, check to see if the connection between the switches has been established.
- Designated LES address  
Check if the designated LES ATM address specified for the LEC, especially the SEL field, is correct.
- Max SDU size/ELAN name  
Check if the same maximum SDU size and ELAN name are defined on the LEC and LES. If these values don't match, the registration process fails. And some LECs, such as the IBM 8285 internal LEC, don't have specific values for themselves, but instead get the values from their LES.
- Registration sequence  
Reissue the LANE registration request from the LEC. Several devices have limited retry counts to issue the registration request and only do so during the initialization phase. Therefore, they won't register when the LES is restarted. Furthermore, network or LES congestion may prevent them from successfully completing the registration process within the allowed period.  
  
For example, PCs using the IBM ATM device driver have a retry count limit for the registration request, but IBM 8281 and 8285 internal LECs do not.

#### A.1.4 Other Considerations

When communication between LECs is unable to be established even though both LECs are registered with the LES, the typical reasons are as follows:

- Ethernet type  
Check to see if the same Ethernet type is configured for both LECs. For LECs to communicate with each other, they should be configured with the same Ethernet type, 802.3 or DIX/Ethernet V2.  
  
If one of the LECs that is unable to communicate is the IBM 8285's, you can check the Ethernet type from the console using the `set device` command as shown in Figure 528.

- IP network number

If one of the LECs that is unable to communicate is the IBM 8285's, check to see if the IP interfaces, CIP, Ethernet LEC and token-ring LEC, have been defined to different subnetworks. If the IP interfaces are on the same subnetwork, only the CIP interface is used.

### A.1.5 ATM-Ping

With Version 4 code on the 8265 switch IBM introduced the ATM-Ping function. The aim of this is the same as other ping functions, namely to check that an address is active on the network and can be reached. An example of this follows.

#### Note

At the time of writing this book this is only available on 8265s running Version 4 code.

```
8265> atm_ping
Enter remote address: 39.00.00.00.00.00.00.00.01.01.01.17.82.65.23.0c.14.58.01
Starting ATM ping (hit CTRL-C to stop) ...
--- ATM ping statistics ---
SVC established. Packets sent
ATM address: 39.00.00.00.00.00.00.00.01.01.01.17.82.65.23.0C.14.58.01
ATM Ping: 1 packets sent, 1 received
ATM Ping: 2 packets sent, 2 received
ATM Ping: 3 packets sent, 3 received
ATM Ping: 4 packets sent, 4 received
8265>
```

Figure 531. ATM-Ping in IBM 8265

---

## Appendix B. Special Notices

This publication is intended to help networking specialists who are responsible for configuring and installing campus ATM networks. The information in this publication is not intended as the specification of any interfaces that are provided by IBM ATM networking products. See the PUBLICATIONS section of the IBM Programming Announcement for IBM ATM networking products for more information about what publications are considered to be product documentation.

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## Appendix C. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

---

### C.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see “How to Get IBM Redbooks” on page 461.

- *Internetworking over ATM: An Introduction*, SG24-4699
- *MSS Release 2.1, Including the MSS Client and Domain Client*, SG24-5231
- *IBM 8260 as a Campus ATM Switch*, SG24-5003
- *Understanding and Using MSS Release 1.1 and 2.0*, SG24-2115
- *IBM Nways 2219, 2225, 2230 WAN Switches: Services and Technology*, SG24-4777
- *Installing and Implementing 2220 Networks*, SG24-2589 (available in PDF format only from <http://www.redbooks.ibm.com/> )
- *IBM Nways 2216 Multiaccess Connector Description and Configuration Scenarios - Volume 1*, SG24-4957
- *Layer 3 Switching Using MSS and MSS Release 2.2 Enhancements*, SG24-5311
- *OSA-2 Implementation Guide for OS/390*, SG24-4470
- *S/390 I/O Connectivity Handbook*, SG24-5444
- *8260 Multiprotocol Intelligent Switching Hub*, GG24-4370

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### C.2 Redbooks on CD-ROMs

Redbooks are also available on the following CD-ROMs. Click the CD-ROMs button at <http://www.redbooks.ibm.com/> for information about all the CD-ROMs offered, updates and formats.

| CD-ROM Title                                                   | Collection Kit Number |
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| System/390 Redbooks Collection                                 | SK2T-2177             |
| Networking and Systems Management Redbooks Collection          | SK2T-6022             |
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| RS/6000 Redbooks Collection (BkMgr Format)                     | SK2T-8040             |
| RS/6000 Redbooks Collection (PDF Format)                       | SK2T-8043             |
| Application Development Redbooks Collection                    | SK2T-8037             |
| IBM Enterprise Storage and Systems Management Solutions        | SK3T-3694             |

---

### C.3 Other Publications

These publications are also relevant as further information sources:

- *8265 Nways ATM Switch Command Reference Guide*, SA33-0458

- *Planning for the System/390 OSA Feature*, GC23-3870
- *Open Systems Adapter Support Facility User's Guide*, SC28-1855

---

## C.4 Referenced Web Sites

- <http://www.redbooks.ibm.com>
- <http://www.networking.ibm.com>
- <http://www.raleigh.ibm.com>
- <http://www.intel.com>
- <http://w3.itso.ibm.com>
- <http://www.elink.ibm.link.ibm.com/pbl/pbl>



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