IBM

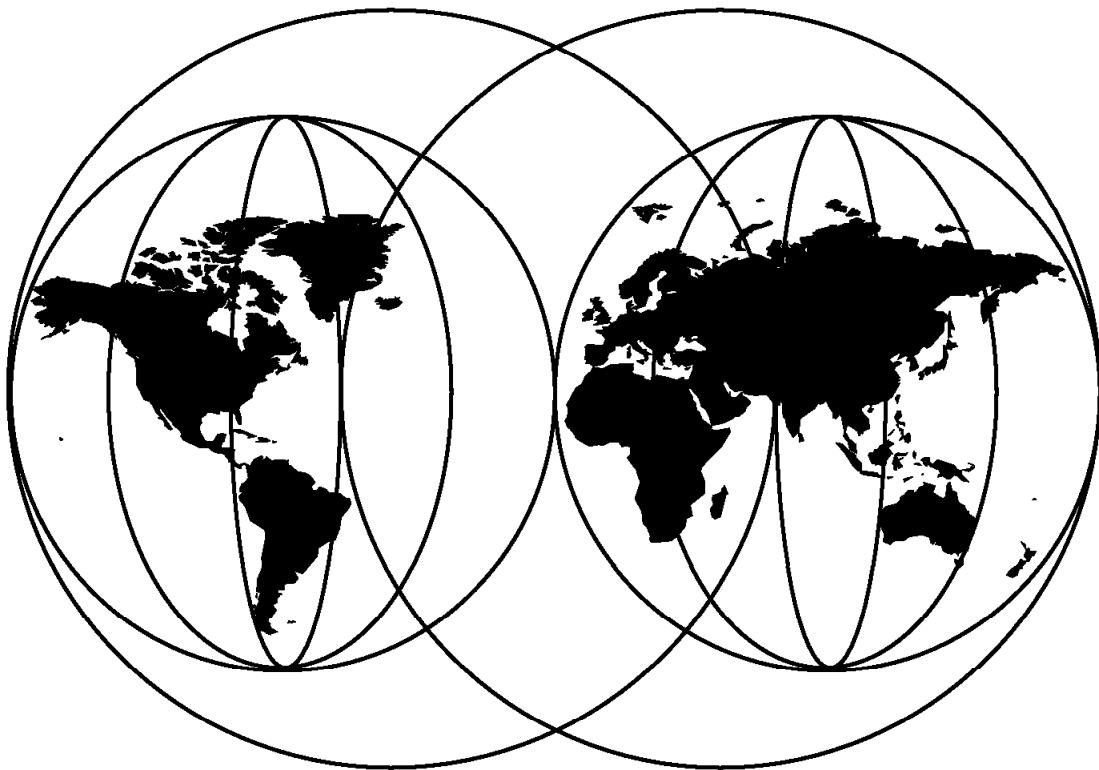# Installing and Implementing 2220 Networks

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International Technical Support Organization

SG24-2589-02

Installing and Implementing 2220 Networks

May 1999

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┌─ Take Note! ─────────────────────────────────────────────────────────────┐
│                                                                            │
│  Before using this information and the product it supports, be sure to read the general information in │
│  Appendix D, "Special Notices" on page 367.                                │
│                                                                            │
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Contents

Preface

This redbook provides you with detailed information on how to install and implement an IBM Nways 2220 Release 4.4 BroadBand Switch Network. However, before embarking on such a task, you must first fully understand the concepts and products available in the Nways Switch family. Therefore, we strongly recommend that you read the *IBM 2220 Nways Switch: Concepts and Products,* SG24-4307. The enhancements with Release 4.4 covered in this book include:

- ATM Frame Relay interworking
- ATM Switched Virtual Circuits
- Adding X.25 to the protocol merge on LSA3
- Video support enhancements
- Trunk control point on ATPA2
- Year 2000 Readiness
- Nways Switch Manager (NSM) enhancements

ATM, Voice, X.25, frame relay, HDLC, and the circuit emulation access agents are covered. This redbook shows interoperability scenarios that include the 6611, 3745, 3174, 2210 and the IDNX Micro/20. These scenarios will help you to configure, install and implement Nways 2220s in your network. Configuration information for the attached devices can be found from related appendixes.

Some knowledge of wide area networking is assumed.

The Team That Wrote This Redbook

This redbook was produced by networking professionals at the International Technical Support Organization, Raleigh Center.

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Chapter 1. Nways Switch Product Overview

This section provides a description of the components of the Nways Switch product. The purpose of this publication is not to cover these components in detail but rather to give the reader a basic understanding of the Nways Switch product in order to better understand the examples described in later sections.

The Nways 2220 Release 4.4 is Year 2000 compliant. This means that when used is accordance with its associated documentation, Release 4.4 is capable of correcting, processing and/or receiving date data within and between the 20th and the 21 centuries, provided all other products (for example, software, hardware and firmware) used with the 2220 can also exchange accurate date data.

The Nways 2220 Release 4.4 is EuroReady. This means that when used in accordance with its associated documentation, it is capable of correctly processing monetary data in the Euro denomination, respecting the euro currancy formatting conventions. This assumes that all other products (for example, hardware, software etc.) used with the Nways 2220 are also EuroReady.

The *IBM 2220 Nways Switch: Concepts and Products*, SG24-4307 covers in greater detail the components and architecture of the product. If you need specifics on the connectors or planning information please refer to *IBM 2220 Nways BroadBand Switch Planning Guide*, GA33-0293.

The Frame Relay, voice, ATM and X.25 access services are described in detail in chapters dealing with these specific topics. The implementation examples in:

- Chapter 8, "Nways Switch Router Interoperability - Scenario 1" on page 263,
- Chapter 9, "Nways Switch IBM 3745 Interoperability - Scenario 2" on page 279
- Chapter 10, "Nways Switch IDNX Interoperability - Scenario 3" on page 307;

are from the previous version of this book and were done using Release 2 code.

With Release 4.4, the Nways 2220 provides voice, ATM and frame relay functions. A summary of the 2220's capabilities are listed below:

- Frame relay
- X.25
- Digital CAS voice
- Digital CCS voice
- Circuit Emulation Services (CES)
- HDLC (for example, PPP and SDLC links)
- ATM and ATM SVC
- ISDN
- QSIG
- Frame relay to ATM interworking
- Video

1.1 2220 Model 500 Functional Organization

The following is a block diagram of the main components of the 2220 Model 500. Note that the Model 300 is conceptually similar to the Model 500 illustrated here and varies only in the number of adapters supported. Please refer to 1.1.2, "Adapter Maximum Configurations" for more information.
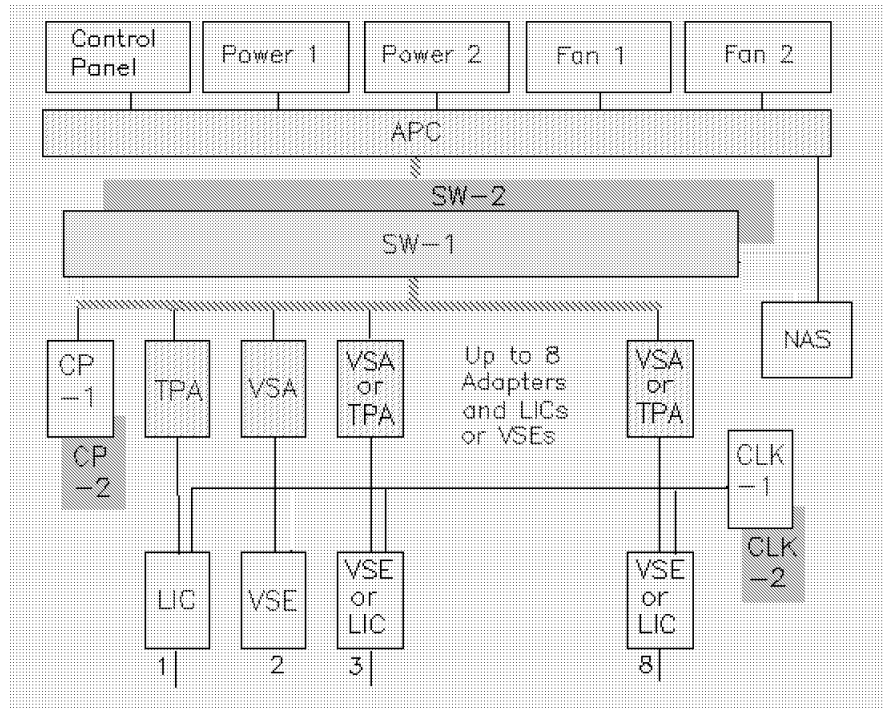
Figure 1. Various Components of the Nways Switch Product

1.1.1 Adapter

The figure shows an Nways Switch with a control panel, redundant power supplies, redundant fans, redundant switch processors and various adapters.

- A control point adapter
- A trunk adapter
- A port adapter
- A voice server adapter
- An ATM adapter

A trunk or port adapter is associated with a line interface coupler (LIC), and a voice server adapter is associated with a voice server extension (VSE).

1.1.2 Adapter Maximum Configurations

The following table contains the adapter maximum configurations depending on the Nways Switch models.

Table 1 (Page 1 of 2). Maximum Adapters Configuration						
Nways Switch Model	LSAs and LICs	HSAs and LICs	ATMAs and LICs	VSAs (and VSEs)	Control Point	Total

Table 1 (Page 2 of 2). Maximum Adapters Configuration

300	Up to 4	Up to 4	Up to 4	Up to 2	Up to 2	Up to 8
500	Up to 8	Up to 8	Up to 8	Up to 4	Up to 2	Up to 10
501	Up to 6	Up to 6	Up to 6	Up to 6	Up to 0	Up to 6

The totals can include a mixture of LSAs, HSAs, ATMAs and VSAs for the front of the subracks and a corresponding mixture of LICs and VSEs for the rear of the subracks:

Legend:
HSA   High-speed adapter
LIC   Line interface coupler
LSA   Low-speed adapter
ATMA   ATM adapter
VSA   Voice server adapter
VSE   Voice server extension

1.1.3 Alarm and Power Control (APC)

The alarm and power control (APC) is an Nways Switch module that:

- Controls the power input circuits, fans, and control panel

- Checks for adapter and clock presence and, if necessary, resets them

- Switches from the active switch module to the backup, if necessary

- Connects the Nways Switch administration station (NAS) to the Nways Switch

- Reports alarms to the NAS

1.1.4 Clock

The clock (CLK) is an Nways Switch module that monitors the LIC oscillators according to the configuration of the clock references. It allows you to synchronize all the physical line interfaces of a node with a system reference clock.

The system reference clock is either retrieved from the network through a LIC, an external office clock, or generated locally by the clock adapter when it detects a failure of the network reference clock.

Every LIC (except LIC511 and LIC512) has the capability of providing the clock adapters with a network reference. According to your configuration definition, the APC tells the clock card(s) which LIC clock to use as the reference.

The primary clock (CLK-1) is optional. However, it is recommended when transmitting constant bit rate traffic (voice or video). In the redundant clock configuration, there is a backup clock (CLK-2).

For more specific information on clocking in a 2220 network, refer to *Just in Time for IDNX and 2220 Clock Synchronous Planning,* SG24-4462.

1.1.5 Clock Redrive

A clock redrive (CLKRD) is a module of the 2220 Model 501 that drives the signals from the Model 500 clock to the adapters of the Model 501. The switch redrive is physically connected to the switch module in the Model 500 frame via a set of four signal cables.

The primary clock redrive (CLKRD-1) is optional and is installed when the primary clock (CLK-1) is present. In the redundant clock configuration, the clock module is duplicated (CLK-2) together with the clock redrive (CLKRD-2).

1.1.6 Control Point (CP)

In the Nways Switch, a control point (CP) is a logical resource that provides the following network control functions of the NBBS architecture:

- Spanning tree provides the logical trunk connections of all the nodes that are part of the network. The spanning tree is dynamically built and maintained by negotiations between the nodes.

- The spanning tree creates a topology that informs other nodes of changes (via messages) in the network

- Path selection consists of finding the best path between two nodes in the network with respect to conditions such as:

  - The dynamic status of the network

  - The requested connection metrics

  - The path transfer delays

  - The overflow probability

  - The maximum size of the packets

  - The real-time capability

The control point is housed in modules of the following types:

- Low-speed adapter type 3 (LSA3)

- High-speed adapter type 3 (HSA3)

- ATM adapter type 2 (ATMA2) only at Version 2 Release 3 or higher

Note: The low-speed adapters types 1 and 2 (LSA1 and LSA2) have been withdrawn from marketing. The high-speed adapters (HSA1 and HSA2) have been withdrawn from marketing. The ATMA1 has been withdrawn from marketing. These older adapters may be installed in your customer's network.

An adapter plugged into slot 10 or 12 of the 2220-300 or 2220-500 logic subrack, houses only the network control functions (as a control point). An ATMA, VSA or VSE cannot act as a control point   .

An adapter type LSA3 or HSA3, plugged in slots 1 to 6 (2220-300) or 1 to 8 (2220-500), can house both network control (as a control point) and transport services (as a trunk adapter).

CP-1 is the primary control point. In redundant control point configuration, CP-2 is the backup. The duplex control point (DCP) is responsible for detecting and correcting control point failures.

1.1.7 Fan

Fan 1 and fan 2 are assemblies with two fans in each enclosure. All systems come with two fan enclosures. The system can modify the fan speed according to the cooling requirements of a given configuration. This extends the life of these mechanical components.

In the case of fan failure in a fan unit, there is an alarm generated and the node can run with the remaining fans. The defective unit can be replaced without interruption because the other fan unit can temporarily take the extra load. You have two minutes to replace the defective unit once you have removed it or the machine will power down as a precaution to avoid damaging the electronic components. It only takes a few seconds to replace the fan unit.
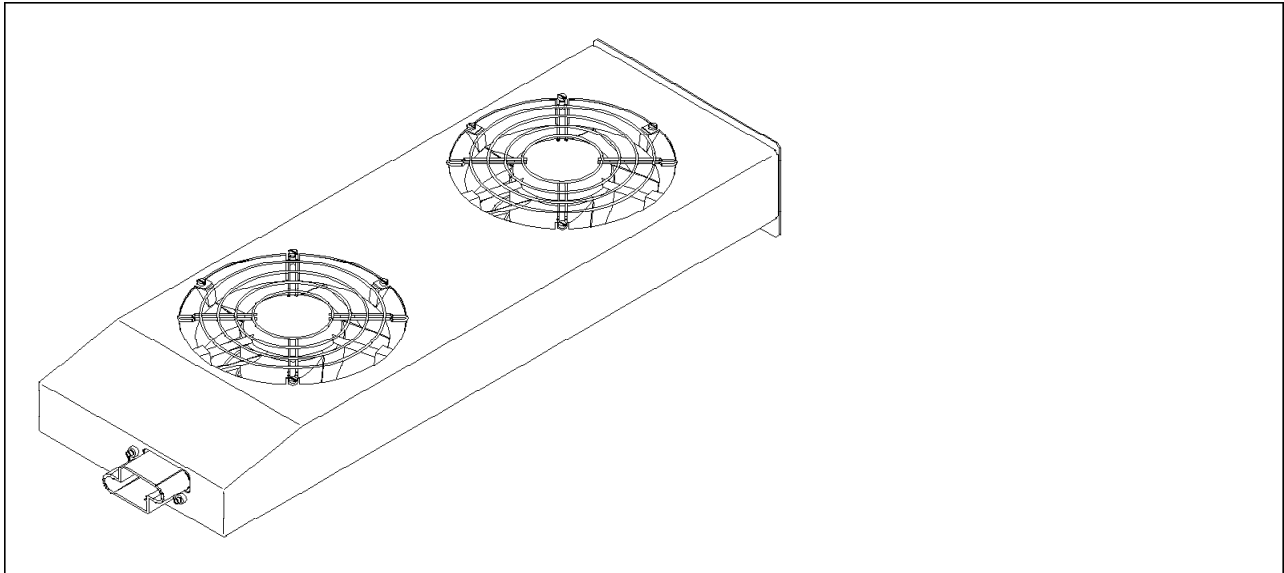
Figure 2. 2220 Fan Assembly

1.1.8 Dummy Module

In the Nways Switch, a dummy module is a cover inserted in the place of a module to ensure correct air cooling inside the logic subracks. During normal operation, the dummy modules must *not* be removed.

1.1.9 IP Gateway Adapter

An IP gateway adapter is a logical function of a port adapter that the Nways Switch uses to route IP messages between NASs and the network management station(s).

In a management access Nways Switch, the IP gateway adapter must have a backup. This is very important because if you lose that adapter, you have lost your management access to the whole network. The network will still run, but you will not be able to manage it centrally.

1.1.10 Line Connection Box (LCB)

A line connection box (LCB) is a metallic box that provides the following:

- Multiplexing of up to 30 lines to one connector of a line interface coupler type 511 (LIC511)

- Reduced cable requirements between the Nways Switch and the DCE or DTE locations

There are two types of LCBs that are functionally equivalent as follows:

- Line connection box base (LCBB), which connects to the LIC511

- Line connection box expansion (LCBE), which connects to the LCBB

The LCBs fit in standard 19-inch racks. They each house 15 active remote connectors (ARCs).

1.1.11 Line Connection Box

This figure shows how the line connection boxes (LCBs) are connected to the LIC type 511. Up to 60 lines can be attached through LCBs to a single LIC511.
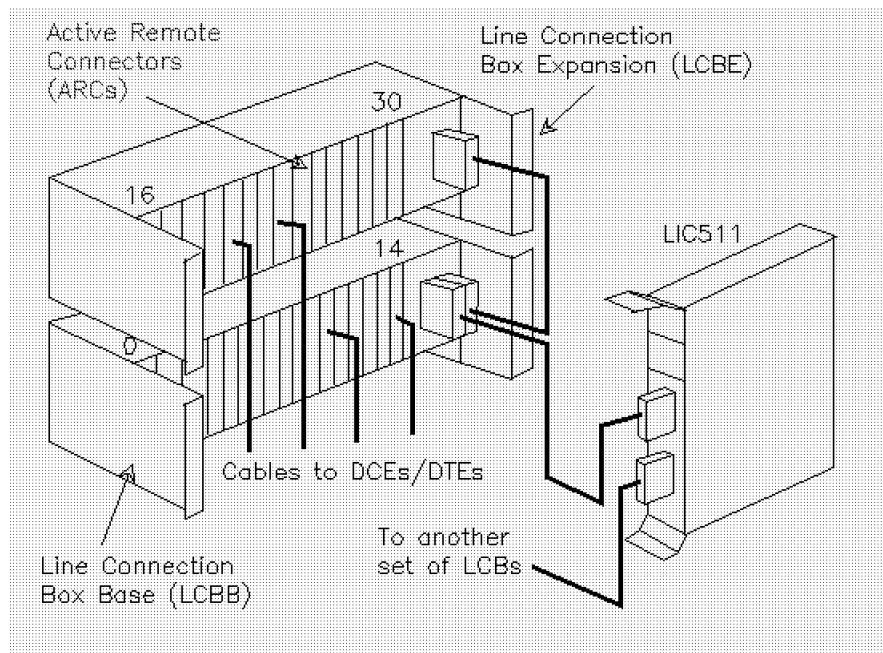
Figure 3. Illustration of a Line Connection Box (LCB)

1.1.12 Line Interface Coupler (LIC)

A line interface coupler (LIC) is an Nways Switch module that physically connects the trunk or port lines. Each line interface coupler is associated with a trunk or port adapter and supports specific line protocols.

The low-speed LICs connect lines with speeds not greater than 2.048 Mbps and are associated with low-speed adapters. Depending on the LIC type, the number of line attachments varies.

The high-speed LICs connect one line with a speed greater than 2.048 Mbps and are associated with high-speed TPAs.

1.1.13 Trunk or Port Adapter (TPA)

The Trunk or Port Adapter (TPA) is a versatile component that can be configured either for trunks or ports. Trunks are used to interconnect an Nways Switch with another Nways Switch. Ports provide the access point for attaching external devices or networks supporting standard interfaces to the Nways Switch network and perform the adaptation required to transport the user data to and from other external devices across the network. The TPA works either as a trunk or a port adapter. You cannot use a TPA for both trunks and ports simultaneously. If you need both, you must use two adapters.

The TPA has a very innovative design combining both hardware and software. This design approach allows you to define the same adapter as either a trunk or a port based on the software that is loaded. This allows a great deal of flexibility.

The performance objectives have been reached by using custom hardware, controlled by a specialized 32-bit processor called P3, which stands for Parallel Packet Processor. This approach is similar to loading software on an EPROM chip; it is still software, but it runs very fast providing flexibility and speed.

1.1.14 Trunk Adapter

A trunk adapter is an Nways Switch module running the code that provides the transport services of the NBBS architecture to the trunks. Every trunk manages its link bandwidth and status. The main functions of the trunk are to:

- Negotiate the link establishment and report the link status to the control point topology database through TRUNK_XID exchanges.

- Handle link bandwidth requirements and inform the topology database of the link utilization.

One very critical task of the trunk is the management of the traffic priorities and the allocation of internal buffers to reduce delay and congestion.

Each trunk adapter is associated with a line interface coupler (LIC).

The modules that can be used as trunk adapters are:

- Low-speed adapter type 3 (LSA3)

- High-speed adapter type 3 (HSA3)

- ATM adapter type 2 (ATMA2)

An adapter type LSA3 or HSA3, plugged in slots 1 to 6 of the 2220-300 logic subrack or 1 to 8 of the 2220-500 logic subrack, can house both transport services (as a trunk adapter) and network control (as a control point).

Note: LSA1, LSA2, HSA1, HSA2 and ATMA1 may be used as trunk adapter but these adapters have been withdrawn from marketing. LSA2 and HSA2 may also be used as a combination trunk and control point but have also been withdrawn from marketing.

1.1.15 Port Adapter

A port adapter is an Nways Switch module running the code that provides the access services of the NBBS architecture to the port lines.

A port is located at the boundary of an NBBS network and allows terminal equipment to exchange information through an NBBS network without the knowledge of the NBBS protocols.

The main functions of the port are:

- To establish, maintain and terminate end-to-end NBBS connections
- To receive various protocol data units from the end devices and send them as packets over the network to a destination port
- Convert them from NBBS packets to the original protocol at the other end

The supported protocols are:

- Frame relay
- HDLC
- Circuit Emulation Services (CES)
- X.25 Services
- ATM Services
- ISDN (QSIG)
- Voice (CCS and CAS)

Note: The source and destination ports may be located on the same node.

Each port adapter is associated with a line interface coupler (LIC).

The modules that can be used as port adapters are:

- Low-speed adapter type 3 (LSA3)
- High-speed adapter type 3 (HSA3)
- ATM adapter type 2 (ATMA2)

1.1.16 LIC Types

Table 2 shows the protocol merge according to LIC type.

Table 2 (Page 1 of 2). Protocol Merge According to LIC Types							
LIC	**Interfaces**	**CES**	**CAS/CCS**	**HDLC**	**Frame Relay**	**ATM**	**X.25**
511	V.24 (RS-232), V.35, X.21, up to 256 Kbps	Yes	No	Yes	Yes	No	Yes
513	T3	No	No	Yes	Yes	No	No
514	T1, J1	Yes	T1 only	Yes	Yes	No	No
515 516	E1 75 ohms E1 120 ohms	Yes	Yes	Yes	Yes	No	No
517	JJ-20 TTC	Yes	Yes	No	No	No	No
522	V.35, V.36, X.21	Yes	No	Yes	Yes	No	Yes
523	E2, J2, E3	No	No	Yes	Yes	No	No

Table 2 (Page 2 of 2). Protocol Merge According to LIC Types

LIC	Interfaces	CES	CAS/CCS	HDLC	Frame Relay	ATM	X.25
530	HSSI	No	No	Yes	Yes	No	No
544	8×T1 or J1	Yes	T1 only	Yes	Yes	No	No
545	8×E1 75 ohms	Yes	Yes	Yes	Yes	No	No
546	8×E1 120 ohms	Yes	Yes	Yes	Yes	No	No
551	2×DS3	No	No	No	No	Yes	No
552	2×E3	No	No	No	No	Yes	No
553	SDH/Sonet Electrical	No	No	No	No	Yes	No:
554	SDH/Sonet SMF LR	No	No	No	No	Yes	No
555	SDH/Sonet SMF SR	No	No	No	No	Yes	No:
556	SDH/Sonet MMF	No	No	No	No	Yes	No
567	4 x E1	Yes	Yes	Yes	Yes	No	No

Notes:

1. **SMF:** single-mode fiber
2. **MMF:** multimode fiber
3. **SR:** short range
4. **LR:** long range

LIC511 Up to 60 lines with four LCBs (bases and expansions). RS232/V.24, V.35, or X.21 low-speed full-duplex interfaces. Compatible with low-speed adapter type 3 (LSA3) configured in a port adapter. Access services: HDLC, frame relay, CES, X.25, and merged HDLC/FR/CES with LSA3. Limitations: Up to 2 in Model 300, up to 4 in Model 500.

LIC513 One full-duplex T3 interface. Compatible with high-speed adapter type 3 (HSA3) configured in a port or trunk adapter. Access services: HDLC and frame relay.

Redundant T3 LIC: The same trunk line can be attached through a Y-cable to two LIC513s to provide an automatic backup in case of LIC failure. The attached adapter type HSA3 can not be used for both the trunk adapter and control point.

LIC514 Four T1/FT1 or J1/FJ1 interfaces. DS1 interface with D4 SF and D5 ESF framing, B8ZS, and AMI coding. J1 multi-access service is supported. Compatible with low-speed adapter type 3 (LSA3) configured in a port or trunk adapter. Access services: HDLC, frame relay, PCM voice (T1 only), and CES.

LIC515 Four E1/FE1 interfaces with 75 ohm terminating impedance. Compatible with low-speed adapter type 3 (LSA3) configured in a port or trunk adapter. Access services: HDLC, frame relay, PCM voice, and CES.

LIC516 Four E1/FE1 interfaces with 120 ohm terminating impedance. Compatible with low-speed adapter type 3 (LSA3) configured in a port or trunk adapter. Access services: HDLC, frame relay, PCM voice, and CES.

LIC517   Four 2 Mbps JJ-20 TTC Japanese PBX interfaces. Compatible with low-speed adapter type 3 (LSA3) configured in a port adapter. Access services: PCM voice and CES.

LIC522   Four full-duplex X.21/V.36/V.35 compatible interfaces. Compatible with low-speed adapter type 3 (LSA3) configured in a port adapter. Access services: HDLC, frame relay, CES, and X.25.

LIC523   One full-duplex E2/E3/J2 interface. Compatible with high-speed adapter type 3 (HSA3) configured in a port or trunk adapter. Access services: HDLC and frame relay.

LIC530   One full-duplex HSSI interface. Compatible with high-speed adapter type 3 (HSA3) configured in a port or trunk adapter. Access services: HDLC and frame relay.

LIC544   Eight T1 or J1 interfaces. Compatible with low-speed adapter type 3 (LSA3) configured in a port adapter. Access services: HDLC, frame relay, PCM voice (T1 only), and CES.

LIC545   Eight E1 interfaces with 75 ohm terminating impedance. Compatible with low-speed adapter type 3 (LSA3) configured in a port adapter. Access services: HDLC, frame relay, PCM voice, and CES.

LIC546   Eight E1 interfaces with 120 ohm terminating impedance. Compatible with low-speed adapter type 3 (LSA3) configured in a port adapter. Access services: HDLC, frame relay, PCM voice, and CES.

LIC551   Two ATM DS3 (45 Mbps) interfaces. Compatible with ATM adapter type 2 (ATMA2) configured in a port or trunk adapter. Access services: ATM.

LIC552   Two ATM E3 (34 Mbps) interfaces. Compatible with ATM adapter type 2 (ATMA2) configured in a port or trunk adapter. Access services: ATM.

LIC553   One ATM SONET or SDH multimode fiber 155 Mbps electrical interface. Compatible with ATM adapter type 2 (ATMA2) configured in a port or trunk adapter. Access services: ATM.

LIC554   One ATM SONET or SDH single-mode fiber 155 Mbps optical interface. Compatible with ATM adapter type 2 (ATMA2) configured in a port or trunk adapter. Access services: ATM.

LIC555   One ATM SONET or SDH short range single mode fiber 155 Mbps optical interface. Compatible with ATM adapter type 2 (ATMA2) configured in a port or trunk adapter. Access services: ATM.

LIC556   One ATM SONET or SDH multimode fiber 155 Mbps optical interface. Compatible with ATM adapter type 2 (ATMA2) configured in a port or trunk adapter. Access services: ATM.

LIC567   Four E1/FE1 interfaces with 120 ohm terminating impedance. Compatible with low-speed adapter type 3 (LSA3) configured in a port or trunk adapter. Access services: HDLC, frame relay, PCM voice, and CES.

1.1.17 LICs Compatibility with Port and Trunk Adapters

As mentioned before, LICs are not compatible with all TPAs. To help you choose the right LIC and TPA we have included three LIC compatibility tables. The first table is LICs for low-speed adapters, the second is LICs for high-speed adapters and the third lists LICs for ATM adapters.

1.1.17.1 Low-Speed Adapters

Table 3 shows which LIC can be used as a port adapter.

Table 3. LICs Compatibility with Low-Speed Adapters	
LIC Number	**LSA3**
511	Port
514	Port
515 516	Port
517	Port
522	Port
544	Port
545	Port
546	Port
567	Port

1.1.17.2 High-Speed Adapters

Table 4 shows which LIC can be used as a port or trunk depending on the type of adapter.

Table 4. LICs Compatibility with High-Speed Adapters	
LIC Number	**HSA3**
513	Port or Trunk
523	Port or Trunk
530	Port or Trunk

1.1.17.3 ATM Adapters

Table 5 shows which LIC can be used as a port or trunk depending on the type of adapter. .

Table 5. LICs Compatibility with ATM Adapters	
LIC Number	**ATMA2**
551	Port or Trunk
552	Port or Trunk
553	Port or Trunk
554	Port or Trunk
555	Port or Trunk
556	Port or Trunk

1.1.18 Module

In the Nways Switch, a module is a packaged functional hardware unit containing logic cards, connectors, and lights. The modules are used to package adapters, line interface couplers, voice server extensions, and other equipment. All modules are hot pluggable in the logic subracks (see Figure 4).

1.1.19 Power

Power 1 includes the following:

• Power input 1 block

• DC distribution 1 (DCD-1) module

Power 2 is used as backup and includes the following:

• Power input 2 block

• DC distribution 2 (DCD-2) module

1.1.20 Rack

A rack is a metallic structure that houses the Nways Switch hardware elements: logic subrack with modules, fan boxes, and power subrack with power inputs.

1.1.21 Subrack

A subrack is a metallic structure installed in the Nways Switch rack to hold modules or power supply elements.
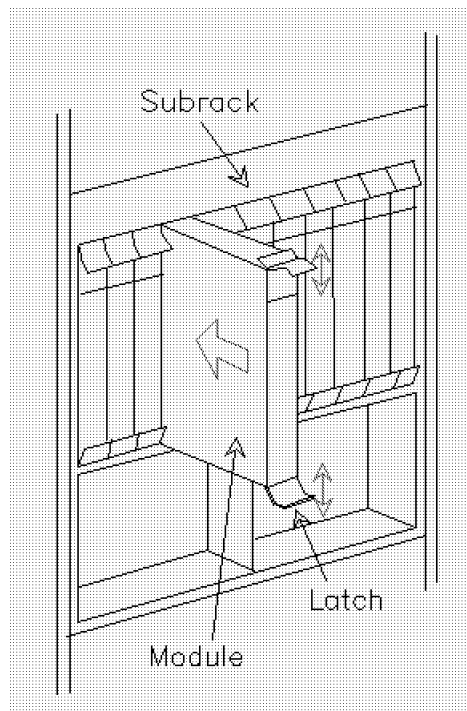
Figure 4. Illustration of a Subrack

Before removing the modules the screws must be unfastened and the latches unlocked.

1.1.22 Switch Module

In the Nways Switch, the switch module (SW) interconnects the adapters through an ATM cell switch. It is packaged in a module. The component is called switch-on-a-chip because it is a self-contained 16 X 16 self-routing non-blocking infinite output queue model switching circuit developed by IBM.

Another publication entitled *ATM Switch-on-a-Chip*, G325-3512 covers the switch architecture in greater detail.

The primary switch module is SW-1. In a redundant switch module configuration the backup is SW-2.

1.1.23 Switch Redrive

A switch redrive (SWRD) is a module of the 2220 Model 501 that drives the signals from the switch module in the Model 500 to the adapters of the Model 501.

The primary switch redrive (SWRD-1) redrives signals from the primary switch module (SW-1). In a redundant switch module configuration, the backup SWRD-2 redrives signals from SW-2.

1.1.24 Voice Server Adapter (VSA)

A voice server adapter (VSA) is an Nways Switch module that provides additional processors for voice functions such as silence and idle removal, voice compression, and fax or modem detection. It allows the attachment of a voice server extension (VSE).

1.1.25 Voice Server Extension (VSE)

A voice server extension (VSE) is an Nways Switch module, attached to a voice server adapter (VSA), that provides the voice functions to an extended number of voice communication channels.

Note: There are two types of voice server extension modules (VSE1 and VSE2).

1.2 Supported Line Interface Standards

The Nways Switch supports existing line interface standards and access services, and thus works with existing and new equipment. The following standards are supported.

1.2.1 E1 Interface Support

The E1 interface is supported, as follows, by the Nways Switch:

Standard
> ITU-T G.703

Alarm
> ITU-T G.732

Framing
> ITU-T G.704 with or without CRC

Frame alignment and CRC procedure
> ITU-T G.706

Channelization

This is from one user channel at 2.048 Mbps to 31 64 Kbps channels.

Aggregate 64 Kbps channels and multiple aggregate channels are possible. Access to fractional E1 services is allowed with a single aggregate channel or HDB3 channel coding.

LIC type and line attachments

LIC515, LIC516, LIC545,and LIC546 provide the connection to E1 facilities. See 1.1.16, "LIC Types" on page 8 for additional details.

Adapter

Low-speed trunk or port adapter

Line speed

1984 Kbps

Line code

HDB3

1.2.2 E2 Interface Support

The E2 interface is supported, as follows, by the Nways Switch:

Physical interface

ITU-T G.703

Framing

ITU-T G.704 and G.742

Channelization

Clear-channel and HDB3 coding

LIC type and line attachments

LIC523 provides the E2 connectivity. See 1.1.16, "LIC Types" on page 8 for additional details. The E2 LIC integrates a DSU/CSU for connecting to European high-speed service networks.

Adapter

High-speed trunk or port adapter (HSA3)

Line speed

8.448 Mbps

Line code

HDB3

1.2.3 E3 Interface Support

The E3 interface is supported, as follows, by the Nways Switch:

Standard

ITU-T G.703

Standard

ITU-T G.751

Channelization

Clear-channel and HDB3 coding

LIC type and line attachments

LIC523 provides the E3 connectivity. See 1.1.16, "LIC Types" on page 8 for additional details. The E3 LIC integrates a DSU/CSU for connecting to European high-speed service networks.

Adapter
High-speed trunk or port adapter (HSA3)

Line speed
34.37 Mbps

Line code
HDB3

1.2.4 E3 ATM Interface Support

The E3 ATM interface is supported, as follows, by the Nways Switch:

Framing
ITU-T G.832

LIC type and line attachments
LIC552 provides two E3 connections. See 1.1.16, "LIC Types" on page 8 for additional details.

Adapter
ATM trunk or port adapter (ATMA2)

Line speed
34 Mbps

1.2.5 DS3 ATM Interface Support

The DS3 ATM interface is supported, as follows, by the Nways Switch:

Framing
C-bit parity multiplex

LIC type and line attachments
LIC551 provides two DS3 connections. See 1.1.16, "LIC Types" on page 8 for additional details.

Adapter
ATM trunk or port adapter (ATMA2)

Line speed
45 Mbps

1.2.6 OC3 ATM Interface Support

The OC3 ATM interface is supported, as follows, by the Nways Switch:

Framing
SONET STS-3c (T1-105) or SDH STM-1 (ITU-T G.708/G.709)

LIC type and line attachments
LIC553, LIC554, LIC555 and LIC556 each provides one connection. See 1.1.16, "LIC Types" on page 8 for additional details.

Adapter
ATM trunk or port adapter (ATMA2)

Line speed
155 Mbps

1.2.7 HSSI Interface Support

The HSSI interface is supported, as follows, by the Nways Switch:

LIC type and line attachment
LIC530 provides the HSSI connectivity. See 1.1.16, "LIC Types" on page 8 for additional details. The LIC is just an extension of the trunk/port adapter native HSSI. DCE direct attachment and DTE interface are supported.

Adapter
High-speed trunk or port adapter (HSA3)

Line speed
Up to 51.84 Mbps

1.2.8 J1 Interface Support

The J1 interface is supported, as follows, by the Nways Switch:

Standards
TTC JT-I411-a, TTC JT-I431-a, ANSI T1.403, NTT HSDS service at the I interface. J1 multiaccess service is supported.

Physical interface
DS1, and DSX1

Framing
D5 (ESF) without CRC

Channelization
This is from one user channel at 1.536 Mbps to 24 user channels at 64 or 56 Kbps.

Aggregate 64 or 56 Kbps channels and multiple aggregate channels are possible. Access to fractional J1 services is allowed with a single aggregate channel.

LIC type and line attachments
LIC514 and LIC544 provides the J1 connectivity. See 1.1.16, "LIC Types" on page 8 for additional details.

Adapter
Low-speed trunk or port adapter

Line speed
1.544 Mbps

Line code
B8ZS or AMI

1.2.9 J2 Interface Support

The J2 interface is supported, as follows, by the Nways Switch:

Standards
TTC JT-I411-a, TTC JT-G703-a, ANSI T1.403, NTT HSDS service at the I interface

Physical interface
TTC JT-G703-a

Framing
D5 (ESF) without CRC

Channelization
> Clear-channel

LIC type and line attachment
> LIC523 provides the J2 connectivity. See 1.1.16, "LIC Types" on page 8 for additional details. The J2 LIC integrates a DSU/CSU for connecting to Japanese high-speed service networks.

Adapter
> High-speed trunk or port adapter (HSA3)

Line speed
> 6.312 Mbps

1.2.10 RS-232, RS-422, and RS-449 Interfaces

The Nways Switch supports, as follows, the RS-232, RS-422, and RS-449 interfaces:

RS-232
> ITU-T V.24 or EIA-232C

RS-422
> ITU-T V.11 or EIA-422A

RS-449
> ITU-T V.35 or EIS-449A

LIC type and line attachments
> LIC511 provides the RS-232, RS-422 and RS-449 connectivity for 60 line attachments through LCBs. See 1.1.16, "LIC Types" on page 8 for additional details.

Adapter
> Low-speed port adapter (LSA3)

Line speed
> Up to 256 Kbps

1.2.11 T1 Interface Support

The T1 interface is supported, as follows, by the Nways Switch:

Standards
> AT&T 62411 and ANSI T1.403

Physical interfaces
> DS1, and DSX1 G-704 and G-732 compatibility are supported for inter-PBX signaling.

Framing
> D4 (SF) and D5 (ESF)

Channelization
> From one user channel at 1.536 Mbps to 24 user channels at 64 or 56 Kbps.
>
> Aggregate 64 or 56 Kbps channels and multiple aggregate channels are possible. Access to fractional T1 services is allowed with a single aggregate channel.

LIC type and line attachments
LIC514 and LIC544 provides the T1 connectivity. See 1.1.16, "LIC Types" on page 8 for additional details. This LIC integrates a DSU for connecting T1 facilities.

Adapter
Low-speed trunk or port adapter (LSA3)

Line speed
1.544 Mbps

Line code
B8ZS, AMI, AMI with 8-bit stuffing

1.2.12 T3 Interface Support

The T3 interface is supported, as follows, by the Nways Switch:

AT&T specifications
54014, TR62415, and Accunet T45

Physical interface
DS3

Channelization
Clear-channel

LIC type and line attachment
LIC513 provides the T3 connectivity. See 1.1.16, "LIC Types" on page 8 for additional details. The T3 LIC integrates a DSU/CSU for connection to DS-3 high-speed service networks in the US.

Adapter
High-speed trunk or port adapter (HSA3)

Framing
M-frame C-bit parity

Line speed
44.736 Mbps

Line code
B8ZS

1.2.13 V.24 Interface Support

The V.24 interface is supported, as follows, by the Nways Switch:

Standards
ITU-T V.24, EIA-232C

LIC type and line attachments
LIC511 provides the V.24 connectivity for 60 line attachments through LCBs. See 1.1.16, "LIC Types" on page 8 for additional details.

Adapter
Low-speed port adapter (LSA3)

Line speed
Up to 256 Kbps

1.2.14 V.35, V.36 and X.21 Interface Support

The V.35 and X.21 interfaces are supported, as follows, by the Nways Switch:

Standards
> ITU-T V.35, EIA-449A, ITU-T X.21

LIC types and line attachments
> LIC511 provides the V.35 and X.21 connectivity for 60 line attachments through LCBs. LIC512 and LIC522 also provide connectivity for V.35 and X.21 line support. See 1.1.16, "LIC Types" on page 8 for additional details.

Adapter
> LIC511 low-speed port adapter (LSA3) and LIC522 for low-speed port or trunk adapter (LSA3).

Line speed
> LIC511: 256 Kbps
>
> LIC512 and LIC522: Up to 2.048 Mbps

The V.36 interface is supported, as follows, by the Nways Switch:

Standard
> ITU-T V.36

Physical interface
> DTE and DCE interfaces supported

LIC type and line attachments
> LIC522 provides the V.36 connectivity. See 1.1.16, "LIC Types" on page 8 for additional details.

Adapter
> Low-speed port or trunk adapter (LSA3)

Line speed
> Up to 2.048 Mbps

1.3 Continuous Availability

Continuous availability is a requirement for backbone network equipment. The Nways Switch provides continuous availability through:

- Hardware redundancy
- Power and cooling
- Configuration changes for software and hardware resources
- Distributed control
- Nondisruptive path switching
- Advanced error management

1.3.1 Hardware Redundancy

The following components of the Nways Switch can be duplicated:

- Switch module
- Module running the control point function
- Clock module

- IP Gateway Adapter

The switchover to the backup module is nondisruptive.

The failure of the NAS has no impact on the connections. However, in the case of NAS failure, accounting information is not recorded, network management information is not transmitted, and code download to the adapters is not possible.

For trunk type T3 a Y-cable can be used to connect one trunk to two LICs. This allows automatic backup for the link in case a LIC or associated adapter fails.

1.3.2 Power and Cooling

The Nways Switch is available with dual AC or DC power supplies as an option. Power distribution is duplicated as well.

The AC power supplies allow for dual AC input. Also, the AC supplies have battery backup which provides up to five minutes of operation after power failure.

Fans are duplicated on all models. They can be changed without disruption of the machine operation.

1.3.3 Configuration Changes

Using the Nways Switch Manager from a network management station allows the user to dynamically update the logical resources of an Nways Switch: NBBS ports, NBBS trunks, and connections. The physical resources such as TPAs and LICs may be added or removed but require manual servicing. However, all modules are hot pluggable, allowing for concurrent service.

The functions, such as the control point, can be updated by upgrading the backup control point, and issuing an operator command for a switchover.

Nways Switches, adapters, LICs, physical trunk and port lines can be added or deleted from a centralized configuration station. The new configuration must be transferred to the destination NAS, and the NAS or Nways Switch must be restarted to activate the new configuration.

1.3.4 Distributed Control

NBBS is a distributed-control architecture where there is no fixed point of control. All Nways Switches are peer.

If the links or Nways Switches fail, the control point, once the link or switch recovers, in each node is able to dynamically rebuild the logical network.

1.3.5 Nondisruptive Path Switching

Nondisruptive path switching (NDPS) ensures that when a link or node fails in the NBBS network, all connections are rerouted onto another path if available.

When this option is not selected, the connections are not re-established.

1.3.6 Advanced Error Management

The Nways Switch is designed to keep running even after a component fails.

Many loopback tests are continuously being performed within one module, through the switch module, and across buses, lines, and remote LICs.

In case of an error, the NAS logs, analyzes, and reports the error data. It automatically reactivates hardware resources. When certain thresholds are reached, the NAS reports the alarms to the network management station through the CMIP alarms.

1.4 2220 Physical Layout

This section shows the physical layout of the front and rear of a 2220 Model 300, 500 and 501 expansion frame.

1.4.1 2220 Model 500 Front Side

The following figure shows the physical layout of the front side of a 2220 Model 500.
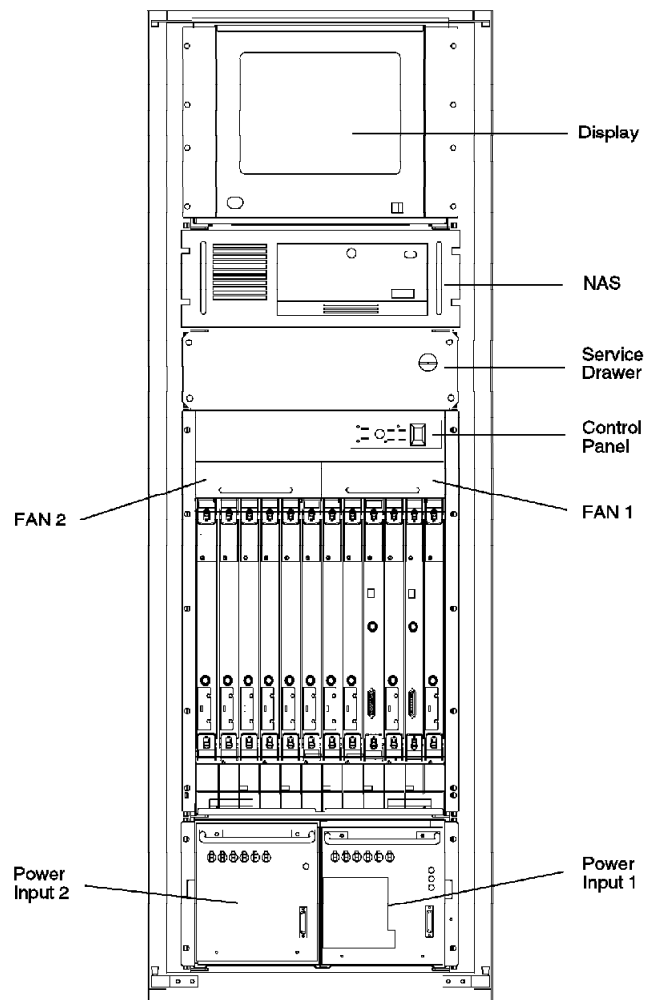
Figure 5. Nways Switch Front View.   Two different power supply types are shown in the following figures.

1.4.2 2220 Model 500 Rear Side

The following figure shows the physical layout of the rear side of a 2220 Model 500.
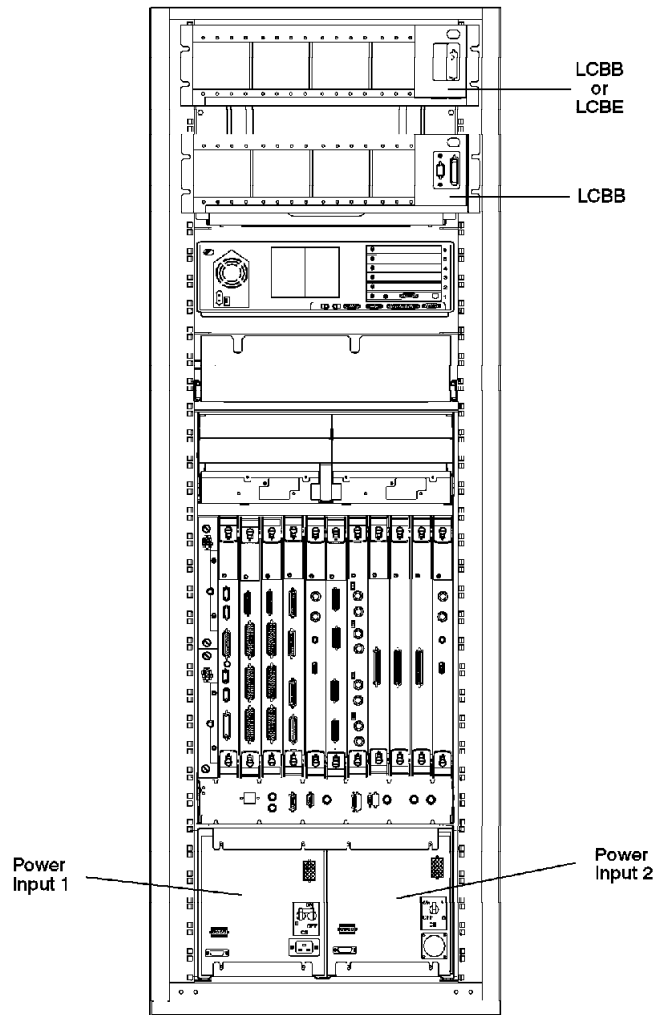
Figure 6. Nways Switch Rear View

1.4.3 Module Locations: 2220-300 Adapters

The above figure shows the front side of the 2220 Model 300.

										Control Panel	
Fan 2						Fan 1					
1	2	3	4	5	6	7	8	9	10	11	12
TPA or VSA	TPA or VSA	TPA or VSA	TPA or VSA	TPA or VSA	TPA or VSA	Dummy	Dummy	CLK (−1)	CP (−1)	CLK (−2)	CP (−2)
Power 2						Power 1					
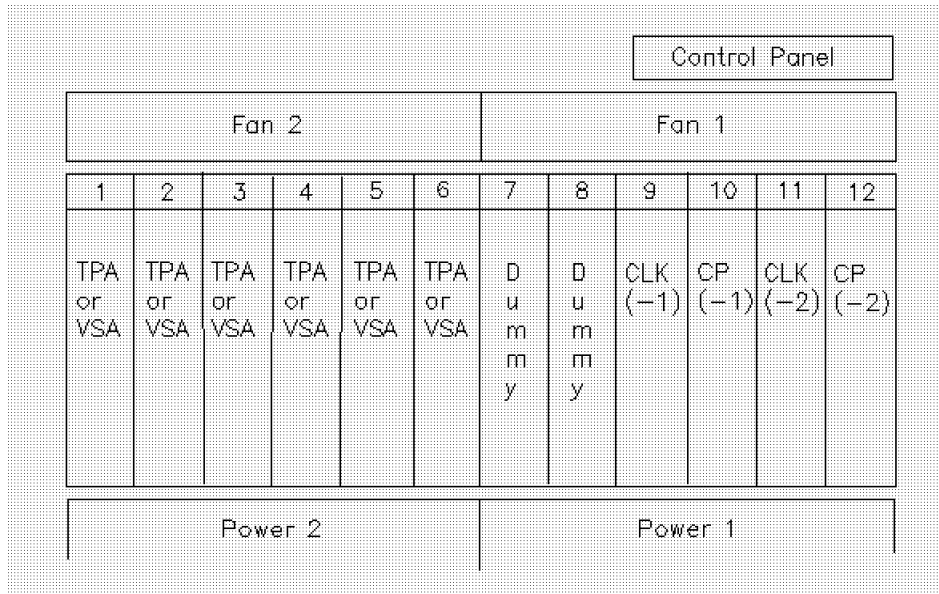
Figure 7. Model 300 Front View

Legend:
CLK   Clock
CP   Control point
Dummy   Dummy module
TPA   Trunk or port adapter
VSA   Voice server adapter

1.4.4 Module Locations: 2220-300 LICs

This figure shows the rear side of the 2220 Model 300.

Fan 1						Fan 2					
DCD	APC	10	9	8	7	6	5	4	3	2	1
DCD (−1) / DCD (−2)	APC	SW (−2)	SW (−1)	Dummy	Dummy	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE
Power 1						Power 2					

Cable Side

Figure 8. Model 300 Rear View

Legend:

APC   Alarm and power control
DCD   DC distribution
LIC   Line interface coupler
SW   Switch module
VSE   Voice server extension

1.4.5 Module Locations: 2220-500 Adapters

This figure shows the front side of the 2220 Model 500.
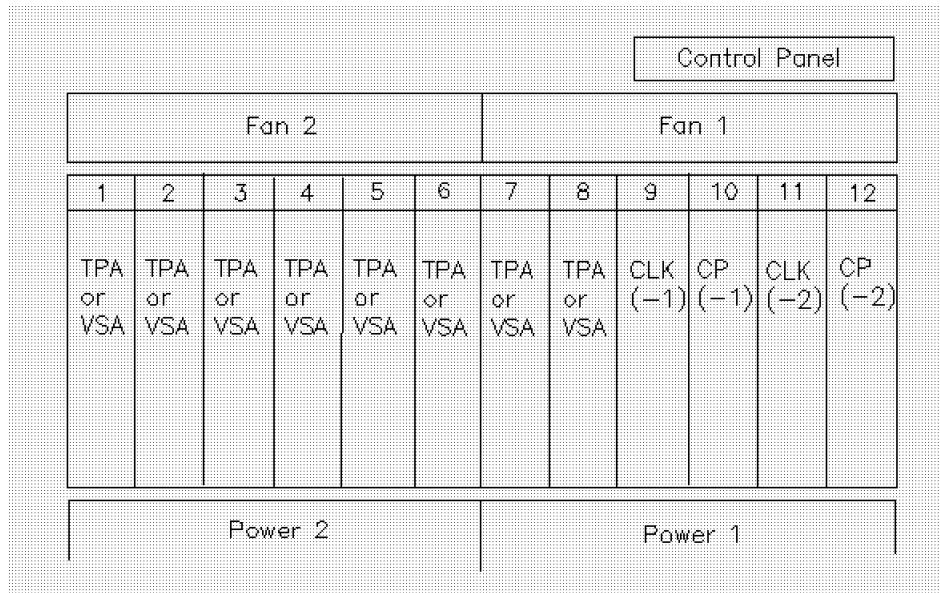
Figure 9. Model 500 Front View

Legend:

CLK   Clock
CP   Control point
TPA   Trunk or port adapter
VSA   Voice server adapter

1.4.6 Module Locations: 2220-500 LICs

This figure shows the rear side of the 2220 Model 500.

```
┌─────────────────────────────────┬─────────────────────────────────┐
│            Fan  1               │            Fan  2               │
└─────────────────────────────────┴─────────────────────────────────┘
┌─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┐
│ DCD │ APC │ 10  │  9  │  8  │  7  │  6  │  5  │  4  │  3  │  2  │  1  │
├─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┤
│ DCD │ APC │ SW  │ SW  │ LIC │ LIC │ LIC │ LIC │ LIC │ LIC │ LIC │ LIC │
│(−1) │     │(−2) │(−1) │ or  │ or  │ or  │ or  │ or  │ or  │ or  │ or  │
│     │     │     │     │ VSE │ VSE │ VSE │ VSE │ VSE │ VSE │ VSE │ VSE │
│     │     │     │     │     │     │     │     │     │     │     │     │
│ DCD │     │     │     │     │     │     │     │     │     │     │     │
│(−2) │     │     │     │     │     │     │     │     │     │     │     │
└─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┘
┌─────────────────────────────────┬─────────────────────────────────┐
│           Power 1               │           Power 2               │
└─────────────────────────────────┴─────────────────────────────────┘
                                     Cable Side
```

Figure 10. Model 500 Rear View

Legend:
APC   Alarm and power control
DCD   DC distribution
LIC   Line interface coupler
SW   Switch module
VSE   Voice server extension

1.4.7 Module Locations: 2220-501 Adapters

This figure shows the front side of the 2220 Model 501 expansion frame.

```
                                          ┌─────────────────┐
                                          │  Control Panel  │
                                          └─────────────────┘
┌─────────────────────────────────┬─────────────────────────────────┐
│            Fan  2               │            Fan  1               │
└─────────────────────────────────┴─────────────────────────────────┘
┌─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┬─────┐
│  1  │  2  │  3  │  4  │  5  │  6  │  7  │  8  │  9  │ 10  │ 11  │ 12  │
├─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┤
│ TPA │ TPA │ TPA │ TPA │ TPA │ TPA │  D  │  D  │CLKRD│  D  │CLKRD│  D  │
│ or  │ or  │ or  │ or  │ or  │ or  │  u  │  u  │(−1) │  u  │(−2) │  u  │
│ VSA │ VSA │ VSA │ VSA │ VSA │ VSA │  m  │  m  │     │  m  │     │  m  │
│     │     │     │     │     │     │  m  │  m  │     │  m  │     │  m  │
│     │     │     │     │     │     │  y  │  y  │     │  y  │     │  y  │
└─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┴─────┘
┌─────────────────────────────────┬─────────────────────────────────┐
│           Power 2               │           Power 1               │
└─────────────────────────────────┴─────────────────────────────────┘
```
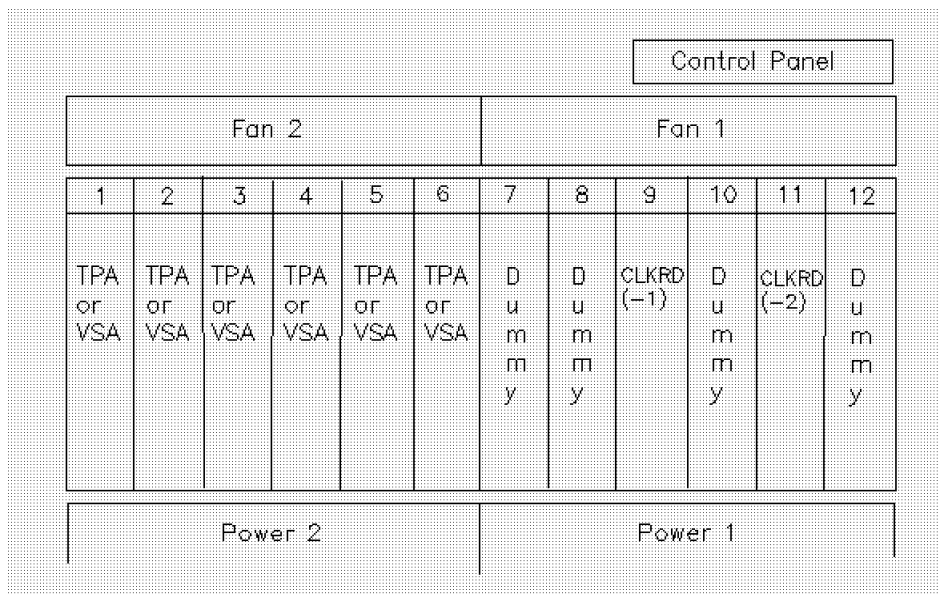
Figure 11. Model 501 Front View

Legend:
CLKRD   Clock redrive
Dummy   Dummy module

| TPA | Trunk or port adapter |
| VSA | Voice server adapter |

1.4.8 Module Locations: 2220-501 LICs

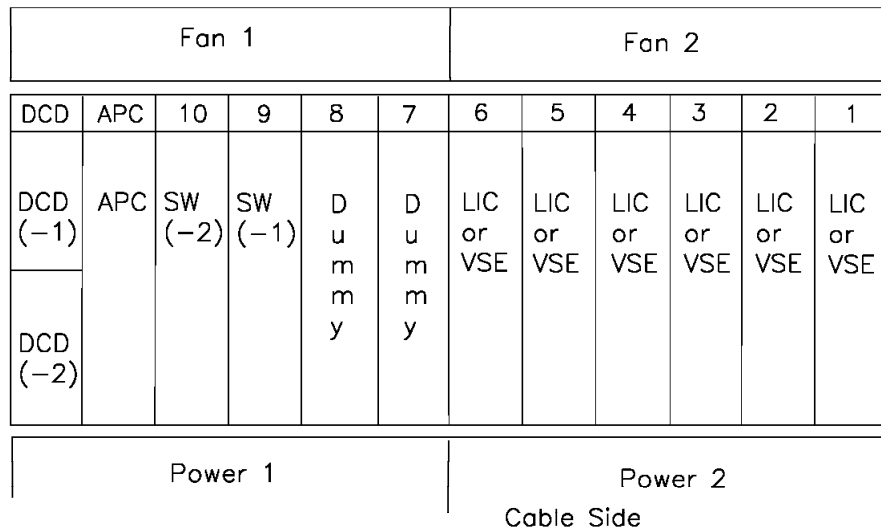This figure shows the rear side of the 2220 Model 501 expansion frame.
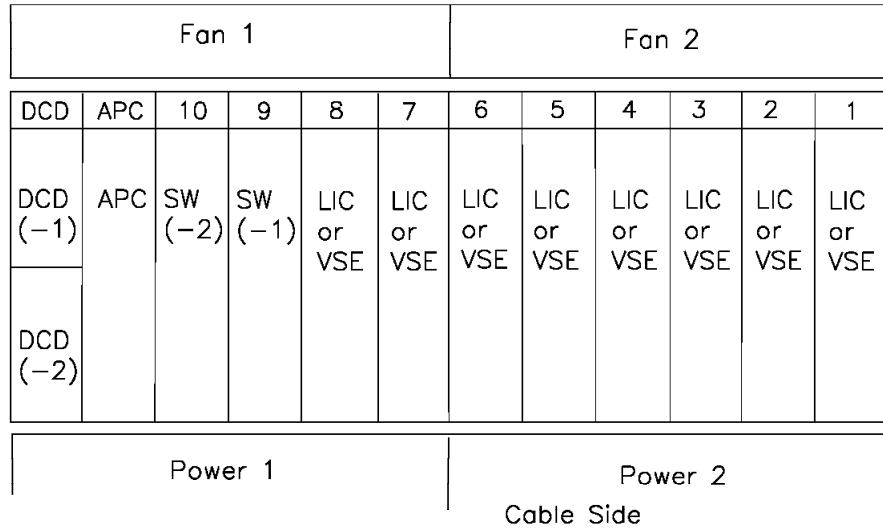
Fan 1						Fan 2					
DCD	APC	10	9	8	7	6	5	4	3	2	1
DCD (−1) / DCD (−2)	APC	SW (−2)	SW (−1)	D u m m y	D u m m y	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE

Power 1	Power 2

Cable Side
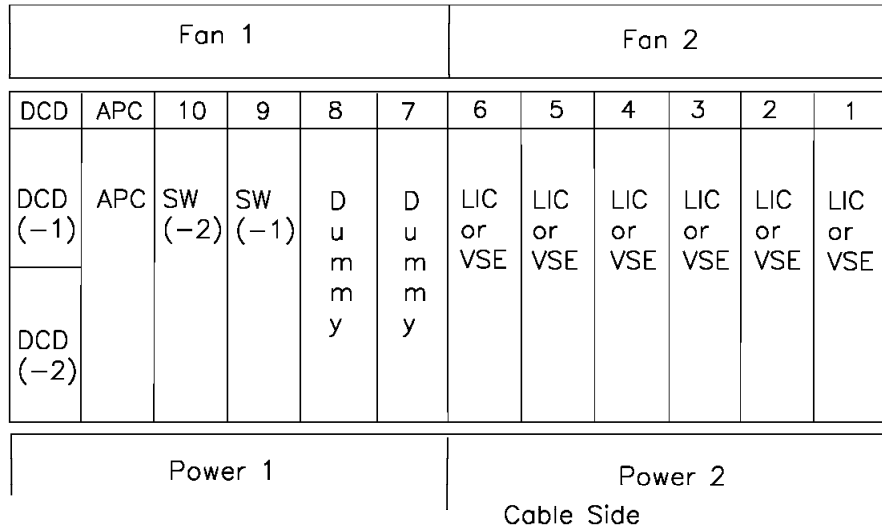
Figure 12. Model 501 Rear View

Legend:

APC	Alarm and power control
DCD	DC distribution
Dummy	Dummy module
LIC	Line interface coupler
SWRD	Switch redrive module
VSE	Voice server extension

1.5 Management Stations and Remote Consoles

The figure below shows how the Nways Switch administration stations (NAS) are connected to the network management station and the remote consoles.

Note: For a more detailed diagram please refer to the *IBM 2220 Nways BroadBand Switch Planning Guide*, GA33-0293.

Management Access
Nways Switch   Nways Switch

NAS   NBBS   NAS
                 Network

M   M

Ethernet or
Token-Ring
LAN

Nways Switch
Manager

Network   Public
Management   Switched   M   OS/2
Station (NMS)   Network
                                                      Remote
Software   Console
Distribution
Manager   M

Change Control
Server (CCS)

OS/2   IBM
                                      Network Support
Remote   Center
Console
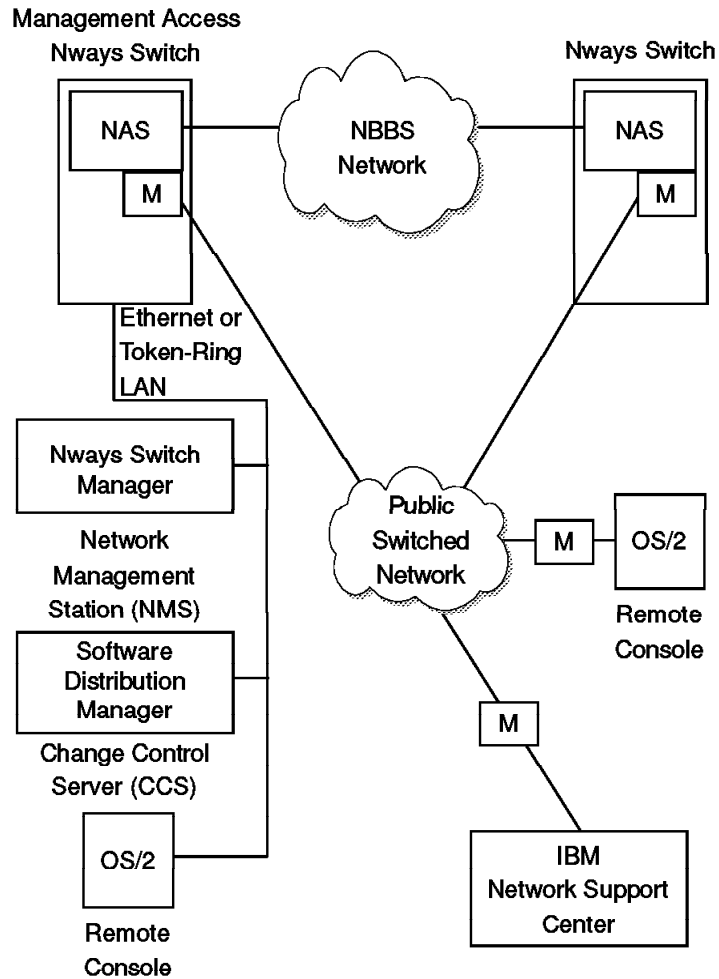
2589\AHAHC1(

Figure 13. Management Console Interconnections

1.5.1 Nways Switch Administration Station (NAS)

The NAS is a PS/2 provided with the Nways Switch. It can be used to install, configure and operate the Nways Switch locally. The PS/2 comes preconfigured by IBM manufacturing (both hardware and software) with the following basic features:

- Hardware:

  - 64 MB of memory

  - 2.5 - 4.0 GB hard disk

  - 2.5 - 4.0 GB backup hard disk

  - Ethernet attachment to the Nways Switch node

  - Hayes 7857 or 7858 external ASCII modem

- Software:

  - OS/2 Warp 4.0

  - DB/2

– TCP/IP

   – Software Distribution Manager 3.1

   – Communication Manager

   – Nways BroadBand Switch Control Program

1.5.2 Network Management Station

A network management station (NMS) runs Nways Switch Manager (NSM) on top of the AIX and TME 10.

Nways BroadBand Switch Control Program Version 2 Release 3 provides the following features: in your network:

- Provides NBBS accounting management, performance management, configuration updates, problem analysis and automation capabilities.

- Runs in a client/server environment.

- Provides distributed management through NetView for AIX workstations for improved network availability and control.

- Responds to alarms: filtering, thresholds, discrimination and logging.

- Provides graphical topology views.

- Displays and recomputes paths for connections

- Provides frame relay performance management through specific frame relay counters.

- Provides status and operational control of NBBS connections

- Provides statistical information logging for accounting and network planning applications.

- Provides security options for different classes of operators.

- Manages up to 100 switches of medium size.

A network management station is connected to its management access Nways Switch via an Ethernet LAN, directly or via a router.

In a large NBBS network, there may be several network management stations.

Hardware guidelines for the NMS are detailed in the *IBM 2220 Nways BroadBand Switch Planning Guide*, GA33-0293.

The client/server functionality offloads some processes onto smaller AIX stations for a distributed operation; the server may also run the client function.
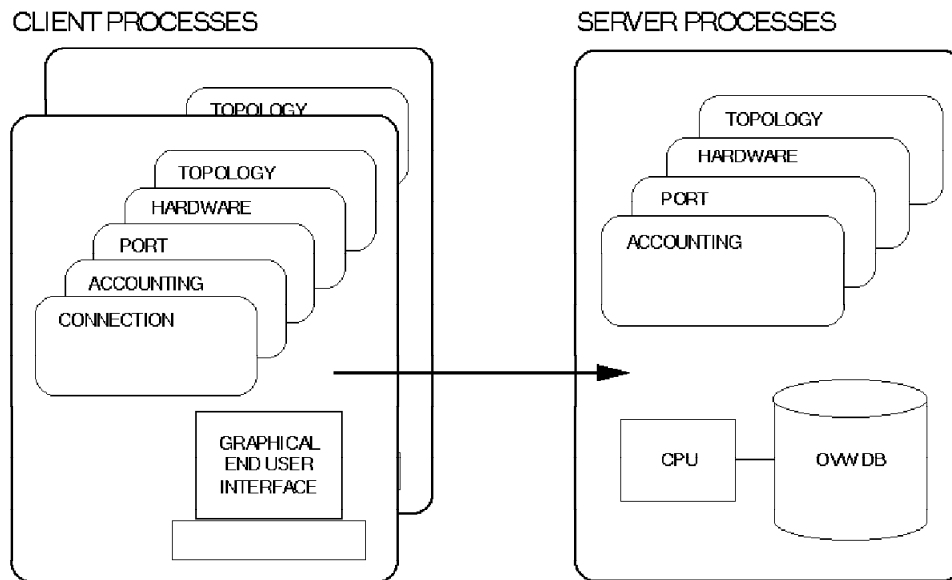
Figure 14. NSM Client/Server Structure

Figure 14 shows the client/server structure in use; the implementation is strictly based on NetView Version 5.1.

The server runs the processes that interface with the Nways Switch, such as the discovery of nodes. The clients supply the end user interfaces (menus and windows). The interprocess communication uses TCP/IP sockets and from a bandwidth usage perspective is more efficient than the X-window interface used with Nways Switch Manager (NSM). The OVWDB is not distributed but is accessible from client machines.

NSM provides security facilities for various types of operators. Three templates of operator profiles are provided but you can define and modify your own if required. The three supplied profiles are as follows:

1. Basic operator:

   - Display configuration

   - Display event desk

   - Performance management

   - Activate, lock and monitor connections

2. Configurator:

   - Update configurations

3. Accounting operator:

   - Start, stop and retrieve accounting information

1.5.3 Change Control Server (CCS)

A change control server (CCS) is a station that runs the Software Distribution Manager to store the Nways Switch programs and control the code changes.

A change control server is connected to its management access Nways Switch via an Ethernet LAN or routed network.

The change control server may be installed in the same station as the network management station.

1.5.4 Remote Console

A remote console is a station running OS/2 WARP 4.0, TCP/IP and the remote Nways Switch Resource Control program. It can be connected to any Nways Switch administration station (NAS) to operate and service the Nways Switch remotely.

The connection may be made through either of the following:

- A switched line using a modem

- The NBBS network if the remote console is connected to its access Nways Switch through an Ethernet LAN

Any NAS can be used as a remote console of another NAS.

1.5.5 Network Support Center (NSC)

The Network Support Center (NSC) is a location where IBM provides remote support to NBBS networks.

1.6 Network Configuration Overview

There are three methods that can be used to configure your network:

- Online configuration from the (NSM)

- Offline configuration from the Network Configuration Tool (NCT) on the NAS

- Offline configuration from the Network Configuration Tool (NCT) on the NSM

1.6.1 Online Configuration

With the online configuration method, the modifications to the active configuration (while the NAS is running) will have a limited impact on active resources.

In order for this method to be used, first the initial node configuration would have been completed using the offline method and then the node attached to the network. The online network generation functions the would allow you to create new resources and to delete and modify the attributes of the existing ones.

1.6.2 Offline Configuration

This method is used at installation time and it allows the node it to configure all of its hardware and logical resources.

This is done by using the NCT function on the NAS or the centralized configuration PC or RS/6000. You can also use the save, restore and transfer (import/export) configuration functions.

1.6.3 Online versus Offline Configuration

The offline method is mandatory, at least the first time, for a given node. It is also mandatory if you upgrade the node with a hardware MES such as a 501 expansion frame or a clock feature.

The offline configurations for all your nodes can be done from one NAS station or any workstation with the NCT code. The only prerequisites are OS/2 and DB/2 for a PC and DB/2 for AIX. The configurations should be done from one central console, because of the automatic IP address assignment done by NCT. See 1.7.6, "What IP Addresses Should You Care About" on page 36 for additional details.

Different levels of checking are done by NCT and NSM. The NCT ensures consistency of data manipulated during an NCT session against the local node database. The NCT also offers a verification phase during which the whole local database consistency is checked.

NSM performs some intranode verification, but it performs no internode verification. By intranode verification we mean the NCT is actually verifying in the database that an adapter or feature is physically defined on the node. Internode verification means to verify something in a node different from the one where NCT is running. You have the three following choices for your configuration:

- All with NCT

  With this method you control both the hardware and logical resources from NCT either on the destination or centralized NAS. The advantage is that the NCT can do intra and internode consistency checking. It can, for example, check what adapter type is in a given slot and validate that your selection is correct.

  The disadvantage of this method is a re-IPL of the NAS; this is undesirable when there are frequent modifications of logical resources.

- All with NSM

  With this method you control both hardware and logical resources from a centralized NSM. The advantage of this method is that both medium and long term definitions and changes can be performed online.

- A mix of both NCT and NSM

  This method combines the advantages of both the NCT and NSM. You can control the hardware configuration of all or part of your network through the centralized NCT console. This would provide for a centralized repository database for all the nodes. You could also control logical resource for this network from your centralized NSM system. The advantage of this method is that the daily operations, such as logical resources definitions and changes,

can be done online without rebooting the NAS and there is a consistency check at the hardware level.

The drawback of this method is that there is no consistency checking of logical resources spanning through several nodes.

Note: The code level of the NCT used must match the code level running on the Nways switches. There are migration tools available to do conversions between different levels.

1.7 IP Operation

This section discusses IP addressing and operation in detail. In an NBBS network, the key players, as far as IP addressing is concerned, are:

- Nways Administration Station (NAS), an OS/2-based processor
- Network Management Station (NMS), an RS/6000 with AIX NV/6000 and NSM software
- Change Control Server (CCS), an RS/6000 with Software Distribution Manager which can be the same physical RS/6000 as the network management station
- The Nways Switch itself.
- Remote consoles.
- Node Configuration Tool (NCT), an OS/2-based or AIX-based tool to configure Nways Switches (The NCT is not necessarily part of the NBBS network)
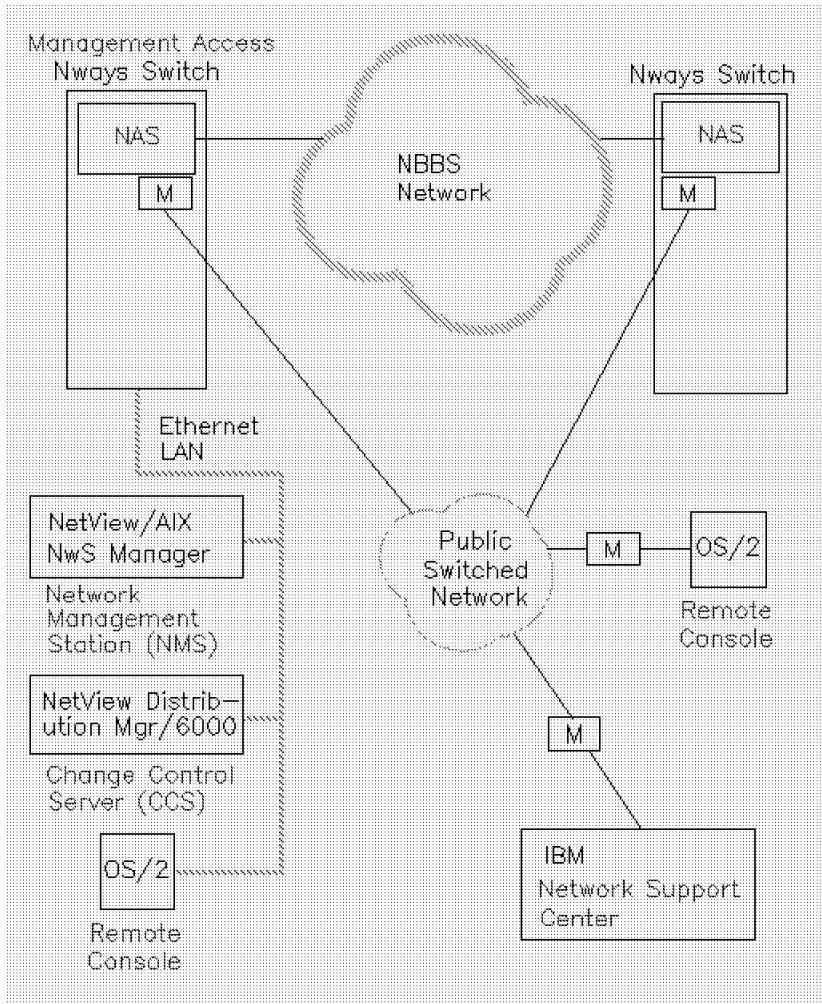
Figure 15. An NBBS Network Components

1.7.1 Planning for IP Addressing

To exchange messages between the network management station (NMS) and the Nways Switches, TCP/IP is used. All the Nways Switches including their NAS and adapters must be organized as an IP network or an IP subnetwork. The change control server (CCS), NMS and remote consoles may be attached to the service bus of an Nways Switch in the following two ways:

- Directly attached. In this case, the the CCS, NMS, and router must be in the same network as the Nways Switch and the NAS.

- Indirectly attached through a router. In this case, the CCS and NMS belong to another IP network. Their IP addresses are defined by the user.

The Nways Switch uses a service bus to exchange the information needed to manage its operation. This exchange takes place between the Node Administration Station (NAS) and the various adapters of the Nways Switch. This service bus is actually an internal Ethernet LAN.

In addition, there is, of course, information exchanged between the Nways Switches and NMS and possibly between the CCS and remote consoles. To allow this to happen, an IP addressing scheme needs to be established. These network addresses are defined by the Node Configuration Tool (NCT) at

configuration time. This IP network is dedicated to the NBBS network management and administration and **must** not be used for other IP traffic.

The NAS, the switched remote consoles, the NMS (directly or router attached), the CCS and the remote consoles are called externally attached hosts. These hosts are directly addressable by the user. Each adapter in an Nways Switch has an IP address as well. But these are internally addressed resources and are not addressable by the user (see 1.7.9, "NID Function" on page 39). Knowing the total number of existing (or planned) externally addressable hosts is necessary for selecting the appropriate network IP address class.

The following drawing illustrates the key IP players in an NBBS network.

Note that the hub (in the APC card) is a built-in function in each Nways switch.
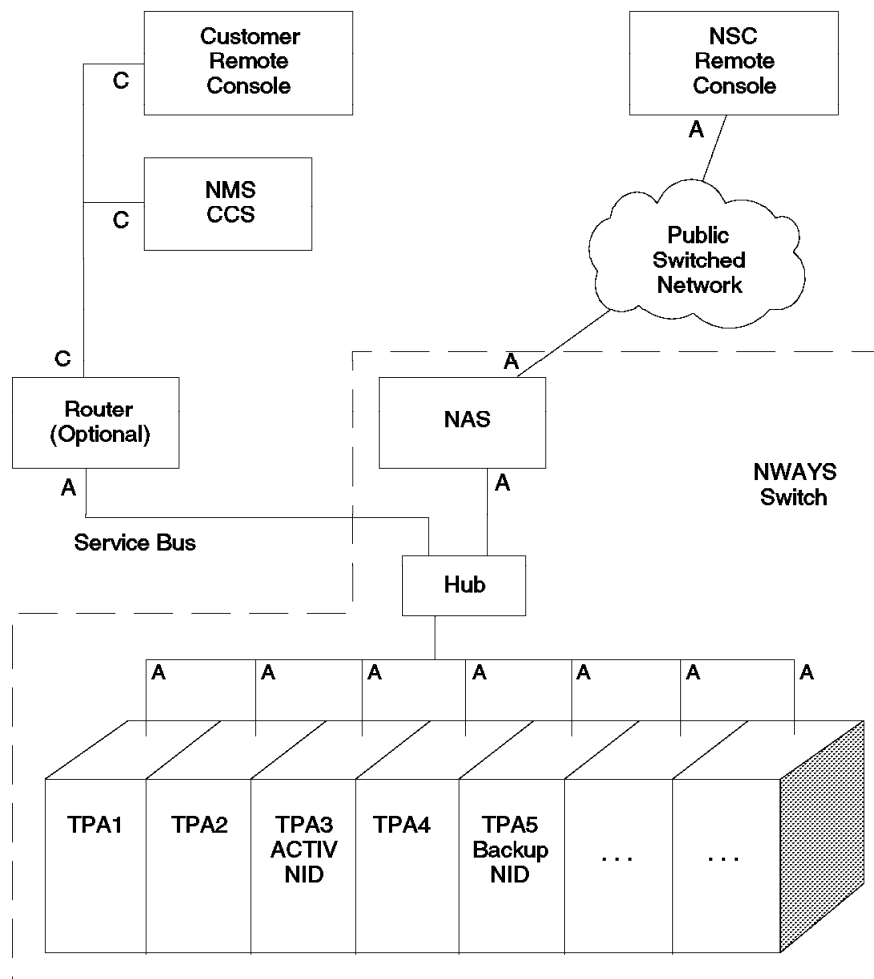
Figure 16. The Key IP Players in an NBBS Network

1.7.2 Dealing with A, B or C Classes

The IP address class choice depends on the number of externally addressable hosts. Typically, very large organizations use class A or B addresses whereas smaller organizations use class C. Class C addresses allow for fewer externally addressable hosts, but this number is often directly related to the size of the organization.

If you already have a class A or B network IP address and want your NBBS network to be seen as a network of its own while being accessed via your existing network IP address, you should then give your NBBS network a subnetwork address. This is available only in class B or in class A, which is then used like a class B for subnetworking.

The maximum number of IP addresses available for Nways Switches, NMS, and CCS, depends on both the network IP address class and the network mask.

The following table shows the corresponding capabilities according to the address class and maximum number of nodes.

Table 6. Externally Addressable Host Capabilities			
IP Address Class	Subnetworking Available	Subnet Mask	Maximum Number of Externally Addressable Hosts
B	Yes	255.255.254	190
B	Yes	255.255.252	446
B	Yes	255.255.248	958
B	Yes	255.255.240	1982
B	Yes	255.255.224	4030
B	Yes	255.255.192	8126
B	Yes	255.255.128	16318
B	No	255.255.	32702
C	No	255.255.255	63
Note: Class A is supported as class B.			

1.7.3 Logical NBBS Networks and Subnetworking

You can assign all your Nways Switches to one logical subnet (for example, IP address 187.8.128.0 Mask 255.255.255.0) or you may organize your Nways Switches in logical networks or in subnetworks as in the following cases:

- If the NBBS network has to be accessed using your existing network IP address, the NBBS network is given a subnetwork address.

- You may want to group the Nways Switches according to organizational constraints (for example by geographical area). In this case, the group may be either of the following:

  - Logical NBBS networks, each with their own class C network IP address.

  - Subnetworks, each with its own subnetwork IP address, where all the subnetworks share the same class B network IP address and network mask.

- If you run short of available addresses for network expansion (for example, additional Nways Switches).

There may be up to 16 logical IP networks in an NBBS network. All the network mask bits must be consecutive. The subnetwork addresses need not be consecutive.

1.7.4 Obtaining a Network IP Address

If you need to interconnect your network to other IP networks, your network IP address must be unique. Such an address is obtained through the NIC by specifying the following:

- The address class you want to use

- The number of addressable hosts in your network or the number of subnetworks, this information is needed only to justify your request

The combination of these two items is key to the future growth capabilities of your network. Therefore, careful planning is of the utmost importance.

1.7.5 Attaching User Remote Consoles, NMS and CCS

User remote consoles, NMS, and CCS are attached to their NBBS network through the service bus of an Nways Switch of this network. This section deals with this attachment from the IP addressing standpoint. These attachments can be as follows:

- Directly attached in the following ways:

   − Physically (several hosts on a 10Base2 connector or only one host on a 10BaseT connector).

   − Via a bridge. In this case, they belong to the Nways Switch's IP network. Their addresses are automatically allocated by the NCT.

- Attached through a router (indirect attachment). In this case, they belong to a different IP network. Their addresses must be given to the NCT. The address of the router Ethernet port, which is connected to the service bus, is given by the NCT.

The network management station, the remote console and the router IP addresses must be specified only in the configuration of the Nways Switch to which they are attached (directly or indirectly). The change control server IP address must be defined in every one of its clients Nways Switch configuration

Note: It is recommended that you use the indirect attachment to filter any propagation of broadcast IP traffic to and from the NBBS network.

1.7.6 What IP Addresses Should You Care About

The IP addresses that are of interest are:

- Nways Switch addresses (in fact, the NAS address) and the associated switched remote console addresses

- NMS and CCS addresses when directly attached, or the router, NMS, user remote consoles and CCS addresses when indirectly attached

- Local IP address for the switched remote Network Support Center (NSC) console

In addition, for every Nways Switch, the NCT generates IP addresses for all the adapters in the machine. The first 128 (for class A or B networks) or 64 (for class C networks) addresses are reserved for adapters and broadcast purposes.

You do not have to be concerned about these addresses but knowing their existence should help you understand the overall NBBS network IP addressing.

All the IP addresses previously mentioned (except those of the indirectly attached NMS and CCS) are generated by the NCT.

The NCT allocates these addresses automatically in the following ways:

NAS

The first available odd-numbered addresses are taken in increasing sequence starting after the addresses reserved for the Nways Switch adapters. There are 129 for class A and B and 65 for class C.

Switched remote consoles

The even-numbered addresses immediately follow the NAS address of the same Nways Switch.

NSC remote console local IP address

This is the higher available address (254 for class C, xx.254 for classes A or B).

Note

xx (set to all 1s) is the part corresponding to the bits left free by the subnetwork address in the third byte.

Directly attached NMS, CCS or router

These addresses are in decreasing sequence, starting from the end of the available range (253 for class C, xx.253 for classes A or B).

All these addresses are automatically allocated and generated by the NCT. Knowing these rules should help you define your needs in terms of network IP address class and network mask. You must know the network address the maximum number of nodes desired to start with the NCT, which then generates the network mask.

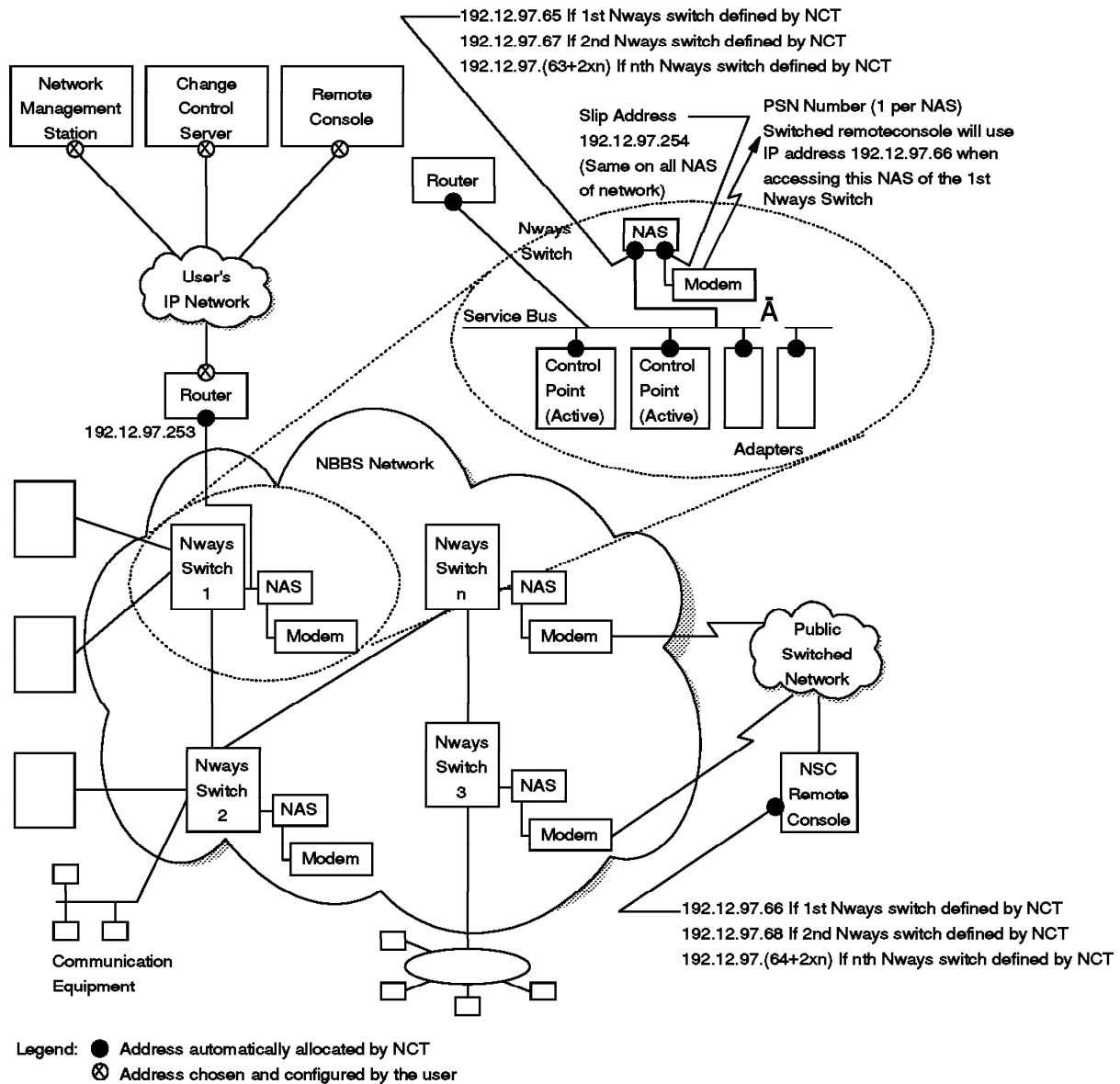Here is an example of IP addressing in an NBBS network:

Figure 17. IP Addressing in an NBBS Network

1.7.7 Using a Single Configuration Database

The mechanism of automatic IP address allocation previously described requires you to generate all these addresses on a single NCT station to ensure the consistency of the addressing and the unity of the IP addresses when needed.

Note: There is only one database, and the only limitation for the number of node configurations is the station memory size. There can be only one configuration per node. It is not possible to use the NCT to configure multiple networks. All of the nodes must belong to the same network even if they belong to several subnets (up to 16). To configure multiple networks, it is recommended to use different NCTs.

Therefore, it is necessary to do the following by using a single NCT:

- Enter the IP network address and the maximum number of nodes.

- Create all the Nways Switches of that network.

- Create the directly attached NMS and CCS, and routers for indirectly attached hosts.

This NCT can reside on an NAS or any PS/2 workstation with OS/2 or AIX with DB/2. Further configuration can be performed on that same station, but the previously mentioned steps are the absolute minimum to ensure a proper IP address generation. The configuration files for the different Nways Switches can then be exported via FTP, diskettes, or other media to other configuration stations (usually the NAS of the corresponding Nways Switches), where they are imported before continuing the configuration locally.

An NBBS network can have up to 16 logical IP networks but must conform to the following:

- All the IP addresses of every IP logical network configuration must be defined in a single configuration database.

- The same NCT can be used to prepare configurations of several logical IP networks, but each configuration must be different from the others.

- Any Nways Switch may belong to only one logical IP network at a time.

1.7.8 Setting the Routers and Externally Addressable Hosts

When you are planning for connections to routers and externally addressable hosts, please be aware of the following:

- All the directly attached externally addressable hosts (NMS, CCS, and remote consoles) and routers must run RIP in passive (listening) mode.

  They must also have BOOTPD *off* to prevent them from answering BOOTP requests. The NAS must be the only host to answer these requests.

- The routers must be configured by entering the IP addresses generated by the NCT and the routing tables must correspond to the other attached networks.

- The routers must be configured so that the propagation of all broadcast traffic, whether coming from other networks or from the Nways Switches, is filtered.

1.7.9 NID Function

You may notice that in an NBBS network the IP addresses for the NAS, remote consoles, directly attached NMS or CCS, and routers for indirectly attached NMS and CCS, are unique, whereas adapter addresses (TPAs) are not. This is because only the NAS communicates with its adapters, and there is no Nways Switch-to-Nways Switch or adapter-to-adapter IP communication. This means, in a given NBBS network, TPAs in the same slot of different Nways Switches have the same IP address. For example, the TPA in Slot 5 from Node 1 has the same IP address as the TPA in Slot 5 in Node 3. This makes the IP addressing scheme much simpler and saves addresses and subnets, but it requires a special function to handle IP communication for the TPAs. This function is called Network Interface Driver (NID).

The NID is software that does not need to be configured. When you configure an Nways Switch, all you need to do is specify the TPA (slot) that should run the IP

gateway adapter in the NCT (NID). The NID can run in a dedicated TPA as well as in a port TPA, but not in a trunk TPA.

The NID filters the TPA IP addresses from all external attached hosts and NASs other than the one local to the node. seen by the externally attached hosts. This function is similar to a TPA gateway function. In order to achieve maximum availability, a backup TPA slot can be defined as a backup NID. The NID function will then be loaded in both TPAs, one serving as a backup for the other. Here is a brief description of how the NID works:

- It receives the IP datagram or ARP from the service bus and checks whether or not the sender is known.

- If the destination is unknown, it sends a query DA to find the node TPA gateway that knows this IP address.

  This destination may be a NAS, a NMS, a CCS, a customer remote console or an IBM station.

- The first response received will be used to send the IP packets.

- It receives the IP datagram from the NBBS network and checks that the destination is one of the directly or indirectly attached hosts, the NAS or the switched remote console.

In addition to these functions, the NID does the following:

- It periodically pings the destination IP addresses contained in its cache.

- It filters IP broadcast packets received from the service bus.

- It advertises to all the hosts on the service bus that this is the gateway to access the other logical networks.

- The active NID is displayed as the "default router" when a **netstat -r** is issued in the NAS.

1.7.10 Video Enhancement

Release 4.4 provides a software solution for automatic bandwidth release when there is no active video to transmit.

The terminal video equipment is connected to CSU/DSU equipment through a V.35 interface and the CSU/DSU is connected to the Nways Switch through a T1 interface.

When the terminal video equipment is turned off or the logical video session is terminated from a "video bridge unit" the Nways 2220 logical connection is stopped. In these cases, there is not external signaling change to the CBR physical port.

There are two new parameters in the NSM and the NCT. They are "connection with idle removal" at the connection level and an "idle removal pattern" at the line level. These parameters are passed through the NAS, to the CBR protocol agent and to the RP3 picocode. The RP3 picocode monitors the data flowing on the connection. When an idle pattern is detected and a given threshold is reached, the RP3 picocode informs the CBR protocol agent. In the same way, when it receives three buffers of non-idle characters, the RP3 picocode also informs the CBR agent. When notified, the CBR agent deactivates or activates the connection. The activation will be successful however, only if the CBR agent

at the other end of the connection has also been notified by RP3 of the ″non-idle″ detection.

The hardware prerequisites are as follows:

- CBR idle removal requires an LSA3 port adapter and is supported on T1/E1/J1 LICs (for example, LICs 514, 515, 516, 544, 545, and 546).

Chapter 2. Nways Switch Configuration

This chapter describes the basic steps to configure an Nways Switch. The specific ports are described in the next chapters.
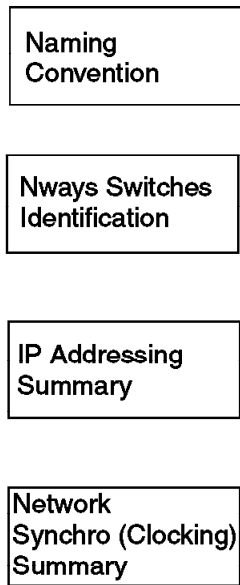
The configuration is done in a hierarchical manner. First, the overall characteristics of the 2220 Nways Switch network must be defined, then each Nways Switch is defined.

For each Nways Switch, there is a definition of the Nways Switch itself, and then a definition of its resources. The configuration includes:

- The IP address
- The physical resources (adapters and lines)
- The logical resources (ports and trunks)
- The logical connections

Figure 18 on page 44 gives a graphical summary of the configuration process.

Network-Level Definitions

Naming
Convention

Nways Switches
Identification

IP Addressing
Summary

Network
Synchro (Clocking)
Summary

Nways Switch Level Definitions

Nways Switch # n

Nways Switch # 2

Nways Switch # 1
Definition
Summary

Potential
Connection
List

Port
List

Trunk
List

Clocking

Logical
Trunk

Trunks
Physical
Configuration

Logical
Port

Port
Physical
Configuration

Potential
Connections

Potential
+ Virtual
Connections

Potential
Connections
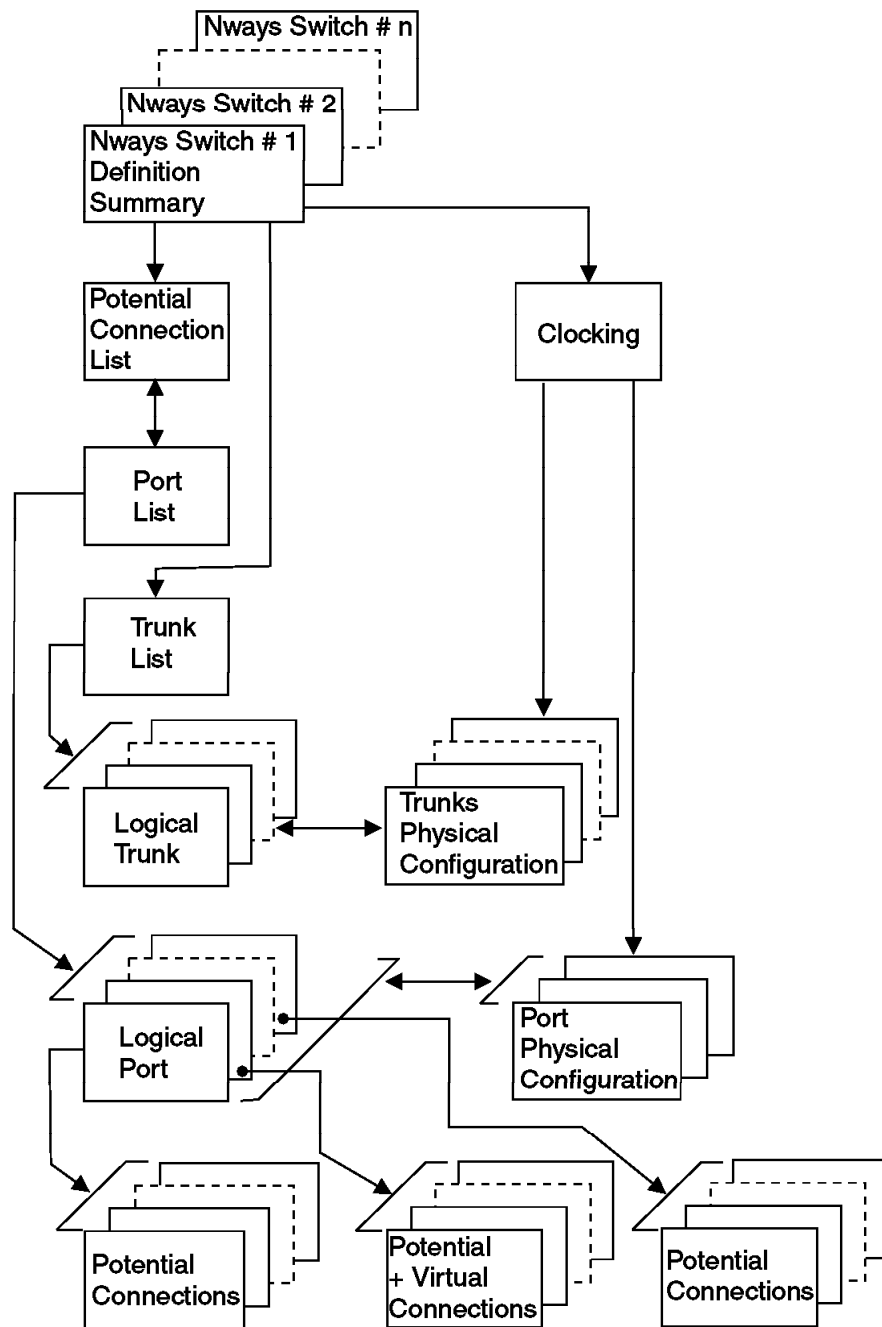
Figure 18.   Nways Switch Configuration Overview

Please take a look at the following icons. You will see them frequently in both
the Nways Switch Configuration Tool (NCT) and the Network Management
Station (NMS). These are the icons used to illustrate various hardware modules
in the Nways Switch.

500_Rack.ico 501_Rack.ico

Power.ico Fan.ico Line Connection Box
(LCB).ico

Switch Control Program (CP) Clock APC
Module.ico Adapter Module.ico Module.ico Module.ico

Trunk Trunk-CP Voice Server Voice Server
Adapter Module.ico Adapter Module.ico Adapter Module.ico LIC Module.ico

Port Port-Gateway ATM Line.ico
Adapter Module.ico Adapter Module.ico LIC Module.ico

1 interface 2 interfaces 4 interfaces 8 interfaces
LIC Module.ico LIC Module.ico LIC Module.ico LIC Module.ico

Figure 19. Icons Used to Show Physical Resources of the Nways Switch

Protocol.ico Network.ico

500_Node.ico 501_Node.ico

Control Program (CP) Clock References Voice Server (VS)
Function.ico Function.ico Function.ico

Logical Trunk Logical Logical Port Logical
Container.ico Trunk.ico Container.ico Port.ico
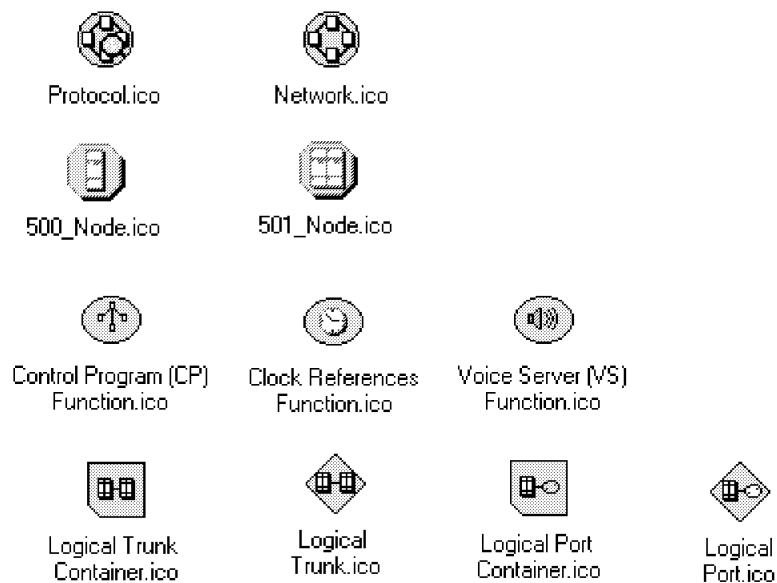
Figure 20. Icons Used to Show Logical Resources of the Nways Switch
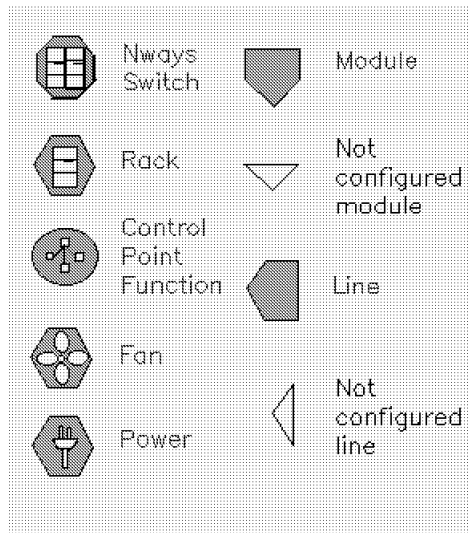
Figure 21. More Icons Used to Show Nways Switch Resources

2.1 Basic Nways Switch Configuration Scenario

In order to illustrate the basic Nways Switch configuration, we connected three Nways Switches, labeled N1, N2 and N3. We used one ATM OC3 trunk and two T3 trunks. The Network Management Station (NMS) is directly connected to the first N1 node via the Ethernet LAN.

2.2 Scenario Physical Setup

The following illustration shows the physical setup of the environment.
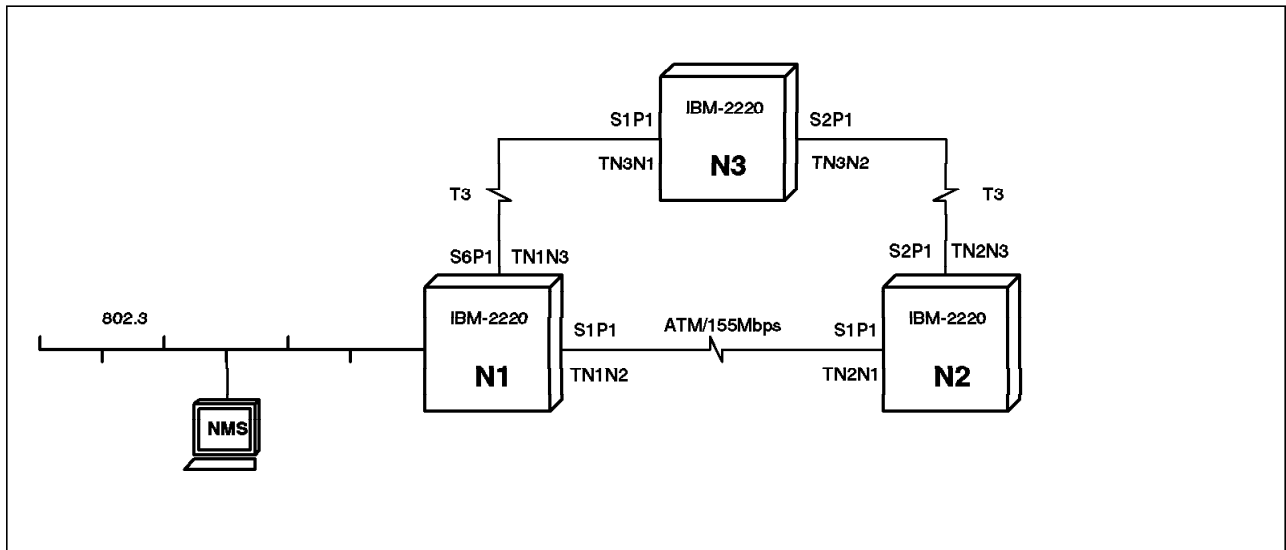
Figure 22. Basic Nways Switch Configuration Physical Illustration

2.3 Scenario Logical Setup

The following illustration describes the logical or protocol view of the network.
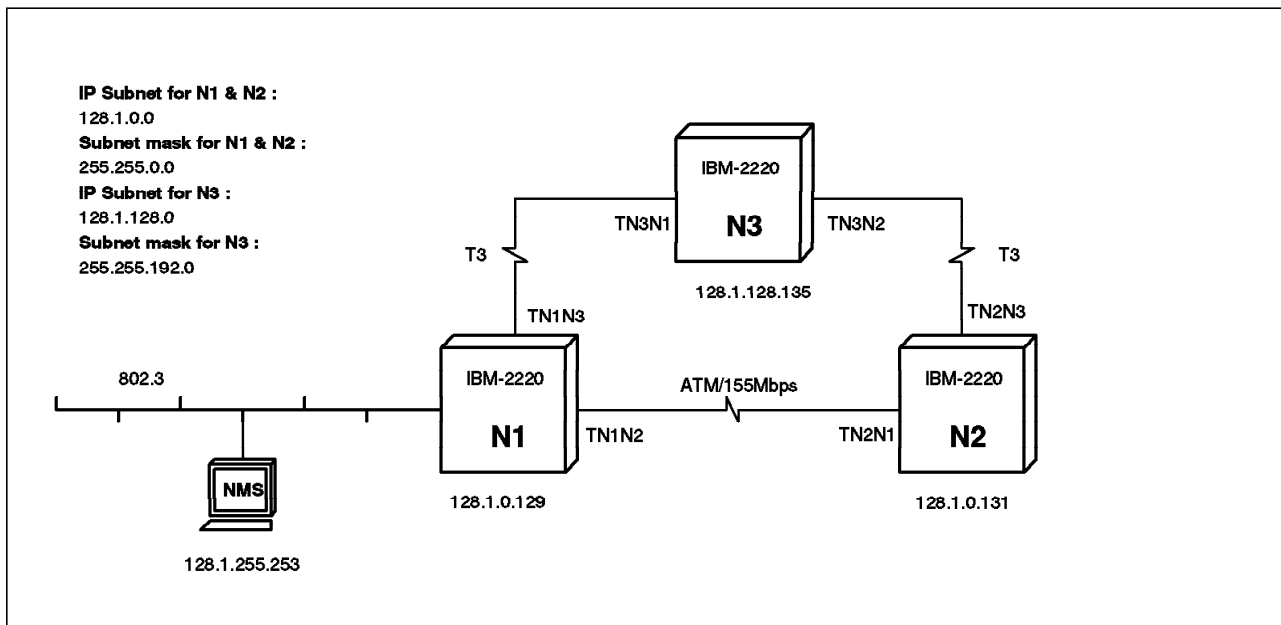
Figure 23. Basic Nways Switch Configuration Logical Protocol Illustration

2.4 Nways Switch Machine Description

For our test we used a non-redundant Nways Switch Model 500 together with the 501 extension and with single power supplies. All three Nways Switches have the same physical configuration.

ATM Adapters Type 2 (ATMA2) are installed in slots 1, 2 and 3 and High-Speed Adapters Type 3 (HSA3) in slots 4 and 6. The trunk adapters are an ATM Adapter Type 1 (ATMA1) placed in slot 1 and a High-Speed Adapter Type 2 (HSA2) placed in slot 6. The control point is located on a single High-Speed Adapter Type 3 in slot 4.

The rear of our machine contains the DC Distribution (DCD), and Alarm and Power Control (APC) cards in slots 12 and 11 (respectively) as well as the matrix switch card (SW) in slot 9. A LIC555, in slot 1, provides an ATM 155 Mbps trunk to the other Nways Switch Node N2. LIC513 resides in slot 6 for a T3 trunk to Nways Switch N3.

2.5 Nways Switch Configuration Tool (NCT) Definitions

In order to generate the correct IP addresses, we must perform our first configuration from the master console. This master console may be one of the Nways Switch Administration Station (NAS)s or any workstation which has the stand-alone version of the NCT code.

We configured this setup of the by using a centralized NCT on the Nways Switch Administration Station (NAS) of our N1 Nways Switch. For each screen we put in

as many details as possible. Whenever we have not specified an item, you may use the default option provided by NCT.

> ┌─ **Please Note** ───
> │
> │ • Our machines are at Nways Switch Configuration Tool (NCT) Version 2
> │   Release 3. Depending on the version that you are using, the screen
> │   format may vary. Whenever your screen is different from the one
> │   illustrated in this redbook, please use the Help function of the NCT.
> │
> │ • Because it is impossible to provide all the details for every parameter
> │   available, we strongly suggest you use the extensive contextual online
> │   help provided with the configuration tool for any item not covered in this
> │   publication.

The configuration of an Nways Switch is a logical process where you will define the various components of your Nways Switch. The Nways Switch Configuration Tool (NCT) facilitates the definition process and also validates your input. You will find that defining an Nways Switch network is much easier if you follow these general suggestions:

- Create all your Nways Switches first.

- All the hardware for a given Nways Switch should be defined before you attempt to define the trunks and ports for that Nways Switch.

- You will not be able to create logical ports or trunks if the physical hardware adapter for the trunks or ports have not been defined.

- The ports must be defined before you attempt to define the connections.

On your desktop you will have a folder called Nways Switch Configuration which contains the following icon view:
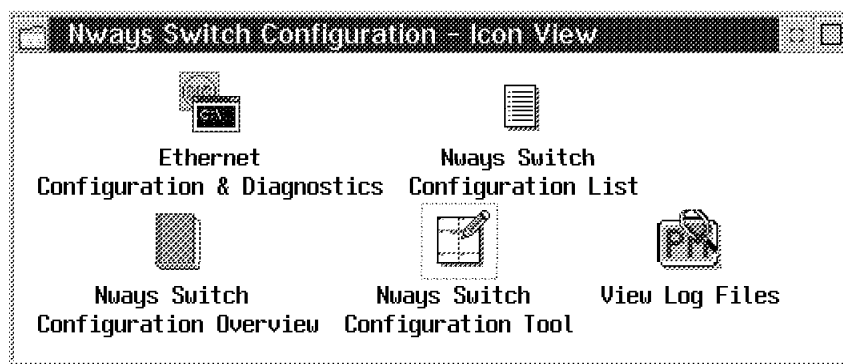
Figure 24. Nways Switch Configuration - Icon View

To create a configuration, double-click on the **Nways Switch Configuration Tool (NCT) 2** icon.

> ┌─ **Please Note** ───
> │
> │ If this is the first time you have used the stand-alone version of NCT since
> │ OS/2 was booted, you will be required to identify yourself to DB2/2. The
> │ default user ID is USERID and the default password is PASSWORD.

The very first time you use the NCT for a new machine, you will have to define your network. This is something you need to do only once. If it is not your first time and your network has already been defined, you may wish to modify an existing network or add a new one.

In our case, we already had a network defined, so what we illustrate here is how to modify one. After having selected **Network** you have to select the **Open** option followed by **Configuration...**.
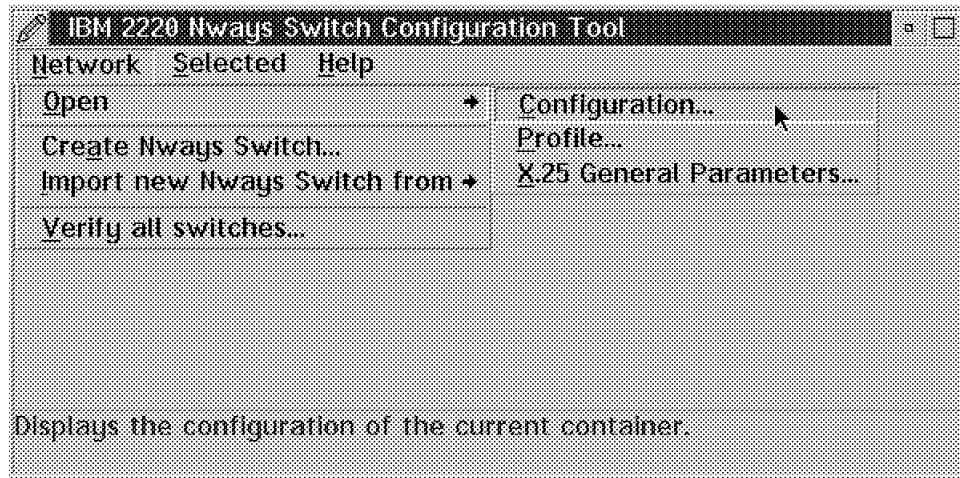
Figure 25. Nways Switch Configuration Tool (NCT) Main Menu

Whether it is your very first time using the NCT and you are creating your first network or you just selected the options to modify an existing one as previously described, you will get the following menu where you name your network.
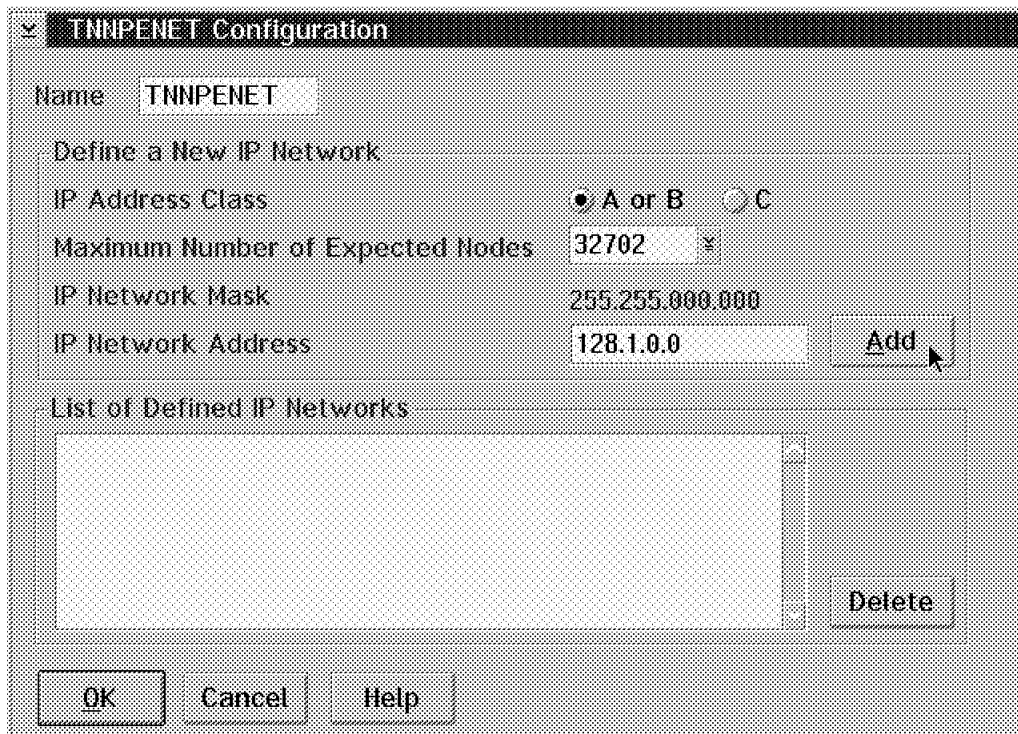
Figure 26. ITSC Configuration

In this example the name we gave our network was TNNPENET. This is also where you define an IP address class and an IP network address. We used a class B address and a 128.1.0.0 IP network address. You will notice that the NCT automatically puts the Maximum Number of Expected Nodes field to the maximum allowed for your address class. You may change this value to the number of hosts you expect to have in your network. For more details about the IP address classes, please refer to 1.7.2, "Dealing with A, B or C Classes" on page 35. Selecting the **Add** button will add the new network address to your list of defined IP networks as shown in the following illustration:
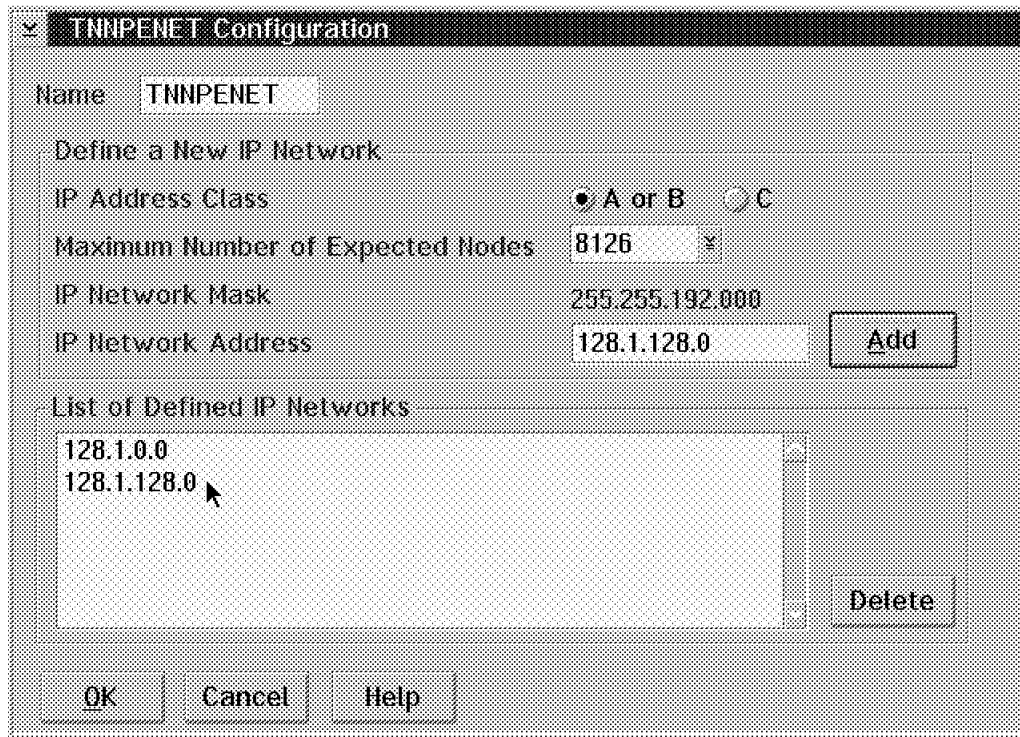
Figure 27. Configuration of IP Networks

You may add other IP networks by repeating the procedure previously described. Once you specify all of the network definitions, you simply select the **OK** button to proceed and the NCT will bring you back to the main menu. As you can see we added a second IP network 128.1.128.0. This allows us interconnection to existing Nways Switches without any IP conflicts. More specifically, the Nways Switch Node N3 belongs to the IP Subnet 128.1.128.0.

2.6 Nways Switch Creation

The next task is to define the Nways Switch. Creating all your Nways Switches at the same time allows them to be displayed on later screens whenever you have a multiple choice selection to perform.

To create a new Nways Switch, select the **Network** option followed by the **Create Nways Switch...** option as in the following illustration.
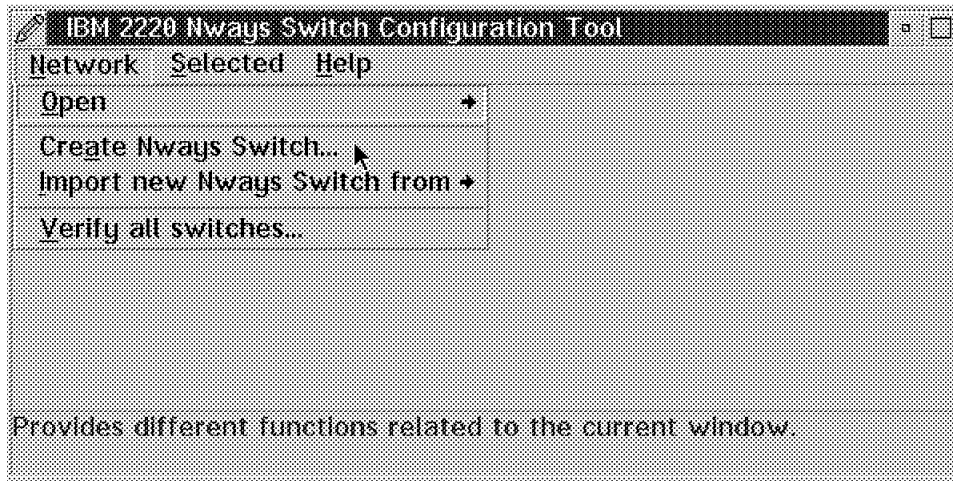
Figure 28. Nways Switch Configuration Tool (NCT) Main Menu

You are then prompted to enter a general description of the Nways Switch itself as illustrated below using the following steps:

1. You select a name; in our case we used N1.

2. You select the type of machine; in our case it was an IBM 2220 Model 500.

3. You select the options; in our case we had a non-redundant model with a single power supply and a clock card.

Figure 29. N1 Configuration

Next you have to decide where your control point function will reside by filling in the Control Point Adapter Location. You will notice that the screen in our example shows just one control point. This is because the Full Redundancy option was set to No. Had we chosen the redundancy option as Yes, the NCT would show a second control point in this screen. A dedicated control point must be either in position 10 or 12; we chose to share the adapter in slot 4 with control point and trunk traffic.

An IP gateway adapter (NID) must be a port adapter of the Nways Switch. It exchanges IP messages between the (NAS) and management stations. You may have a backup IP gateway defined; however, if the Nways Switch you are defining is the one providing access to the Network Management Station (NMS) system, then the IP gateway adapter should have a backup. This is very important because if you lose that adapter, then you have lost your management access to the whole network. The network will still run but you will not be able to manage it centrally. Please refer to 1.7.9, "NID Function" on page 39 for additional details on the IP gateway function.

In our case, we have elected to put this function in the adapter together with the ports we define later. The backup gateway is defined in Rack A Slot 3.

Next, you must choose the IP network address. In our case, we used 128.1.0.0. Since we previously defined two IP networks, we can choose any one we want

by selecting the arrow on the right-hand side of the IP Network Address field. You may subdivide a given network into different domains; therefore, you must specify a domain name. In our case, we have chosen TNNPENET.LAGAUDE.IBM.COM.

Then, you must specify a phone number which should represent the place where someone may be reached for questions about this specific Nways Switch. In general, this number may be used by your network support group or an IBM maintenance person to contact someone in your organization for questions about this Nways Switch. The Maximum Transmission Unit represents the largest transmission unit that can be sent through the modem. In most cases you should leave it at the default value of 296 bytes.

Finally, you must choose a **Voice Compression Support (PCM Law)**. You can select a PCM Law if at least one Voice Server Adapter (VSA) is installed in the Nways Switch. Conversion is then automatically done by a VSA each time the compression law is different on both ends of a voice connection. Select A-Law or Mu-Law depending on the location of the Nways Switch. A-Law is used in Europe, Mu-Law in the USA. To activate compression law conversion, another voice function (such as voice compression) must be requested when configuring voice potential connections. If no VSA is installed, select **Not Applicable**.

After this is done, click on **OK**. Then, create your second Nways Switch called N2 in the same way as the first one you created.

Once the second Nways Switch N2 is defined and both switches are created, you will get the following screen.
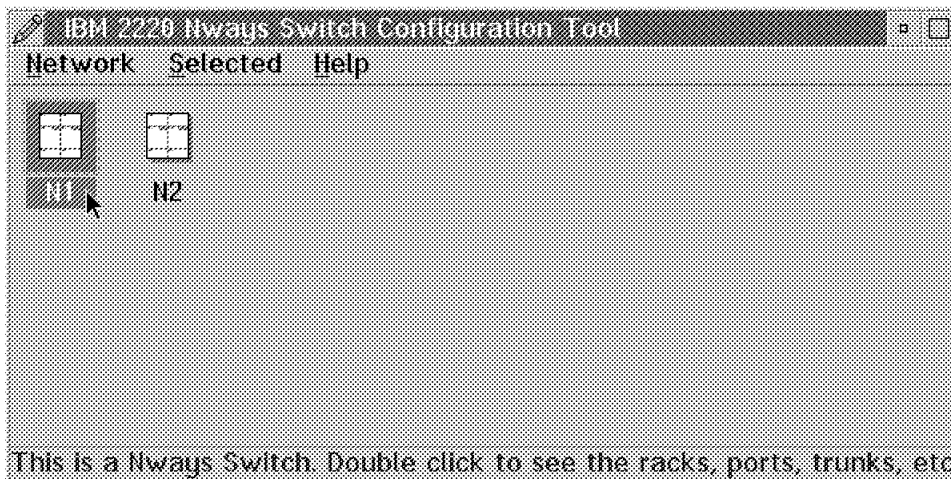
Figure 30. Nways Switch Configuration Tool (NCT) Main Menu

2.7 Physical Rack Definition

The next thing that has to be done is to define the entire detailed physical configuration of all your Nways Switches. To define the physical hardware of the N1 Nways Switch rack, you have to double-click on the **N1 Nways Switch** icon. This brings up a screen with a few icons representing the physical and logical components of the machine as follows:
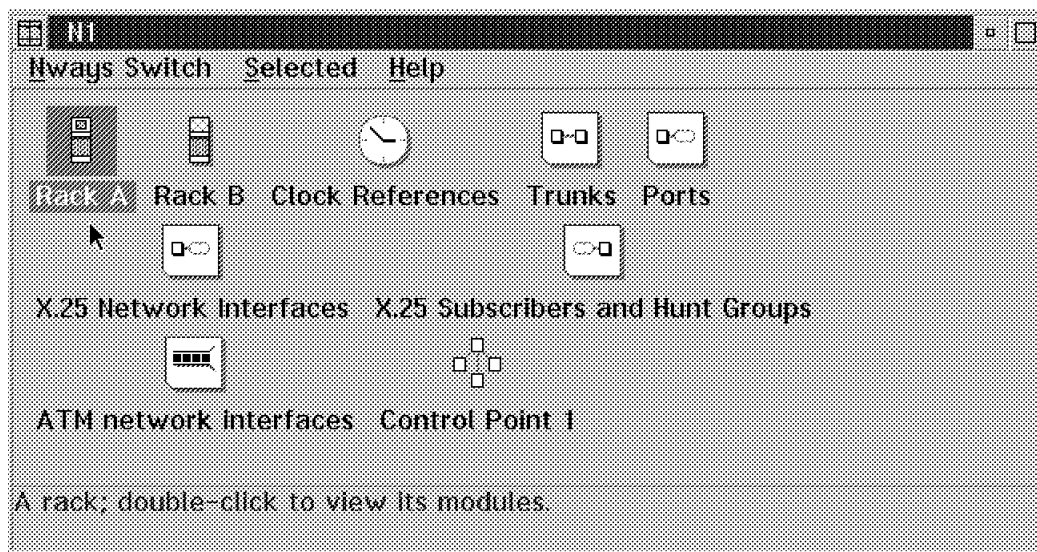
Figure 31. N1 Configuration

Pay attention to the various icons as you will see them in many other places in the system. The first one, called Rack A is where we describe the physical hardware components in our Nways Switch. Since we defined a Model 500 and a 501, we see two rack icons. Rack B is for the 501 extension. For additional details on the rack, please refer to 1.1.21, "Subrack" on page 12.

The second icon, called Clock References, stands for a software function that controls the reception of clock signals used for network synchronization. This icon only displays when Clock Option is set to Yes in the Nways Switch Configuration window.

The third icon, called Trunks, is where we define our logical trunks in more detail. The physical line we use as a trunk has to be defined before we try to create our NBBS trunk. Please refer to 1.1.14, "Trunk Adapter" on page 7 for additional information on what a trunk is.

The fourth icon, called Ports, represents our logical ports. This is where we define our port in more detail. The physical line we use as a port has to be defined before we try to create our NBBS ports. Please refer to 1.1.15, "Port Adapter" on page 8 for additional details on what a port is.

The next two icons represent X.25 Network Interfaces and Subscribers functions. Please note that X.25 support will not be covered in this book.

The next icon, called ATM network interfaces, represents our ATM ports. This is where we define our ATM ports in more detail.

The last icon, called Control Point 1, represents our first control point. If we had defined a fully redundant Nways Switch, you would see two control points on this menu.

To define the various physical adapters and their location in your Nways Switch, double-click on the **Rack A** icon and you will get the following screen:
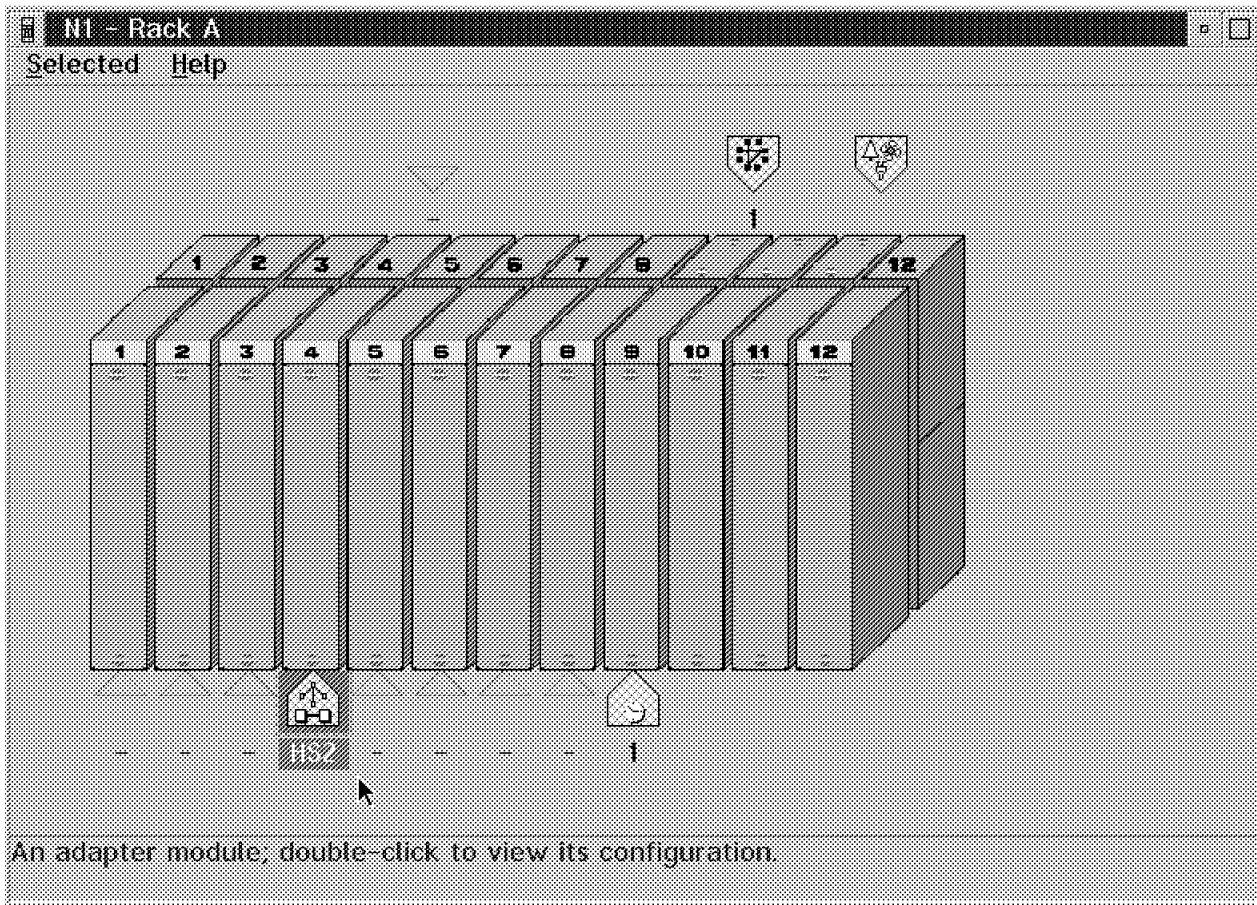
Figure 32. N1 Rack A Screen

As you can see, some components are already defined in the Nways Switch basic subrack because they are mandatory and are always present in the same location or because we have already told the NCT of their presence. This is true for the control point which is located in slot 4 as we specified earlier when we created our Nways Switch. The APC card is symbolized by the icon over the rear slot position 11. SW1 is symbolized by the icon over the rear slot position 9. Even though the control point is present, you may specify the type of adapter used by double-clicking on the icon at the bottom of slot position 4. The following screen allows you to specify the type of adapter for your control point:
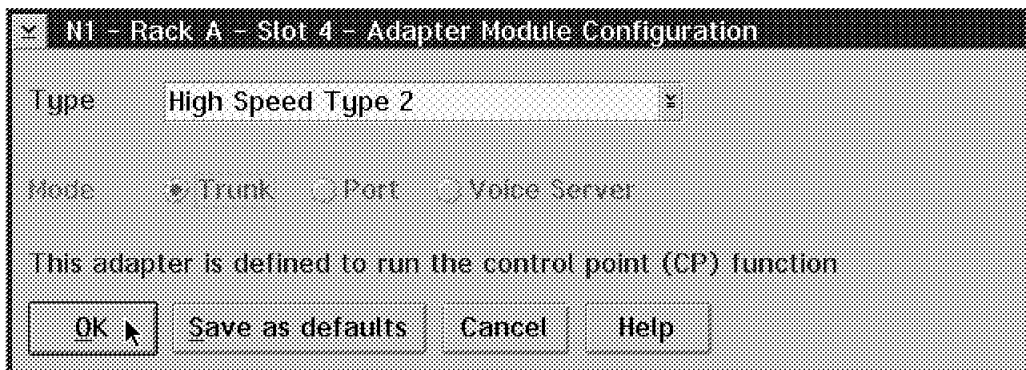
Figure 33. Adapter Module Configuration

In this case, we use High-Speed Adapter Type 2 (HS2). Please note that the Trunk Mode is the only mode available when you share the control point function with line protocols (line interface coupler).

Once you have defined the adapter for your control point, you should save as defaults and return to Figure 32 on page 56.

2.7.1 Trunk Adapter Physical Line Definition

Please notice that on the bottom of the front adapter positions there are empty triangles. These triangles represent unconfigured modules. To define our ATM Adapter Type 1 (ATMA1) card (OC3) in position number one, double-click on the triangle positioned underneath it. This will prompt you to describe the type of adapter as follows:
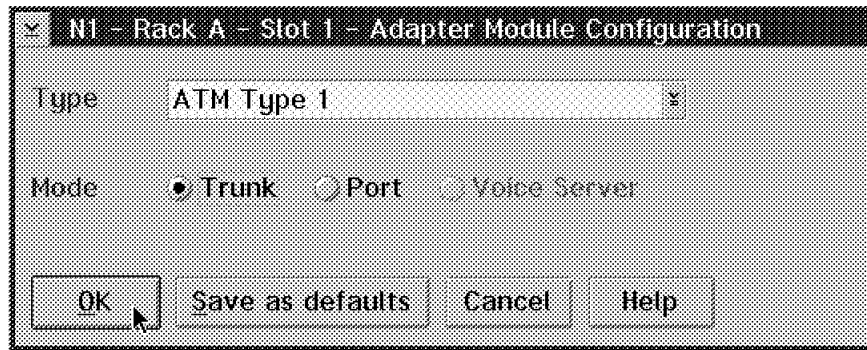
Figure 34. N1 Rack A Trunk Adapter

You may choose a type by clicking the left mouse button on the downward pointing arrow at the right of the adapter type description. On this screen, under Mode, is where one of the following software modules to be loaded in the adapters is indicated:

- Trunk code

- Port code

- Voice server code

In this case, it is defined as Trunk and as ATM Type 1. Once you are done select the **OK** push button to proceed.

This will take you back to the rack screen which now shows an ATM Adapter Type 1 (ATMA1) icon in position 1 as well as an empty triangle above the rear slot for adapter one. By double-clicking on the empty triangle, you will be prompted to define the LIC adapter type that is paired with the adapter you have defined.
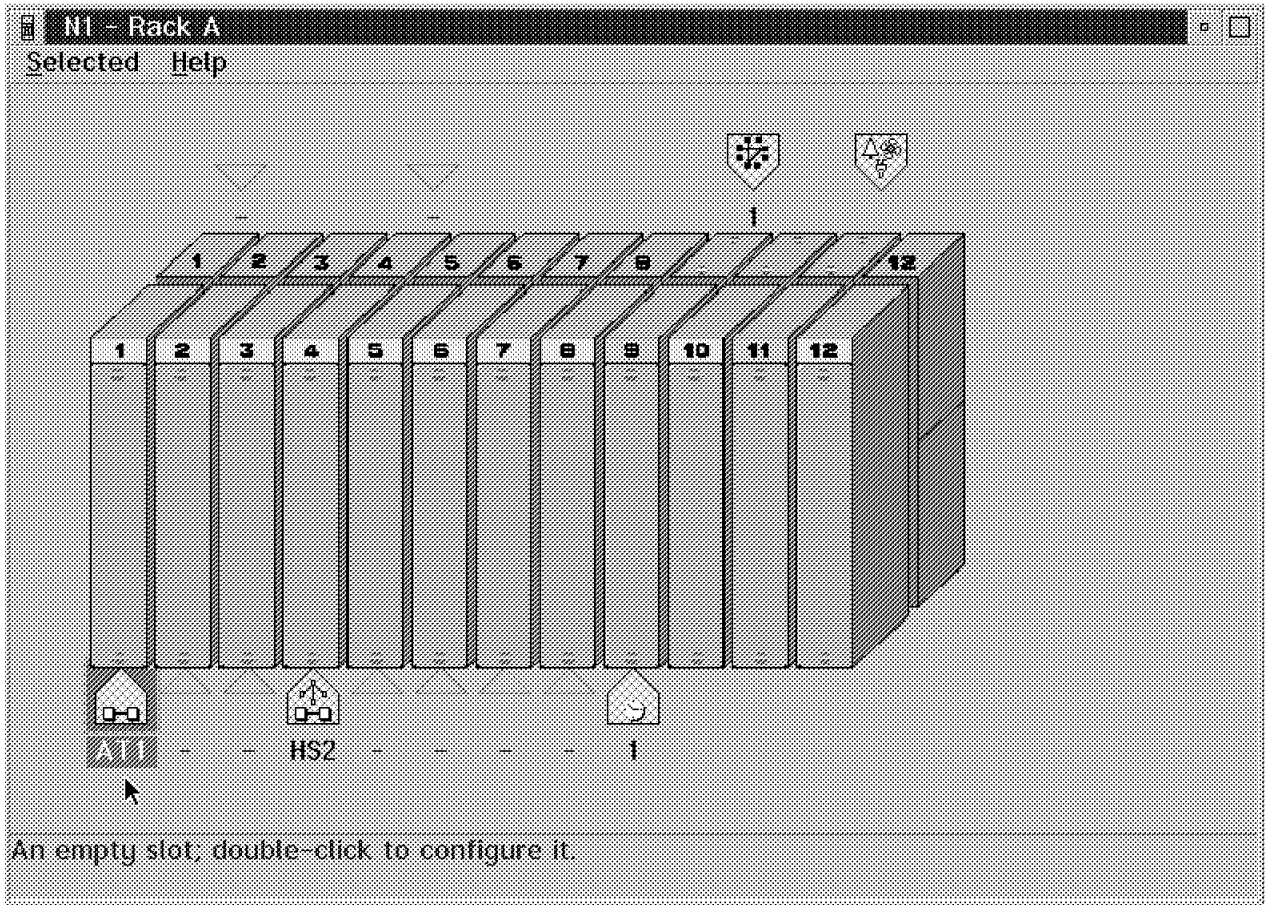
Figure 35. N1 Rack A Configuration

The following screen allows you how to define the type of adapter you want to use. In this case, since an OC3 single-mode fiber is to be used, we select a LIC555. Click on the **OK** push button to proceed, as follows:
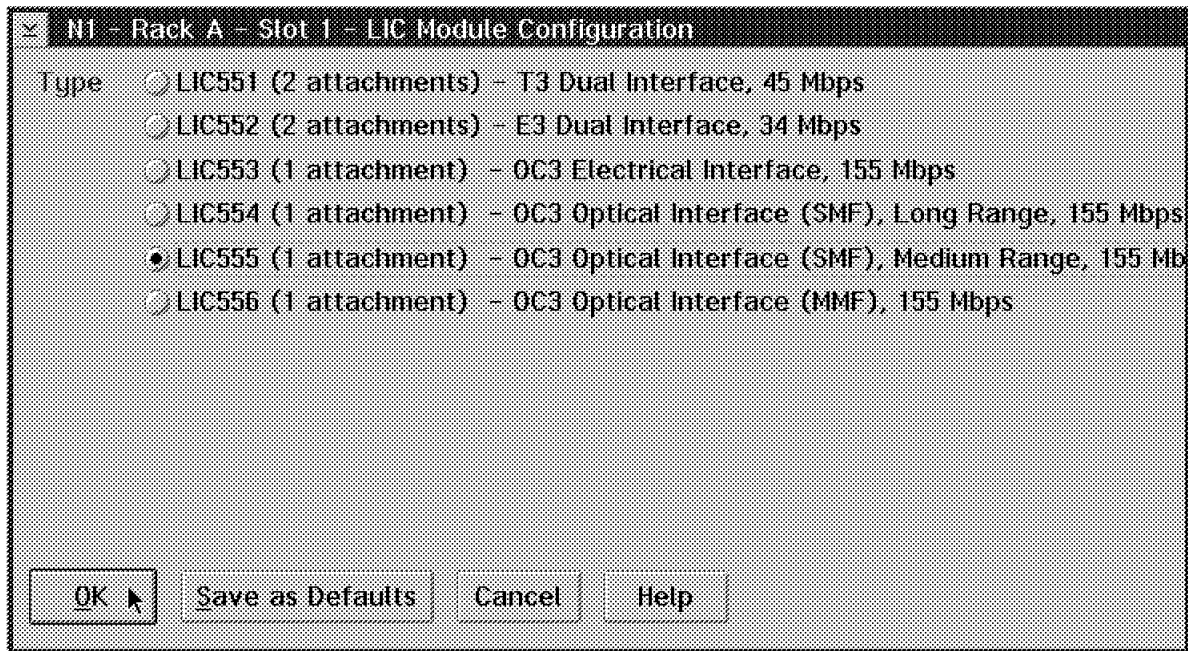
```
╦  N1 – Rack A – Slot 1 – LIC Module Configuration
Type      LIC551 (2 attachments) – T3 Dual Interface, 45 Mbps
          LIC552 (2 attachments) – E3 Dual Interface, 34 Mbps
          LIC553 (1 attachment)  – OC3 Electrical Interface, 155 Mbps
          LIC554 (1 attachment)  – OC3 Optical Interface (SMF), Long Range, 155 Mbps
        ● LIC555 (1 attachment)  – OC3 Optical Interface (SMF), Medium Range, 155 Mb
          LIC556 (1 attachment)  – OC3 Optical Interface (MMF), 155 Mbps




    ┌──────┐
    │ OK ▶ │  Save as Defaults    Cancel     Help
    └──────┘
```

Figure 36. ATM LIC Module Configuration

This will again take you back to the rack screen which now shows an OC3 LIC icon. To configure the next trunk repeat all previous steps. In our second example we used a High-Speed Adapter Type 2 (HSA2) together with T3 line. In this case, we selected a LIC513.

```
╦  N1 – Rack A – Slot 6 – LIC Module Configuration
Type    ● LIC513 – T3
          LIC523 – E3, E2, or J2
          LIC530 – HSSI








    ┌──────┐
    │ OK ▶ │  Save as Defaults    Cancel     Help
    └──────┘
```
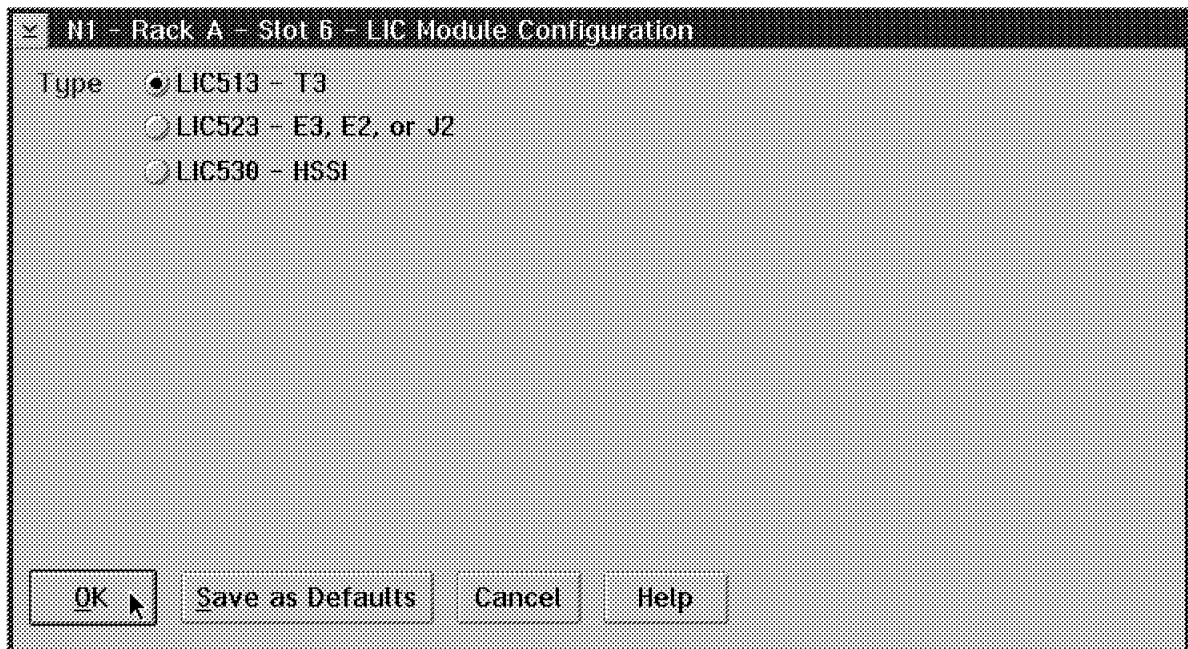
Figure 37. T3 LIC Module Configuration

Figure 38 on page 60 shows the basic N1 rack with both trunks' hardware defined.
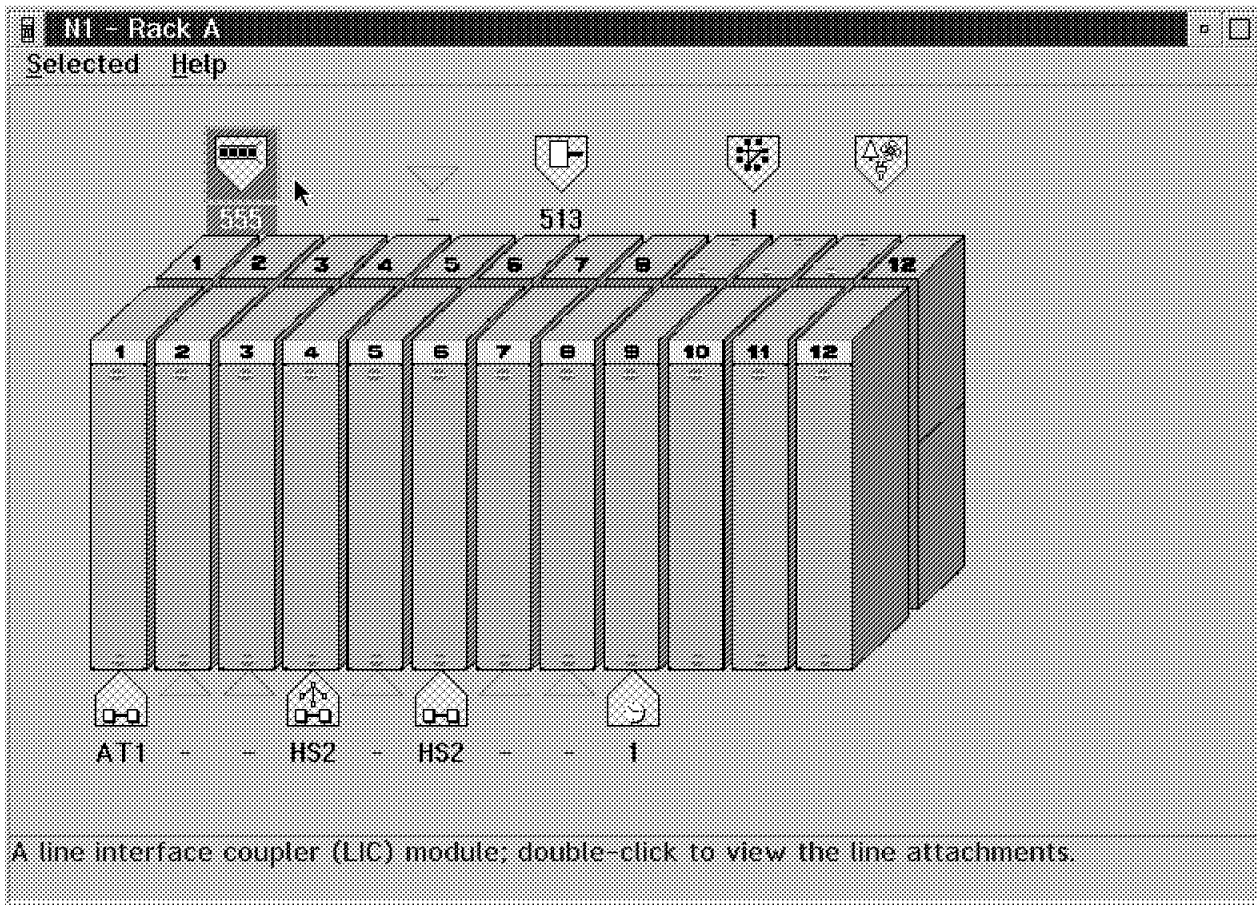
Figure 38. N1 Rack A Trunk and Control Point Definition

> Now that the line interface coupler type is defined, the lines on the adapter need to be defined. In order to define the physical line characteristics, double-click on the **555 LIC** icon. This type of LIC comes with one connector. To define the line, double-click on the **LINE 1** icon as follows:
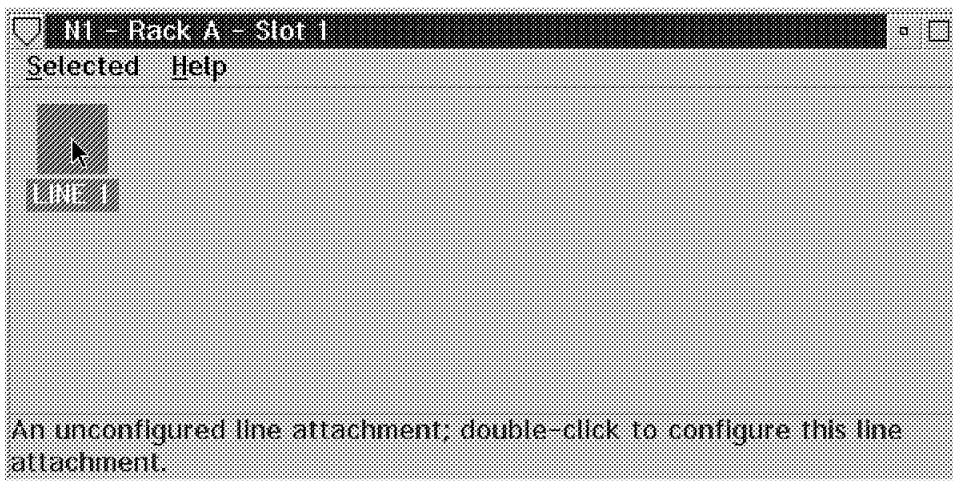
Figure 39. N1 Rack A Slot 1

> This brings up the line definition screen. In this screen you must specify the trunk destination. We suggested earlier that you define all the Nways Switch(es)

initially because now under the item labeled Nways Switch you will be able to select the switch you want. If you have not defined all of your Nways Switch(es) ahead of time, you will have to manually enter the destination name.

Other important items here are the rack, slot and position of the adapter. When you are doing a configuration on the Nways Switch Configuration Tool (NCT), the application can check to see whether or not there is an adapter defined in that position. It can also perform a validity check and prompt you in case there is an error.

You must also specify the Line Framing option:

- SDH for Synchronous Digital Hierarchy, an international recommendation for the internal operation of carrier optical networks.
- Sonet for Synchronous Optical Network, a U.S. standard for transmitting digital information over optical interfaces.

Then you have to specify the Clock Role option as internal or external as well as the Cell Discard Policy. In our case we have decided to let the N1 Nways Switch provide the clocking and have therefore defined this clock as Internal. For the Cell Discard Policy we chose the recommended default value.

If you will be defining many similar Nways Switch(es), you may select the **Save as Defaults** option which will store the options you have chosen. The next time you create a new line attachment, the system will already have the correct options set up. This will save you some typing and is useful if you have many similar line attachments. The default parameters you may save are the Line Framing, Clock Role and Cell Discard Policy options. Select the **OK** button to proceed.
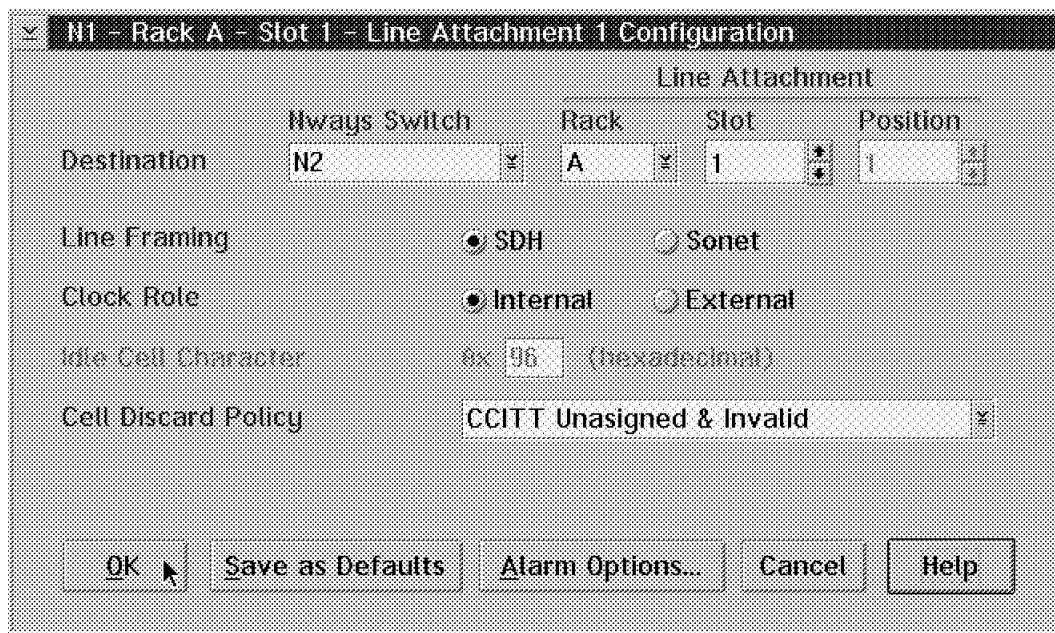
Figure 40. Slot 1 Line Attachment 1 Configuration

In the screen above you can see the Alarm Options...button. After pressing that button, you get two main alarm indication options:

- Time to set alarm: Time before the alarm is raised by the control program if a problem is detected on the line.
- Time to clear alarm: Time after which the alarm indication signal is cleared by the control program.

We strongly recommend you use the default values unless you experience specific error conditions that might require you to change some of the options to aid in diagnosis of problems.
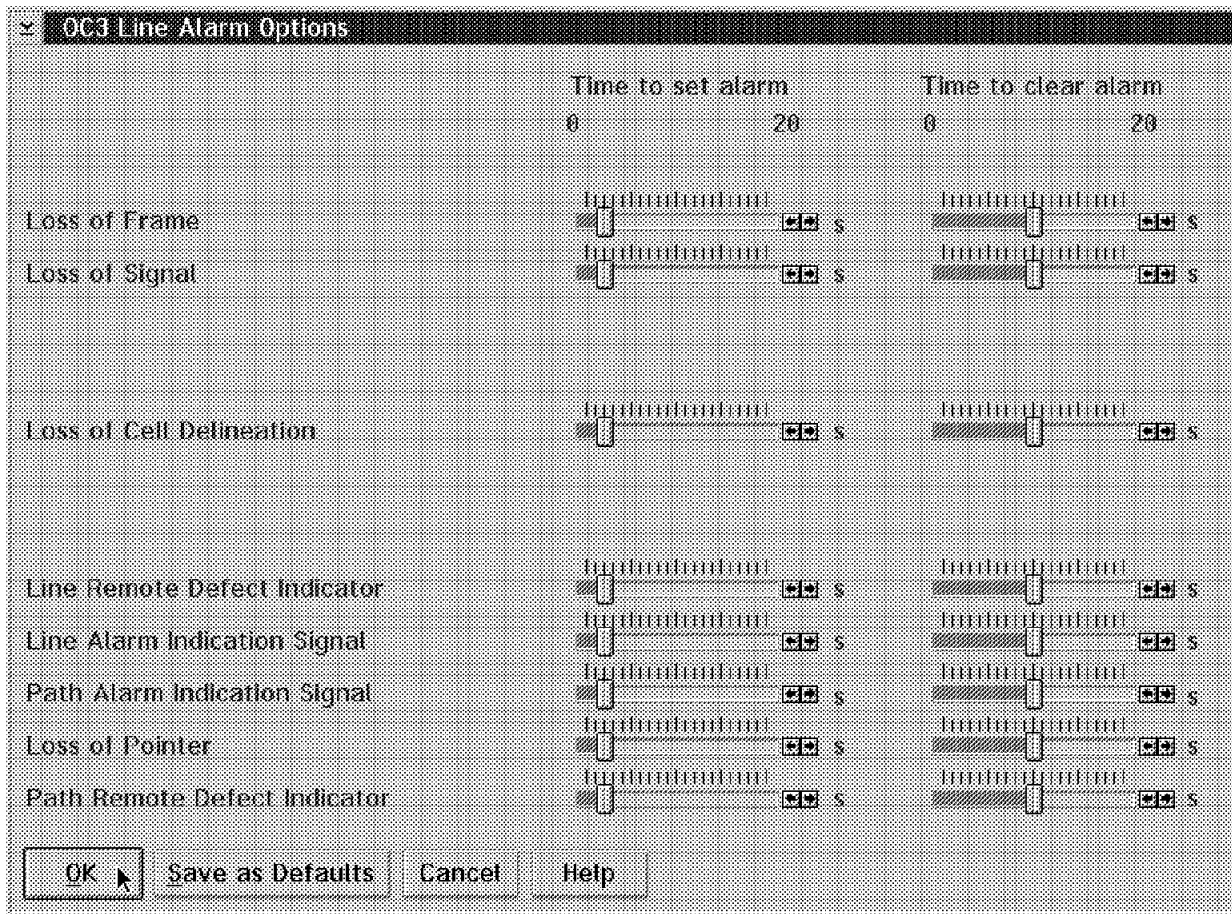

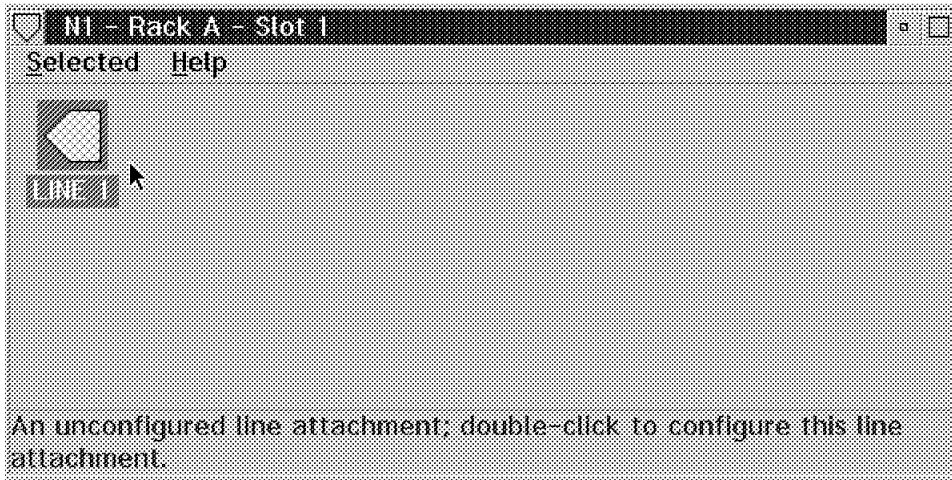Figure 41. OC3 Line Alarm Options

The next window reflects our last physical line definition:

Figure 42. N1 Rack A Slot 1

For the second trunk connected to node N3, we define it on the rear side of the High-Speed Adapter Type 2 (HSA2) in slot position 6. Again the trunk destination has to be defined. Depending on the cable length, choose the appropriate value. This indication is important for signal attenuation. Finally the clock role is provided by the Nways Switch.
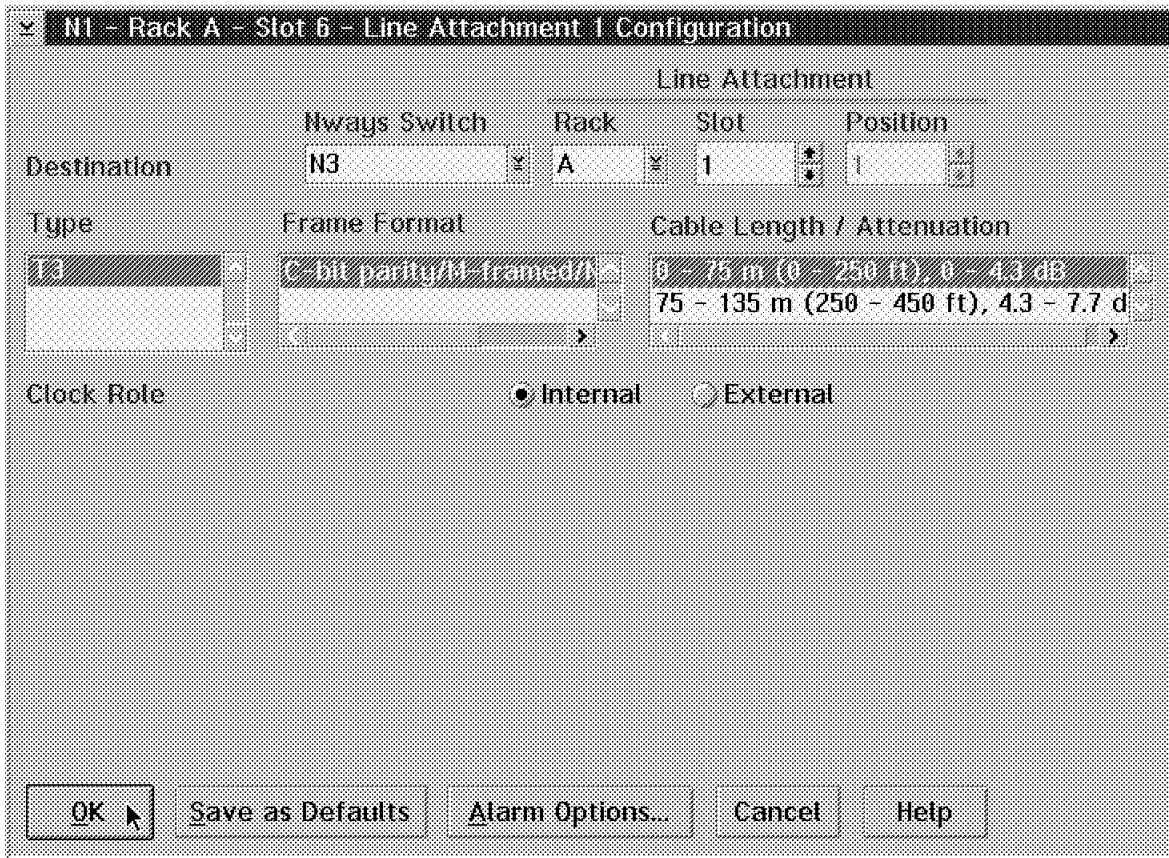
Figure 43. Slot 6 Line Attachment 1 Configuration

2.8 NBBS Trunk Definition

After defining all of the physical adapters for our two Nways Switches, we need to define the NBBS logical trunk definitions. We started by selecting the **Trunks** icon, as shown in the following figure:
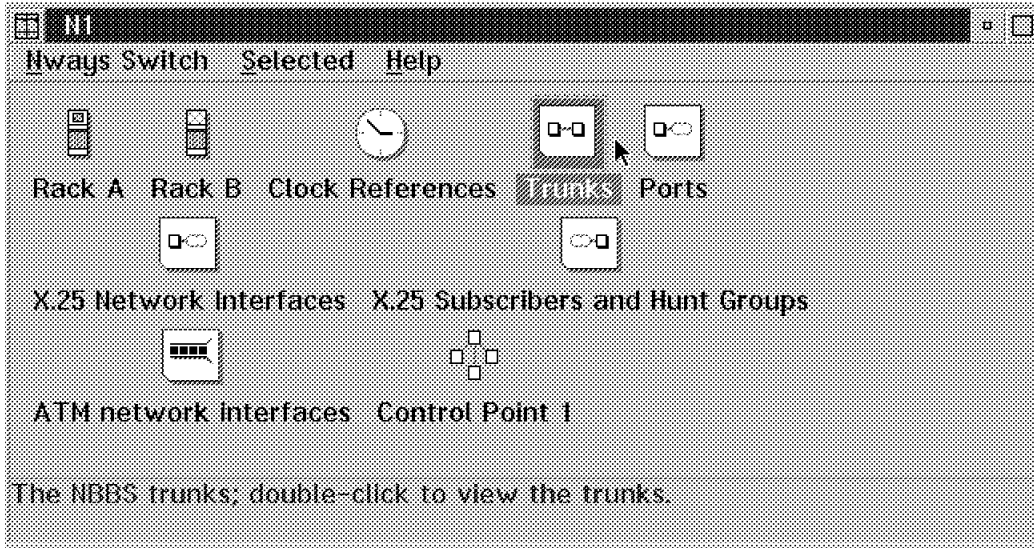
Figure 44. N1 Menu

Double-click on the **Trunks** icon and the following screen will appear:
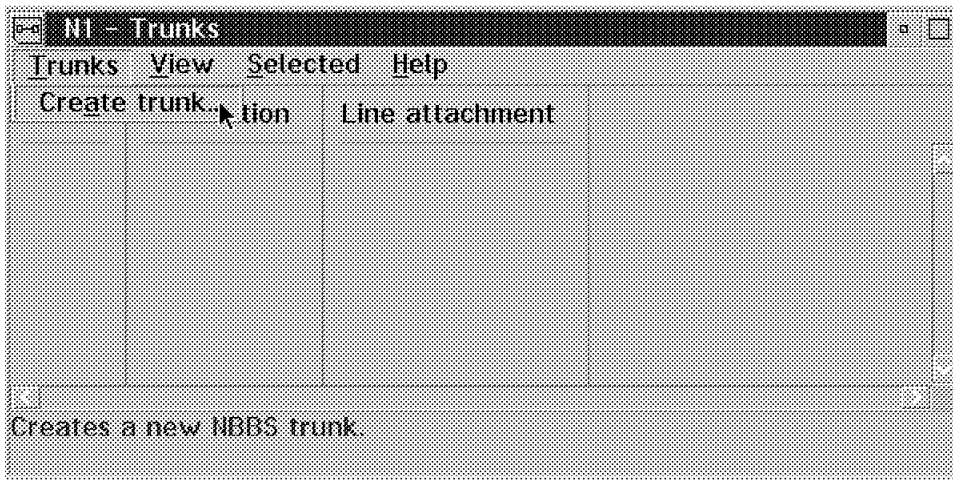
Figure 45. Trunks Configuration

Select **Trunks** and **Create trunk...**. The following screen describes the trunk:
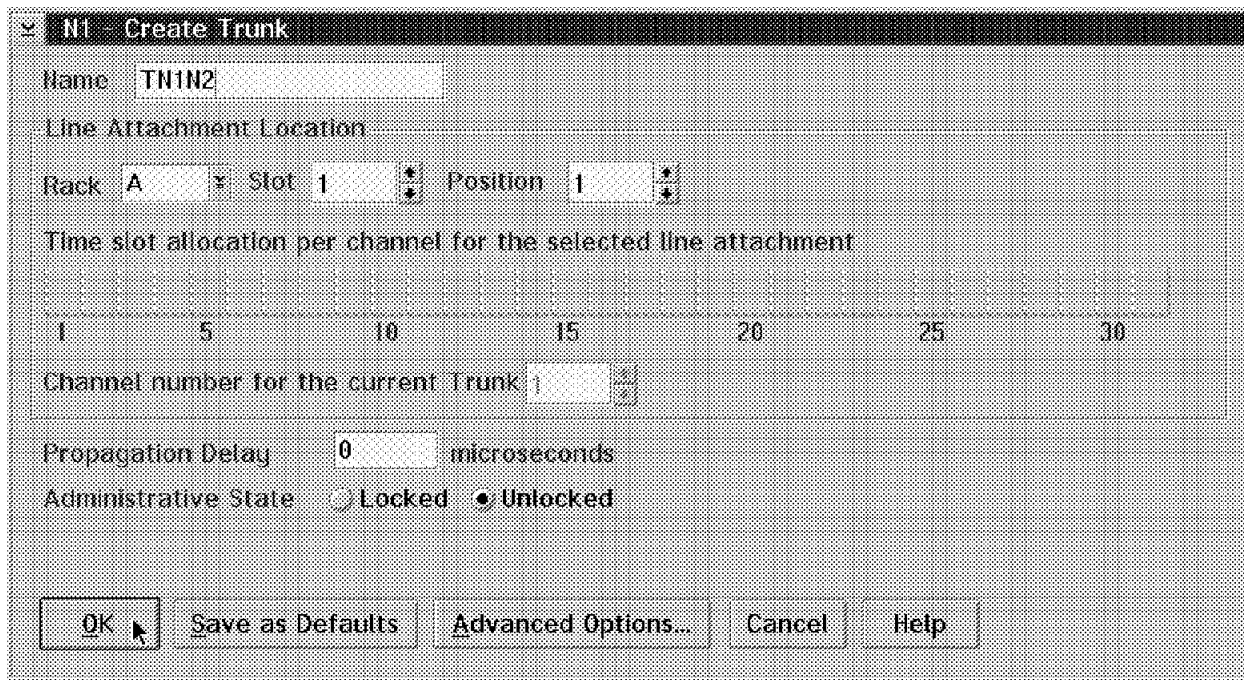
Figure 46. N1 Trunks

Please note the naming convention we used. Since this is a trunk going from N1 to N2 and this is our first trunk logical definition, we have used the name TN1N2. It is best to establish an easy naming convention before you start defining objects.

Whenever you define NBBS trunks or ports, you should relate them to a physical definition that you made earlier. This is done by specifying the rack, slot, and position of the adapter. There is a validation that takes place here to ensure that there is a physical definition of an adapter defined as a trunk in that position.

Time slot allocation per channel only has meaning for channelized lines. You will notice that there is a field called Propagation Delay. In our example, we have allowed it to default to zero. The value you may put in this field is what you want the average propagation delay in microseconds to be over that specific trunk line. The Nways Switch will take this value into account whenever it is selecting a path.

Note: Although the Propagation Delay option defaults to zero, a real value should be entered. This will be difficult since propagation delay depends not only on cable length but also on inline equipment.

The Administrative State option describes what status the trunk will be in when it is started. One choice is to have it come up in a locked state. Locked means that the trunk is installed and available. However traffic is prohibited from flowing on it until there is an operator intervention. The other choice is Unlocked, where traffic is allowed to flow as soon as the adapter is loaded. We decided to have it come up as unlocked. Please note that we have selected the Advanced Options... item in our previous example. When you select the Advanced Options... item on the Create Trunk screen you will get the following screen:
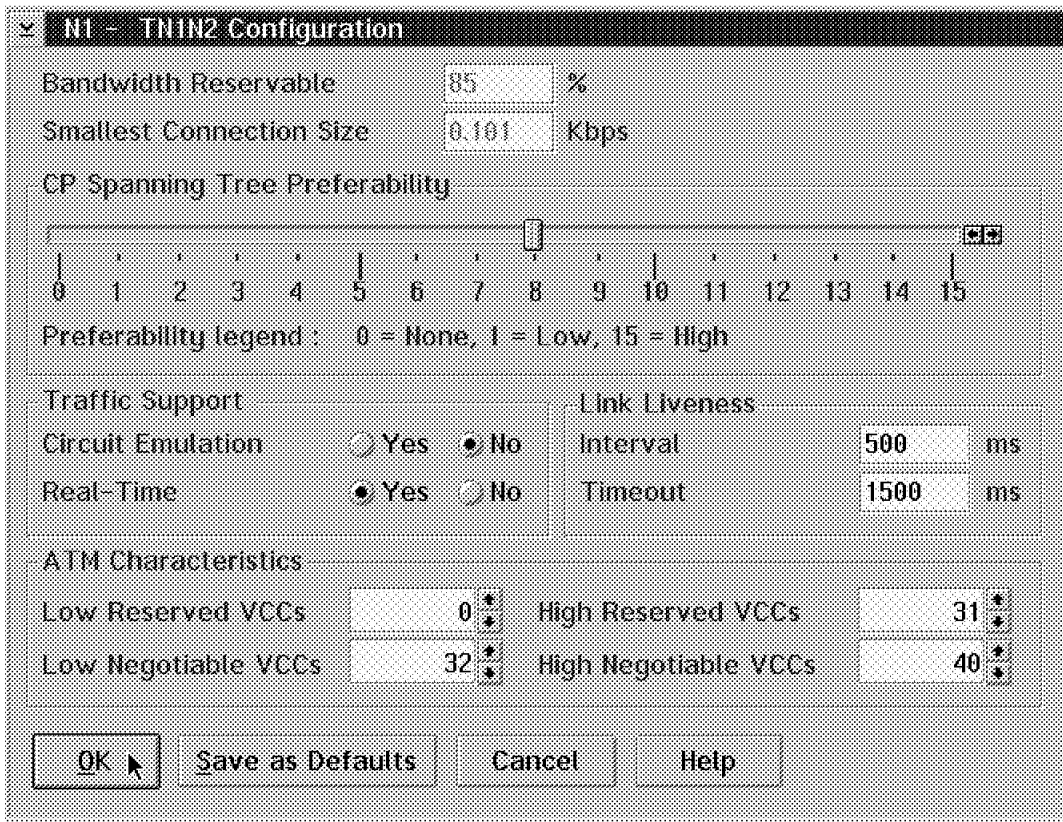
Figure 47. N1 Trunk Configuration Advanced Options

Here you have a choice of selecting the following items:

- The Bandwidth Reservation option indicates the percentage of bandwidth that is reserved for traffic. The remaining part is used for network controls. The default value cannot be changed.

- The Smallest Connection Size option indicates to the Nways Switch the smallest amount of bandwidth that can be reserved for the trunk connection. It is recommended you set the smallest connection size to a very low value. In our case, we used the default option.

- The CP Spanning Tree Preferability option. The CP spanning tree is a distribution tree for connecting the control points of the NBBS network. It carries the network control and management traffic. Without this option, the Nways Switch is not seen from the Network Management Station (NMS). You select a level by dragging the cursor. When the level is set to 15, this NBBS trunk is the first one to be used. The default value is 8.

- The Circuit Emulation Traffic Support option indicates whether or not you will use circuit emulation on this trunk.

- The Real-Time Traffic Support option is offered only if you have selected No for Circuit Emulation Traffic Support. If you are planning to support real-time traffic in something other than circuit emulation mode, then you should select **Yes** for this option.

- The Link Liveness Interval indicates the time interval in milliseconds between two link liveness messages.

- The Link Liveness Timeout value indicates the time in milliseconds after which, if there is no acknowledgment of the link liveness message reception, the trunk line is considered as failing and recovery actions are taken.

- ATM Characteristics options are subdivided in two parts:

   − Low and High Reserved VCCs specifies the range of reserved VCC values. The default range is 0 to 31, as recommended by the ITU-T and ATM Forum standards.

   − Low and High Negotiable VCCs specifies the range of negotiable VCC values. The default range is 32 to 40, as recommended by the NBBS architecture. In fact NBBS today uses only VCC 32 on VPID 0 for all the non-ATM traffic transported through an ATM trunk. Please refer to Chapter 4, "Nways Switch ATM Services" on page 109 for more information.

Note: It is recommended you not modify the Trunk Advanced options if you do not have a clear understanding of these options and their effect on the trunk operation.

Once the trunk logical definition is complete and you select the **OK** button, you will see the definition we have just completed. We defined the second trunk to Nways Switch N3 in the same way. Being a non-ATM T3 trunk, the ATM Characteristics are no longer available in the Advanced Options window.

The next screen shows both defined trunks TN1N2 and TN1N3:
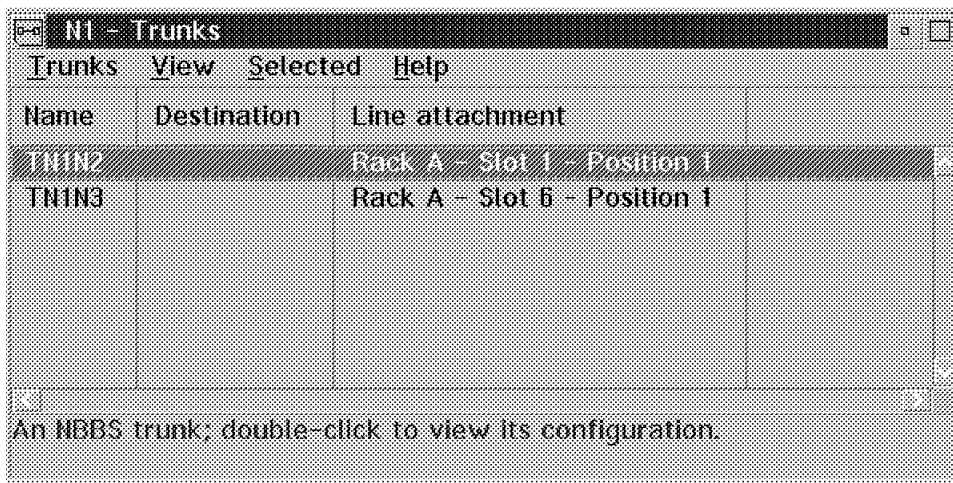
Figure 48. N1 Trunks

2.9 Administrative Details

We have almost completed our configuration; however, there are a few administrative details left. You must go back to the main screen and double-click on the Nways Switch that you want to work on (which was N1 in our case), and then select **Selected** and **Open profile...**.

2.9.1 Profile

The Nways Switch profile is where you may specify the location of your machine. After clicking on Open Profile you will see the details for this definition as shown in Figure 50 illustrated in the following image:
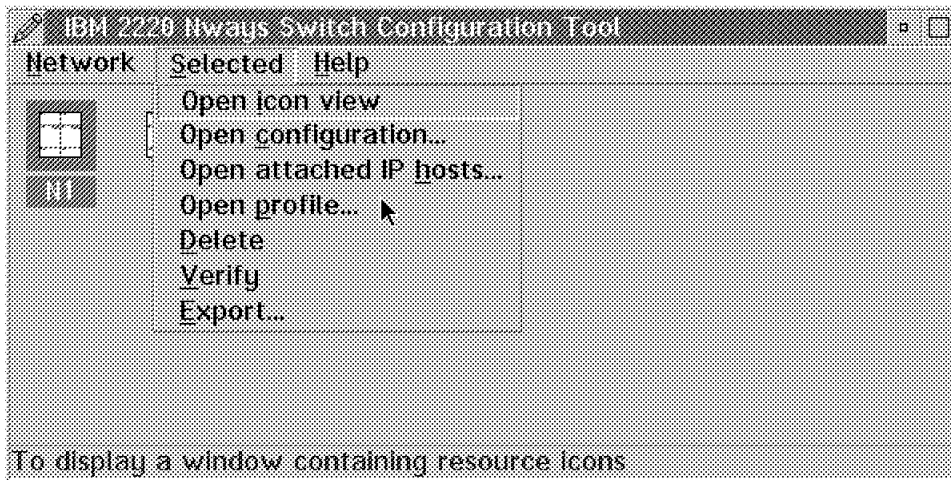

Figure 49. 2220 Nways Switch Configuration Tool (NCT) Main Menu

Please refer to 1.7.2, "Dealing with A, B or C Classes" on page 35 for more details on these addresses. You may fill in the field Nways Switch Location (building, room, etc.) with a description of your machine's exact location. You may also, on this screen, specify the power cords.
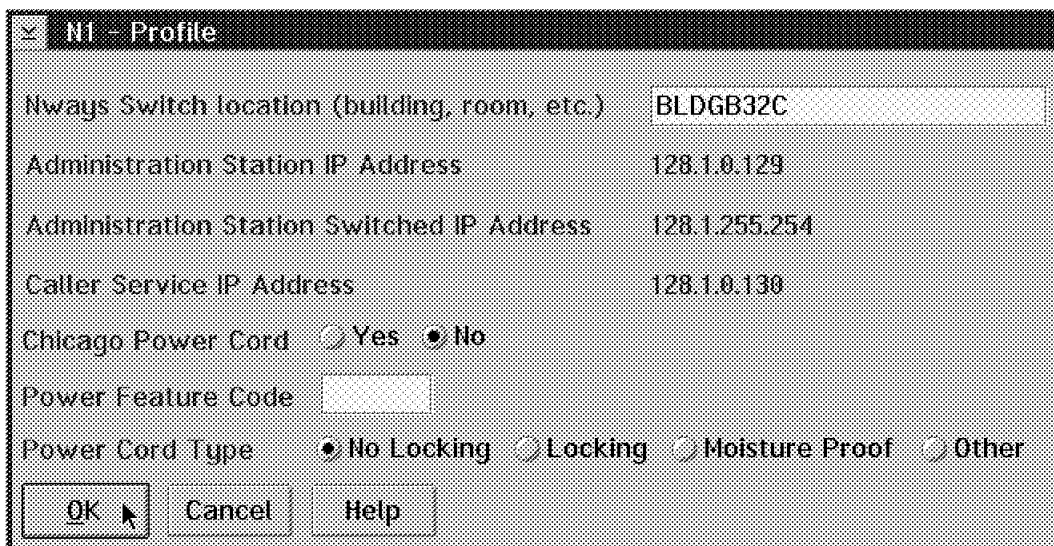
Figure 50. Profile Configuration

2.9.2 IP Host Definition

To get to the IP Host Definition, select **Selected** and then **Open attached IP hosts** as follows:
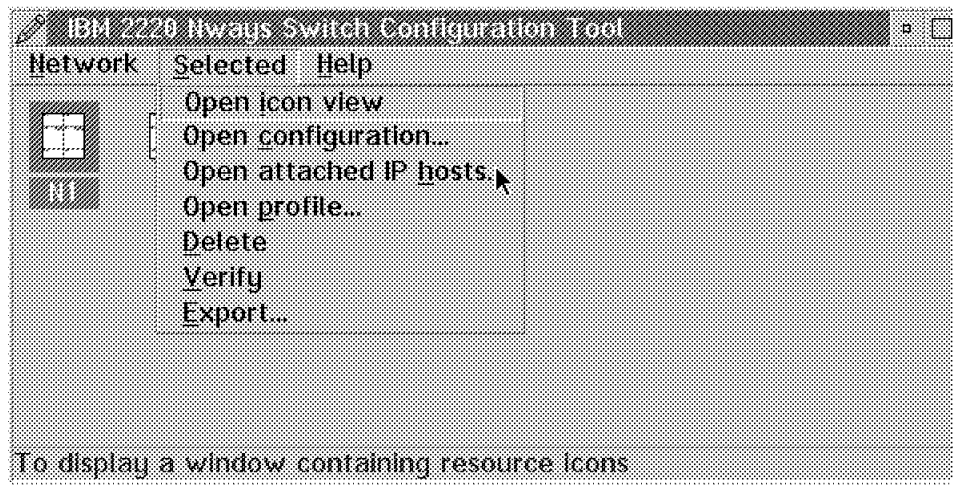
Figure 51. 2220 Nways Switch Configuration Tool (NCT) Tool Main Menu

This screen is used to define any station or remote console attached to an Nways Switch. In our case, the Network Management Station (NMS) and the Change Control Server (CCS) consoles are physically attached to N1, so we define this as such in the following illustration:
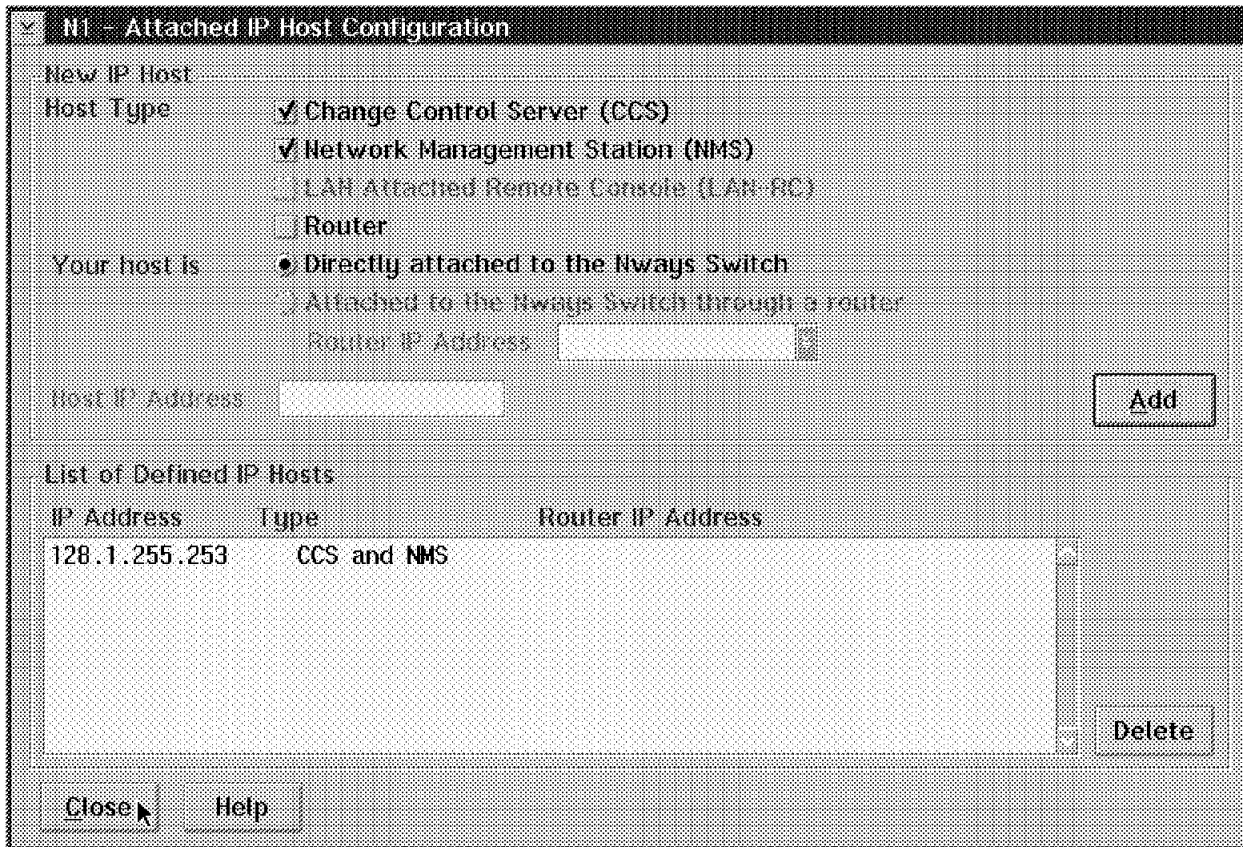
Figure 52. Attached IP Host Configuration

We have both the Network Management and Change Control Server on the same RISC 6000 machine so therefore we have selected the **Change Control Server (CCS)** and **Network Management Station (NMS)** options for the Host Type.

Then for the Your host is option we have selected the **Directly attached to the Nways Switch** option. After selecting the **Add** button, the NCT adds the CCS and NMS with the same IP address (128.1.255.253) the List of Defined IP Hosts option.

2.9.3 Profile Definition

Finally, if you select **Network**, **Open** and **Profile** as follows, you will be able to see the Nways Switch profile:
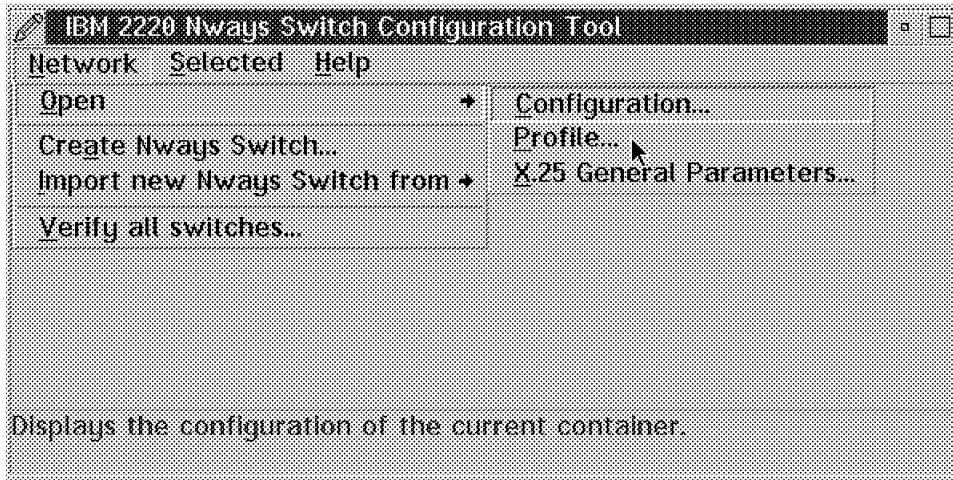
Figure 53. Displaying Profile Parameters

In the Nways Switch profile you may specify the name of a contact person and his or her telephone number. This person can be contacted if network problems occur.
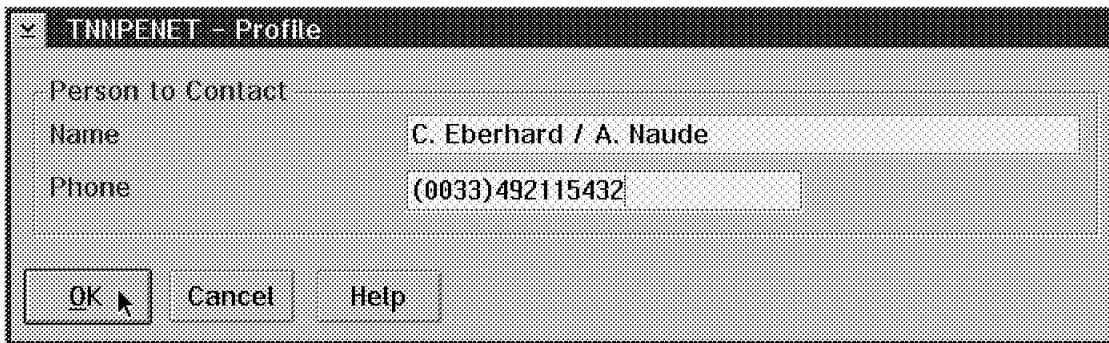
Figure 54. Person to Contact

This completes the basic steps to configure an Nways Switch.

Chapter 3. Nways Switch Frame Relay Services

This chapter describes the Nways Switch frame relay services. The frame relay services are implemented in the frame relay access agent. The frame relay access agent provides Permanent Virtual Circuit (PVC) frame relay bearer services (FRBSs) via the NBBS network. The frame relay access agent is used to support the same frame relay bearer services (as available from many telecommunications carriers) and an enhanced frame relay bearer service that includes bandwidth adaptation.

Note: We assume that the user has a basic knowledge of frame relay architecture. Not all frame relay standards are described in this chapter.

3.1 Frame Relay Overview

The following frame relay support is provided:

- Only Permanent Virtual Circuit (PVC) support is provided through the UNI and NNI specifications.
- Both LMI and non-LMI DTEs are supported.
- The frame relay port can be configured as either a frame relay service equipment (FRSE) or terminal equipment (FRTE). The FRTE provides attachment to other frame relay service providers.
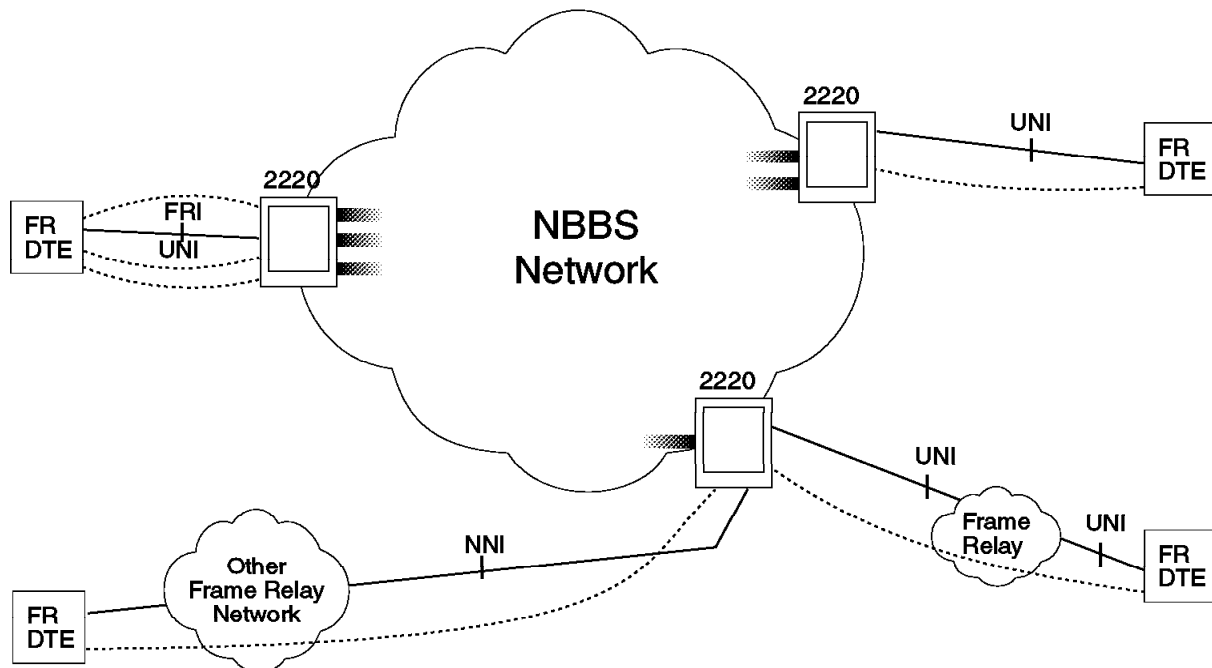

Figure 55. Frame Relay Connection Example

The NBBS network provides the following services for frame relay:

- Full-duplex transfer of frames within virtual connections.

- Transparent transport of the user data contents (information fields) for each frame. Only the frame address and FCS fields may be modified.

- Transport of variable-length frames (from 5 to 8 KB).

- Detection of transmission, format, and operation errors.
- The frames are transferred in the correct order within each virtual connection.
- User notification at the onset of congestion and the need of the user to reduce the volume of data sent.
- User notification of the end of congestion.

3.1.1 Functions Supported

The following functions are supported:

- Frame delimitation, alignment, and code transparency provided by the use of flags and zero bit insertion
- Frame multiplexing/demultiplexing using the address field
- Frame inspection to ensure that the number of octets before insertion or after extraction of the zero bit is an integer in each frame
- Frame inspection to check each frame for correct length
- Detection of transmission errors
- Congestion notification

Note: All frames with an error are discarded by the NBBS network without notification of the frame relay CPE.

The following additional functions are supported through the LMI:

- Optional asynchronous status message is supported in both directions.
- Remote signalling of PVC activity is supported (end-to-end PVC status management in the network).

The following functions are not supported:

- NCP echo cancellation is not supported.
- Automatic interface sensing is not performed (LMI).

3.1.2 DLCI Allocation

Table 7 shows the DLCI allocation, and those that are available to the user.

Table 7. Valid DLCI Range	
DLCI Number	**Function**
0	Reserved for in-channel signalling (LMI)
1-15	Reserved
16-991	Available to the user for logical link identification
992-1007	Not available (Layer 2 management of frame mode service provider is not supported.)
1008-1022	Reserved
1023	Not available (In-channel, layer 2 management is not supported.)
Note: CLLM (consolidated link layer management) messages are not supported by the NBBS network.	

3.1.3 Local Management Interface

The local management interface (LMI) operates on DLCI 0 and informs the frame relay CPE about the status and configuration of the PVCs within the access channel.

The LMI is a set of procedures and messages defined to operate between a user device and a frame relay network both at the:

- User-to-network interface (UNI) level

  The UNI local management complies with the ANSI T1.617 Annex D and ITU-T Q.933 Annex A for permanent virtual circuits (PVCs).

- Network-to-network interface (NNI) level

  The NNI support is a bidirectional UNI. The network is user and network-side at the same time. In this case, N392 and N393 are both defined with the same value for the count of user-side errors and network-side errors but both counters must be used.

Information frames are exchanged using unnumbered information (UI). The LMI supports synchronous exchange of status between the user side and the NBBS network. The Nways Switch is also able to send asynchronous messages to report changes in one specific PVC status.

3.1.4 Bandwidth Management

The bandwidth management is intended to allocate users a bandwidth corresponding to their needs. This is based on connection parameters defining the traffic characteristics and the requested quality of service.

3.1.4.1 Bandwidth Modes

Bandwidth management in frame relay uses either the frame relay standard mode or the IBM Value Added mode. Table 8 summarizes the valid combinations of traffic descriptors in both of these modes.

Table 8. Frame Relay Bandwidth Modes				
Frame Relay Standard Mode		**IBM Value Added Mode**		
CIR≠ 0	**CIR=0**	**NBBS Fixed Bandwidth**	**NBBS Bandwidth Adaptation**	
			Without Limits	**With Limits**
AR CIR Bc Be QoS without ADJ	AR CIR=0 Bc (meaningless) Be QoS without ADJ	R m b QoS without ADJ	R m (initial) b (initial) QoS with ADJ	R m (initial) b (initial) Bandwidth min. Bandwidth max. QoS with ADJ

Legend:

AR   Access rate or peak rate
CIR   Committed information rate
QoS Quality of Service
ADJ Bandwidth Adaptation
Bc   Committed burst
Be   Burst in excess
R   Peak bit rate
m   Mean bit rate
b   Mean burst length

Note: For a more detailed explanation of the above parameters, refer to documents such as *Frame Relay Forum* and ITU-T I-122 Recommendations.

3.1.4.2 Allocated Bandwidth

The Nways Switch enforces fairness among users (VCs) and provides very low delay across the network. Accepting a request for a connection is a contract based on the connection parameters. This contract is a credit of network resources (buffers) guaranteed for the duration of the connection.

When no data is transmitted on a given connection, it accumulates transmission credit, allowing bursts of data at the maximum access rate (port speed) rather than the assigned rate.

The network resources are reserved according to the initial connection parameters or the modified value when the bandwidth adaptation option is specified. The NBBS network finds the best path for the connection, then accepts the new connection by:

- Allocating the bandwidth needed to meet the terms of the contract, thus guaranteeing the requested QoS.
- Smoothing the incoming traffic by buffering data for each connection at the entry point into the network.

The combination of these two operations gives the *equivalent capacity (Ec)*, which is the final amount of bandwidth reserved for the connection.

3.1.4.3 Leaky Bucket Policing

Once the allocated bandwidth is reserved, a policing process based on a leaky bucket algorithm ensures that the reservation contract will be respected. Burst traffic conforming to the contract is accepted using the transmission credit (green traffic) accumulated by the connection. When the transmission credit is exhausted, the traffic is considered as non-conforming and the following may occur to this traffic:

- It is buffered, thus introducing a short delay.
- It triggers the FECN/BECN congestion notification mechanism.
- It is marked as "red" traffic and enters the NBBS network to be transmitted on a best effort basis.
- It is discarded.

3.1.5 Bandwidth Modes Description

This section describes the specificities of each bandwidth mode presented in Table 8 on page 75:

- Frame relay standard (CIR$\neq$0)
- Frame relay standard (CIR=0)
- NBBS fixed bandwidth
- NBBS bandwidth adaptation without limits
- NBBS bandwidth adaptation with limits

3.1.5.1 Frame Relay Standard Mode (CIR$\neq$O)

The input parameters are:

- AR: Access rate (kbps) (should be equal to the link speed)
- CIR: Committed information rate (kbps)
- Bc: Committed burst (Kbps)
- Be: Burst in excess (Kbps)
- QoS without ADJ

In this mode, the leaky bucket is defined to comply with the frame relay standards. These parameters characterize the expected traffic as a *contract* between the user and the NBBS network.

Allocated Bandwidth: Based on the contract, an amount of traffic (called *equivalent capacity*) is computed according to the QoS defined for the connection. When a QoS with FRHDLC is selected for a connection, the equivalent capacity is reserved as non-real-time traffic. All the trunks along the path as well as the other side of the connection are involved in this reservation. They first check that this capacity is available and then prevent the other connection from getting it.

Once the reservation is made, a policing process based on a *leaky bucket* algorithm is set up.

Conforming Traffic (CIR and Bc): The received traffic that conforms to the contract is accepted and sent through the NBBS network as green traffic. This is in the case of a burst of traffic that does not exceed Bc at the access rate, assuming the average traffic stays below CIR.

The throughput allowed for green traffic is given by the formula green traffic = CIR.

Exceeding Traffic (Be): The received traffic that is above the contract is handled by the leaky bucket mechanism:

- The traffic that exceeds Bc but is below Be is accepted and sent through the NBBS network as red-marked traffic. The red traffic is never guaranteed and is transported if the trunks are not overloaded. When congestion occurs, the red traffic is selectively discarded.

  The throughput allowed for red traffic is given by the formula red traffic = (Be÷Bc)×CIR.

- The traffic that exceeds Bc+Be is discarded without entering the NBBS network.

FECN/BECN Handling: The leaky bucket mechanism uses the FECN and BECN congestion notification bits in the data frames to inform the sources to reduce traffic when the allocated bandwidth is going to be reached. FECN/BECN bits are normally sent prior to any red-marking decision to allow a source that obeys FECN/BECN to only use green traffic. A source that does not obey FECN/BECN is exposed to red traffic or discarded once the contract is exceeded.

Example:

- AR = 64 Kbps
- CIR = 5 Kbps
- Bc = 6 Kbps (maximum burst size accepted green marked)
- Be = 60 Kbps (Be÷Bc = 10)
- QOSFRHDLCNDPS

The allocated bandwidth (*equivalent capacity*) is 5.2 kbps. This corresponds to the accepted green-marked traffic if the burstiness does not exceed 6 Kbps contiguous at 64 kbps. 10×5 Kbps exceeding traffic is accepted as red-marked traffic but traffic exceeding (green+red) throughputs is discarded. Therefore up to (5 Kbps & plus.50 Kbps) could be accepted (but limited to the access rate).

This connection reserves 5.2 Kbps but can send 55 Kbps which will be accepted by the NBBS network if trunks are not overloaded.

3.1.5.2 Frame Relay Standard Mode (CIR=0) (Lower or Equal to the Link Speed)

The input parameters are:

- AR: Access rate (kbps)
- CIR = 0 kbps
- Bc = 0
- Be: Burst in excess
- QoS without ADJ

Note: AR and Be parameters are those described in 3.1.5.1, "Frame Relay Standard Mode (CIR≠O)" on page 76. In this mode, AR can be less than or equal to the link speed.

Allocated Bandwidth: No reservation is made. (In fact NBBS always reserves the minimum connection size of 101 bps per connection.)

Accepted Traffic: The received traffic up to AR is accepted as red-marked traffic. Be specifies the maximum size of expected frames.

Exceeding traffic: The received traffic that exceeds AR is rejected. This case should not occur if AR is defined to the line access rate.

FECN/BECN Handling: FECN/BECN is never set (best effort basis inside the NBBS network).

Example:

- AR = 45 Kbps / Link speed = 64 Kbps
- CIR = 0 Kbps
- Bc = 0 Kbps
- Be = 12 Kbps
- QOSFRHDLCNDPS

The red traffic is accepted up to 45 kbps in average. If the access rate is defined lower than the link speed, the burst is limited to Be (12 Kbps) contiguous at link speed.

3.1.5.3 NBBS Fixed Bandwidth Mode

The input parameters are:

- R: peak rate (kbps). This represents the speed of the line that receives the traffic from the user. It is the maximum throughput that the line can send to the NBBS access node.

- m: mean rate (kbps). It represents the average of the traffic received from the user.

- b: burstiness (seconds). It represents a maximum duration of a burst of traffic that is received at the peak rate from the user.

- QoS without ADJ.

These four parameters characterize the expected traffic as the contract between the user and the NBBS network.

Allocated Bandwidth: Based on the contract, an amount of traffic (called *equivalent capacity*) is computed according to the QoS defined for the connection. When a QoS with FRHDLC is selected for a connection, the equivalent capacity is reserved as non-real-time traffic. All the trunks along the path as well as the other side of the connection are involved in this reservation. They first check that this capacity is available then prevent the other connection from getting it.

Once the reservation is made, a policing process based on a *leaky bucket* algorithm is set up.

Conforming Traffic: The received traffic that conforms to the contract is accepted and sent through the NBBS network as green-marked traffic. In normal conditions, the green traffic is never discarded.

Exceeding Traffic: The received traffic that is above the contract is handled by the leaky bucket mechanism:

- Traffic exceeding 20% above the allocated bandwidth is accepted and sent to the NBBS network as red-marked traffic. The red traffic is never guaranteed and is transported if the trunks are not overloaded. When congestion occurs, the red traffic is selectively discarded.

- The traffic that exceeds 20% of the allocated bandwidth is discarded without entering the NBBS network.

FECN/BECN Handling: The leaky bucket mechanism uses the FECN and BECN congestion notification bits in the data frames to inform the sources to reduce the traffic when the allocated bandwidth is going to be reached. FECN/BECN are normally sent prior to any red-marking decision to allow a source that obeys FECN/BECN to only use green traffic. A source that does not obey FECN/BECN is exposed to red traffic or discarded once the contract is exceeded.

Example:

- R = 64 kbps
- m = 10 kbps
- b = 0.01 second
- QOSFRHDLCNDPS

The allocated bandwidth (*equivalent capacity*) is 10.1 kbps. This corresponds to the accepted green-marked traffic while the burstiness does not exceed 0.01 second at 64 kbps. 2 kbps of exceeding traffic is accepted as red-marked traffic. Traffic exceeding 12 kbps is discarded.

3.1.5.4 NBBS Bandwidth Adaptation without Limits Mode
The input parameters are:

- R: peak rate (Kbps). This represents the speed of the line that receives the traffic from the user. It is the maximum throughput that the line can send to the NBBS access node.

- m: initial mean rate (Kbps). It represents the initial bandwidth to allocate at the connection setup. The mean bit rate is reserved within the NBBS network.

- b: initial burstiness (seconds). An initial value of $4 \div R$ is recommended in this mode. This value will change since the adapter dynamically changes the allocated bandwidth as needed.

• QOS with ADJ, with or without KEEP.

Allocated Bandwidth: The initial mean bit rate is allocated first. As soon as the connection is set up an adapter mechanism periodically:

• Analyzes the received traffic over a certain period of time

• Compares the received traffic to the allocated contract

• Decides if the allocated contract must be changed to fit with the received traffic

The allocated contract is dynamically changed according to the received traffic. The value of the reserved bandwidth varies from a few bps to the peak rate.

Bandwidth Increase/Decrease Granted by the Network: When the NBBS network grants a new contract that is dynamically computed by the adapter, all the received traffic should be accepted.

If there is traffic exceeding the current contract, it is sent as red-marked traffic, and a new contract is computed within the next seconds. During the bandwidth adaptation period, a large bandwidth is assigned to the connection to accept the red-marked traffic. No FECN/BECN bits are sent to let the traffic originator get the benefit of the new bandwidth allocation.

Bandwidth Increase Not Granted by the Network: When the NBBS network cannot increase the bandwidth for some reason (for example because there is no more available bandwidth along the path), the nondisruptive path switching (NDPS) mechanism (if enabled by the QoS) is attempted. If the required bandwidth still cannot be allocated at this time:

• If bandwidth keeping acceptability (KEEP option in QoS) has not been selected, the connection is deactivated.

• If the KEEP option has been selected, the connection is kept active with the previously allocated contract, in a mode named *slow adaptation mode*.

The slow adaptation mode is characterized by:

• FECN/BECN bits are sent as soon as traffic exceeding the current contract is received.

• Only 20% of red traffic is allowed to protect the NBBS network against huge amounts of red traffic.

• Periodically, the adapter stops sending FECN/BECN bits and trys to increase the bandwidth (since some bandwidth may be released at any time by other connections). These bandwidth increases are performed at a low frequency to reduce the flow control traffic in the NBBS network and occurs only if the received traffic still exceeds the current contract.

The connection returns to the normal mode as soon as bandwidth adaptation has been successfully granted by the NBBS network.

Example:

• R = 64 Kbps
• Initial m = 10 Kbps
• Initial b = 4÷64 or 1÷16 second
• QOSFRHDLCADJKEEPNDPS

The initial allocated bandwidth is 10 Kbps then dynamically varies from 100 bps to 64 Kbps according to the received traffic and the NBBS network capability to allocate the new requested bandwidth.

3.1.5.5 NBBS Bandwidth Adaptation with Limits Mode
The input parameters are:

- R: peak rate (Kbps). This represents the speed of the line that receives the traffic from the user. It is the maximum throughput that the line can send to the NBBS access node.

- Maximum_bw (Kbps). This is the maximum bandwidth that can be allocated to the connection. The maximum_bw must be below or equal to the peak rate.

- Minimum_bw (Kbps). This is the mimimum bandwidth reserved even when no traffic is received. The minimum_bw is expected to be below the maximum_bw.

- m: initial mean rate (Kbps). It represents the initial bandwidth to allocate at connection setup and must be in the range (minimum_bw, maximum_bw). The mean bit rate is reserved within the NBBS network.

- b: initial burstiness (seconds). An initial value of $4 \div R$ is recommended in this mode. This value will change since the adapter dynamically changes the allocated bandwidth as needed.

- QOS with ADJ, with or without KEEP.

The maximum_bw and minimum_bw parameters are the limits for the bandwidth adaptation algorithm.

Allocated Bandwidth: The initial mean bit rate is allocated first. At soon as the connection is set up an adapter mechanism periodically:

- Analyzes the received traffic over certain period of time

- Compares the received traffic to the allocated contract

- Decides if the allocated contract must be changed to fit with the received traffic

The allocated contract is dynamically changed according to the received traffic. The value of the reserved bandwidth varies from minimum_bw to maximum_bw. Figure 56 on page 82 shows the input parameters and the bandwidth adaptation principle.
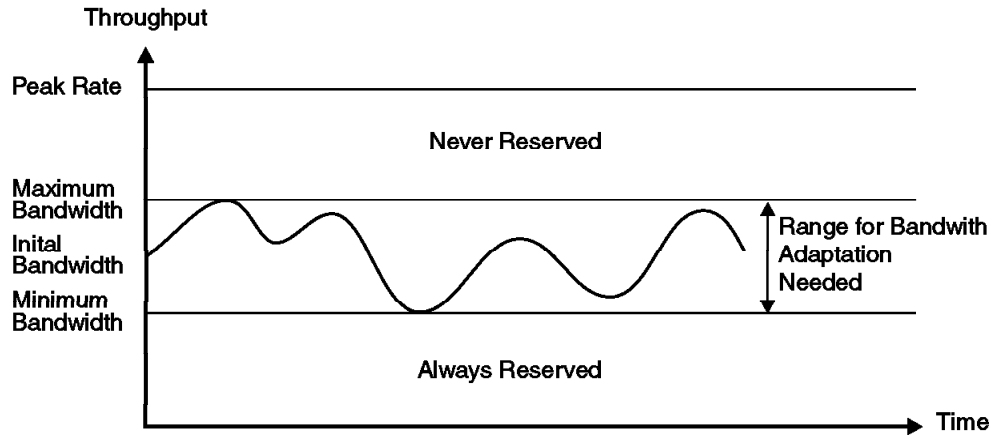
Figure 56. Bandwidth Adaptation Principle

The maximum_bw or minimum_bw parameters can be used separately.

- Example 1: minimum_bw = 10 Kbps, maximum_bw = peak rate. This ensures a minimum bandwidth reservation and the bandwidth adaptation flexibility for exceeding traffic.

- Example 2: minimum_bw = 0, maximum_bw = 20 Kbps, peak rate = 45 Kbps. This ensures that the connection will never take all the available bandwidth. 25 Kbps remain for the other connections.

When a bandwidth increase is not granted by the NBBS network, the connection enters *slow adaptation mode* as described in "Bandwidth Increase Not Granted by the Network" on page 80.

If the received traffic exceeds the maximum_bw, the adapter forces the new reservation at the maximum_bw and goes in a specific mode named maximum_bw reached mode. (Since no more bandwidth can be allocated, the network must be protected against any further exceeding traffic.)

The maximum_bw reached mode is characterized by:

- FECN/BECN bits are sent when traffic exceeding the maximum_bw contract is received.

- Only 20% of red traffic is allowed, to protect the network against huge amounts of red traffic.

The maximum_bw reached mode is similar to the slow adaptation mode except that:

- In maximum bandwidth reached mode, no more bandwidth can be allocated per network operator decision.

- In slow adaptation mode, the bandwidth limitation comes from the NBBS network. Since new bandwidth can be available at any time (for example because of bandwidth released by other connections, a new trunk activated, and so on), tentative bandwidth increase is periodically performed.

The connection returns to the normal mode as soon as a significant bandwidth decrease is performed.

Example:

- R = 64 Kbps
- Initial m = 10 Kbps
- Initial b = 4÷64 or 1÷16 second
- QOSFRHDLCADJKEEPNDPS
- Maximum_bw = 20 Kbps
- Minimum_bw = 5 Kbps

The initial allocated bandwidth is 10 Kbps then dynamically varies from 5 Kbps to 20 Kbps according to the received traffic and the NBBS network capability to allocate the new requested bandwidth.

3.1.5.6 Bandwidth Mode Selection

Table 9 shows some recommendations on how to select the bandwidth mode according to the connection and traffic characteristics. These recommendations apply in most cases. However, depending on your network, you may have to select modes other than those recommended for better network utilization.

Table 9. Bandwidth Selection Recommendations		
Characteristics	**Traffic Sources Obeying FECN/BECN**	**Traffic Sources Ignoring FECN/BECN**
Recommended Modes	• NBBS fixed bandwidth • NBBS bandwidth adaptation • NBBS bandwidth adaptation with limits	• Frame Relay standard • Frame Relay CIR=0
Traffic Examples	SNA	Routers

Notes:

1. For sources obeying FECN/BECN, the leaky bucket mechanism offers the allocated bandwidth for green-marked traffic. FECN/BECN bits handled by the adapters provide guidance to stabilize the source at the optimum green traffic throughput. Avoiding the use of red-marked traffic provides the appropriate quality of service since the green traffic is rarely discarded in normal network conditions.

2. For the sources not obeying FECN/BECN bits, the use red traffic the network allows to absorb IP traffic burstiness, as long as the path is not fully loaded. When the path becomes loaded, discards will occur, thus forcing applications to retry sending discarde frames.

3.1.5.7 Example of SNA and IP Traffic Merging

In this example the SNA traffic has priority over the IP traffic. The IP traffic transport is based on a best effort.

1. SNA traffic in Networking BroadBand Services adaptation bandwidth with limits mode:

   - R = 64 Kbps
   - Initial m = 10 Kbps
   - Initial b = 4÷64 = 1÷16 second
   - QOSFRHDLCADJKEEPNDPS
   - Maximum_bw = 35 Kbps
   - Minimum_bw = 5 Kbps

2. IP traffic in frame relay standard mode (CIR=0):

- AR = 64 Kbps
- CIR = 0 Kbps
- Bc = 0 bits
- Be = 12 Kbps
- QOSFRHDLCNDPS

3.1.6 QoS Classes for Frame Relay Connections

The QoS must be selected in accordance with the type of traffic and the way you want the connection to be handled by the NBBS network.

There are five options corresponding to the possible characteristics of the potential connection:

- Bandwidth Adaptation (ADJ)

- Nondisruptive Path Switching (NDPS)

- Bandwidth Keeping (KEEP)

- Low-Speed Trunk Line (LS)

- High Priority (HPRI)

These options are chosen only via the QoS selection. The following sections describe the different options.

3.1.6.1 Bandwidth Adaptation (ADJ)

Bandwidth adaptation was explained earlier in sections 3.1.5.4, "NBBS Bandwidth Adaptation without Limits Mode" on page 79 and 3.1.5.5, "NBBS Bandwidth Adaptation with Limits Mode" on page 81.

3.1.6.2 Nondisruptive Path Switching (NDPS)

Nondisruptive Path Switching ensures that when a path or Nways Switch fails in the NBBS network, the connections with NDPS option are rerouted onto another path, if available. The connection initiator Nways Switch is responsible for rerouting the connections. When the option is not selected, the connections are deactived and then restarted during the next connection agent retry period which is every two minutes.

Note: Many connections requiring NDPS at the same time induce a large amount of control traffic in the network in addition to cascading rerouting processes. This can create important rerouting delays in the network.

3.1.6.3 Bandwidth Keeping (KEEP)

Bandwidth keeping was explained earlier in sections 3.1.5.4, "NBBS Bandwidth Adaptation without Limits Mode" on page 79 and 3.1.5.5, "NBBS Bandwidth Adaptation with Limits Mode" on page 81.

3.1.6.4 Low-Speed Trunk Line (LS)

A trunk can be considered as *low-speed* when its speed is less than or equal to port access or E1 speeds.

In data transmission, the low-speed trunk lines can induce an important end-to-end transfer delay because the transmitted data is queued by the Nways Switch adapters. Because data traffic does not need real-time transmission,

these transfer delays have a minor impact on the data applications that are connected through the NBBS network.

When the low-speed trunk line is selected, the end-to-end delay required is much larger and finding suitable paths is much easier.

Note: When low-speed lines are used and LS is not selected, connections can be rejected because the end-to-end delay calculated on the path is larger than the delay required.

3.1.6.5 High Priority (HPRI)
If a path fails, it is possible that bandwidth no longer exists to support all the existing connections. If high priority is selected, *bandwidth preemption* ensures that this connection is given first access to the available bandwidth. The other connections get bandwidth only if it is available. In addition, the HPRI connections will force a deativation of ″non-HPRI″ connections to acquire the bandwidth necessary for them to activate.

Table 10 shows the QoS values for frame relay traffic.

Table 10. QoS for Frame Relay Traffic				
QoS Name	**Bandwidth Adaptation (ADJ)**	**Non-disruptive Path Switching (NDPS)**	**Bandwidth Keeping (KEEP)**	**Low-Speed Trunk Lines (LS)**
QOSFRHDLC				
QOSFRHDLCADJ	X			
QOSFRHDLCNDPS		X		
QOSFRHDLCADJNDPS	X	X		
QOSFRHDLCADJKEEP	X		X	
QOSFRHDLCADJKEEPNDPS	X	X	X	
QOSFRHDLCLS				
QOSFRHDLCADJLS	X			
QOSFRHDLCNDPSLS		X		
QOSFRHDLCADJNDPSLS	X	X		
QOSFRHDLCADJKEEPLS	X		X	
QOSFRHDLCADJKEEPNDPSLS	X	X	X	
QOSFRHDLCHPRI				X
QOSFRHDLCADJHPRI	X			X
QOSFRHDLCNDPSHPRI		X		X
QOSFRHDLCADJNDPSHPRI	X	X		X
QOSFRHDLCADJKEEPHPRI	X		X	X
QOSFRHDLCADJKEEPNDPSHPRI	X	X	X	X
QOSFRHDLCLSHPRI				X
QOSFRHDLCADJLSHPRI	X			X
QOSFRHDLCNDPSLSHPRI		X		X
QOSFRHDLCADJNDPSLSHPRI	X	X		X
QOSFRHDLCADJKEEPLSHPRI	X		X	X
QOSFRHDLCADJKEEPNDPSLSHPRI	X	X	X	X

3.2 Adapter and LIC Support for Frame Relay

All low-speed (LSA) and high-speed (HSA) adapters can provide frame relay services.

Frame relay is supported by the line interfaces shown in Table 11.

Table 11. Nways Switch Line Interface Supporting the Frame Relay Protocol	
Line Type	**LIC Type**
E1 (75Ω)	515/545
E1 (120Ω)	516/546
T1, FT1 (integrated CSU)	514/544
J1 (integrated CSU)	514/544
E2, J2, E3	523
HSSI	530
T3 (DS3)	513
V.24, V.35, X.21	511
V.35, V.36, X.21	522

Refer to the *IBM 2220 Physical Lines Interface Specifications* , GA33-0379 for any information related to the cables or standards supported at the physical level (layer 1) by the line interfaces.

3.2.1 E1 and T1 Channel Support

On a channelized E1 or T1 interface, the user may define every 64 Kbps slot as a dedicated frame relay link with its own range of DLCIs. For instance, using a LIC 515 with four E1 interfaces the user may define up to 124 (31x4) frame relay links.

It is also possible to define a frame relay link based on several 64 Kbps slots (for example, 256 Kbps); this is called *bonding*. These slots can be either contiguous or not.

Note: The maximum number of connections is defined at the adapter level, not the port level. Whatever the number of ports defined on an adapter, the maximum number of connections the adapter is able to handle at the same time remains the same.

3.3 Frame Relay Configuration

In order to illustrate frame relay interoperability between Frame Relay Terminal Equipment (FRTE) and Nways Switches, we connected a 3745 to two IBM 2220 Nways Switches. We used several other Nways Switches in the NBBS network to represent a meshed network. The 3745 FEPs are connected via a T1 line. A single HSSI trunk line connects the two Nways Switches.

3.3.1 Scenario Physical Setup

The following illustration shows the physical setup of the environment.
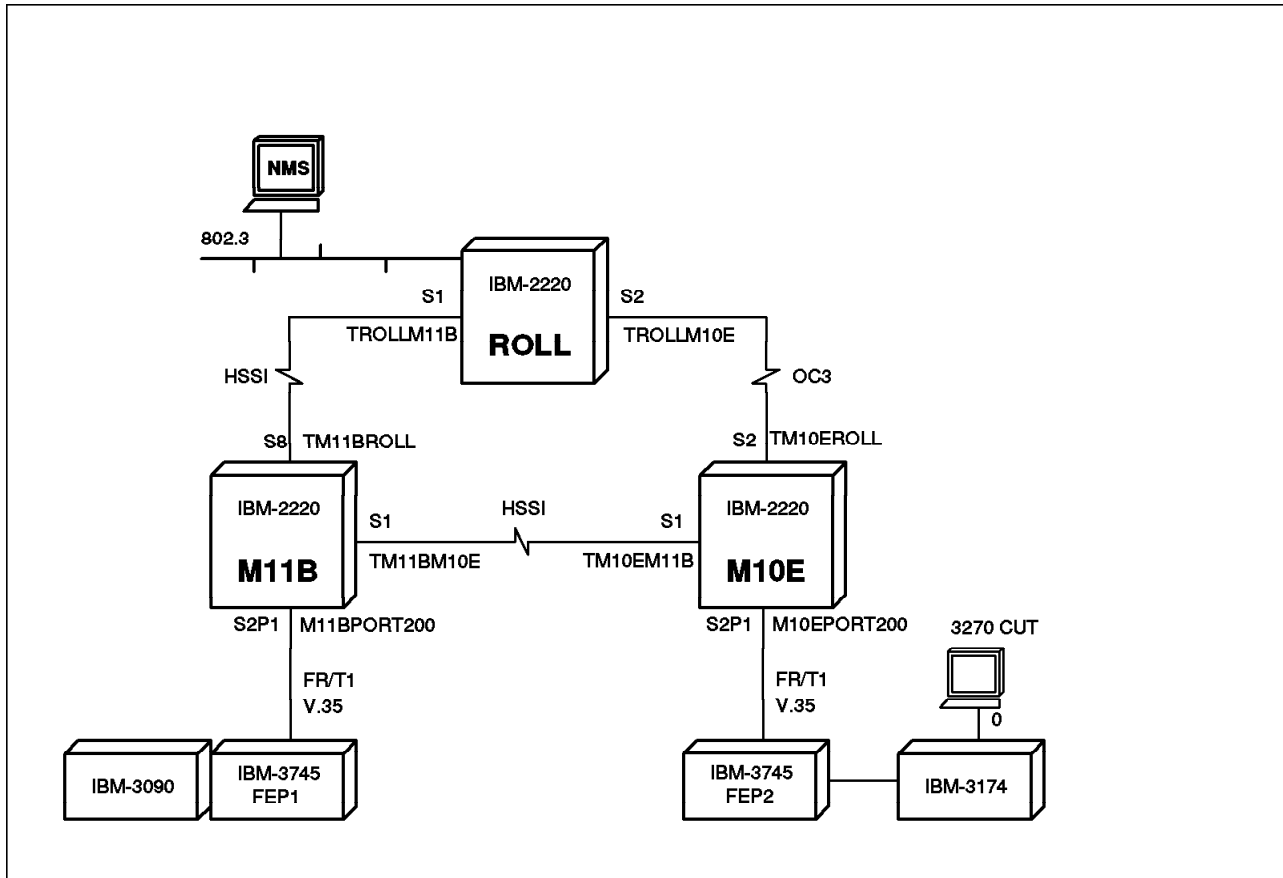
Figure 57. Frame Relay Scenario Physical Illustration

3.3.2 Scenario Logical Setup

The following illustration describes the logical or protocol view of the network.
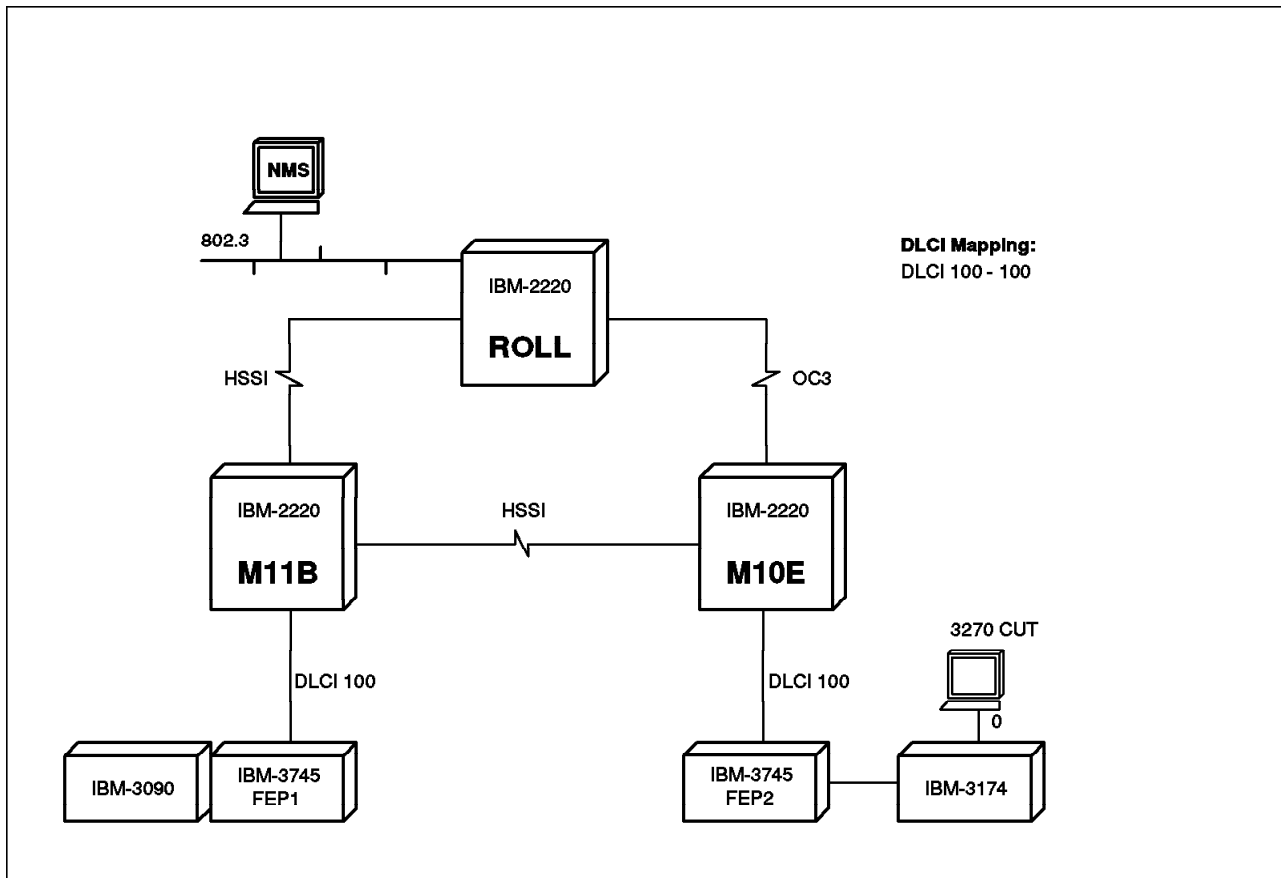
Figure 58. Frame Relay Scenario Logical Illustration

The DLCI we used was 100 for both Nways Switches.

3.4 Frame Relay Physical Configuration

The first task is to define the Nways Switch with the trunks. Please refer to Chapter 2, "Nways Switch Configuration" on page 43 for these basic configurations.

3.4.1 Port Adapter Physical Line Definition

The next task is to define the physical lines that will be used for the frame relay ports. Before you do this you need to define the adapter you will use. In this case, you will define the port adapter in slot 2. By double-clicking on the empty triangle beneath slot 2 the following screen comes up. You will define a Low-Speed Adapter Type 2 (LSA2).
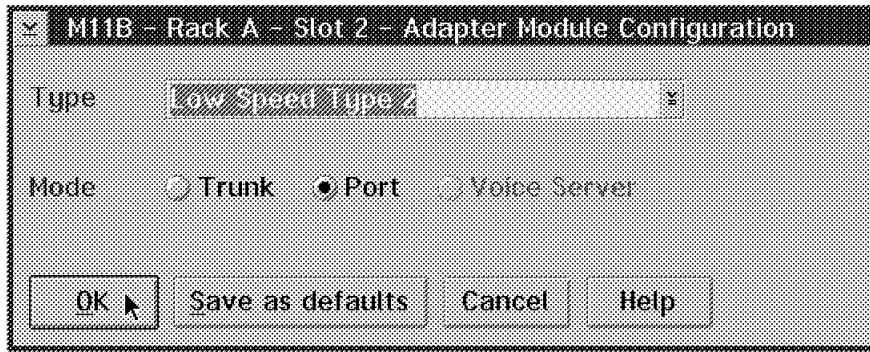
Figure 59. Adapter Module Configuration

Once the previous steps are completed, the following rack screen will appear:
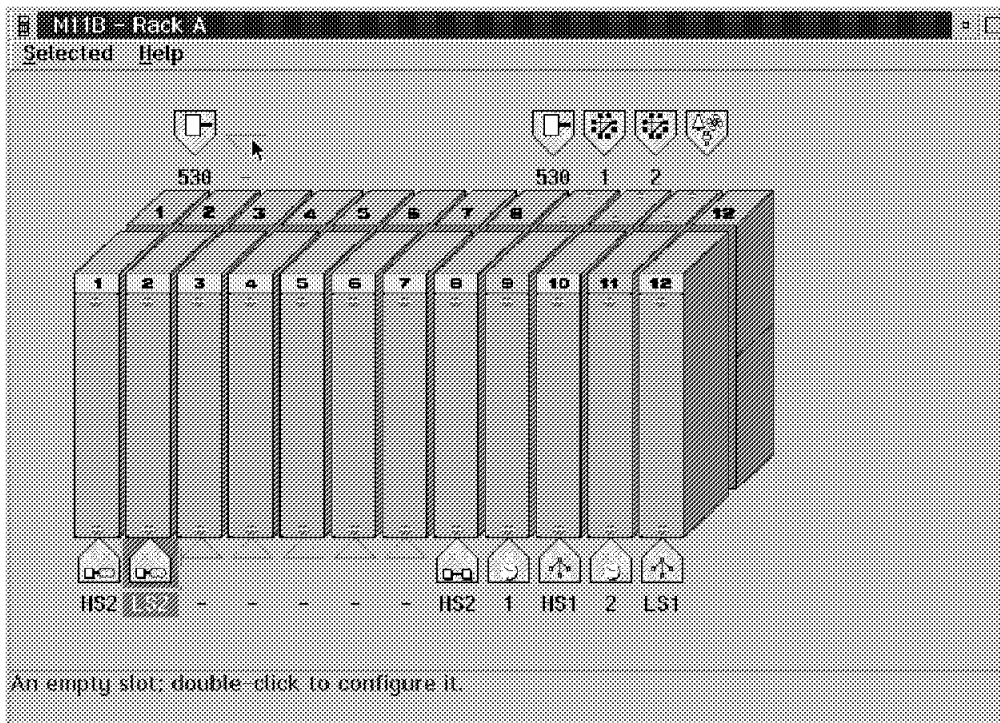
Figure 60. M11B Rack A

You should use a LIC522 to support V.35 lines. Double-click on the triangle in the back of adapter position number 2 and this will bring up the following screen. Select the **LIC522** option as follows and select the **OK** button to proceed.
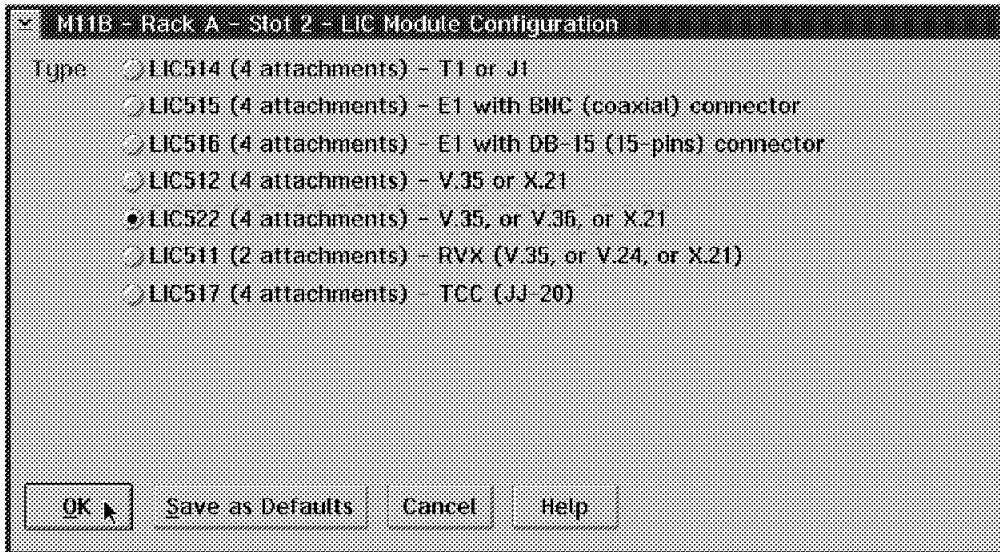
Figure 61. LIC Module Configuration

This will bring you back to the rack menu where you will see all of your adapters. The only thing left to do here is define the physical line on the V.35 LIC522. To do that, double-click on the **522** icon as shown in the following window.
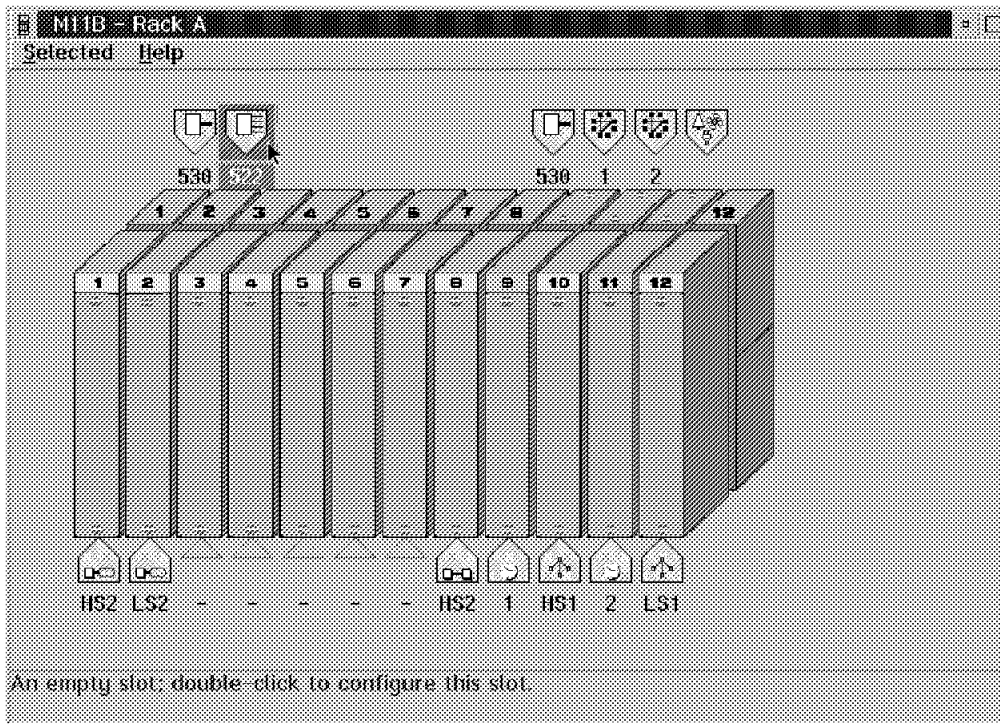
Figure 62. M11B Rack A

We chose to use line position 1. Double-click on the first empty triangle to get the following screen:

```
┌─────────────────────────────────────────────────────────────────┐
│ ≚  M11B – Rack A – Slot 2 – Line Attachment 1 Configuration      │
│                                                                   │
│                                                                   │
│  Type                    │ V35      ▾│                            │
│  Clock Role              ○ Internal   ● External                  │
│  Interface Role          ○ DCE        ● DTE                       │
│  Clock Speed             │ 2048      ▾│ Kbps                       │
│  Access Rate             │ 1536      │ Kbps                        │
│  NRZI                    ○ Yes        ● No                         │
│  Device-Ready Timeout    │ 3000    ▴▾│ ms                          │
│  Ready-For-Sending Timeout │ 3000  ▴▾│ ms                          │
│                                                                   │
│  ┌────────┐                                                       │
│  │ OK  ▶  │  Save as Defaults    Cancel        Help              │
│  └────────┘                                                       │
└─────────────────────────────────────────────────────────────────┘
```
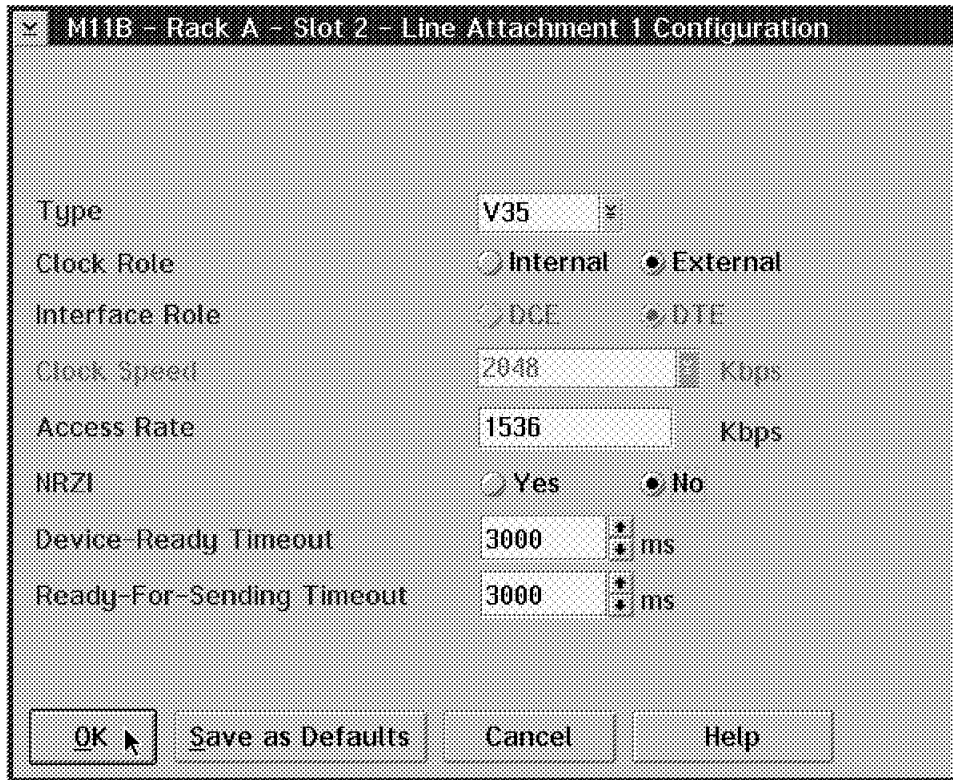
Figure 63. Line Attachment 1 Configuration

We decided to define the line as V.35. You should next specify the Clock Role option. If the clock is provided by the Nways Switch, select **Internal**. If the clock is provided by the attached device, select **External**. If Clock Role is set to Internal, Interface Role is forced to DCE. If Clock Role is set to External, Interface Role is forced to DTE.

Note: The cable must fit the attached device. If the attached device is DTE, the cable is of DTE type and the Nways Switch line interface is DCE. If the attached device is DCE, the cable is of DCE type and the Nways Switch line interface is DTE.

We defined the attached device as DTE. The next parameter is the Access Rate. If Clock Role is set to External, you type in a value in Kbps. This value *must* fit the clock speed of the attached device. Its value is required to optimize the packet sizes and buffer capacities.

Then you specify the NRZI option. The last two timeout parameters may default as in the example:

- Device-Ready Timeout: In V.35, this timeout concerns Data Signal Ready (DSR)
- Ready-For-Sending Timeout: In V.35, this timeout concerns Clear To Send (CTS)

If you plan to have other similar Line Attachment Configuration definitions, you may select the **Save as Defaults** option which will save the Type, Clock Role, NRZI, Device-Ready Timeout and Ready-For-Sending Timeout values for the next line. This will save you some time for subsequent line definitions. After selecting the **OK** push button you will be able to define a similar line by

double-clicking on another empty triangle. Notice that the options we saved for the first line definition are automatically filled in.

Since the NCT does some validation on the physical hardware, it is preferable to first define the physical hardware configuration for all the Nways Switches before proceeding to the port configuration.

3.4.2 NBBS Logical Port Definition

You may now proceed to define the NBBS ports. Double-click on the **Ports** icon on the following menu:
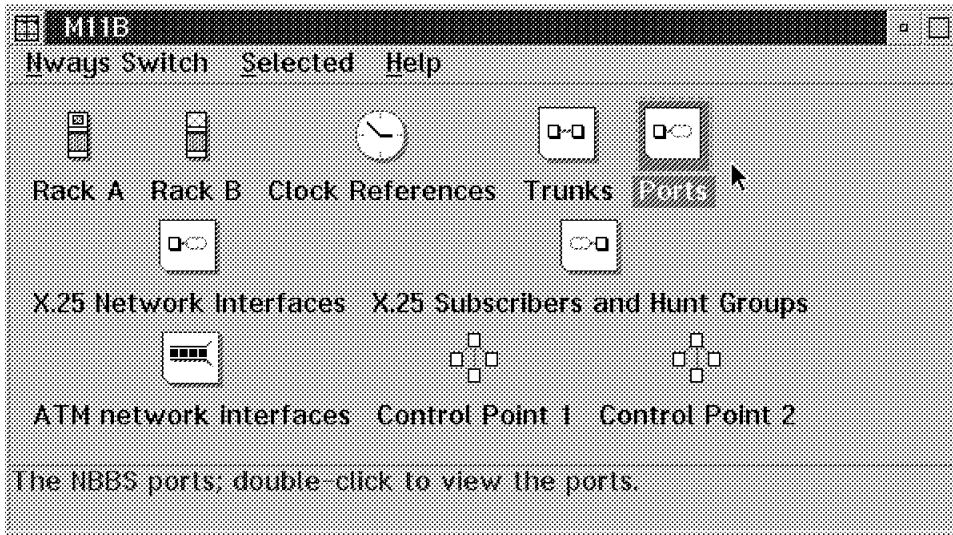
Figure 64. Port Configuration

Then you should select the **Ports** and **Create port...** options as follows:
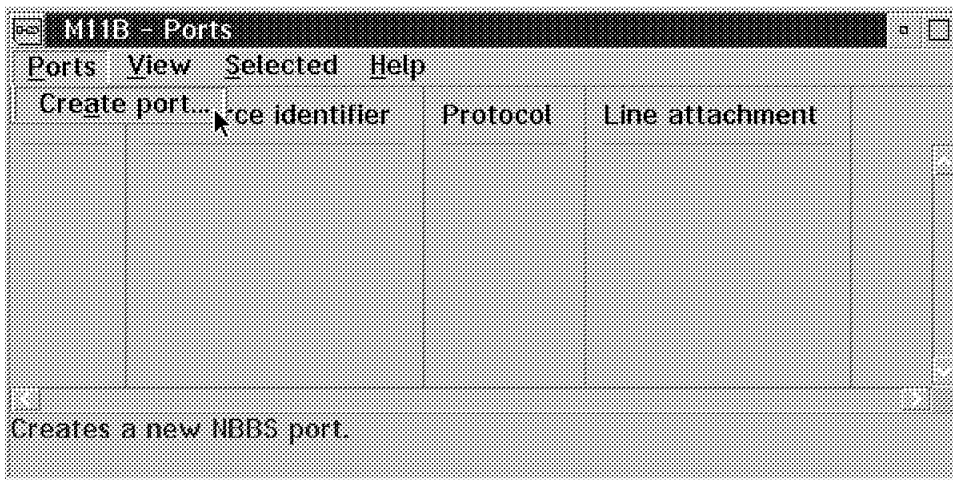
Figure 65. Create a New NBBS Port

This will bring up the following Create Port menu where we have specified the Name M11BPORT200 for our port.
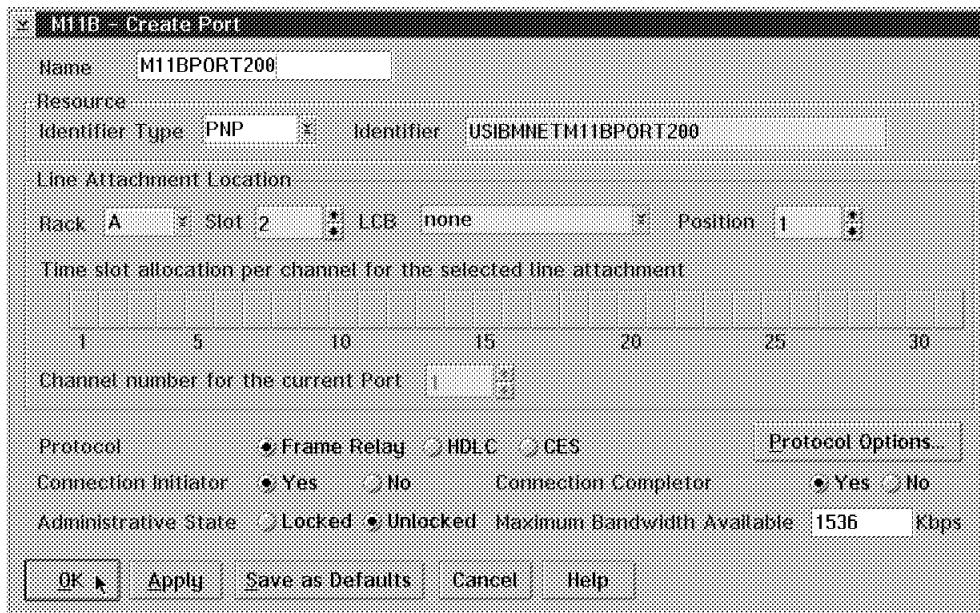
Figure 66. M11B - Create Port Configuration

As soon as you press the Enter key or select one of the options, you will notice that the Nways Switch Configuration Tool (NCT) will automatically, in the Identifier field, prefix the name we gave to this port by the network name USIBMNET. Therefore, the port identifier is now USIBMNETM11BPORT200 in our example.

Notice that for the Identifier Type we have used the Private Numbering Plan (PNP) naming convention, which is the default value. This allows us to use our own naming convention. We need to tie this port definition to a physical line attachment location that we defined earlier in 3.4.1, "Port Adapter Physical Line Definition" on page 88. In our case, we want this frame relay logical port definition to be tied to a physical line definition in rack A, slot 2 and position 1.

The field Time slot allocation per channel for the selected line attachment is used when the physical communication line supports the Time Division Multiplexing (TDM) option. This option divides the physical line into several groups of time slots, and a logical port is associated with each group of time slots (to each channel). This option is only available for the T1 and E1 lines if you have defined them as channelized. Since we are defining this port on a V.35 adapter, the TDM option is not available.

Since this will be our frame relay port, we have selected frame relay as the protocol.

The Locked and Unlocked selections under Administrative State allow us to describe whether we want traffic to start flowing automatically or wait for an operator intervention.

Make sure you select the **Protocol Options...** as we did if you want to modify the default protocol options. The protocol option can only be set for frame relay. This will bring up the following screen:
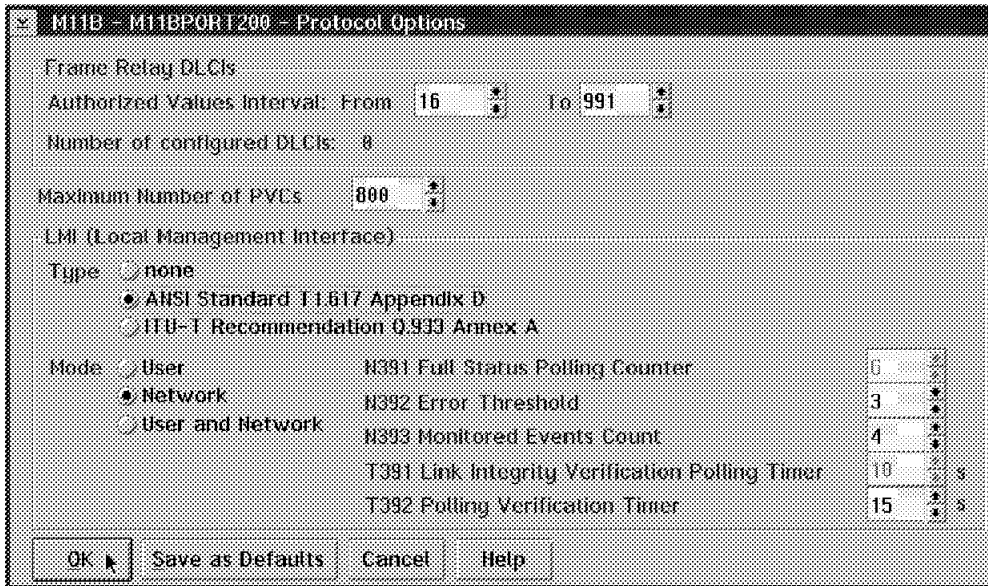
Figure 67. Frame Relay Protocol Options

Most of the fields in this screen are self-explanatory; therefore, we do not explain them in detail. You may refer to the online help or a frame relay document to explain this terminology in detail.

Another redbook called *IBM 2220 Nways Switch: Concept and Products*, SG24-4307 covers in greater detail the frame relay parameters of the product.

In our case, we chose to use the ANSI Standard T1.617 Appendix D for the Local Management Interface (LMI) and we let all the other values default. Select the **OK** button to proceed.

Note: It is very important to select the correct LMI mode, user or network or user and network. In the user and network mode the Nways 2220 frame relay port will negotiate with the attached device. This device could act like a user or a network device.

3.5 Frame Relay Logical Configuration

The frame relay logical configuration consists of creating NBBS connections. Let us first explain what a frame relay connection is.

3.5.1 Frame Relay Connection Explanation

On an Nways Switch, a frame relay connection between two partners is identified by a Virtual Circuit Number (VCN). In order to establish the path through the network over this Virtual Circuit Number (VCN) it is necessary to define a Potential Connection (PCO) in the entry Nways Switch called the initiator side (M11B in our case) and a Virtual Connection (VCO) in the Nways Switch called the completor side (M10E in our case).

We define a Potential Connection (PCO) from the M11B Nways Switch to the M10E Nways Switch. The DLCI we use in this Potential Connection (PCO) definition is used locally only to help the Nways Switch locate its partner (IBM 3745 FEP1 in our case).

A Virtual Connection (VCO) is defined semi-automatically on the M11B Nways Switch using the same Virtual Circuit Number (VCN) we used for our Potential Connection (PCO) definition. It is very important to use the same Virtual Circuit Number (VCN) because this is how the two partners are matched. You define in this Virtual Connection (VCO) the DLCI used by the M10E Nways Switch to locally identify its IBM 3745 FEP2 partner.

Note that the DLCI we use has to match the one used in the 3745 definition but both 3745s could use different DLCI numbers. This is because the DLCI number has local significance only. When the network reserves the resource for the connection, it uses the parameters set in the Potential Connection (PCO).

In the Potential Connection (PCO), the user has to define the Quality of Service (QoS). This definition will be for both the forward and return path of the connection. In order for the network to identify the connection as unique, the user will have to specify a Virtual Circuit Number (VCN). The Virtual Circuit Number (VCN) value has to match both the Potential Connection (PCO) and the Virtual Connection (VCO).

Of course, in the Potential Connection (PCO), the user will specify the bandwidth parameters required for the connection. The set of parameters defined for a connection (virtual circuit) is dependent on the type of frame relay mode.

Recommendation: Before creating frame relay Potential Connection (PCO), NBBS ports with frame relay protocol must be created on both endpoint Nways Switches.

3.5.2 Frame Relay Connection Definition

Before you proceed with the Potential Connection (PCO) and Virtual Connection (VCO) definitions you must make sure you have defined all ports for this configuration. This is because NCT checks this. If you have followed our instructions so far, you have already defined the NBBS ports you will use.

In order to define our connections, we first select the port we want to work on by double-clicking the left mouse button on the M11BPORT200 port, as shown in the following figure.
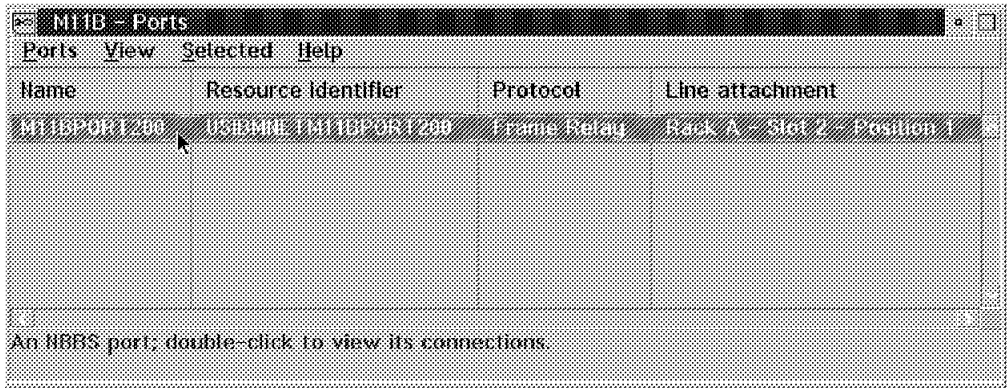
Figure 68. Ports

To create our Potential Connection (PCO), we need to first select the **Port** option followed by the **Create Potential Connection...** option as shown in the following illustration:
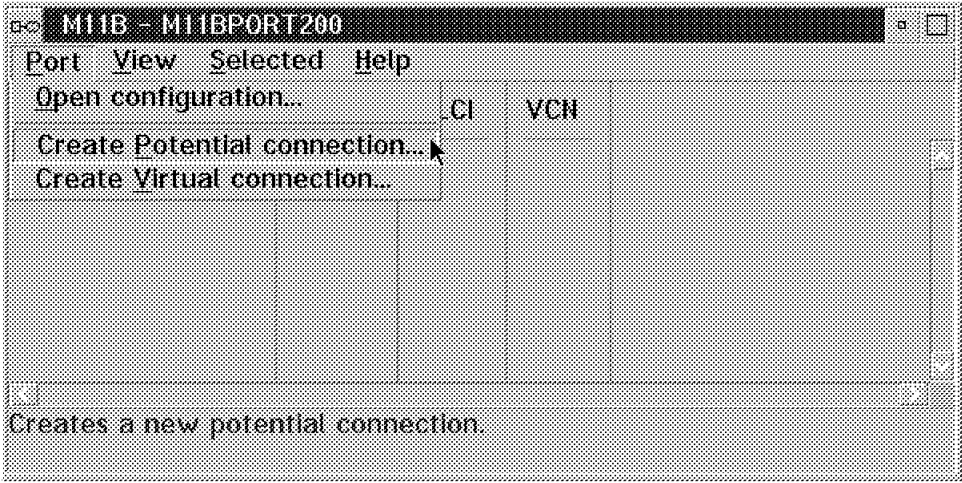
Figure 69. Create a New Potential Connection

This brings up the following screen where we are able to define the Virtual Circuit Number (VCN) as well as the virtual circuit name.
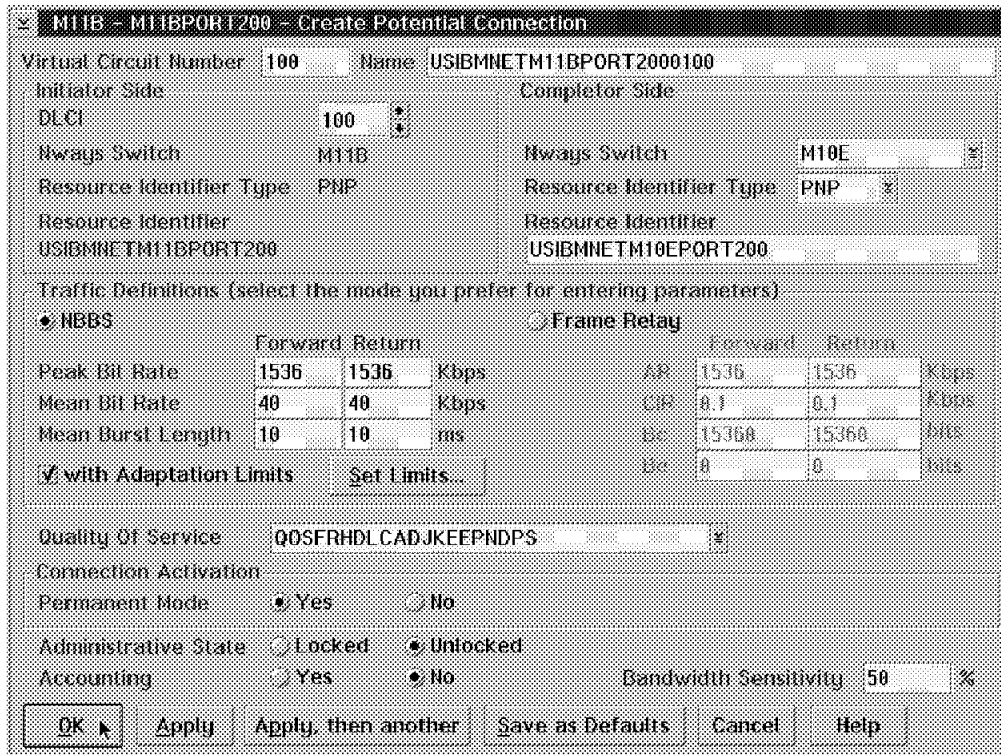
Figure 70. Create Potential Connection

The allowable range for the Virtual Circuit Number (VCN) is from 0 to 65,535 and must be the same at both the initiator and completor side. We have selected the Virtual Circuit Number (VCN) 100. The name that we have selected is USIBMNETM11BPORT200100.

In the Initiator Side pane, the Nways Switch Configuration Tool (NCT) already filled in the Nways Switch, Resource Identifier Type and Resource Identifier fields. The only thing we have to define is the DLCI number. As we mentioned earlier, this DLCI has local significance only and is used to identify the specific frame relay connection for our 3745 FEP1, but it must match the DLCI we used in our 3745 definition.

In the Completor Side pane, we have to tell the system where our partner is so we fill in the specific Nways Switch. This is where predefining all Nways Switches is helpful because we see all of them in the list and can select the one we want. We can still manually input this field if we have not previously defined the other Nways Switch. In our case, since we want to talk to port 200 we used USIBMNETM10EPORT200.

In the Traffic Definitions section, you have to describe the characteristics of your traffic. This traffic could be defined as regular frame relay traffic or as the added NBBS value. 3.1.5, "Bandwidth Modes Description" on page 76 covers in detail the frame relay components of the Networking BroadBand Services.

In our case, because we are defining SNA traffic, we have chosen to define this connection as NBBS. The Peak Bit Rate is already predefined for us using the Access Rate value we defined earlier when we created that line in our LIC. You can change that peak rate value if you wish. We have then defined our Mean Bit Rate as 40 Kbps in both directions, which represents the initial bandwidth to

allocate at the connection setup. We have left the Mean Burst Length default at 10 milliseconds, which is the initial burstiness duration.

We selected the **with Adaptation Limits** option to benefit from the bandwidth adaptation function. Click on **Set Limits...** to display the Bandwidth Adaptation Limits dialog window.
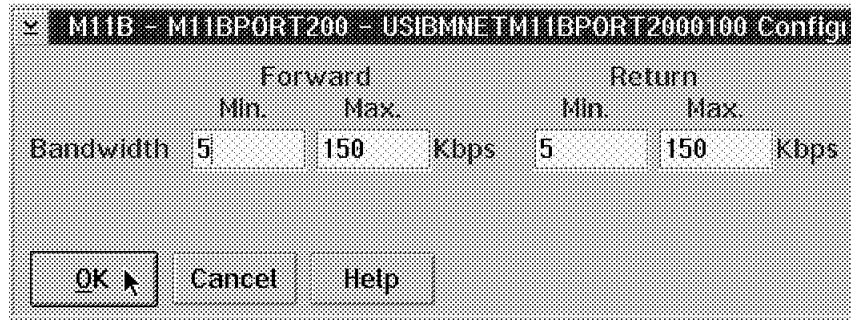
Figure 71. Bandwidth Adaptation Limits

You can select the bandwidth limits in the Forward and Return path. In our case we have chosen to modify dynamically the required bandwidth between 5 Kbps and 150 Kbps. Once this is done and you have clicked on **OK**, you are back to the previous window.

Each Potential Connection (PCO) is configured with a Quality of Service (QoS) similar for the forward and backward directions. When the connection is established, each Nways Switch selects a trunk that meets the characteristics of the required QoS.

In the system, there are already many different Quality of Service (QoS) names that you may select from. This simplifies the QoS selection process. You may modify individual QoS parameters from the Network Management Station (NMS). If you click on the right arrow beside the Quality Of Service item you will see a list of names. In our case, because we are using the Potential Connection (PCO) for frame relay traffic and we want it to use the Bandwidth Adaptation (ADJ) with KEEP option and the Nondisruptive Path Switching function, we have selected the QOSFRHDLCADJKEEPNDPS value.

For the startup mode we have selected Permanent with the Yes value which means the connection is automatically built at the same time the resource is initiated. No means the connection is built whenever an operator or end user device requests it. We specified the Administrative State as Unlocked which means the traffic may flow as soon as the connection is established. We do not wish to gather accounting information yet and thus we specified Accountable as No.

The parameter called Bandwidth Sensitivity states the minimum percentage size change in the bandwidth required before logging an accounting record that indicates a connection traffic variation. In our case, since we have elected not to gather accounting data for this connection, this parameter does not apply.

Once this is done and you have clicked on **OK**, you will have to build the corresponding virtual connection and the system will issue the following message asking you whether to build it for you. This is where predefining all of your Nways Switches comes in handy because if your adapter definition for the

partner exists, you may let the system define the virtual connection for you. In our case we selected **Yes**.
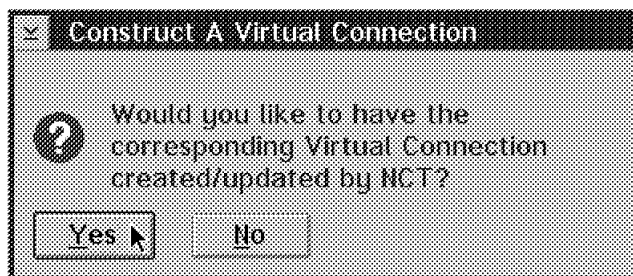
Figure 72. Construct a Virtual Connection

You will now get the following screen showing the new Potential Connection (PCO):

Figure 73. New Potential Connection

To complete the definition of our predefined Virtual Connection (VCO), we will first exit the M11B Nways Switch definition by double-clicking on the top left corner until we are back at the main Nways Switch Configuration Tool (NCT) screen. There we will double-click on the **M10E** icon, double-click on the **Ports** icon and then on the frame relay port **M10EPORT200**. You will now see a Virtual Connection (VCO) with Virtual Circuit Number 100 already defined. Clicking on it will bring up the following menu:
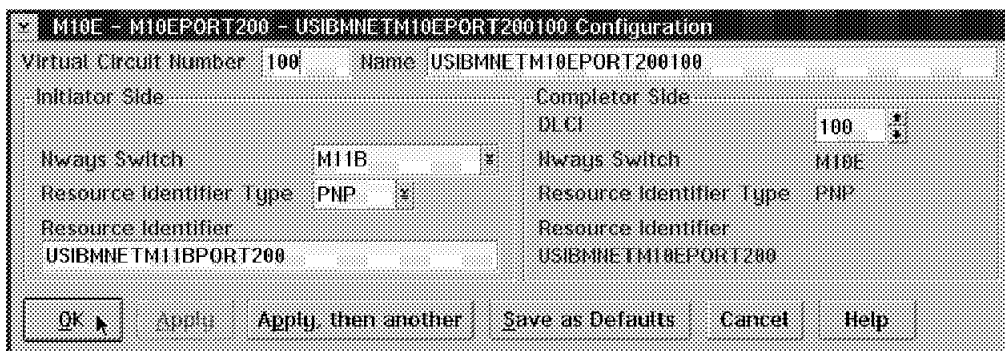
Figure 74. Virtual Connection Configuration

On this screen, you will see the Virtual Circuit Number and its name. You will also see in the Initiator Side pane that the resource called USIBMNETM11BPORT200 on the M11B Nways Switch will be in session with the USIBMNETM10EPORT200 resource identifier of the M10E Nways Switch. We have specified the DLCI as 100 for this particular 3745 connection. Select the **OK** button to end the definition of the Virtual Connection (VCO). Double-click on the top left corner until you are back at the main NCT screen.

3.6 Frame Relay Management

Overall management of the 2220 via the Network Management Station (NMS) is described in Chapter 7, "Nways Switch Manager (NSM)" on page 231. We discuss some specifics related to management of the frame relay connections here.

Figure 75 shows a graphical map of the switched network. Should you have a problem at this high level the trunks or switches will change from green to yellow, red or blue.
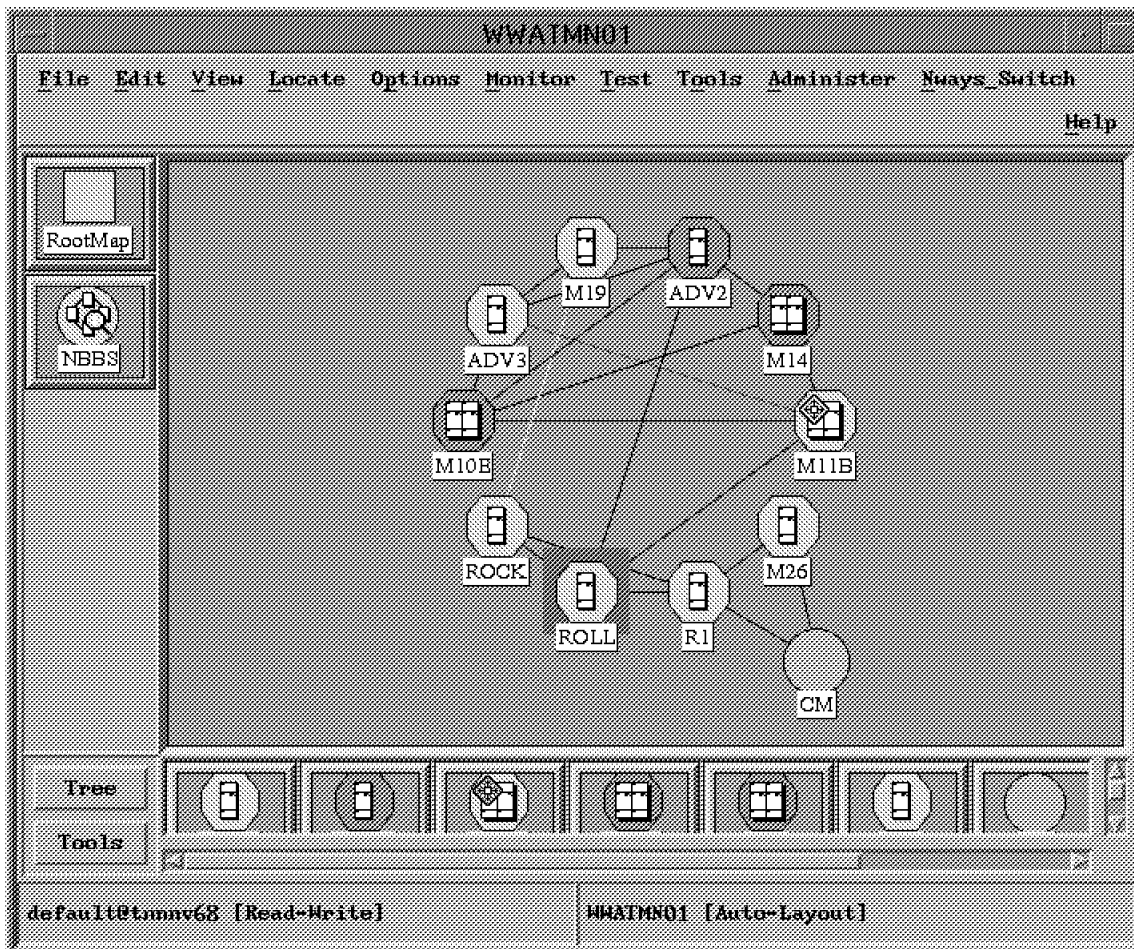
Figure 75. Graphical Map of 2220 Nodes and Trunks

At the top of the window you find a number of actions. If you click on these, a pull-down menu will be displayed from which you may select specific actions to be performed on network objects.

In order to look at specifics related to a frame relay port select the switch node and click on the Nways Switch item at the top of the window.

The pull-down menu shown in Figure 76 is now displayed.
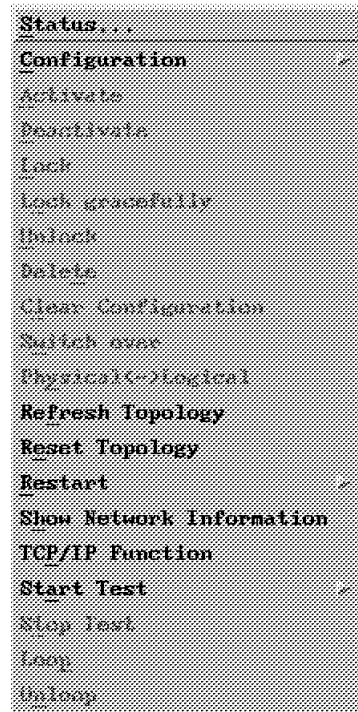
Figure 76. Nways Switch Action List

You may select any of the highlighted items. In our case we want to look at a frame relay connection so we select **Configuration**.

The list shown in Figure 77 is now displayed and for frame relay connections we select the **Frame Relay Ports and Connections...** option.
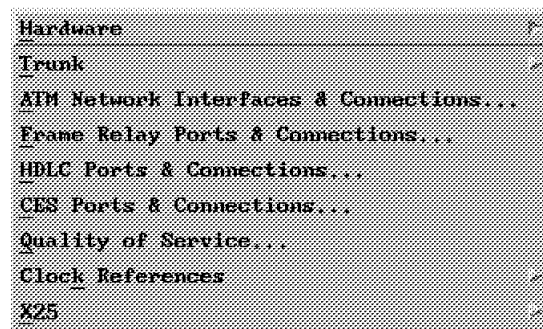
Figure 77. Select Frame Relay Ports and Connections

The node we selected in Figure 75 on page 100 was M11B. The frame relay ports list for this node is now displayed (see Figure 78 on page 102).

Figure 78. Frame Relay Port List for Node M11B

The port list displays the port name, status and physical location of the port hardware. From the list you may select one of four actions:

- Call status
- Protocol status
- Configuration
- Monitoring

Selecting **Monitoring** allows you to activate and de-activate a port.

When you select **Configuration** a pull-down list will appear:
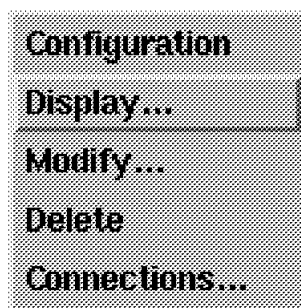
Figure 79. Frame Relay Port Configuration

You will now be able to display, modify or delete the port configuration. Use one of these options to do online configuration activities to this port. In our case we displayed the frame relay port M11BPORT200.
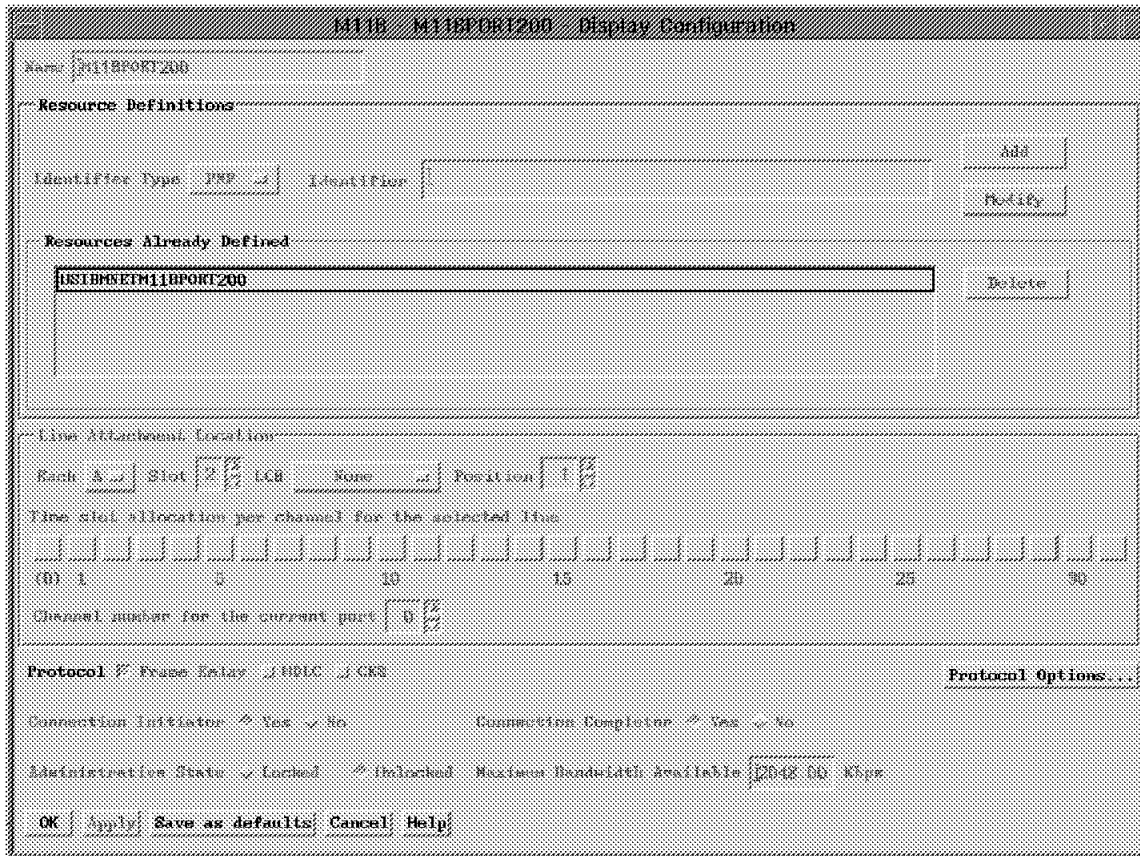
Figure 80. Frame Relay Port Display Configuration

By clicking on **Protocol Options...** you will be presented with the Protocol Options Configuration window:
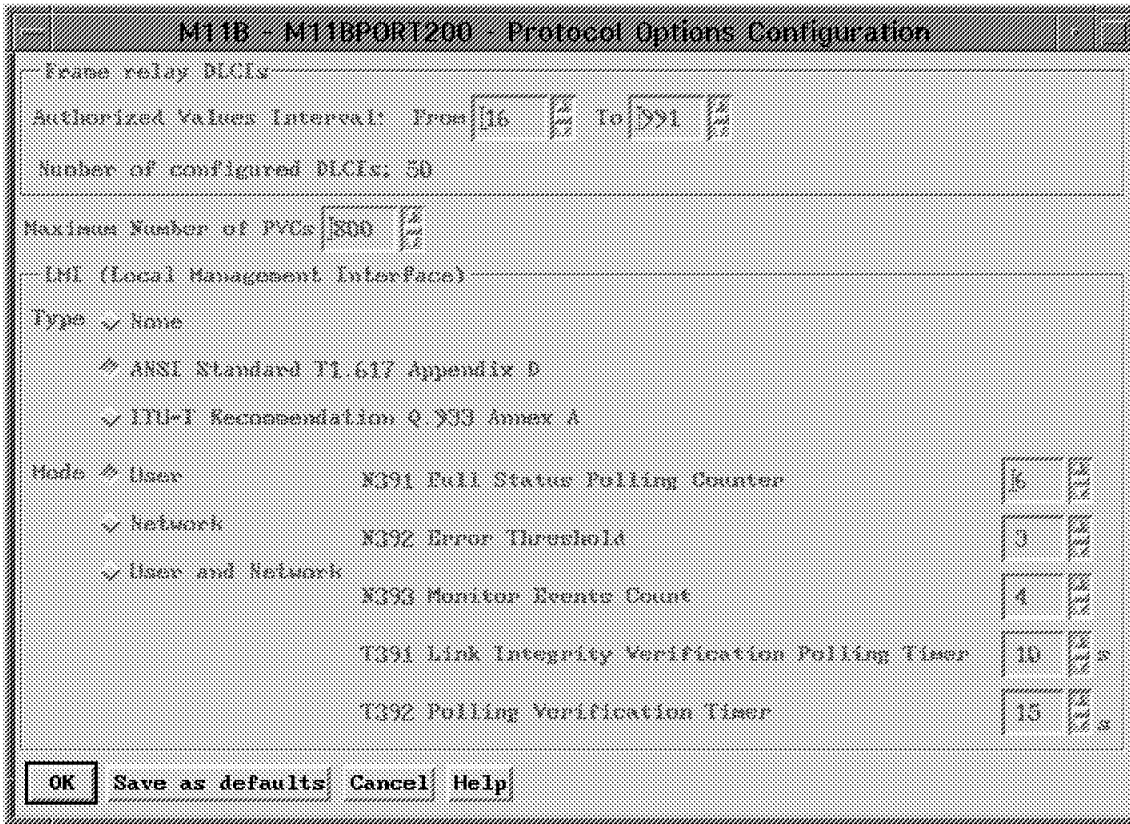
Figure 81. Frame Relay Port Display Protocol Options Configuration

Now, from the Frame Relay Port List screen (see Figure 78 on page 102), select **Configuration**. You will see a drop-down menu similar to the one in Figure 82.
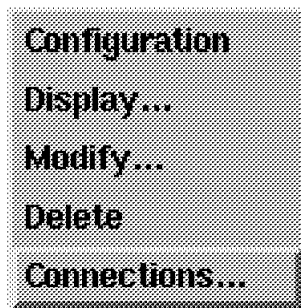
Figure 82. Frame Relay Connections

Select **Connections...** to display the connections associated with the selected port. Such connections are shown in Figure 83 on page 105.

Figure 83. Frame Relay Connection List

Once again we can select the Configuration option and modify, display or delete the connection.

Selecting Monitoring will allow you to stop and start the connection.

If you display the configuration, Figure 84 on page 106 will be presented. Note that the input fields are the same as those in Figure 70 on page 97 used to configure the connections using the Nways Switch Configuration Tool (NCT).

Figure 84. Frame Relay Connection Display/Modify on the NMS

You can now access the different QoS Traffic Parameters by clicking on the **Traffic Options...** box.
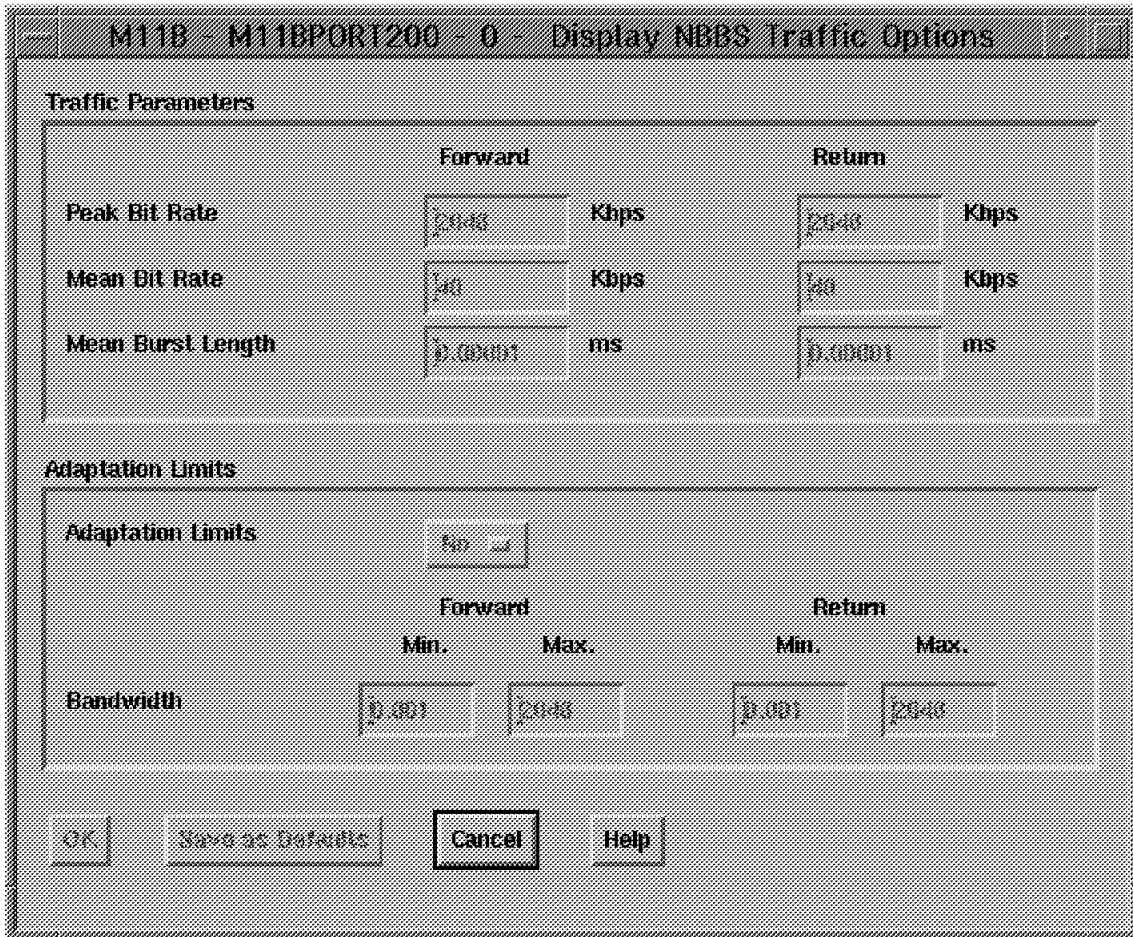
Figure 85. Frame Relay Connection Display NBBS Traffic Options

From the Frame Relay Connection List (see Figure 83 on page 105) select **Monitoring**. You will see a drop-down menu similar to the one in Figure 86.

Figure 86. Frame Relay Connection Monitoring

Select **Manage Path...**. This will display the window shown in Figure 87 on page 108.
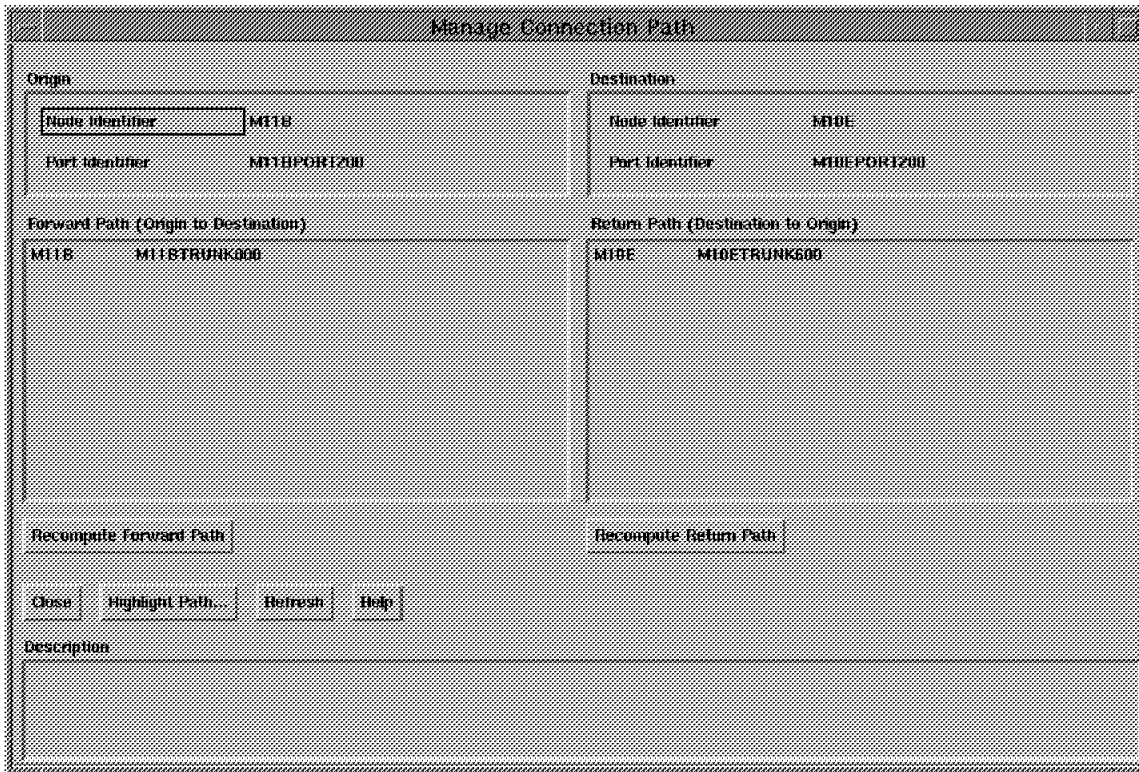
Figure 87. Frame Relay Manage Connection Path

From here you can select a number of options as follows:

- Recompute Forward/Return Path

  If you had a path switched as a result of NDPS, you could recompute the forward and reverse paths. This may be useful if a trunk with better delay characteristics has become active since the NDPS path switch.

- Highlight Path

  This function will highlight the paths taken by this connection on the display shown in Figure 75 on page 100.

From the window in Figure 86 on page 107 you may also select the performance option which allows you to monitor performance aspects of the connection. You must first start the performance application by selecting the **Monitor** option from the window shown in Figure 75 on page 100.

For information on starting the performance application see Chapter 7, "Nways Switch Manager (NSM)" on page 231.

Chapter 4. Nways Switch ATM Services

ATM is supported over both trunks and ports. This chapter focuses on the access or port services. However a brief description of the trunk services is also provided. For more detailed information on the ATM standard please refer to *Asynchronous Transfer Mode (ATM) Technical Overview*, SG24-4625.

4.1 ATM Adapter Logical Interface

This section provides information on the logical ATM interfaces by the Nways 2220.

ATM ports provide ATM services that adhere to the following:

- Comply with the ATM Forum UNI 3.0, 3.1, 4.0 and ITU B-ISDN implementation agreements
- Support both PVCs and SVCs
- Provide virtual connection (VC) and virtual path (VP) services
- Support operation, administration and maintenance (OAM) flows
- Support ILMI for SVCs

The ATM services allow the attachment of ATM devices such as hubs, routers, and stations. The NBBS network handles ATM traffic the same, whether it flows over ATM or non-ATM trunks. Non-ATM trunks natively transport the ATM cells.

Table 12 shows the characteristics of the ATM logical interfaces.

Table 12. ATM Port Adapter Logical Interfaces		
Characteristics	**DS3, E3**	**SDH/Sonet**
LIC Type	551, 552	553, 554, 555, 556
Integrated Local Management Interface (ILMI)	Public UNI	
Operation, Administration, and Management (OAM)	• Physical level: F1, F2, F3 (I.610) • Logical level: F4 and F5 (I.610), segment and end-to-end.	
Framing	• C-bit parity multiplex for DS3 • ITU-T G.832 E3	• SONET STS-3c (T1-105) • SDH STM-1 (ITU G.708/G.709).
Cell Delineation	ATM Forum, I.432	
Rate Decoupling	• I.432 • I.361 • ATM Forum 3.0, 3.1, and 4.0	
VCI and VPI Addresses	Any VP/VC combination allowed except for addresses reserved by standards.	
Addressing Structure	• Private networks: – OSI NSAP (ISO 8348 and ITU-T X.213) – Private numbering plan. • Public networks: – E.164 (ITU-T Recommendation E.164) – Private ATM address structure.	

4.1.1 Integrated Local Management Interface

The Integrated Local Management Interface (ILMI) is supported with Version 2 Release 3 when the SVC support was added.

4.2 ATM Trunk Support

ATM cell transport is supported over both ATM and PTM trunks. ATM transport over low-speed trunks (E1 or below) has to be considered carefully due to the enormous differences in throughput capacities of standard ATM links and low-speed trunks. This scenario (see Figure 88) will result in a bottleneck of such magnitude that efficient and acceptable operation will not be possible.
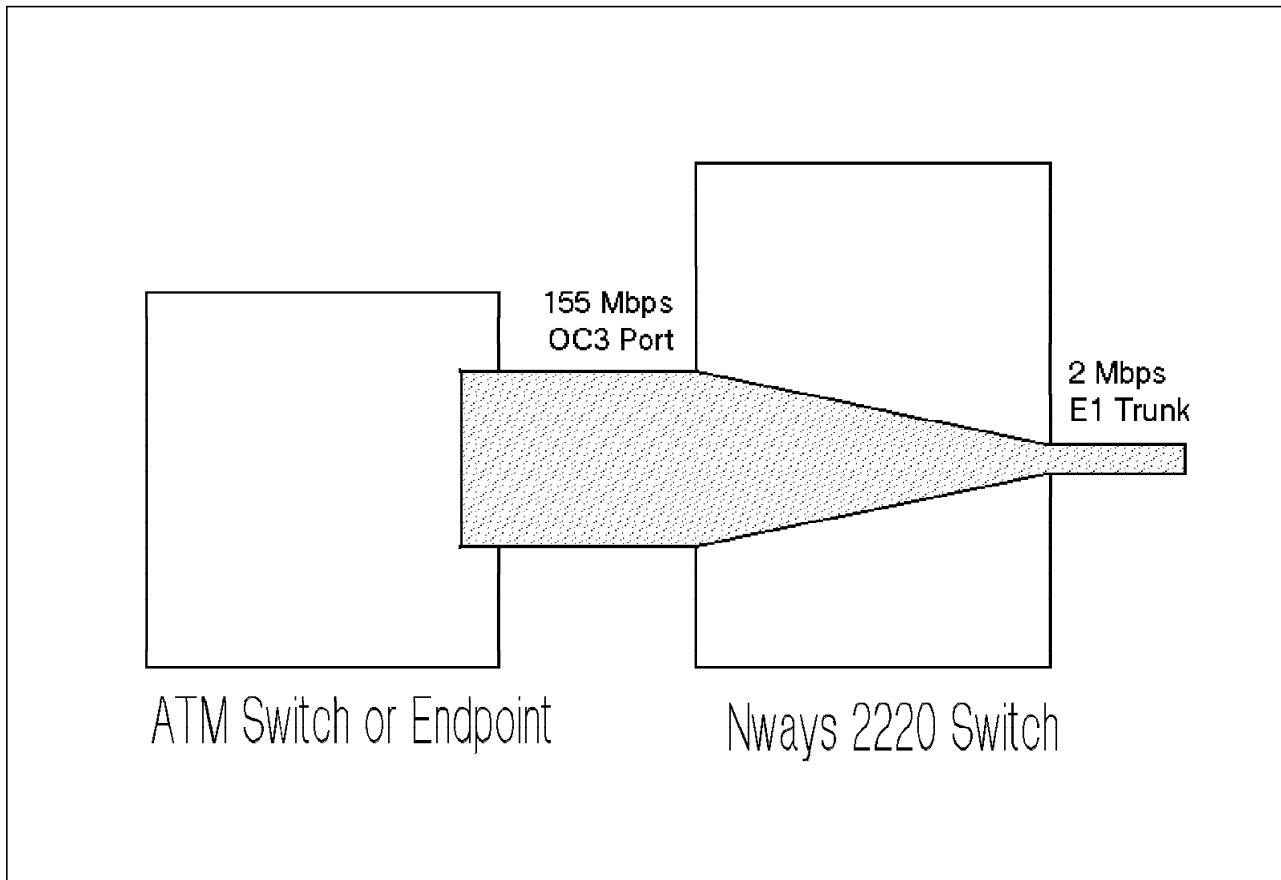
Figure 88. ATM over E1 Trunk

ATM trunks provide high-bandwidth trunks up to OC3 speeds and support all NBBS traffic types, (for example, frame relay and voice connections). Non-ATM traffic is supported over ATM trunks using ATM Adaptation Layer 5 (AAL5) to segment packets into ATM cells. The Preempt/Resume function is not used on ATM trunks because of the high speed of transmission.

Integrated Local Management (ILMI) and Operation, Administration and Maintenance (OAM) flows are not supported for ATM trunks in this release; management of the trunks is done via normal NBBS mechanisms. The ATM trunks are therefore leased lines and/or service provider trunks.

Note: You can also use service provider trunks if the trunk acts like a leased line:

4.2.1 ATM Bearer Service Support

The ATM Bearer Service allows you to split ATM interfaces (ATM UNI and NNI) into several logical trunks. The logical trunks are mapped over ATM virtual paths on an ATM service provider.

ATM interfaces DS3/E3/STM1 in trunk mode with ATM type 2 adapters (ATMA2) are supported. You can define up to 32 logical trunks for each ATM adapter. For LICs with two interfaces (for example, LIC 551 with two DS3s and LIC 552 with two E3s), the 32 logical trunks are shared between the two interfaces.

4.3 ATM Access Services

Access services are supported for SVCs and PVCs with Version 2 Release 3. PVCs are supported in VP and VC modes of operation.

In order to configure an ATM bearer service trunk, you need to have an ATPA2 adapter. Create an ATM network interface for bearer services by doing the following:

- Open the NCT and double click on the node icon and the ATM network interface icon
- At the ATM Network Interface list prompt, click on **Network Interface List** then **Create Network Interface**
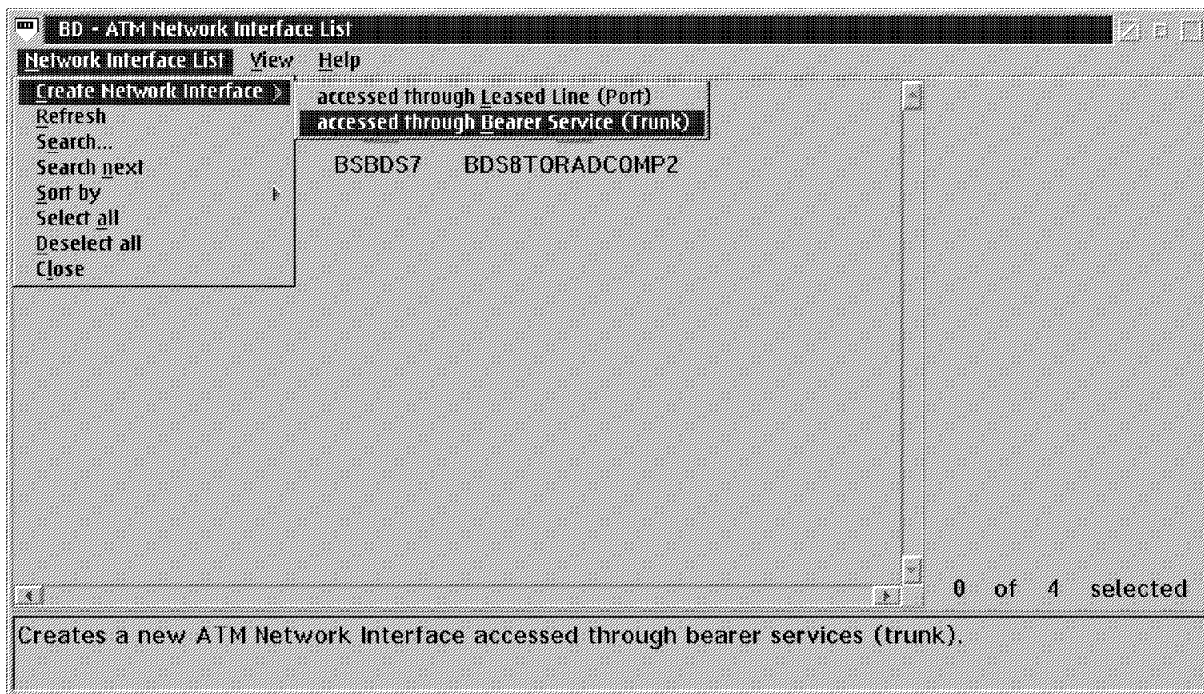
Figure 89. ATM Network Interface List

At the ATM Network Interface through Bearer Service prompt, enter the name, line attachment, the maximum bandwidth available, network interface type and protocol and then click on **OK**. Repeat the above steps to create the ATM network interface for bearer service on a remote node.
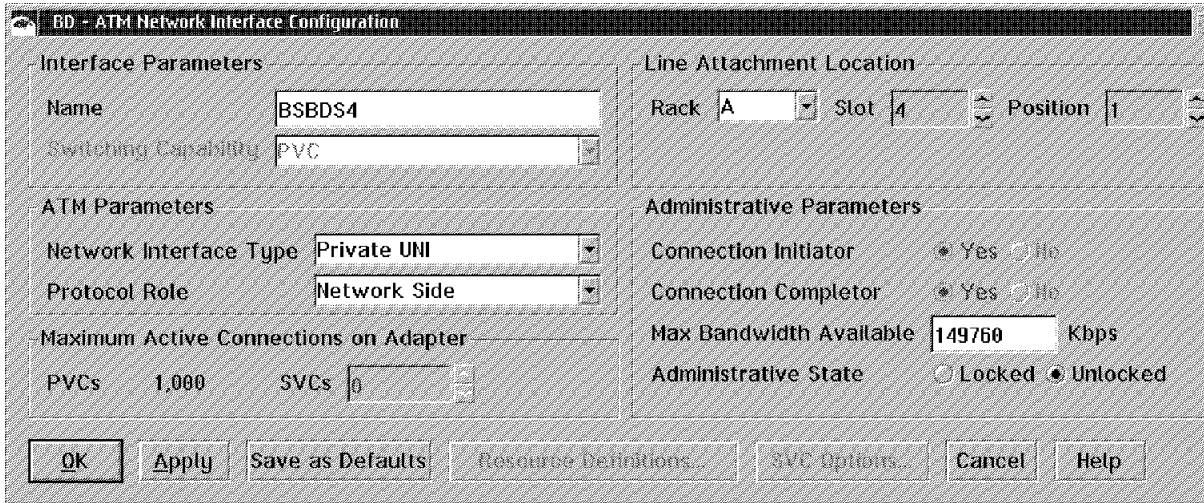
Figure 90. ATM Network Interface Through Bearer Service

A VPC trunk connection is necessary to have multiple NBBS logical trunks (TEP) on the same physical line. Select the network interface created in the previous section and click on the **configuration** button. You then click on **VPC Bearer Service List** and create VPC bearer service.
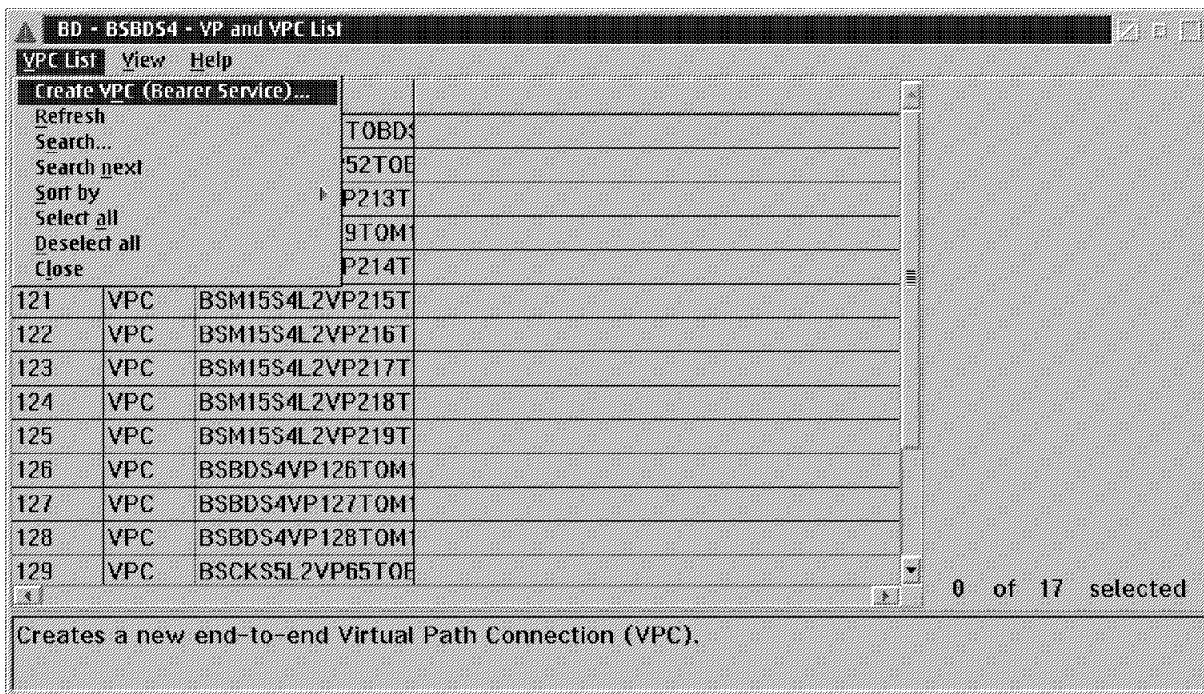
Figure 91. ATM Network Interface Through Bearer Service

A new window prompt will appear; you must enter the name, VPI local side and the shaper speed. The shaper speed value is used to set the bandwidth for the logical bearer service trunk. Next, enter the VPI on remote side. This value can be the same as the VPI on the local side if you are connected directly and are not connected through a service provider. Set the OAM as disabled or enabled by clicking on the **OAM Options** button. After clicking on **OK** the VPC trunk connection is created on both sides.
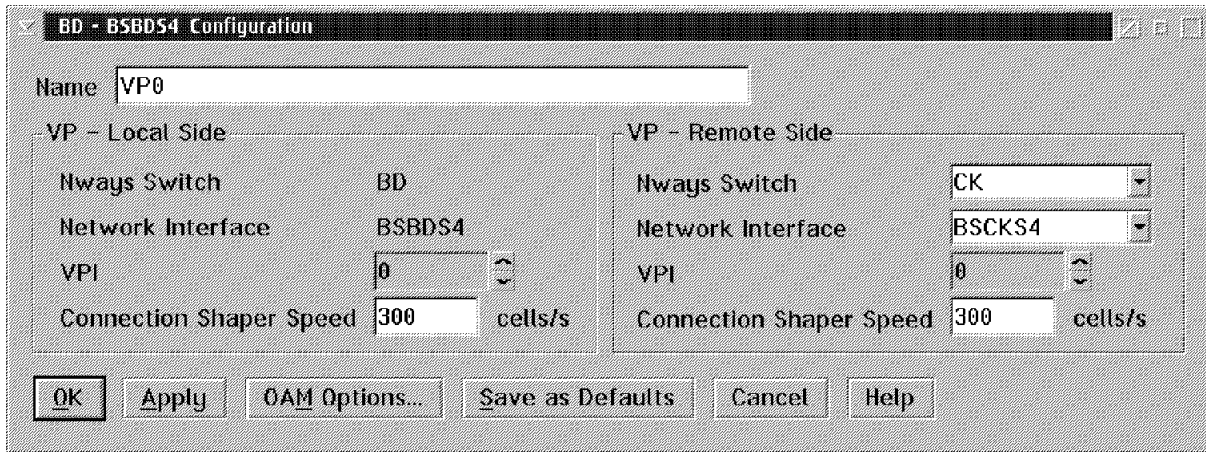
Figure 92. Create VPC Bearer Service

In order to create an NBBS ATM trunk bearer service from the network submap select the node and double click on **ATM Bearer Service Trunk** You will then notice that there are two different icons: Leased Line Trunk and ATM Bearer Service Trunk.
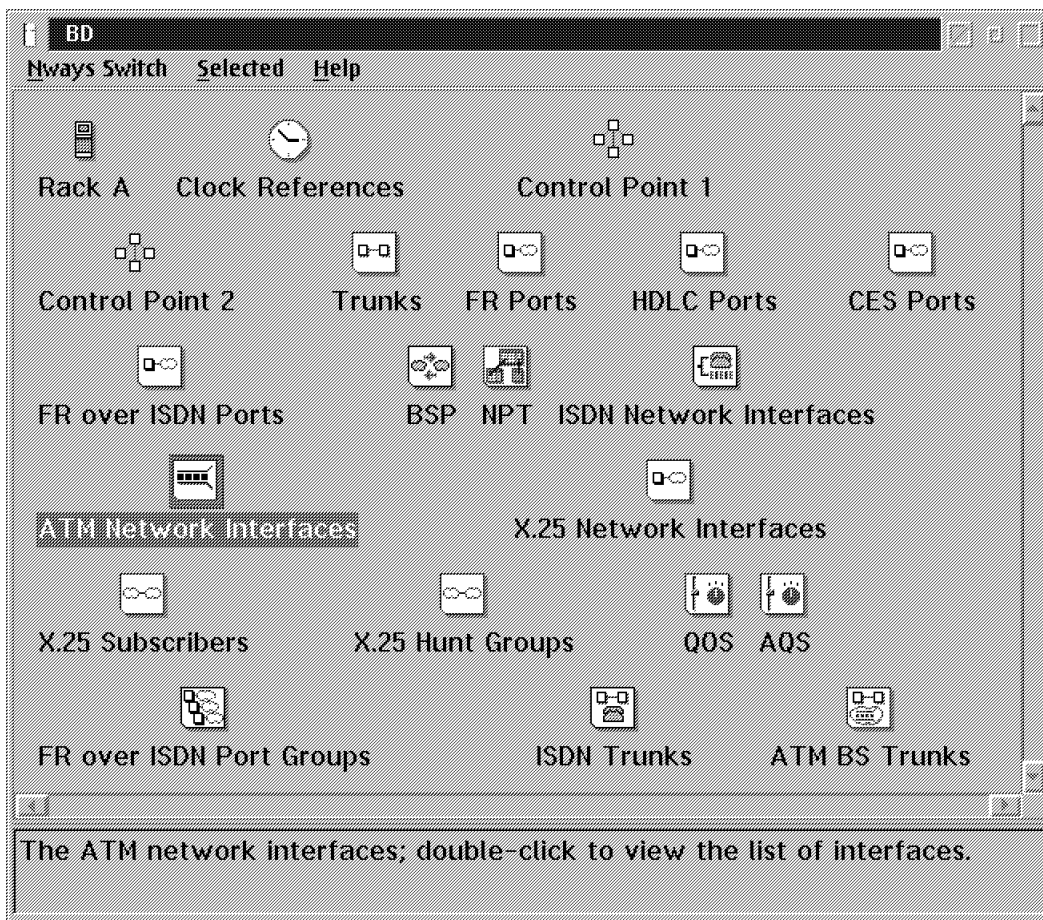
Figure 93. Create NBBS ATM Trunk Bearer Service

At the Create Trunk ATM over Bearer Service prompt, you must enter the name and click on **List** to select the ATM network interface for bearer service and also click on **List** to select the VPC trunk connection. The VPC is associated with

your logical trunk. Next, click on the network connection support to select VPC or VCC emulation mode depending on your traffic type. For VPC emulation, also referred to as VP tunneling, this type of trunk should have spanning tree set to zero. However, if you have more than one trunk between 2220s, you can change this value by clicking on **Advanced Options**. Set the bandwidth reservation to 100% instead of 85%.
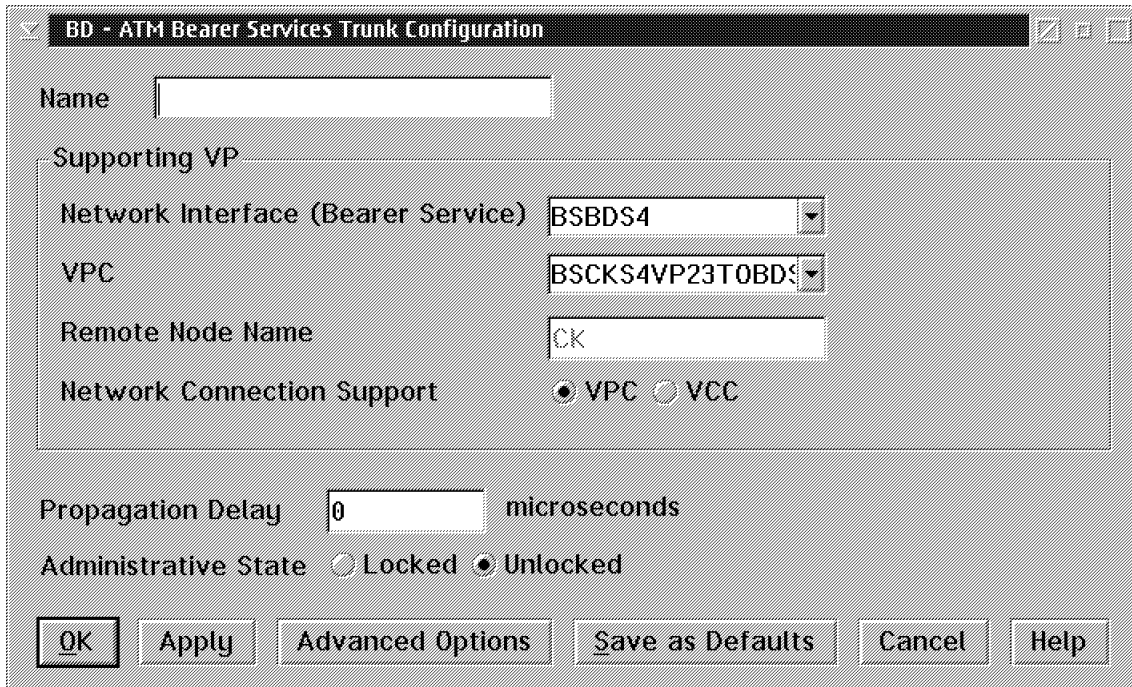
Figure 94. VPC Emulation Configuration

For VCC emulation mode (for example voice, frame relay etc.), the spanning tree should be set to zero and the bandwidth reservation should be set to 85%. The VCI range is from 32 to 65530. We recommend that you use 1 VCI for control traffic and 1 VCI for each VCC connection. If you click on the **Advanced Option** button, you will see that the maximum bandwidth has been set automatically. Finally, click on **OK**. Repeat these steps for the remote node. Export this configuration for both nodes and import into each NAS.
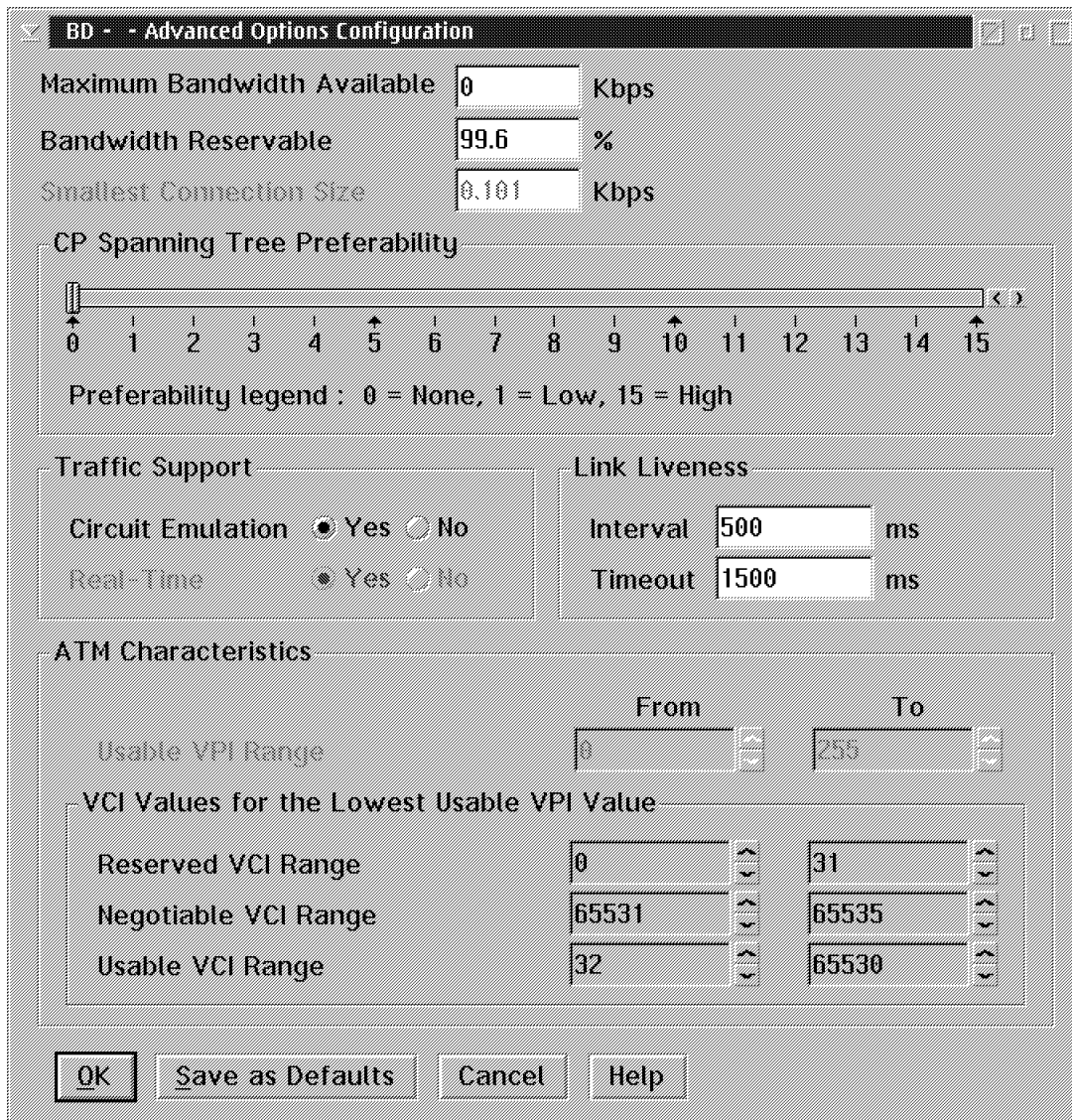
Figure 95. VCC Emulation Configuration

4.3.1 Virtual Path Mode of Operation (VP Mode)

Virtual path mode of operation is illustrated in Figure 96 on page 116. In this scenario each Virtual Path Connection (VPC) is an NBBS connection and only the VPC is managed or seen by the Nways Switch. External devices (ATM switches or end devices) are responsible for the setup and management of the individual VCCs that may make use of the VPCs.
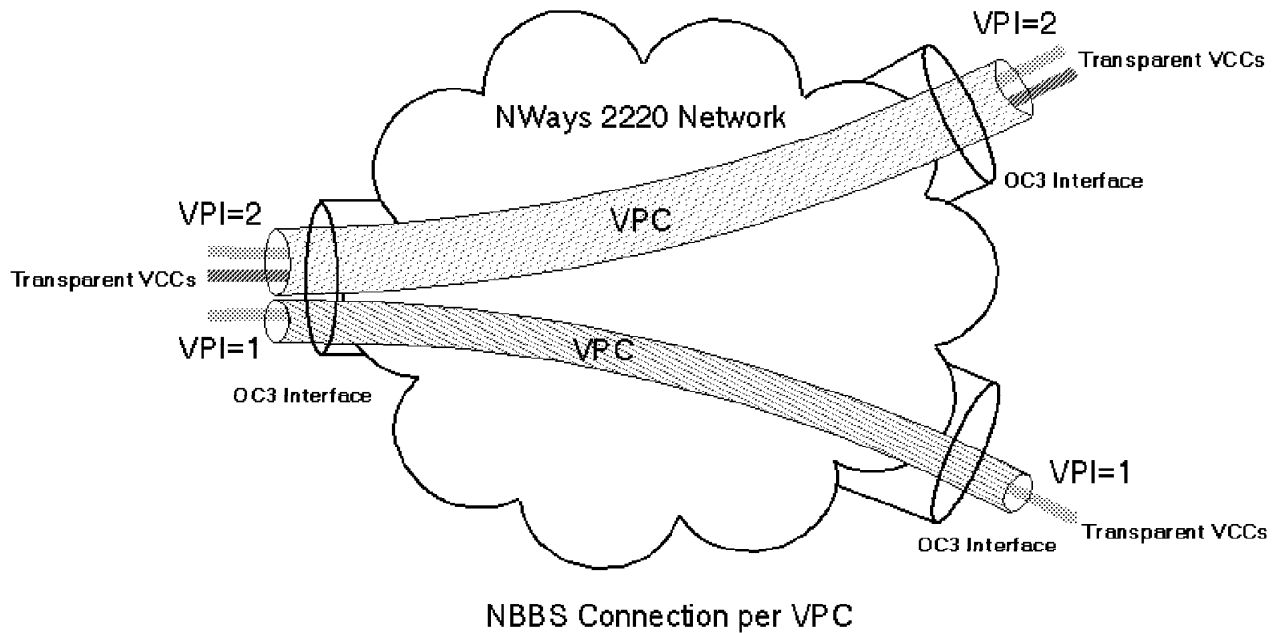
Figure 96. VP Mode of Operation

Notes:

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1. The Nways 2220 can perform label swapping of VPI and VCI values. For instance, it can be VPI=4 on one side and VPI=44 at the destination. VPI and VCI values are similar in function to DCLI values used in frame relay. They are only significant locally.

2. VPI values can vary between 0 to 255 if the connection is UNI.

3. If the connection is NNI, the VPI can have a value between 0 to 4095.

In the VP mode of operation the VPC can be seen as a big pipe to transport a number of VCCs that are transparent to the Nways Switch. As a result the Nways Switch only does VPI swapping because it is not aware of the VCCs. This mode of operation is sometimes referred to as VP tunneling in ATM literature. When configuring this mode of operation you only configure a VPC (VP service).

4.3.2 Virtual Channel Mode of Operation (VC Mode)

In this mode of operation each Virtual Channel Connection (VCC) is managed at the 2220 access level. Each active VCC will have its own NBBS connection and both VPI and VCI swapping are done in the Nways Switch. A view of this mode of operation is shown in Figure 97 on page 117. Note that VCCs to multiple destinations can be defined through one VP; multiple VPs may of course also be defined with each one having its own VCCs.
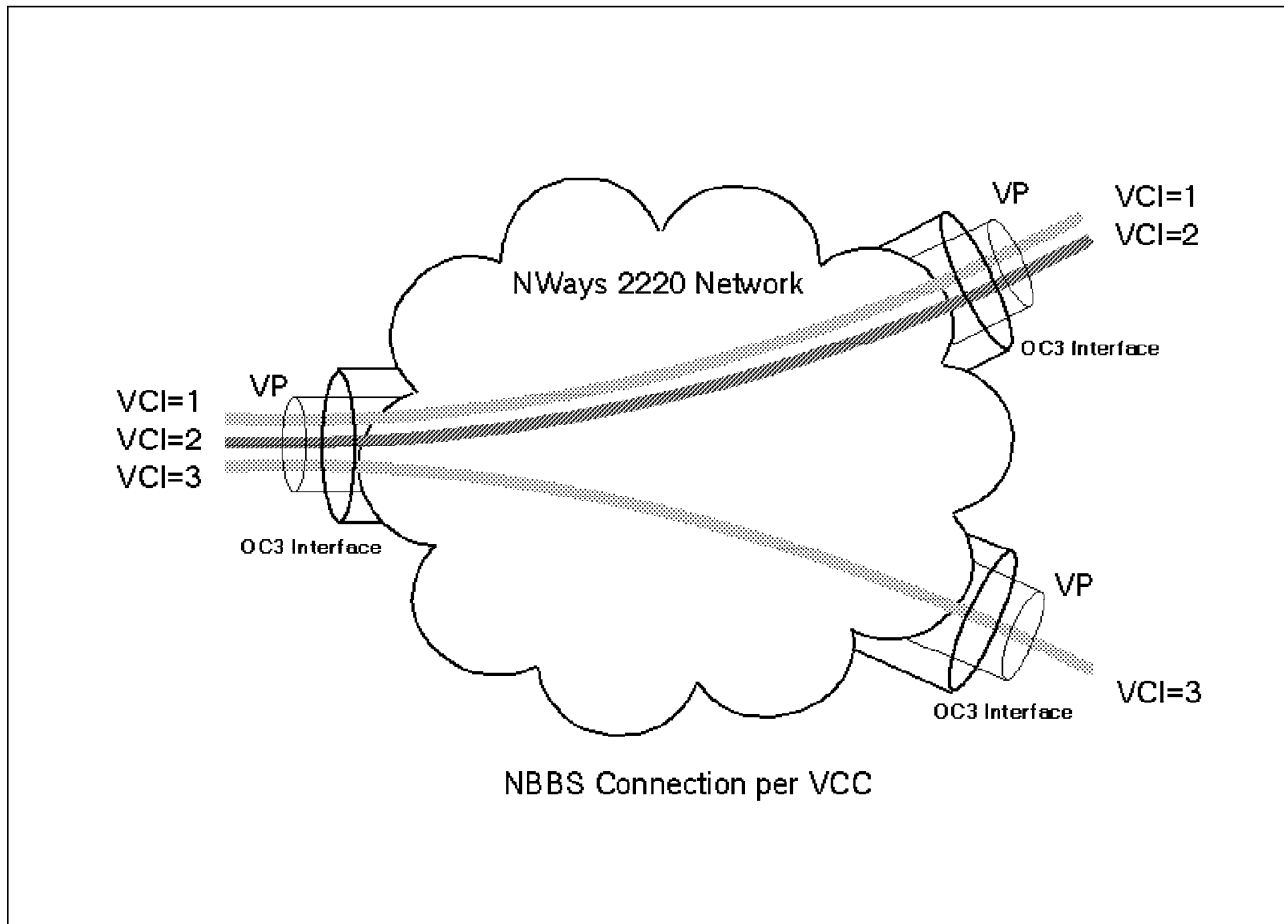
Figure 97. VC Mode of Operation

Notes:

1. The 2220 can perform label swapping. A label is the sum of VPI and VCI values. These values can be swapped at the ingress and egress ports.

2. VPI values can vary between 0 to 255 if the connection is UNI. If the connection is NNI, the VPI can have a value between 0 to 4095.

   VCI values from 0 to 31 are reserved.

In Figure 97, three NBBS connections will be established. The configuration will consist of defining a VP (VC service) as well as each VCC. Traffic flows are controlled for each VCC as opposed to the VP mode of operation where the individual VCCs in a PVC are treated and controlled as one connection.

4.4 ATM Traffic Control

ATM traffic control is a rather complex topic. There are numerous traffic descriptors and parameters used to control the flow of traffic.

You should first identify the type of traffic you would like to transport. You need to know the characteristics of that type of traffic. These include the sensitivity to delay and jitter.

Once you have identified the behavior and requirements you should bear in mind the fact that control is exercised per NBBS connection and this could have an influence on which mode of operation you use (VP or VC).

The implication here is that if you use the VP mode of operation, then all traffic using the VPC will be treated in the same way; there will be no differentiation between voice and data traffic using the same VPC. In order for voice to operate in an acceptable manner you will apply more stringent QoS requirements on the VPC than what is required by data. This in turn has implications on available bandwidth and reservation of bandwidth across the Nways Switch trunks.

Connections are controlled by QOS parameters and traffic descriptors defined at configuration time:

1. Quality of Service (QoS) guarantees the characteristics of a connection and should be selected according to the traffic type. QoS is defined using the following possible options:

   • Real-Time 1 and 2 (RT1 and RT2) and Non-Real-Time (NRT) queues

   • Voice

   • Nondisruptive Path Switching (NDPS)

   • Low-Speed trunk (LS)

   • High Priority (HPRI)

2. ATM traffic descriptors are used to control:

   • Received traffic policing through Usage Parameter Control (UPC)

   • Bandwidth reservation through Connection Admission Control (CAC)

There is obviously a relationship between the various control mechanisms and together they deliver a connection that suits a specific requirement. For example, when you have CBR traffic to transport you should choose both a QoS and ATM traffic descriptor that suits the traffic descriptor's ATM type. QoS parameters are mainly concerned with characteristics of a connection over a trunk. ATM traffic descriptors deal mainly with the manner in which a connection is maintained on a port level, although these parameters also dictate the level of reservation on trunks.

4.4.1 Quality of Service

QoS guarantees connection characteristics such as end-to-end delay, cell delay variation and packet loss ratios. The following are QOS configuration options:

1. Logical queues for managing cell transmission:

   • Real-Time 1 (RT1)

     RT1 is used for real-time applications with very low delay and jitter requirements and is the highest priority queue. Voice applications are a typical candidate for usage of this queue.

   • Real-Time 2 (RT2)

     Usage for this queue is typically for real-time applications that can tolerate some delay or jitter, compressed voice could typically use this queue. RT2 traffic provides better bandwidth utilization than RT1 at the expense of delay. You can use this queue for CBR applications.

   • Non-Real-Time (NRT) queue

Bandwidth is still guaranteed for users of this queue, however the traffic is not sensitive to delay and jitter. These are typically the data protocols.

2. Voice

This option is always induced when selecting any QoS based on the RT1 queue. When used with the RT2 option the delay requirements are less stringent.

3. Nondisruptive Path Switching (NDPS)

Ensures that a connection is rerouted in a nondisruptive manner in the event of a failure of the currently used path. This is of course only possible if the alternate path can satisfy the QoS requirements of the switched connection.

4. Low-speed trunk (LS)

When a low-speed trunk line is selected, the end-to-end delay required is much larger and finding suitable paths is easier. This option is only available for the NRT queue. It is also important that this option be selected when using low-speed trunks due to the inherently large delay associated with low-speed links.

5. High Priority (HPRI)

If HPRI is selected, bandwidth preemption ensures that this connection is given access first to available bandwidth when a connection is required. This option is based on the holding and requesting priority.

The following tables show the possible ATM QoS combinations for the real-time and non-real-time queues.

Table 13 shows the QoS values for ATM non-real-time traffic (for example, data).

Table 13. QoS for ATM Non-Real-Time Traffic			
QoS Name	Nondisruptive Path Switching (NDPS)	Low-Speed Trunk Lines (LS)	High Priority (HPRI)
QOSATMNRT			
QOSATMNRTNDPS	X		
QOSATMNRTLS		X	
QOSATMNRTNDPSLS	X	X	
QOSATMNRTHPRI			X
QOSATMNRTNDPSHPRI	X		X
QOSATMNRTLSHPRI		X	X
QOSATMNRTNDPSLSHPRI	X	X	X

Table 14 on page 120 shows the QoS values for ATM real-time traffic (for example, voice and video).

Table 14. QoS for ATM Real-Time Traffic					
QoS Name	Real-Time 1 (RT1)	Real-Time 2 (RT2)	Voice	Non-disruptive Path Switching (NDPS)	High Priority (HPRI)
QOSATMRT1VOICE	X		X		
QOSATMRT1VOICENDPS	X		X	X	
QOSATMRT1VOICEHPRI	X		X		X
QOSATMRT1VOICENDPSHPRI	X		X	X	X
QOSATMRT2		X			
QOSATMRT2NDPS		X		X	
QOSATMRT2HPRI		X			X
QOSATMRT2NDPSHPRI		X		X	X
QOSATMRT2VOICE		X	X		
QOSATMRT2VOICENDPS		X	X	X	
QOSATMRT2VOICEHPRI		X	X		X
QOSATMRT2VOICENDPSHPRI		X	X	X	X

4.4.2 ATM Traffic Descriptors

The traffic descriptors are defined by the ATM Forum. Table 15 shows the available options with the corresponding traffic descriptors.

Table 15. ATM Traffic Descriptors					
ATM Forum Traffic Descriptors					
3	**4**	**5**	**6**	**7**	**8**
PCR(0+1) CDVT(0+1) No tagging	PCR(0+1) CDVT(0+1) PCR(0) No tagging CDVT(0)	PCR(0+1) CDVT(0+1) PCR(0) Tagging CDVT(0)	PCR(0+1) CDVT(0+1) SCR(0+1) MBS(0+1) No tagging	PCR(0+1) CDVT(0+1) SCR(0) MBS(0) No tagging	PCR(0+1) CDVT(0+1) SCR(0) MBS(0) Tagging
Legend: **PCR** Peak cell rate (cells per second) **CDVT** Cell delay variation tolerance (seconds) **SCR** Sustainable cell rate (cells per second) **MBS** Maximum burst size (number of cells) **(0+1)** Cells with CLP=0 and cells with CLP=1 (aggregate traffic) **(0)** Cells with CLP=0 (cell loss priority) Traffic in excess with CLP=0 is discarded at network entry or accepted on a "best effort" basis, in which case the traffic is tagged by changing the CLP from 0 to 1.					

The traffic descriptor parameters have the following meaning:

- PCR specifies the upper bound on traffic received on the ATM connection in cells per second. The arrival time between cells is therefore 1/PCR.

- CDVT specifies the maximum delay between the arrival time (1/PCR) and an early arrival time for each cell. Figure 98 on page 121 shows an example of policing incoming cells using PCR and CDVT: cell 3 arriving within PCR and CDVT is accepted while cell 4 arriving ahead of the specified tolerance (CDVT) is discarded.
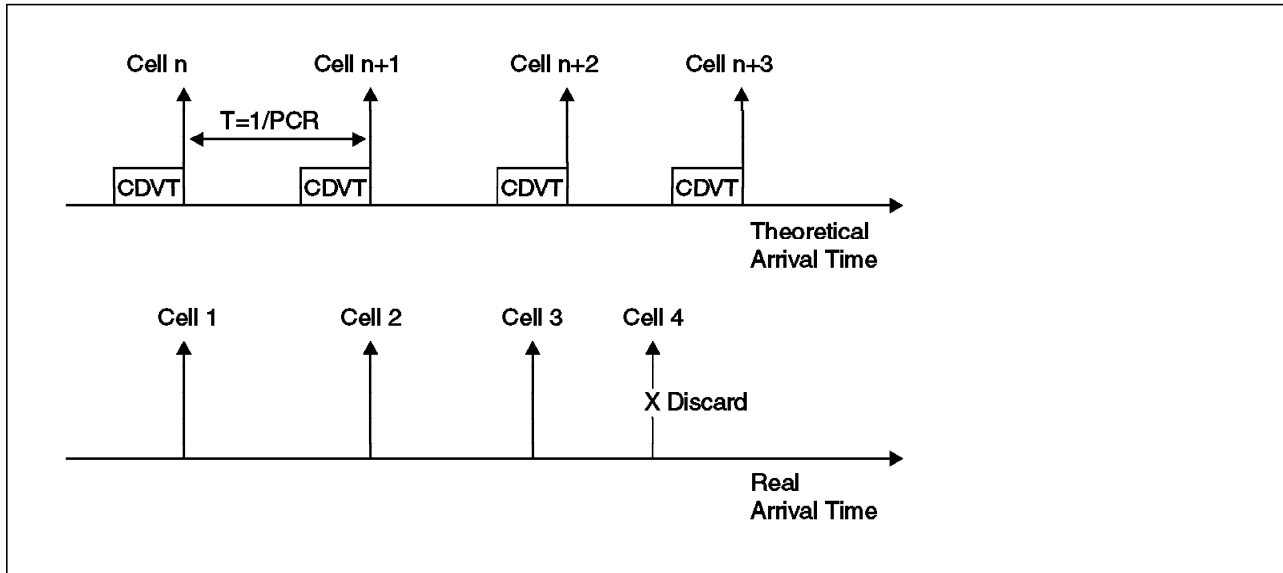
Figure 98. CDVT Tolerance Example

- SCR is the sustainable cell rate that specifies an upper bound on the *average* bit rate traffic. In successive GCRAs the minimum arrival time is 1/SCR.

- MBS is the maximum burst tolerance at peak cell rate. When combined with PCR and SCR, it determines the CDVT used by the successive GCRAs.

4.4.3 Traffic Policing

A description of the traffic policing and Generic Cell Rate Algorithm (GCRA) used for each traffic descriptor is given. Additionally, a mapping of the NBBS rate (R), mean (m), and burst (b) parameters to their equivalent ATM traffic descriptors parameters is given, as this should give you a good idea of the usage of different parameters.

4.4.3.1 Traffic Descriptor 3

The GCRA used for traffic descriptor 3 will pass through all traffic conforming to PCR(0+1) and CDVT(0+1), but no tagging is done. Nonconforming cells will be discarded. This is the traffic descriptor for CBR real-time applications since very little policing is done.
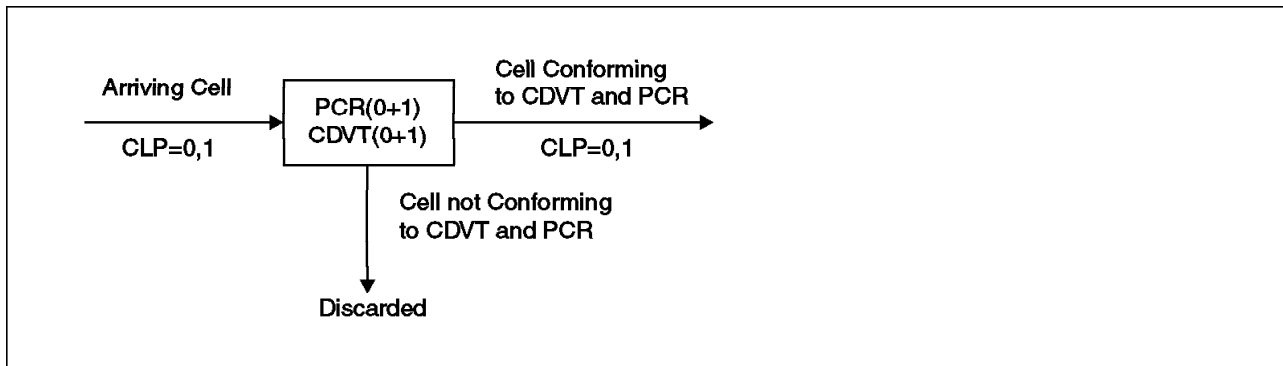
Figure 99. GCRA for Traffic Descriptor 3

Figure 99 shows a diagram of traffic descriptor 3 GCRA operation.

The NBBS-to-ATM traffic descriptors parameter mapping is as follows:

- NBBS R = PCR(0+1)

- NBBS m = PCR(0+1)

- NBBS b = 10e-5 (0.00001 second) (Value of b is insignificant because peak rate is reserved.)

4.4.3.2 Traffic Descriptors 4 and 5

Policing here is performed by two successive GCRAs as follows:

- The first GCRA is based on CDVT(0+1) and PCR(0+1) and operates the same as that for traffic descriptor 3.

- The second GCRA is based on PCR(0) and CDVT(0) cells; it only controls arriving CLP=0 cells. Arriving CLP=1 cells are passed through provided enough resources are available. CLP=1 cells may be subject to selective discarding in the network.

  Note: Tagging refers to the process of changing a CLP=0 to CLP=1, but we can not say that a CLP=1 is tagged. It may have been generated as a CLP=1 by the ATM application.

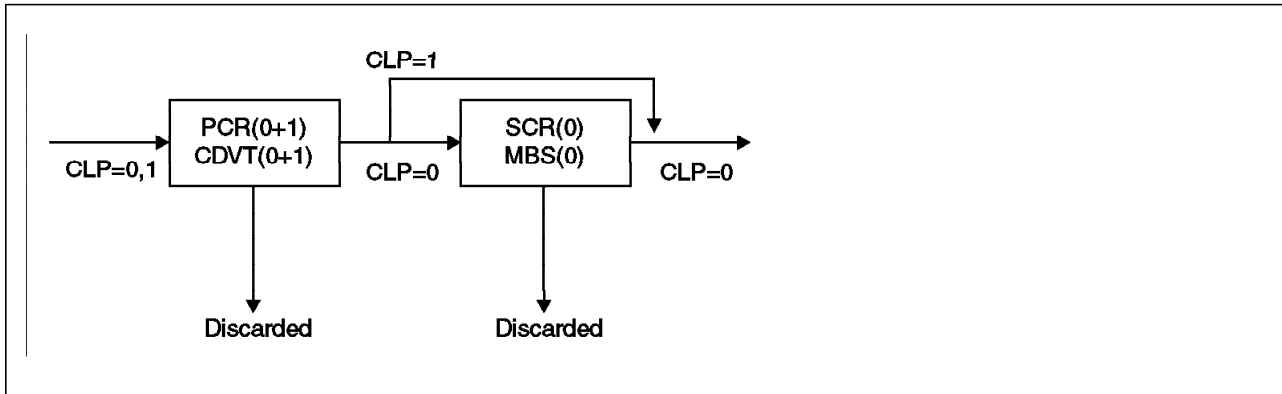 Traffic Descriptor 4 will discard nonconforming cells.
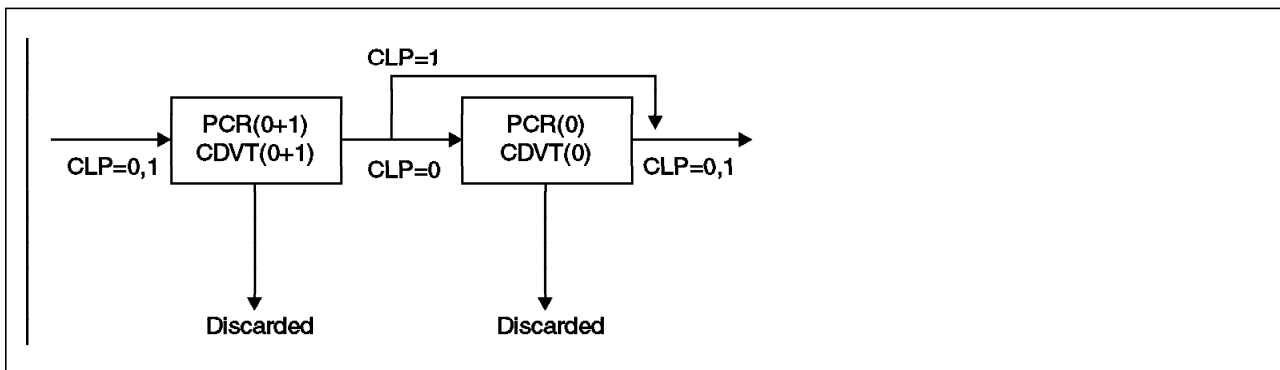
Figure 100. GCRA for Traffic Descriptor 4 (No Tagging)

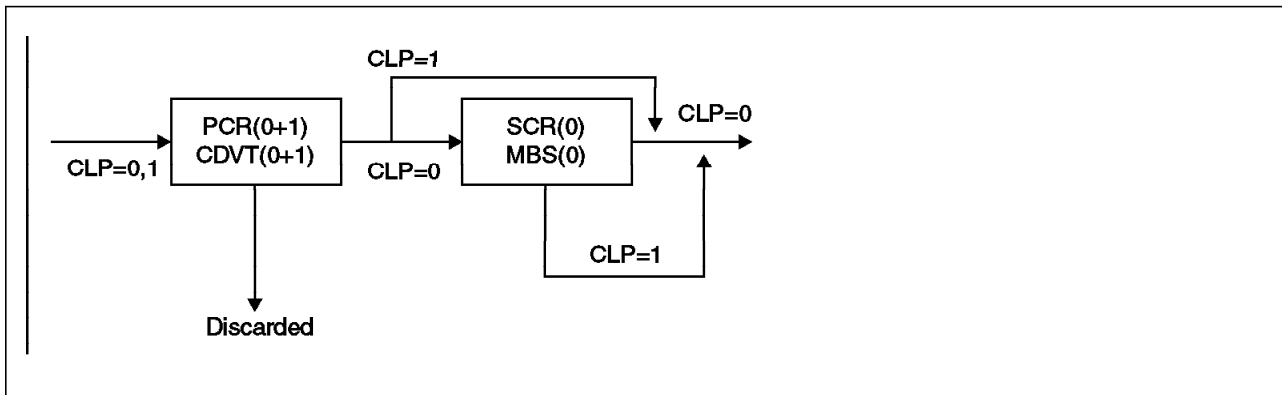Figure 100 shows the GCRA for traffic descriptor 4 checking PCR(0) and CDVT(0) and discarding nonconforming cells.

Traffic Descriptor 5 will tag nonconforming cells (CLP=1).
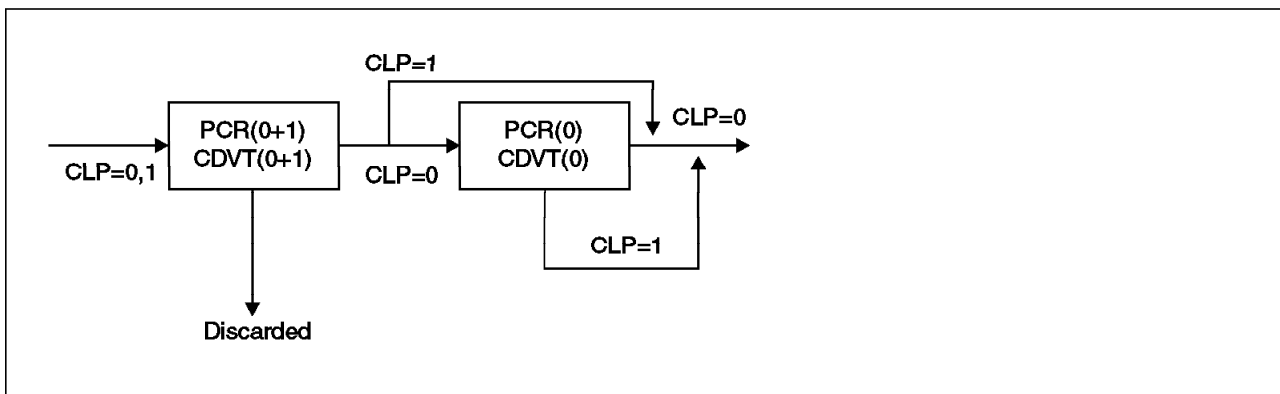
Figure 101. GCRA for Traffic Descriptor 5 (Tagging)

Figure 101 shows the GCRA for traffic descriptor 5 checking PCR(0) and CDVT(0) tagging nonconforming cells and passing them through.

The NBBS-to-ATM parameter mapping for traffic descriptors 4/5 is as follows:

- NBBS R = PCR(0+1)

- NBBS m = PCR(0)

- NBBS b = 10e-5 (0.00001 second) (Value of b is not very important, because peak rate is reserved.)

4.4.3.3 Traffic Descriptor 6

Two successive GCRAs are used as follows:

- The first GCRA operates the same as that for traffic descriptor 3.

- The second GCRA is based on SCR(0+1) and MBS(0+1) and handles both CLP 0 and 1 cells. No tagging is done; nonconforming cells are discarded.
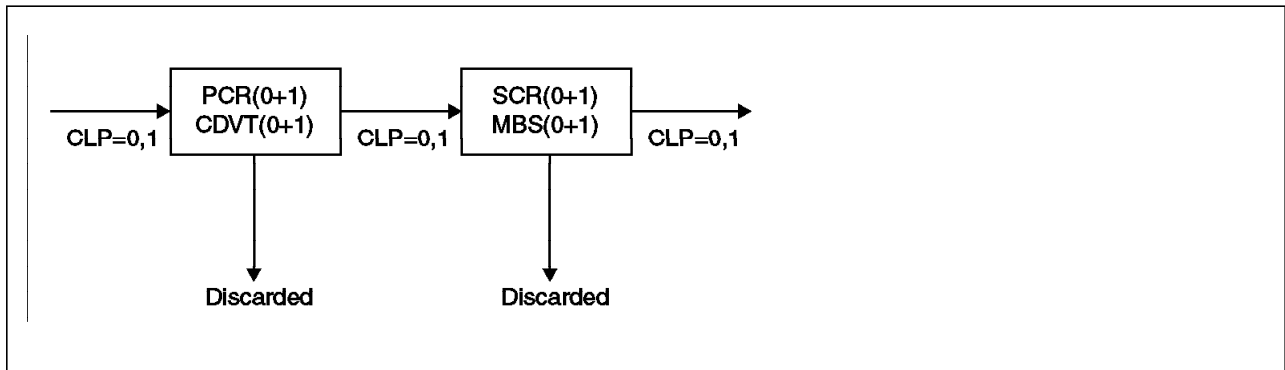
Figure 102. GCRA for Traffic Descriptor 6

Figure 102 shows the GCRAs used for traffic descriptor 6.

The NBBS-to-ATM parameter mapping for traffic descriptor 6 is as follows:

- NBBS R = PCR(0+1)

- NBBS m = SCR(0+1)

- NBBS b = MBS(0+1)

4.4.3.4 Traffic Descriptors 7 and 8

Two successive GCRAs are used as follows:

- The first GCRA operates the same as that for traffic descriptor 3.

- The second GCRA operates on the same parameters as traffic descriptor 6, however only cells with CLP(0) are checked. CLP(1) cells are transmitted unchecked providing enough resources exist. CLP=1 cells may be subject to selective discarding in the network.

  traffic descriptor 7 will discard nonconforming cells while traffic descriptor 8 will tag and transmit them.

Figure 103. GCRA for Traffic Descriptor 7 (No Tagging)

Figure 103 shows the GCRA for traffic descriptor 7 checking MBS(0) and SCR(0) and discarding nonconforming cells.

Figure 104. GCRA for Traffic Descriptor 8 (Tagging)

Figure 104 shows the GCRA for traffic descriptor 8 checking MBS(0) and SCR(0) and tagging nonconforming cells.

The NBBS-to-ATM parameter mapping for traffic descriptors 7/8 is as follows:

- NBBS r = PCR(0+1)

- NBBS m = SCR(0)

- NBBS b = MBS(0)

4.4.4 Bandwidth Reservation

Bandwidth reservation is done for each connection, that is each VPC or VCC activated.

Bandwidth reservation is very important as NBBS will generally be allocating bandwidth to all types of connections using the trunk capacity.

When using traffic descriptor 3, 4 or 5 the following parameters are used to compute bandwidth reservation:

- The access rate

- PCR

- CDVT

The following parameters are used in addition to PCR, access rate and CDVT to reduce bandwidth reservation when using Traffic Descriptor 6, 7 and 8:

- SCR

- MBS

See 4.4.3, "Traffic Policing" on page 121 for a mapping of the NBBS parameters (mean, burst and rate) to ATM traffic descriptors.

4.4.5 Traffic Shaping

As a result of the type of ATM NICs and applications in the market today the type of traffic that campus ATM switches have to deal with is mainly UBR. In a campus environment UBR traffic might not be problematic; however in the WAN you have a limitation on bandwidth and trunks that have to be shared by different ATM VPC/SVCs and other data link services.

In order for ATM connections to operate in an acceptable manner, traffic shaping should be done on the output of external ATM devices that connect to the 2220 ATM ports. The shaping should match the traffic descriptor that is used; if this is not done then excessive discarding of cells could occur. If one cell of a data frame is discarded then all the cells in the frame will be re-transmitted. Excessive cell discarding would have a big impact on end-to-end performance.

The ATM traffic descriptors conform to CBR (Traffic Descriptors 3-5) and VBR (Traffic Descriptors 6-8). Campus switches that provide shaping must therefore shape their output to one of the traffic descriptors; this should be done per VPC or VCC. Traffic shaping on a port basis will only be effective if you only have one ATM connection.

This traffic management challenge is not a shortcoming on the part of the 2220; the point is that you have a finite amount of bandwidth across WAN trunks and currently there is no mechanism for a WAN switch to effectively control input ATM traffic.

Traffic shaping in the Nways Switch is provided at the network exit in the transmit part of the ATM port adapters. Shaping is not provided at the network entrance. Shaping is optional and can be set during configuration.

Shaping at the network exit does not protect the 2220 network; however it will minimize discarding of traffic when crossing the next NNI/UNI interface.

The shaper will limit the throughput of the egress (forward) traffic, thus, you must ensure that the incoming traffic will not exceed the shaper speed to prevent traffic overflow. When too many connections are in continuous overflow condition, global congestion may occur in the egress (forward) adapter.

To prevent a situation where too many connections in continuous overflow saturate the adapter, very stringent checking is performed at connection setup to guarantee that incoming traffic does not exceed the shaper capacity.

The shaping speed is configured as a number of cells per second; the total aggregate shaping speed of VCC and VPC connections on a port must be less than the port capacity:

- For traffic descriptor 3 the connection is rejected if the shaper speed is less than PCR(0+1).

- For traffic descriptor 6 connections the shaper speed must be higher than SCR(0+1).

- For the other traffic descriptor types it is not possible to predict the amount of CLP=1 traffic that will be accepted into the network. The maximum is PCR(0+1), thus the connection will be rejected if the shaping speed is less than PCR(0+1). This is done to protect other connections.

The Traffic Type has the following options. We list the equivalent ATM traffic descriptors with each option:

- traffic descriptor 3 - No CLP/No SCR

- traffic descriptor 4 - CLP without tagging/No SCR

- traffic descriptor 5 - CLP with tagging/No SCR

- traffic descriptor 6 - No CLP/SCR

- traffic descriptor 7 - CLP without tagging/SCR

- traffic descriptor 8 - CLP with tagging/SCR

4.4.6 ATM Congestion Management

The 2220 uses three methods to manage congestion in the ATM access network as follows:

- VP or VC Traffic Policing

  This type of congestion management is described in 4.4.3, "Traffic Policing" on page 121. Traffic descriptors without tagging will prevent adapters from reaching VP or VC congestion.

- VP or VC Congestion

  VP or VC congestion occurs on the transmit side when resources used by the VP or VC connection reach a certain maximum threshold. This can typically happen when using traffic descriptors that allow tagging coupled with a large number of cells with CLP=1 being transmitted. When congestion occurs cells are discarded until the resources and buffers used go below the maximum threshold.

- Severe Adapter Congestion

  Severe adapter congestion can occur when too many VP/VC connections using traffic descriptors that allow tagging handle excessive CLP=1 traffic. Severe adapter congestion occurs when there are no more resources available in the adapter; in this case all cells for the VP/VC connections are discarded.

4.5 ATM Configuration Flow

The Figure 105 on page 127 shows a suggested flow for your ATM configuration.
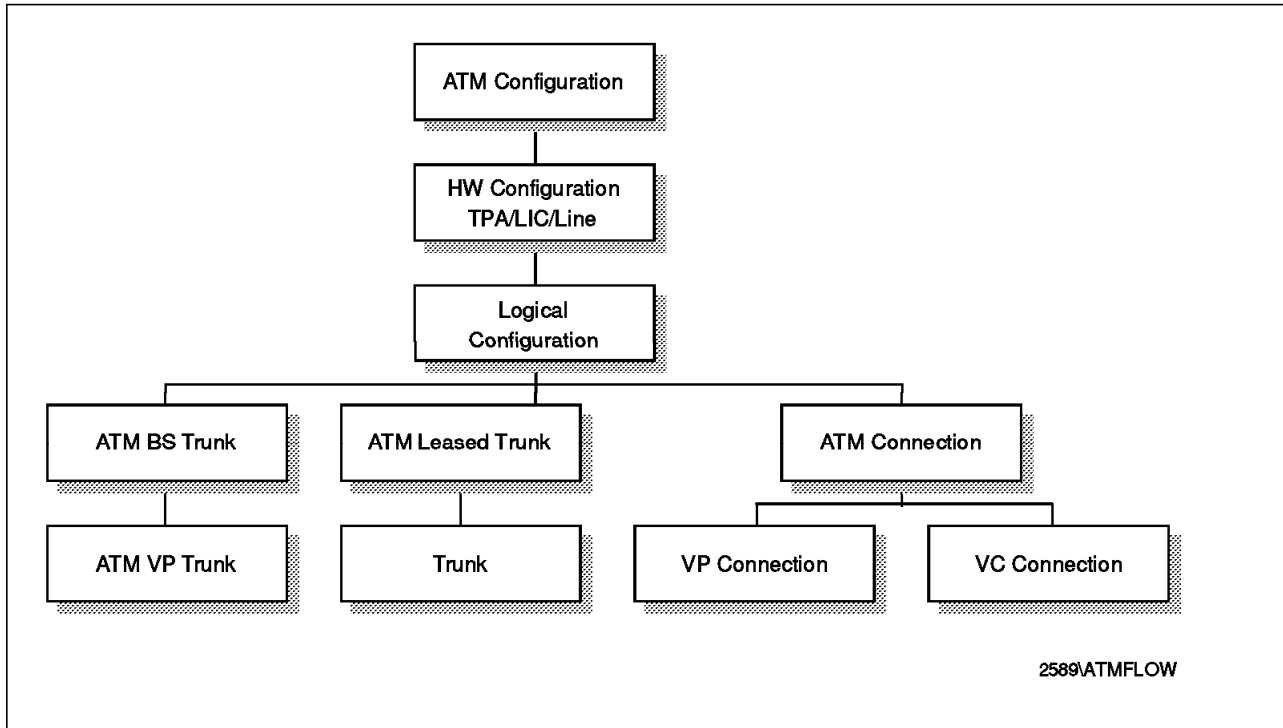
Figure 105. ATM Configuration Flow

4.6 ATM Access Services Configuration

First we have to define the hardware for our ATM port. In the example we use an ATMA2 adapter and a LIC556 as hardware to connect to an 8260 campus switch. See Figure 106 for the topology used during the setup. The trunk is an OC3 trunk as defined in Chapter 2, "Nways Switch Configuration" on page 43.
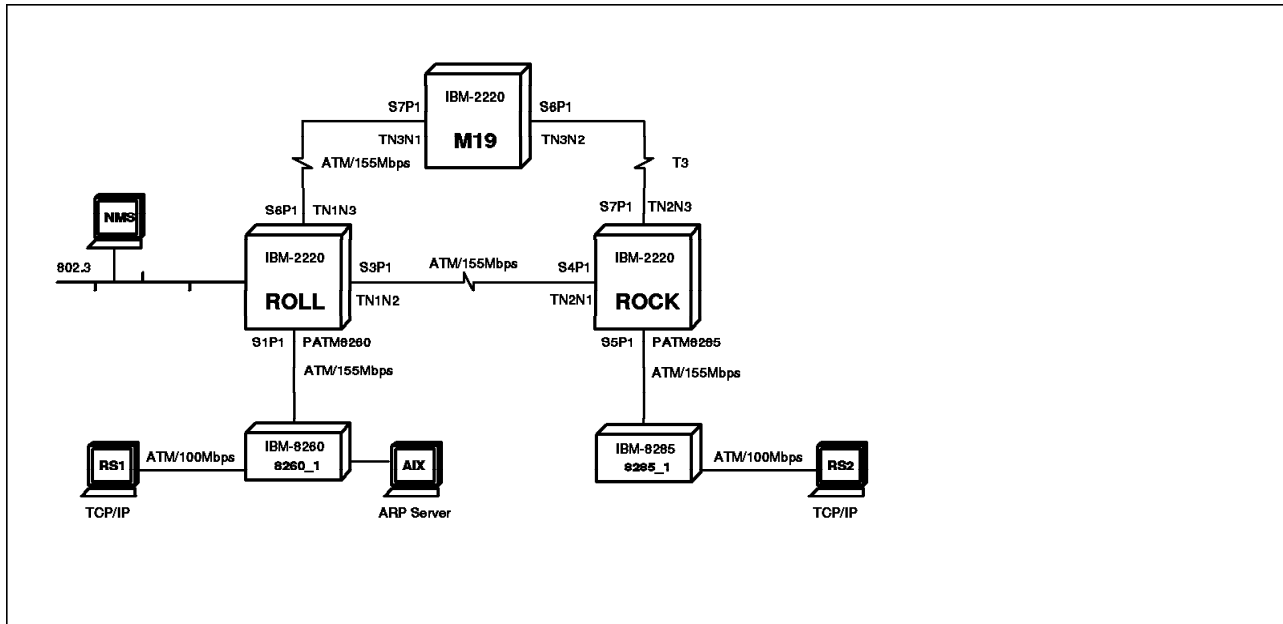
Figure 106. Physical Topology

The logical topology is shown in Figure 107 on page 128. The connection that we configured between the 8260 and 8285 was a single VPC.
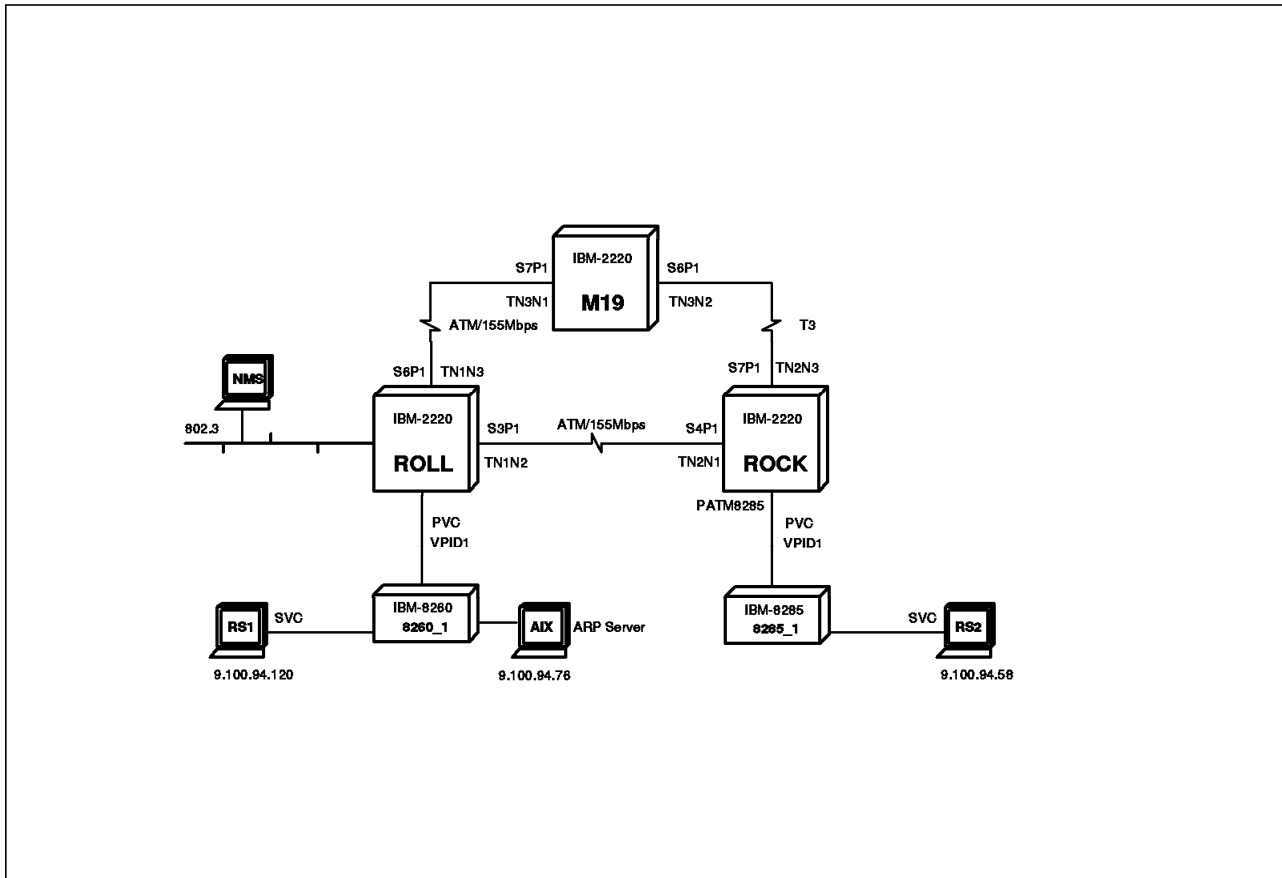
Figure 107. Logical Topology

In the 8260 the defined parameters were as follows:

```
SLOT=17 , PORT=1 (8260 slot and port) , VPI=1(to be defined in ROLL),
TARGET=10 , ROLE=NETWORK_SIDE , UNI=3.0 , TRAFFIC_TYPE=NON RESERVED
```

The 8285 parameters were as follows:

```
SLOT=4 , PORT=1 (8285 slot and port) , VPI=1(to be defined in ROCK),
Target=01 , ROLE=USER_SIDE , UNI=3.0 , TRAFFIC_TYPE=NON RESERVED
```

Note that the parameters that have an influence on the 2220 definitions are the VPI values, interface role and traffic type. The 2220 definition will consist of a single VPC with VPI=1 on both ends and a network role catering for both the network and user side.

Note: Because the 2220 can swap VPI values, the VPI is not necessarily the same at both ends of the VP like it is in the picture. For instance, it can be VPI=4 on one side and VPI=44 at the other end.

We also show how to configure a VC mode operation. However, this was not tested.

You go through the following sequence when defining ATM services:

- Configure the ATM adapter and LIC on initiator and target 2220.

- Configure an ATM line attachment on initiator and target 2220.

- Create an ATM network interface on initiator and target 2220.

- Create the VPC for VP mode operation on initiator 2220.

- Create the VP on the target 2220 then create the VP on the initiator 2220. Once the VPs have been defined you create the VCC on the initiator 2220 and the return path will be created automatically.

The hardware configuration *must* be done on both switches before we proceed with the logical (VP and VC) configuration.

4.6.1 ATM Port Hardware Configuration

From the NCT select the node followed by the rack you are configuring and the window in Figure 108 will be displayed. Now you select the slot in which you have the ATM adapter that you wish to configure. Select the slot by double-clicking on the empty triangle below the slot.
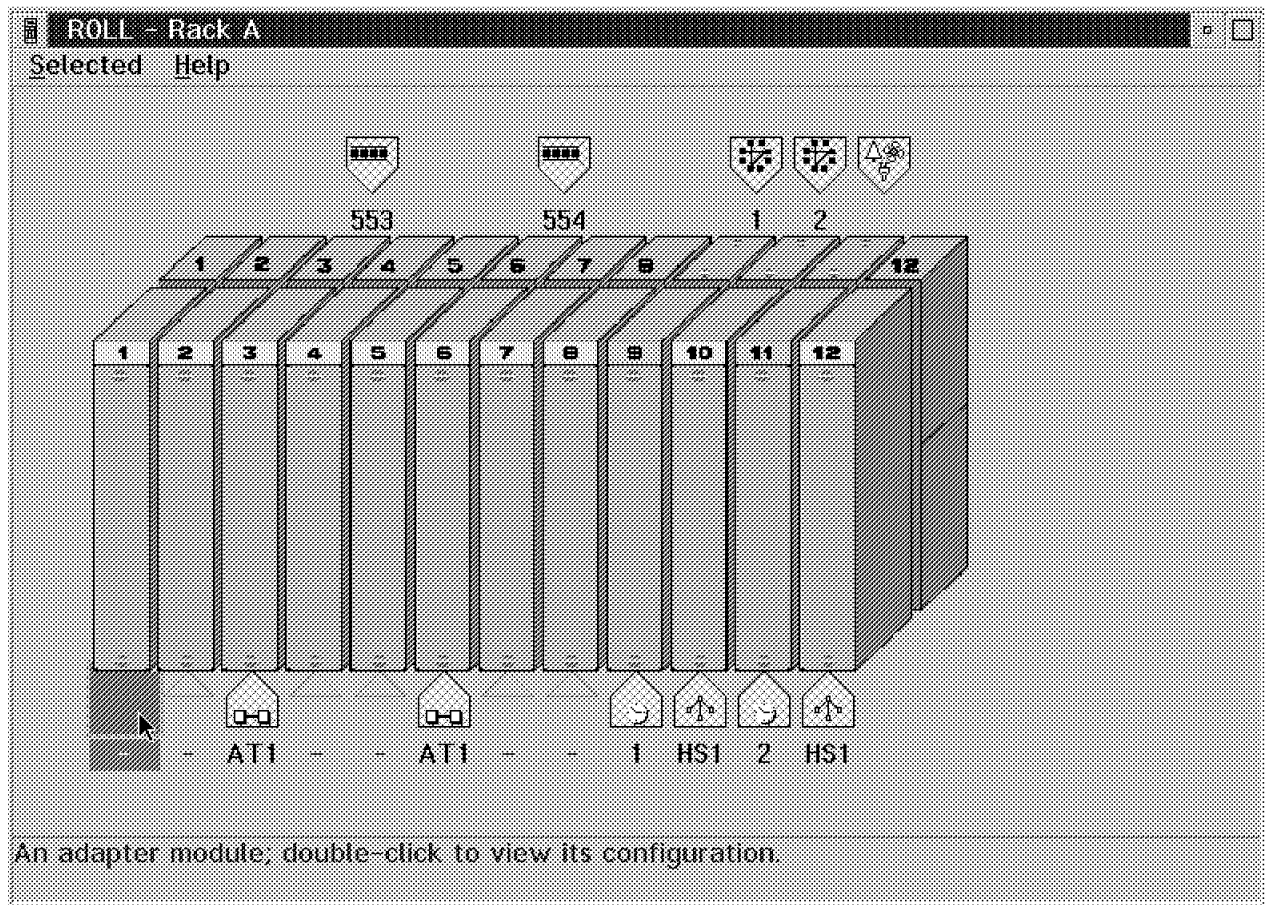
Figure 108. Selecting Adapter Configuration
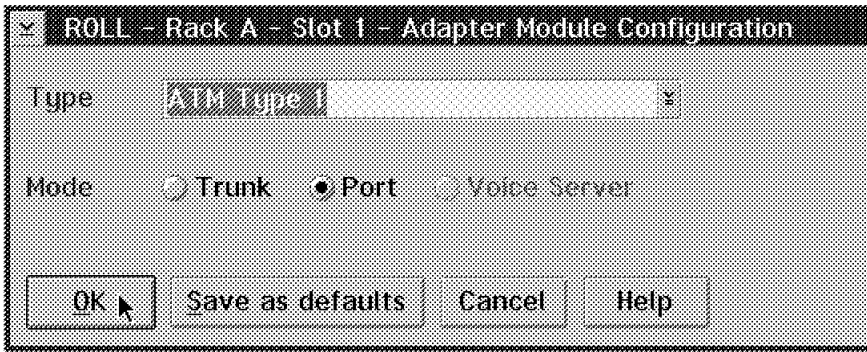
Figure 109. Adapter Module Configuration

The window in Figure 109 is now displayed. Select the port mode and the relevant type of adapter and click on the **OK** button. This is all that is needed to configure the adapter.

The rack will once again be displayed (see Figure 110). Note that the adapter has been updated and the icon appears empty on the backplane for slot 1.
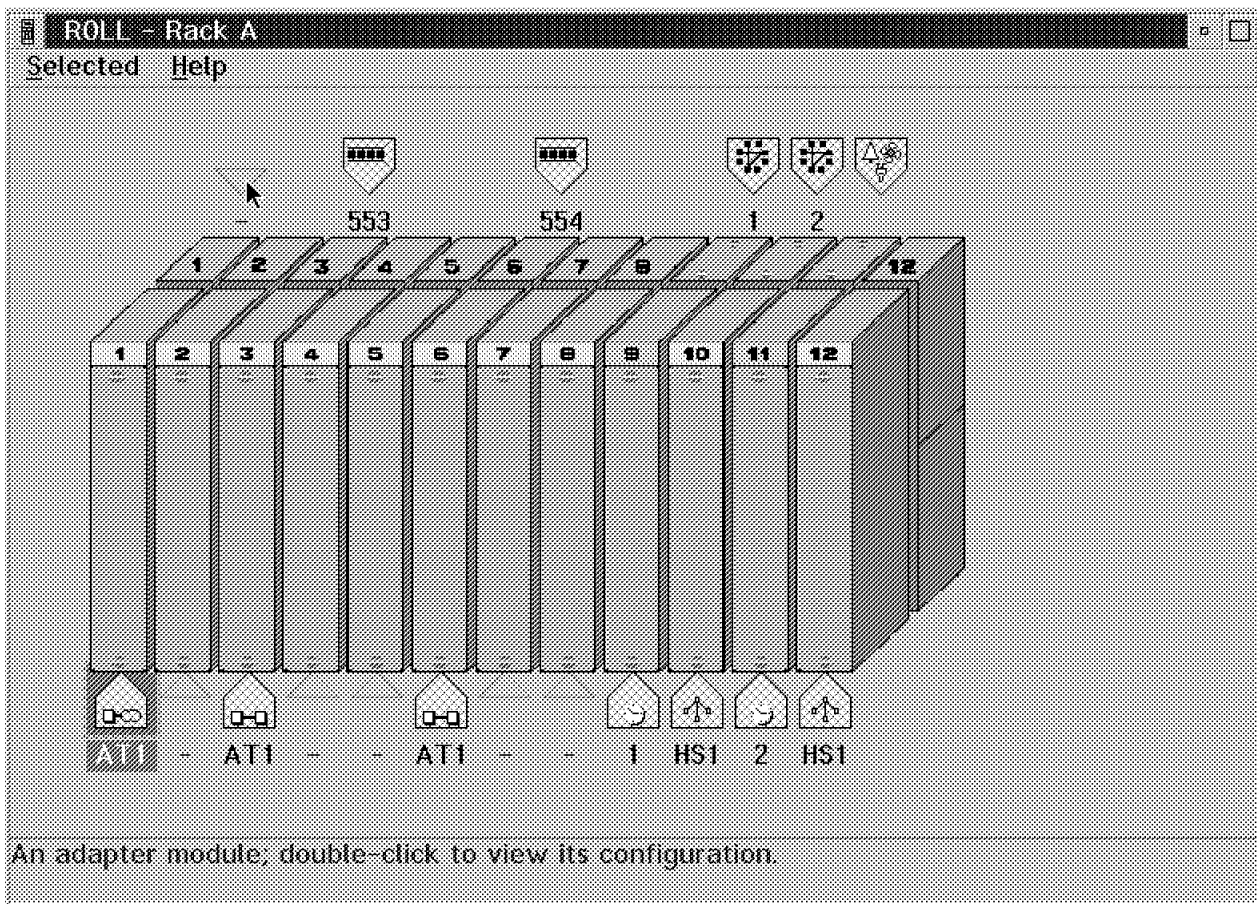
Figure 110. LIC Configuration

The next bit of hardware to define is the Line Interface Coupler (LIC). Select the empty icon above slot 1 by double-clicking on it. You are now able to select the LIC type; see Figure 111 on page 131.
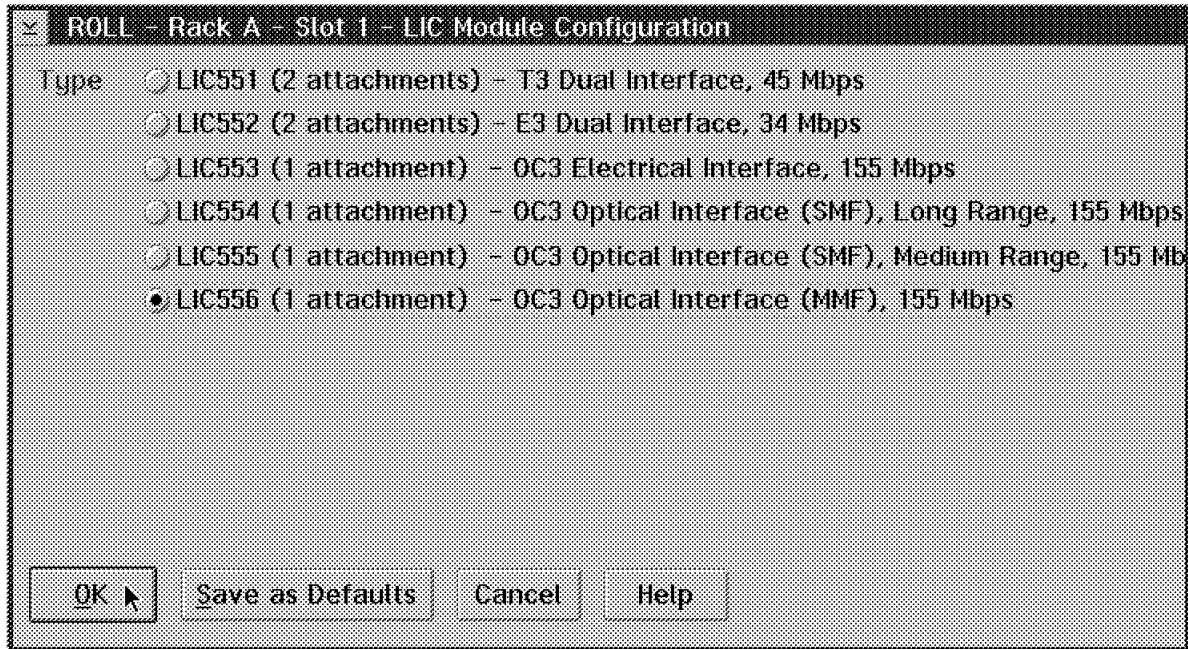
Figure 111. Configuring the LIC Type

In our example the LIC used was an LIC556 which is an OC3 Multimode Fiber (MMF) LIC. Select the LIC type and click on **OK** and you will be returned to the rack display (see Figure 110 on page 130).

4.6.1.1 ATM Line Attachment Configuration

The window showing the rack (Figure 110 on page 130) with an ATM icon shown above the LIC just configured is displayed. From here double-click on the LIC and select the line. You will now see Figure 112 displayed.
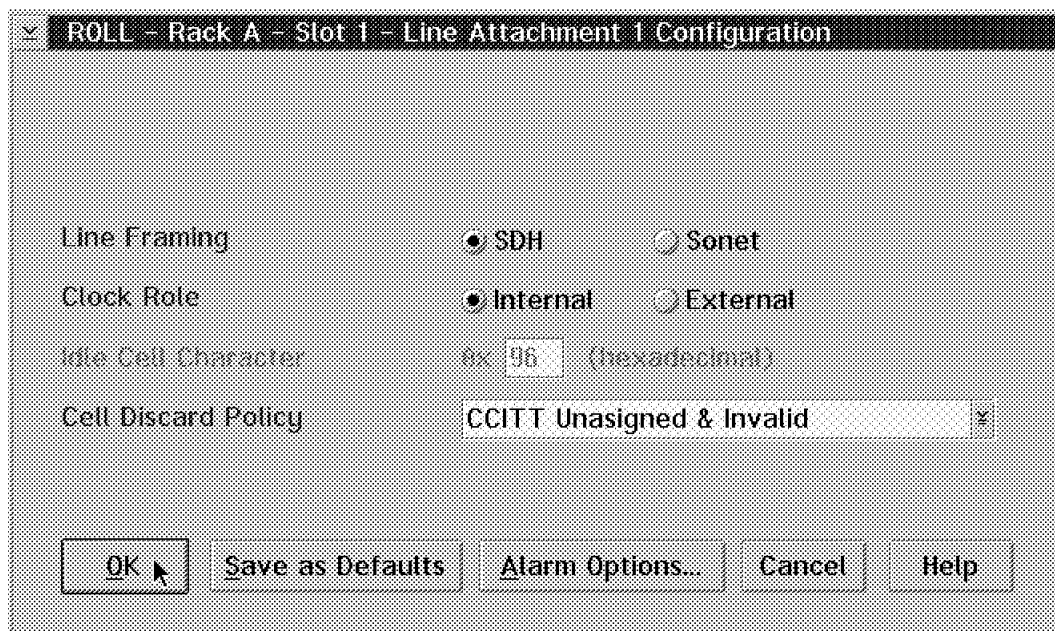
Figure 112. Line Attachment Configuration

Line framing will depend on the equipment you connect to. SDH is an ITU standard and Sonet is a North American standard. Make sure that the same framing is used on the 2220 and the attached device. Framing is of local significance only.

Clock role should be internal on one side and external on the other. In our case we selected to use internal clocking on the 2220s and external clocking on the 8260s (end devices).

For Cell Discard Policy we chose the recommended default value. This is to discard empty and invalid cells in the port adapter. The impact should you choose the incorrect option is minimal and will only affect debugging operations.

You may now click on the **Alarm Options** after which the window shown in Figure 113 will be displayed.
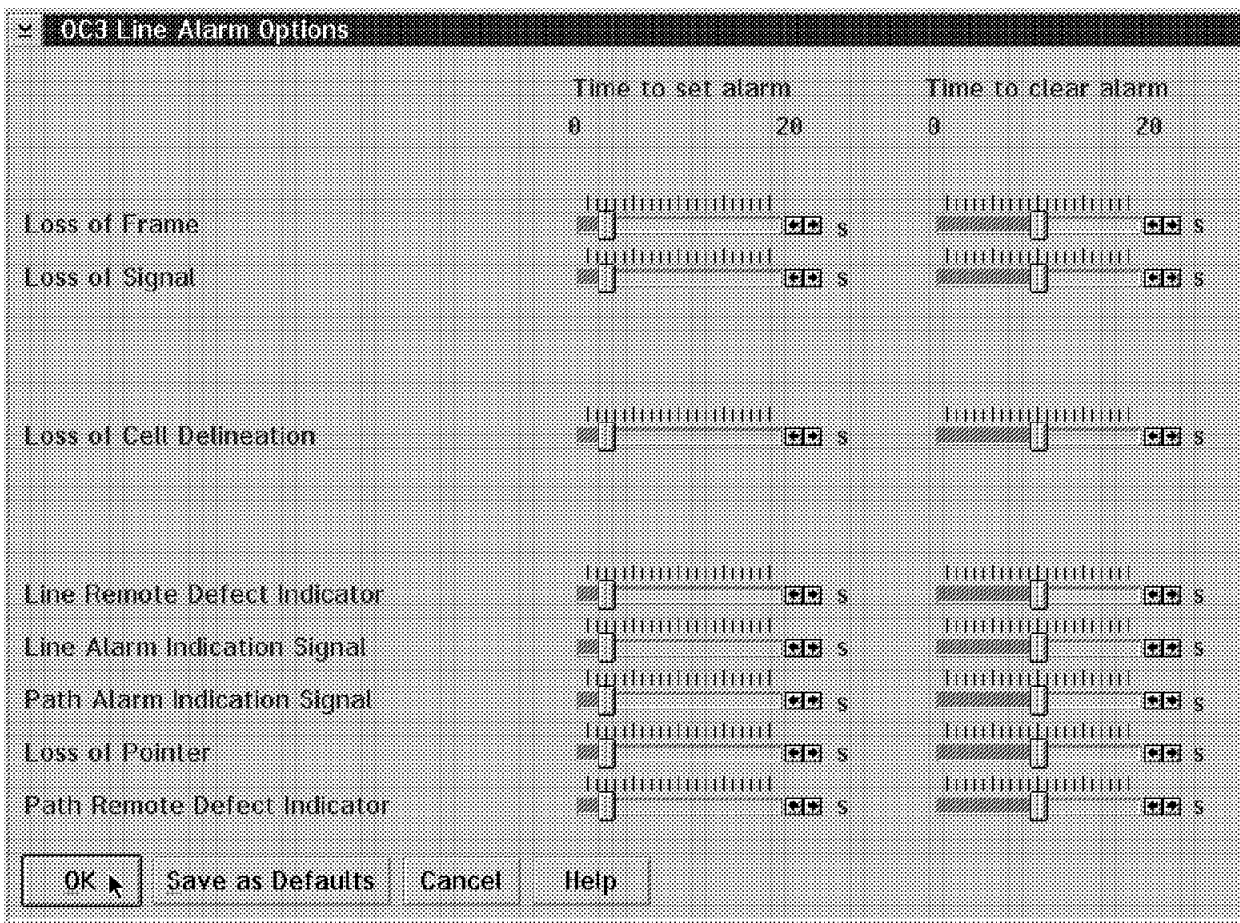
Figure 113. Line Alarm Options

This display allows you to change the time used by the control program to set an alarm after the type of failure indications as shown. You also have the capability to change the time used to clear an alarm after recovery.

We recommend that you use the defaults unless you experience specific error conditions that might require you to change some of the options to aid in diagnosis of problems.

At this point click on the **OK** button until you are back in the window displayed in
Figure 114 on page 133.

4.6.1.2 Create an ATM Network Interface
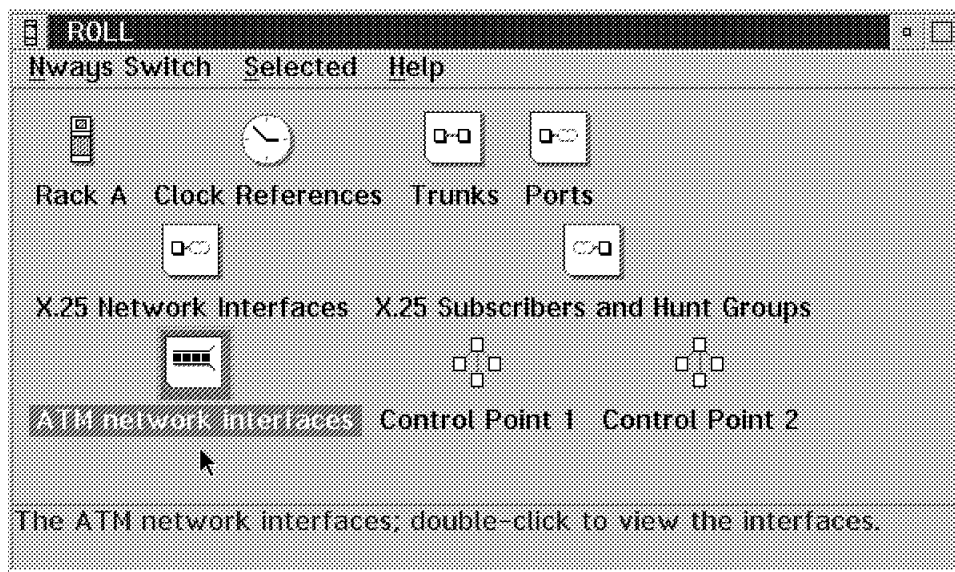
Figure 114. Node Selection Window

What we do now is click on the **ATM network interfaces** icon after which
Figure 115 will be displayed. On this screen we click on the **Interfaces** button
and select the **Create Interface** option.
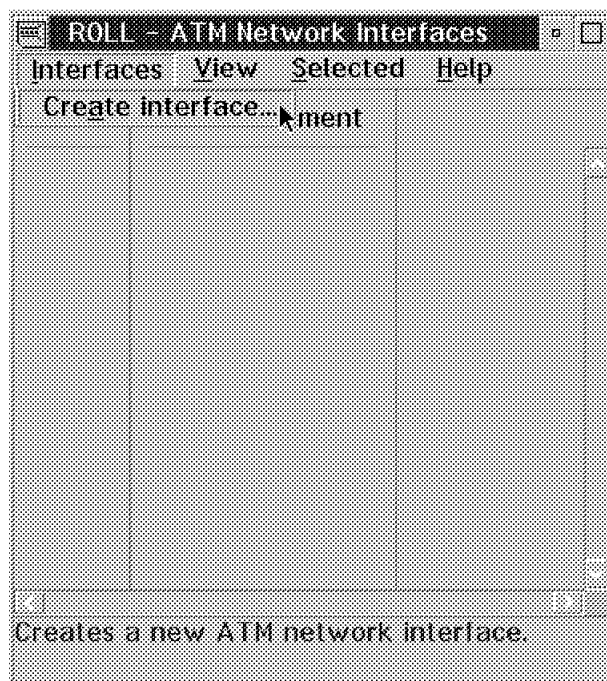
Figure 115. Create a New Interface

The window shown in Figure 116 on page 134 is displayed and requires the
following input:
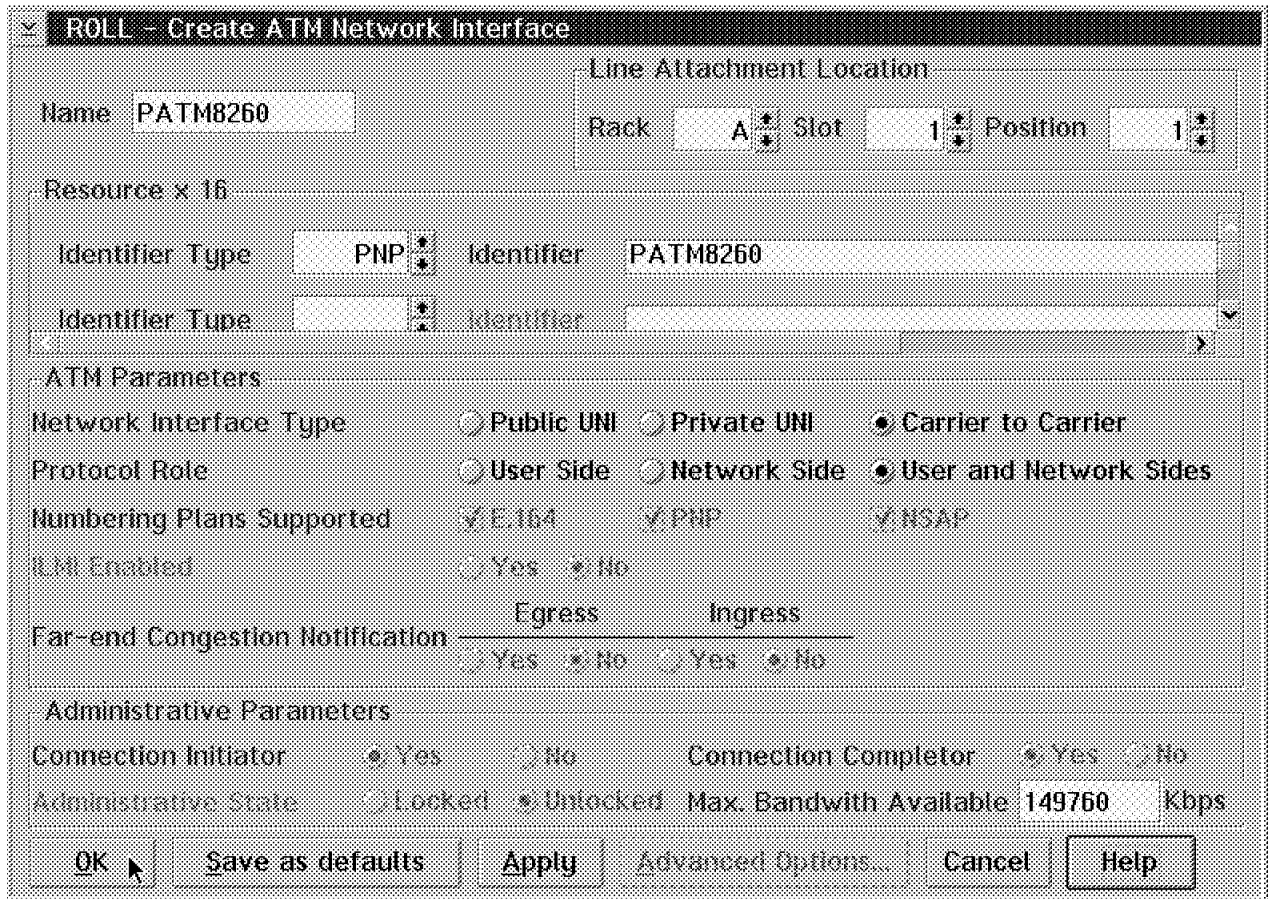
Figure 116. Create ATM Network Interface

- Name specifies the name of the ATM interface which can be up to 32 alphanumeric characters.

- Line Attachment Location specifies the rack, slot and line position for this interface.

- Resource x 16 is where you can specify up to 16 external resources that you are attaching to this interface. The identifier type defines what numbering plan you are using; this must be the same as that used by the end user equipment. Options are:

  − PNP - Private numbering plan (up to 28 characters)

  − E.164 - (15 digits from 0 to 9)

  − NSAP - Network service access point (40 hex digits)

  The identifier is a name that conforms to the identifier type that you specified and must be a unique name in the network.

- ATM Parameters:

  − Network Interface Type specifies which interface is to be used. You need to specify an option that is supported by the attaching equipment.

  − Protocol Role specifies whether you are acting as a user or network side. The option to support both is also available.

  − Numbering Plan Supported specifies the numbering plans supported over this link. The default is all three.

– ILMI Enabled is forced to No for this release.

– Far-end Congestion Notification specifies if FECN is used on the forward path (egress) and return (ingress) path. (Not available yet, which is why this is gray in Figure 116 on page 134.)

- Administrative Parameters

  – Connection Initiator and Completor specify whether the connection can be initiated and completed by this 2220. The default for both is yes; we recommend that you use the defaults.

  – Administrative State should be unlocked; the lock option will require operator intervention in order to use this port.

  – Max. Bandwidth Available specifies the maximum amount of bandwidth available for this port. The value defaults to the line speed. Note that the amount in Figure 116 on page 134 shows the bandwidth available for actual payload.

Click on **OK** and you will be finished with the hardware physical configuration for this switch.

Note: Before you define the VP or VCs you *must* first define the hardware configuration on the far-end switch.

4.6.2 ATM Logical Configuration

What you define depends on the mode of operation that you will use. For our example we used the VP mode of operation to connect to the 8260s (see Figure 108 on page 129).

We first take you through the VP mode configuration followed by a VC mode definition.

4.6.3 VP Mode Logical Configuration

From the ATM Network Interfaces display (see Figure 117 on page 136) select the interface you wish to create a connection for. In our case this is PATM8260, the interface we previously created.
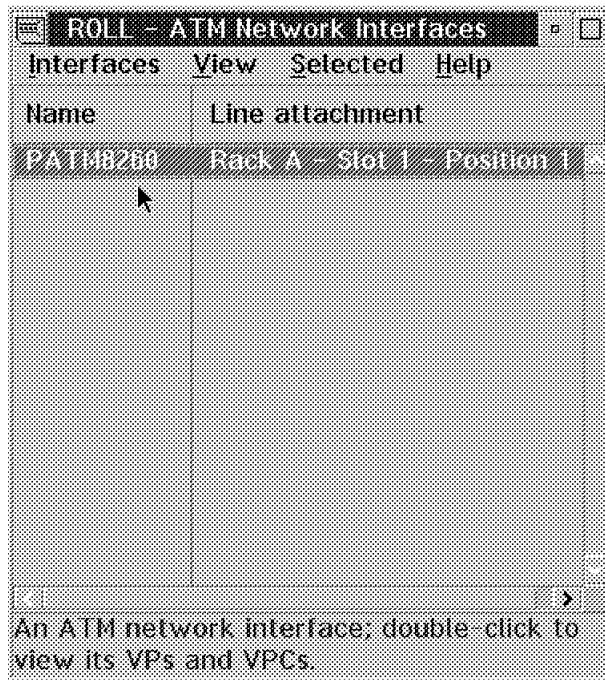
Figure 117. Select an ATM Interface

Simply double-click on the interface to select it.
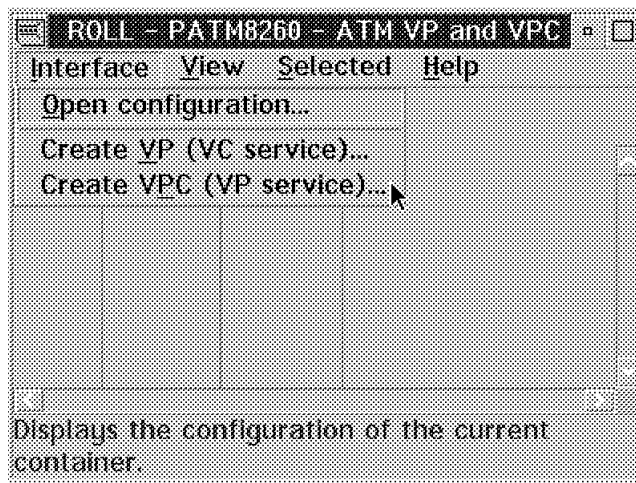
Figure 118. Create VPC (VP Service)

The window shown in Figure 118 will now be displayed.

4.6.3.1 Creating a VPC

When working in VP mode you are going to create a VPC (Virtual Path Connection). First click on **Interface** then click on the **Create VPC (VP service)** option.

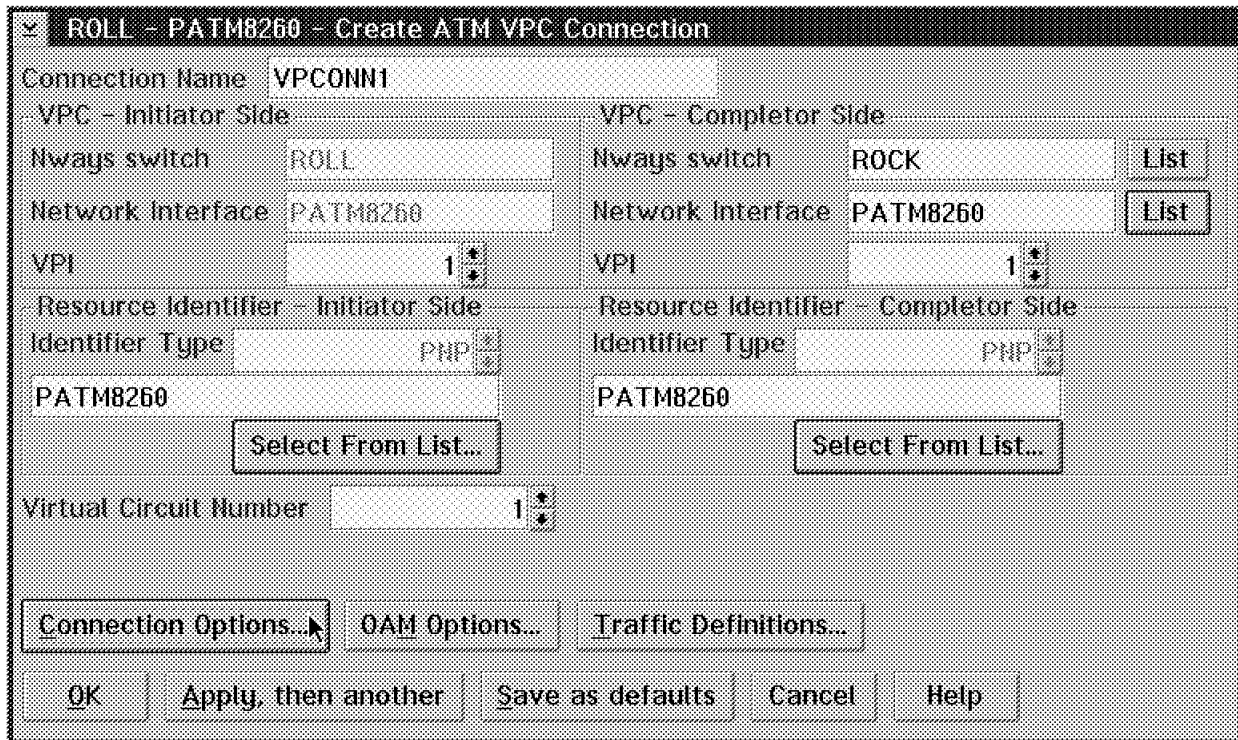The window shown in Figure 119 on page 137 is now presented and the following entries are required:

Figure 119. Creating an ATM VPC

- **Connection Name**

  A VPC name is proposed by the NCT, however you may enter one of your
  choice. The name may be up to 32 characters (0-9 and A-Z).

- **VPC Initiator Side**

  NCT displays the interface and node names, and proposes a VPI value. The
  VPI value may be changed but must be unique on this interface.

- **VPC Completor Side**

  Click on the list box for the Nways Switch, select a node from the list
  displayed and click on **OK**.

  Next you click on List, then select an interface and click on **OK**.

  Once again a VPI will be proposed by the NCT which you are allowed to
  change.

- **Resource Identifier**

  For both the Initiator and Completor sides select a resource from the list for
  those nodes.

- **Virtual Circuit Number (VCN)**

  The NCT proposes a VCN; each VPC pair has a unique VCN (initiator
  resource ID and completor resource ID).

4.6.3.2 Connection Options

From the Create ATM VPC Connection panel, click on **Connection Options** which will result in the window shown in Figure 120.
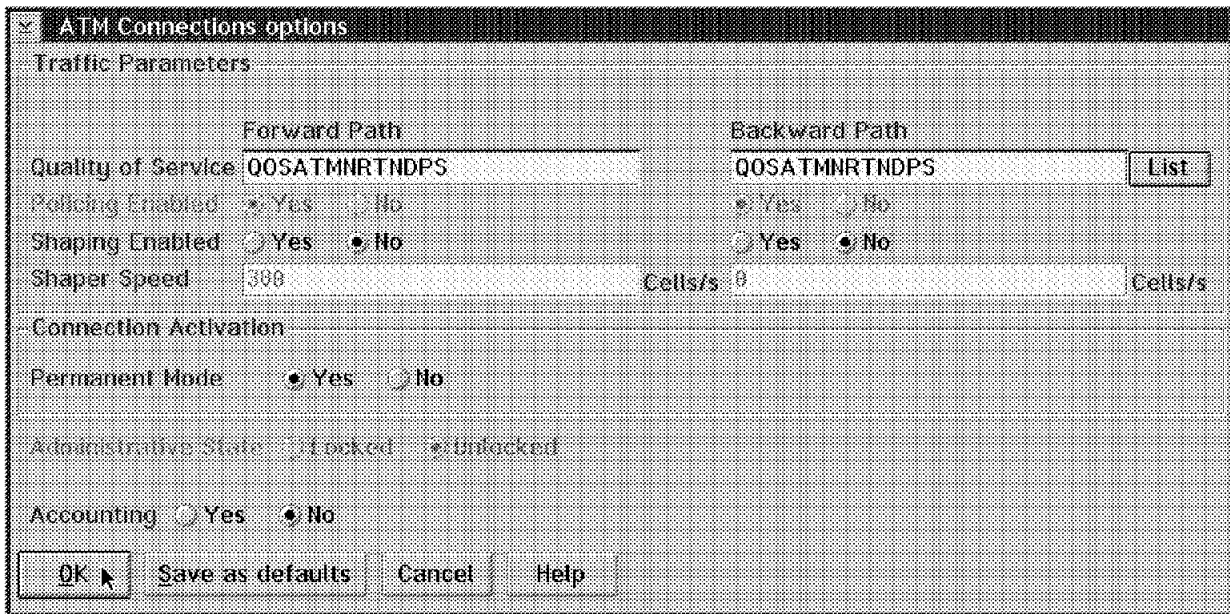
Figure 120. ATM Connection Options

You may click on the **List** button to select a QoS definition for this connection. See 4.4.1, "Quality of Service" on page 118 for an explanation of the QoS parameters.

Policing Enabled is permanently forced to Yes.

Shaping may be enabled here which allows you to enter a shaping speed. See 4.4.5, "Traffic Shaping" on page 125 for an explanation of the shaping function.

Connection Activation selects whether the connection will be activated at the same time as the resource. The default is yes.

Administrative State selects the status of the connection after adapter and LIC initialization. It is forced to Unlocked.

With the Accounting option you can specify Yes or No to collect accounting information.

Click on **OK** which will return you to the Create VPC Connection Panel shown in Figure 119 on page 137.

4.6.3.3 OAM Configuration

From the Create Connection panel shown in Figure 119 on page 137 we now select **OAM Options**.

Figure 121. OAM Options

From the OAM Options window you may select the Fault Support and Loopback options. OAM Performance Monitoring and Continuity checking are not supported in Release 4.

Click on **OK** which will return you to Figure 119 on page 137.

4.6.3.4 Traffic Definitions

From the Create VPC Connection panel shown in Figure 119 on page 137 we can select the **Traffic Definitions** button.

Figure 122 is now displayed and from here we fill in the ATM traffic descriptor parameters for the forward and return paths.
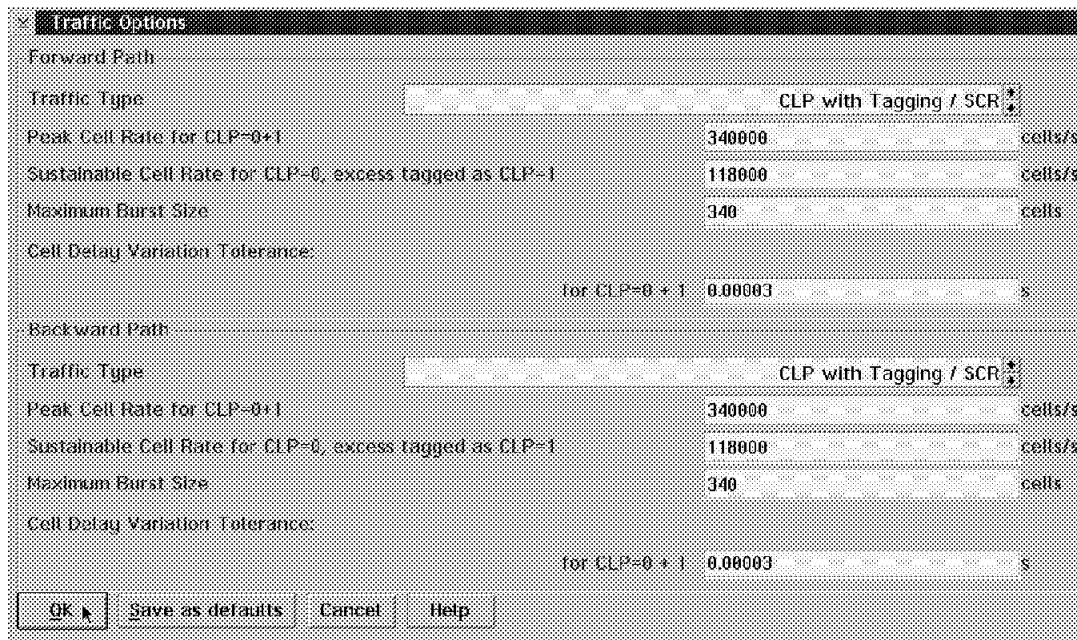
Figure 122. ATM Traffic Definitions

The Traffic Type has the following options. We list the equivalent ATM traffic descriptors with each option:

- Traffic descriptor 3 - No CLP/No SCR

- Traffic descriptor 4 - CLP without tagging/No SCR

- Traffic descriptor 5 - CLP with tagging/No SCR

- Traffic descriptor 6 - No CLP/SCR

- Traffic descriptor 7 - CLP without tagging/SCR

- Traffic descriptor 8 - CLP with tagging/SCR

Depending on the traffic type selected you have to fill in the traffic descriptors fields. See 4.4.2, "ATM Traffic Descriptors" on page 120 for an explanation of these fields.

The values we chose were as follows:

- PCR = 340000 cells = 144 Mbps (1/PCR = 0.000003 s)

- SCR = 118000 cells = 50 Mbps

- MBS = 340 cells

- CDVT = 0.00003 s (This tolerance is 10 times 1/PCR.)

The traffic type was traffic descriptor 8. This would not reserve all the bandwidth on the OC3 trunk. Excess cells would be tagged CLP=1 and transmitted provided enough resources were available.

The intention was to load the trunk and observe the connection's behavior.

The connection shown in Figure 107 on page 128 worked OK; however, we were not able to generate any significant traffic as a result of CPU constraints on the devices that were used.

When you have completed your input click on the **OK** button which will take you back to the window displayed in Figure 120 on page 138. Clicking **OK** in this screen will complete the VPC configuration and take you back to the ATM VP and VPC list display which will now reflect the newly created VPC.

This concludes the definitions for the VPC; the return path will be created automatically. At this point you would export and import the updated configuration as explained in Chapter 6, "NAS Operation" on page 199. The adapter may now be reloaded and activated with the new code.

This concludes the VP mode configuration. This was the configuration used to test the scenario shown in Figure 107 on page 128.

4.6.4 VC Mode Configuration

The process here is to create a VP and a VC connection within that VP. A number of the displays are the same as those used when defining a VPC because you have to specify the same parameters.

In the VC mode of operation your definitions should be done as follows:

1. Create a VP on the completor switch.

2. Next you create a VP on the initiator switch.

3. Now you create the VCCs on the initiator switch. The NCT will automatically create the VCC for the return path.

4.6.4.1 Creating the VP

From the ATM Network Interfaces display (see Figure 123) select the interface you wish to create a connection for. In our case this is PATM8260, the interface we previously created.
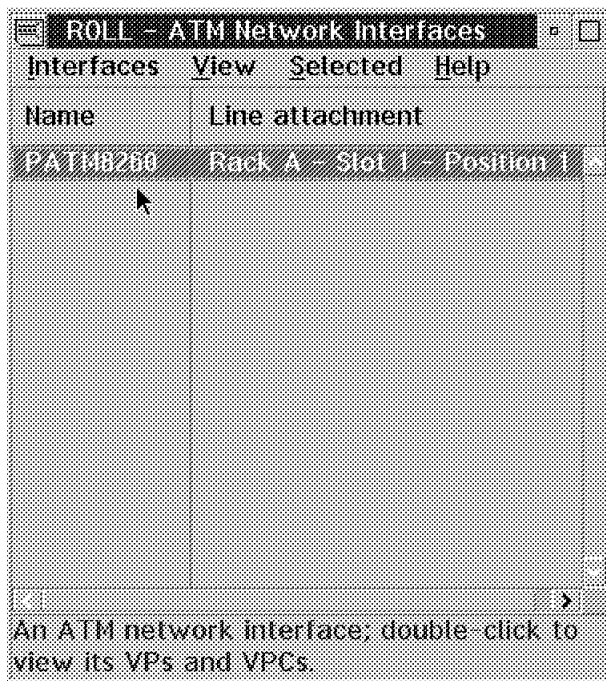

Figure 123. Select an ATM Interface
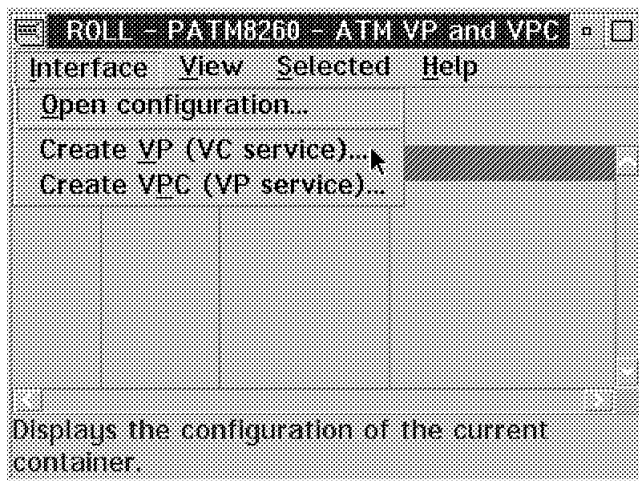
Simply double-click on the interface to select it.

Figure 124. Create VP (VC Service)

The display shown in Figure 124 will now be displayed. When defining a VC mode operation, we are first going to create a VP (Virtual Path). Click on the **Interface** button then select the **Create VP (VC service)** option from the action list.

The window shown in Figure 125 on page 142 is now presented and the following entries are required:

- **Connection name**

    A VP name is proposed by the NCT; however, you may enter one of your
    choice. The name may be up to 32 characters (0-9 and A-Z).

- **VPI number**

    NCT proposes a VPI value. The VPI value may be changed but must be
    unique on this interface.

- **Enable Group Shaper Speed**

    Should you wish to have all the VCCs using this VP shaped as one single
    bundle with a given speed, you click on this button and define the shaping
    speed.
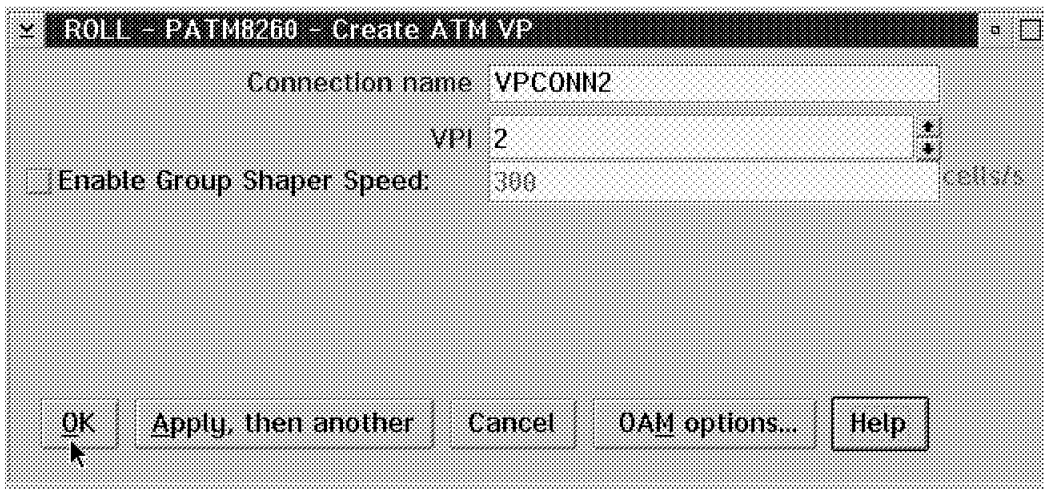
Figure 125. Creating an ATM VP

Click on **OK** to save and return to the updated VP and VPC list as shown in
Figure 126.
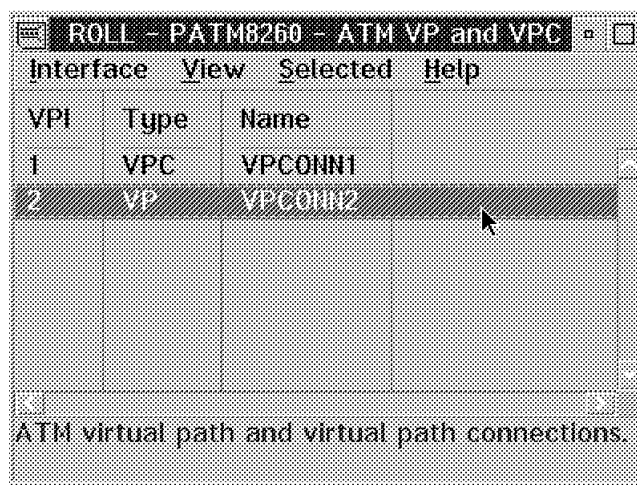
Figure 126. VP and VPC List Showing the New VP

The list shows both the newly created VP as well as the VPC (VPCONN1) we
created previously.

Ensure that you have created the VPs on both ends before proceeding with the next illustration which will be the creation of the VCC.

4.6.4.2 Creating the VCC

From the window displayed in Figure 126 on page 142 we select the VP (VPCONN2) created previously. Click on **VPCONN2** then click on **Select** and from the displayed action list select **Open VCC list**.

Figure 127 is now displayed and would show all VCCs if any existed.
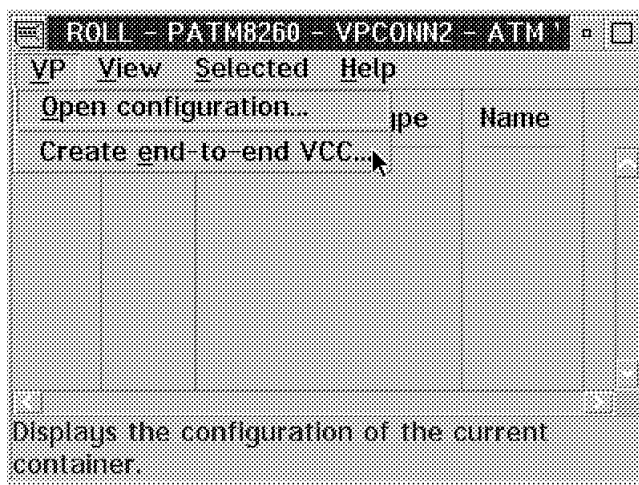
Figure 127. Create End-to-End VCC

Click on VP, then click on **Create end-to-end VCC**. The window seen in Figure 128 is now displayed.
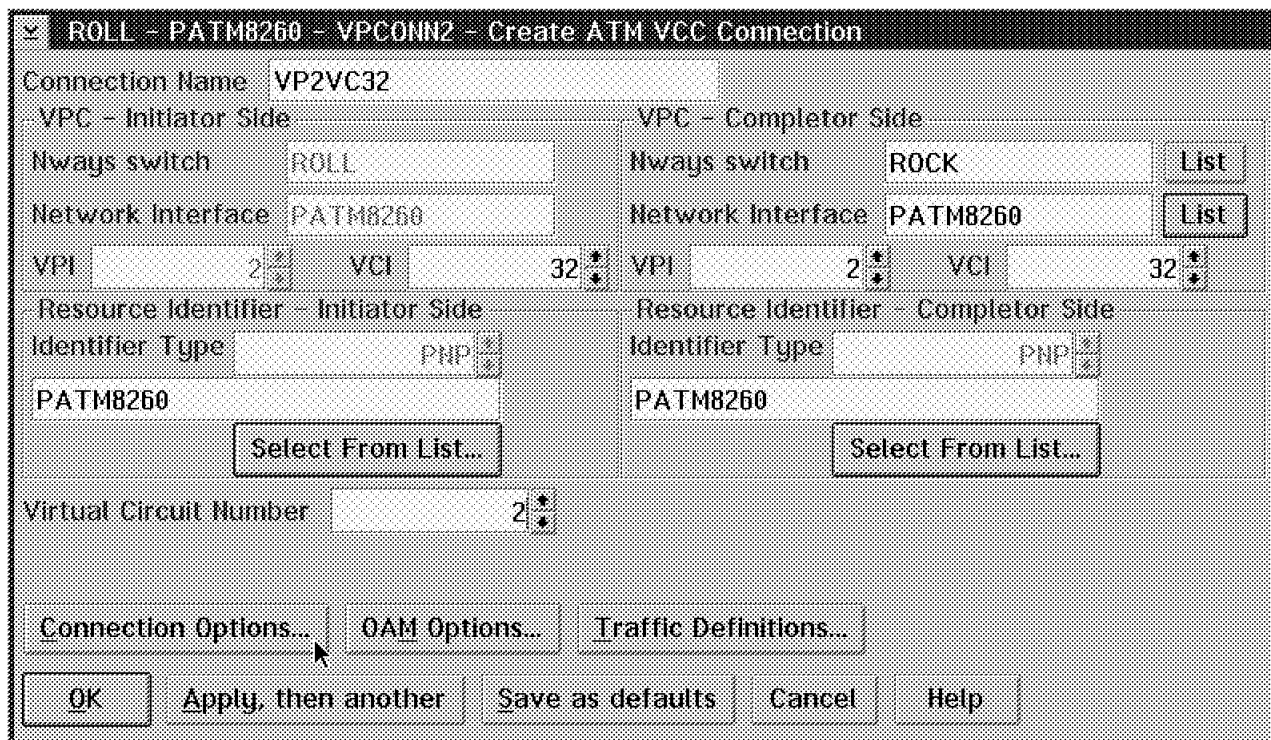
Figure 128. ATM VCC Definition

We have to fill in the following information as shown in the window displayed in Figure 128:

- **Connection Name**

  A VCC name is proposed by the NCT; however, you may enter one of your choice. The name may be up to 32 characters (0-9 and A-Z).

- **VPC Initiator Side**

  NCT proposes a VCI number. You may change the VCI number based on the range specified in the ATM advanced options. The VCI must be unique within a specific VP.

- **VPC Completor Side**

  Click on the **List** button for the Nways Switch and select a completor switch. Next you click on list for the completor interface and select an interface from the displayed list. Once you have selected an interface you select the VPI you configured on the completor node. A VCI is once again filled in by NCT and you may change this number.

- **Resource Identifier**

  On both the initiator and completor sides, select resources from the list by clicking on the **List** option.

- **Virtual Circuit Number**

  This is a number that identifies the connection to NBBS and should not be confused with the Virtual Channel Identifier (VCI) that is used by end user equipment. VCNs are proposed by NCT and are unique in the NBBS network. You may change this number.

4.6.4.3 Connection Options
In Figure 128 on page 143 click on **Connection Options** which results in the window shown in Figure 129 being displayed.
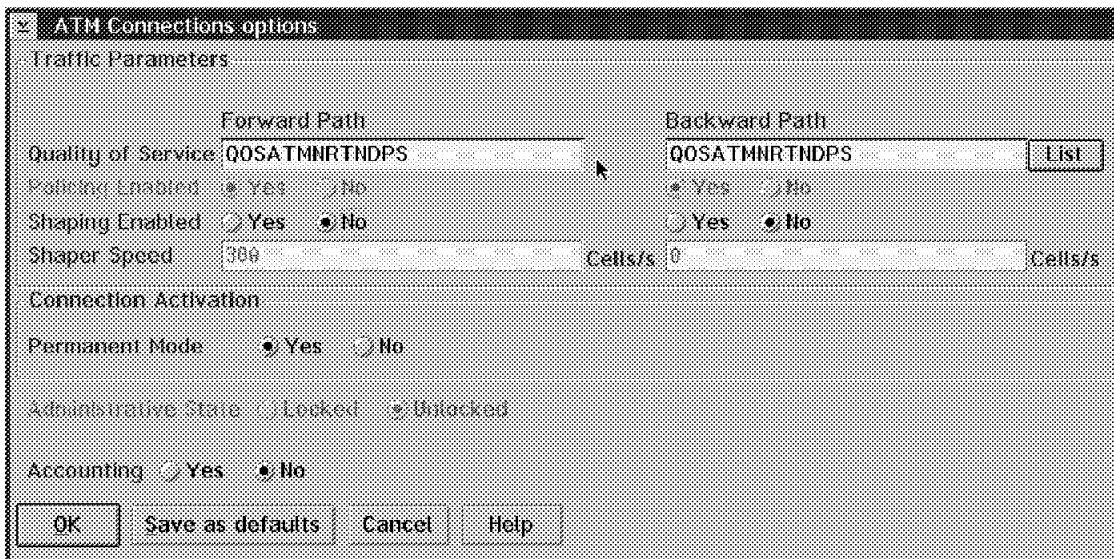
Figure 129. ATM Connection Options

You may click on **List** to select a QoS definition for this connection. See 4.4.1, "Quality of Service" on page 118 for an explanation of the QoS parameters.

Policing Enabled is permanently forced to Yes.

Shaping may be enabled here which allows you to enter a shaping speed. See 4.4.5, "Traffic Shaping" on page 125 for an explanation of the shaping function.

Connection Activation selects whether the connection will be activated at the same time as the resource. The default is Yes.

Administrative State selects the status of the connection after adapter and LIC initialization. It is forced to Unlocked.

When Accounting is set to Yes it will collect accounting information. The default is No.

Click on **OK** which will return you to the display shown in Figure 128 on page 143.

From the window shown in Figure 128 on page 143 we now select **OAM Options**.
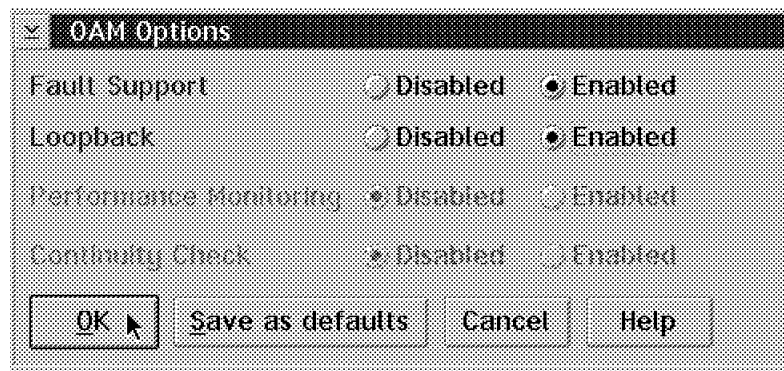
Figure 130. OAM Options

From the OAM Options window you may select the Fault Support and Loopback options. OAM performance monitoring and continuity checking are not supported in Release 4.

Click on **OK** which will return you to the display as shown in Figure 128 on page 143.

4.6.4.4 VCC Traffic Definitions
From the window shown in Figure 128 on page 143 we now select the **Traffic Definitions** button.

Figure 131 on page 146 is now displayed and from here we fill in the ATM traffic descriptor parameters for the forward and return paths.
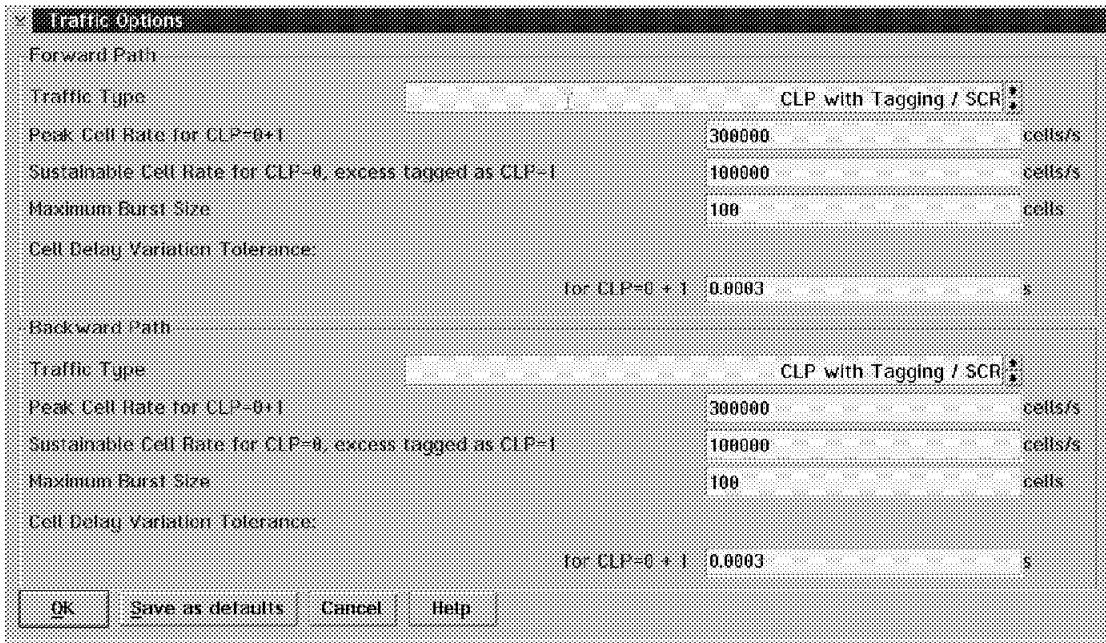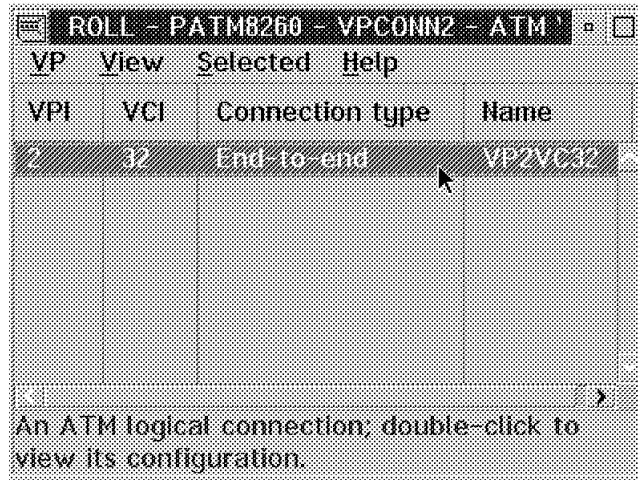
Figure 131. Traffic Definitions

The Traffic Type has the following options. We list the equivalent ATM traffic descriptors with each option:

- Traffic descriptor 3 - No CLP/No SCR

- Traffic descriptor 4 - CLP without tagging/No SCR

- Traffic descriptor 5 - CLP with tagging/No SCR

- Traffic descriptor 6 - No CLP/SCR

- Traffic descriptor 7 - CLP without tagging/SCR

- Traffic descriptor 8 - CLP with tagging/SCR

Depending on the traffic type selected you will have to fill in the traffic descriptor fields. See 4.4.2, "ATM Traffic Descriptors" on page 120 for an explanation of these fields.

When you have completed your input click on the **OK** button which will take you back to the window displayed in Figure 128 on page 143. Clicking on **OK** in this screen will complete the VCC configuration and take you back to the ATM VCC list display which will now reflect the newly created VPC (see Figure 132 on page 147).

Figure 132. Updated VCC List

This concludes the definitions for the VCC; the return path will be created automatically. At this point you would export and import the updated configuration as explained in Chapter 6, "NAS Operation" on page 199. The adapter may now be reloaded and activated with the new code.

4.7 ATM Management

Overall management of the 2220 via the Network Management Station (NMS) is described in Chapter 7, "Nways Switch Manager (NSM)" on page 231. We deal here with some specifics related to management of the voice connections.

Figure 133 shows a graphical map of the switched network. If you have a problem at this high level, the trunks or switches will change from green to yellow, red or blue.
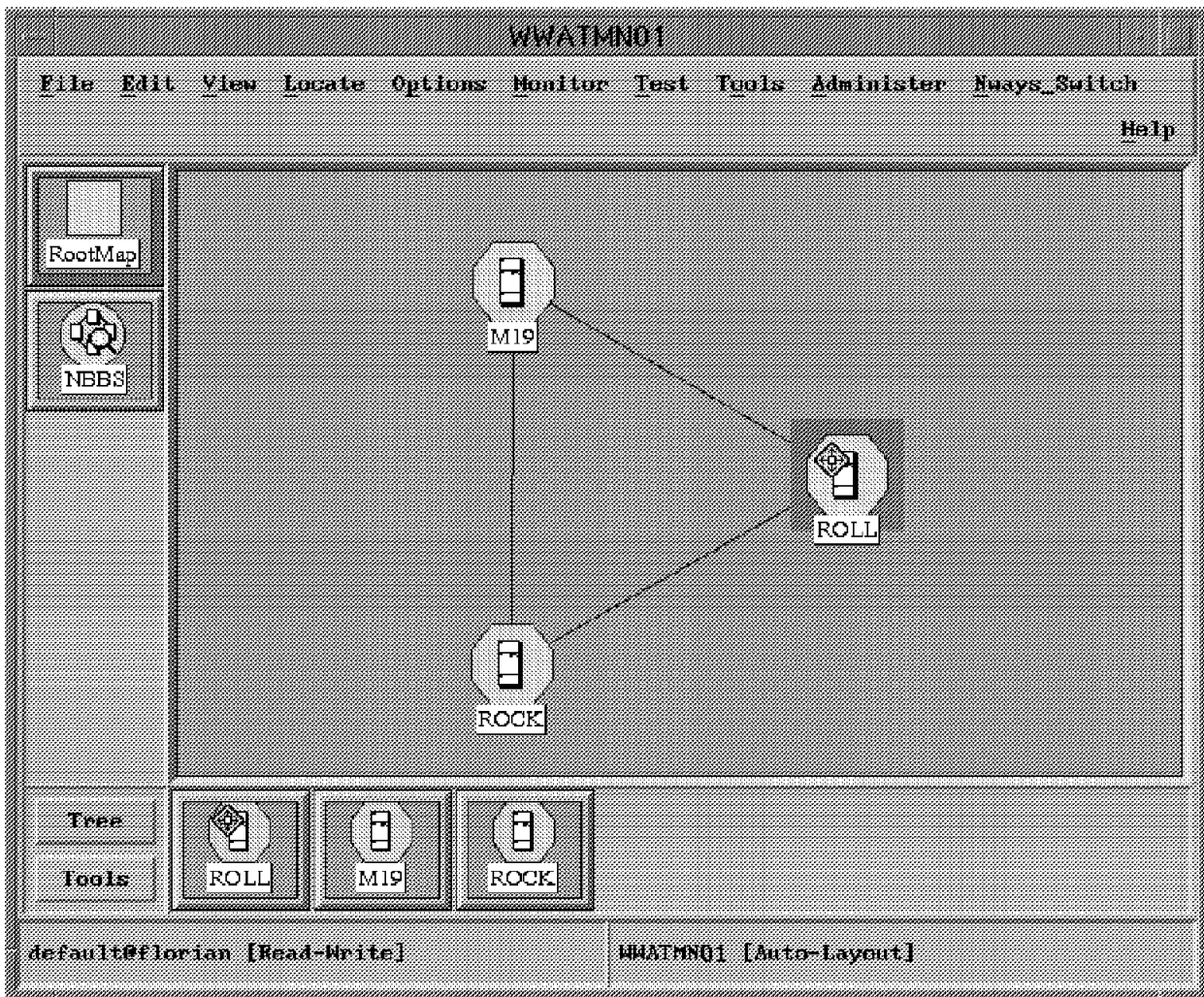
Figure 133. Nodes and Trunks Displayed

At the top of the window you find a number of actions. If you click on one of these, a pull-down menu will be displayed from which you may select specific actions to be performed on network objects.

In order to look at specifics related to an ATM port, select the switch node and click on the **Nways Switch** at the top of the window.

The pull-down menu shown in Figure 134 on page 149 will now be displayed.
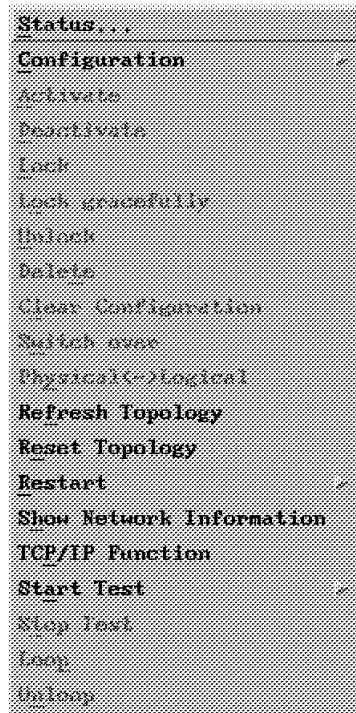
Figure 134. Nways Switch Action List

You may select any of the highlighted items. In our case we want to look at an ATM connection so we select **Configuration**.

The list shown in Figure 135 is now displayed and we select the **ATM Network Interfaces and Connections...** option.
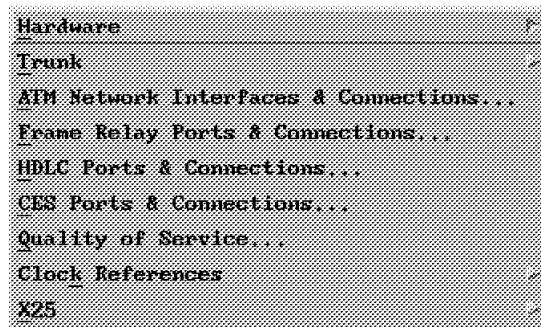

Figure 135. Select ATM Network Interfaces and Connections

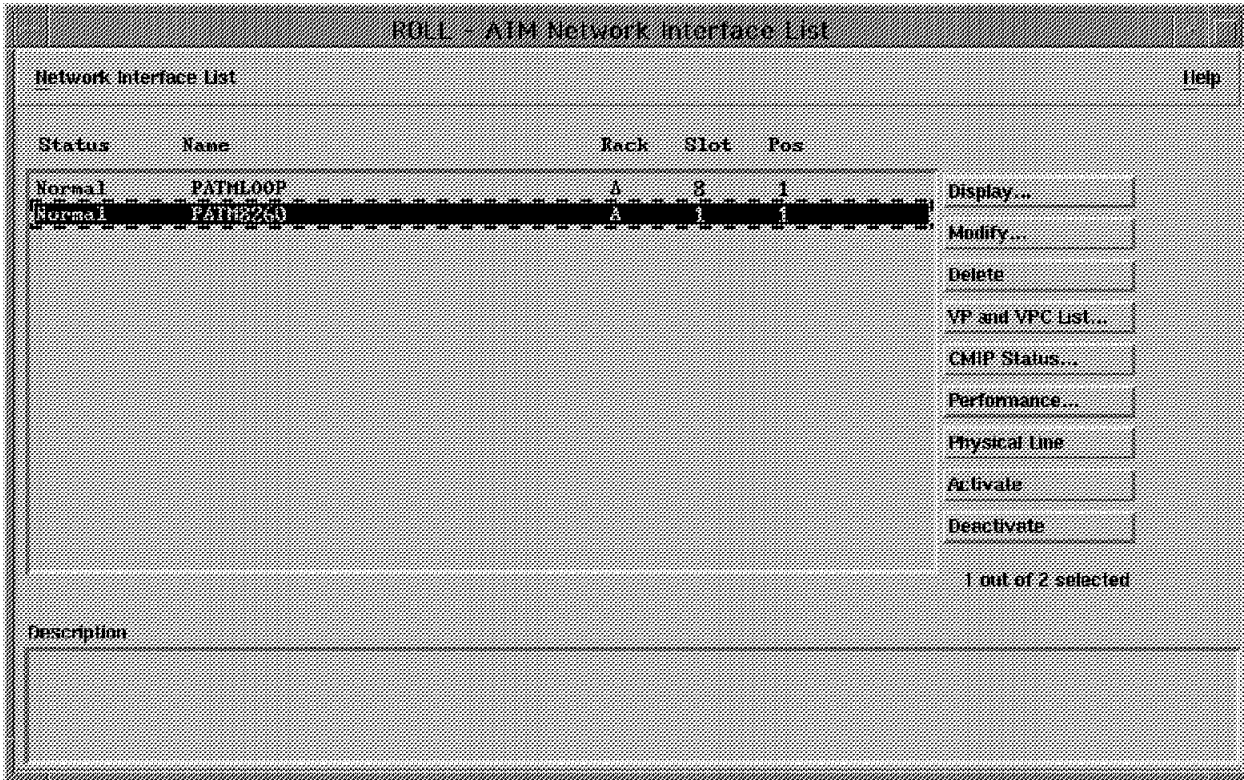The node we selected in Figure 133 on page 148 was ROLL. The ATM Interfaces for this node are now displayed (see Figure 136 on page 150).

Figure 136. ATM Interfaces List

The Network Interface List displays the ATM interface name, status and physical location of the port hardware. From the list you may select a number of actions as shown in Figure 136.

You may change or display the interface configuration.

You may activate or deactivate an interface.

Performance monitoring may be started on an interface level, but the monitoring application needs to be active first.

4.7.1.1 ATM Connections Display
In order to view the ATM logical connections we click on the **VP and VPC List** button. The list of VPs and VPCs defined on interface PATM8260 will now be displayed (see Figure 137 on page 151).
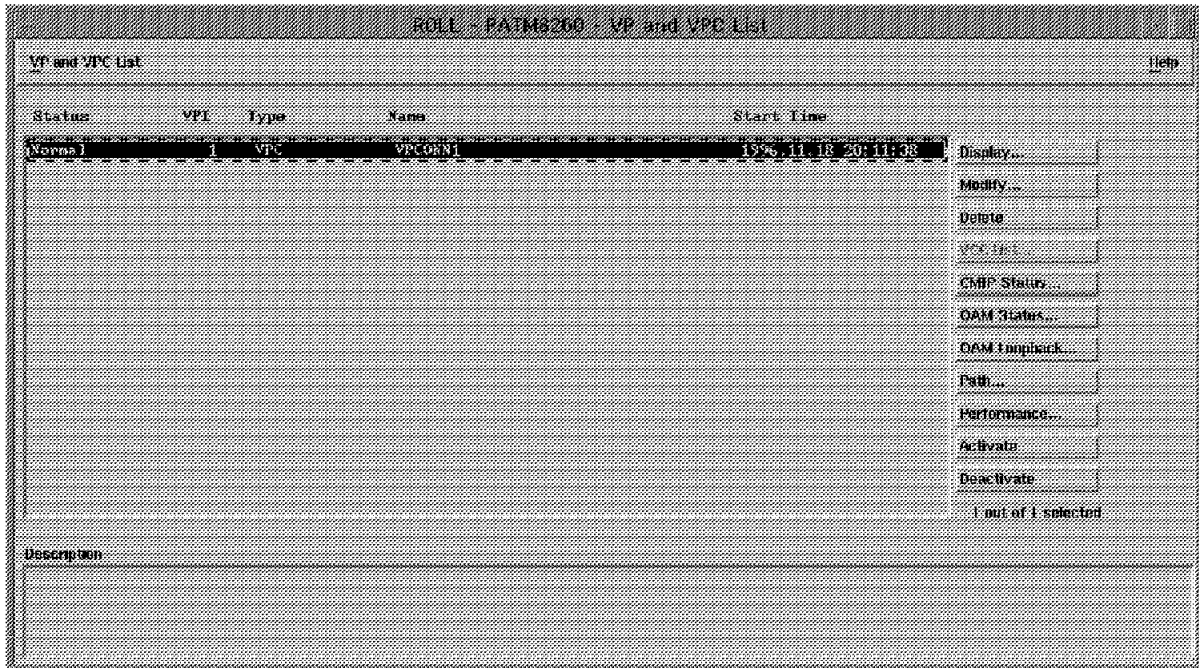
Figure 137. VP and VPC List for PATM8260

Figure 137 shows the VPC (VPCONN1) that we defined. It displays the status, the date and time that the connection was started.

You may change or display a connection's configuration.

You may activate or deactivate a connection.

The VCC List option is not selectable as there is only one VPC defined on the interface (VCCs run in a VP).

4.7.1.2 OAM Management Support
In order to view the OAM status we click on the **OAM Status** button. The display in Figure 138 on page 152 is presented.
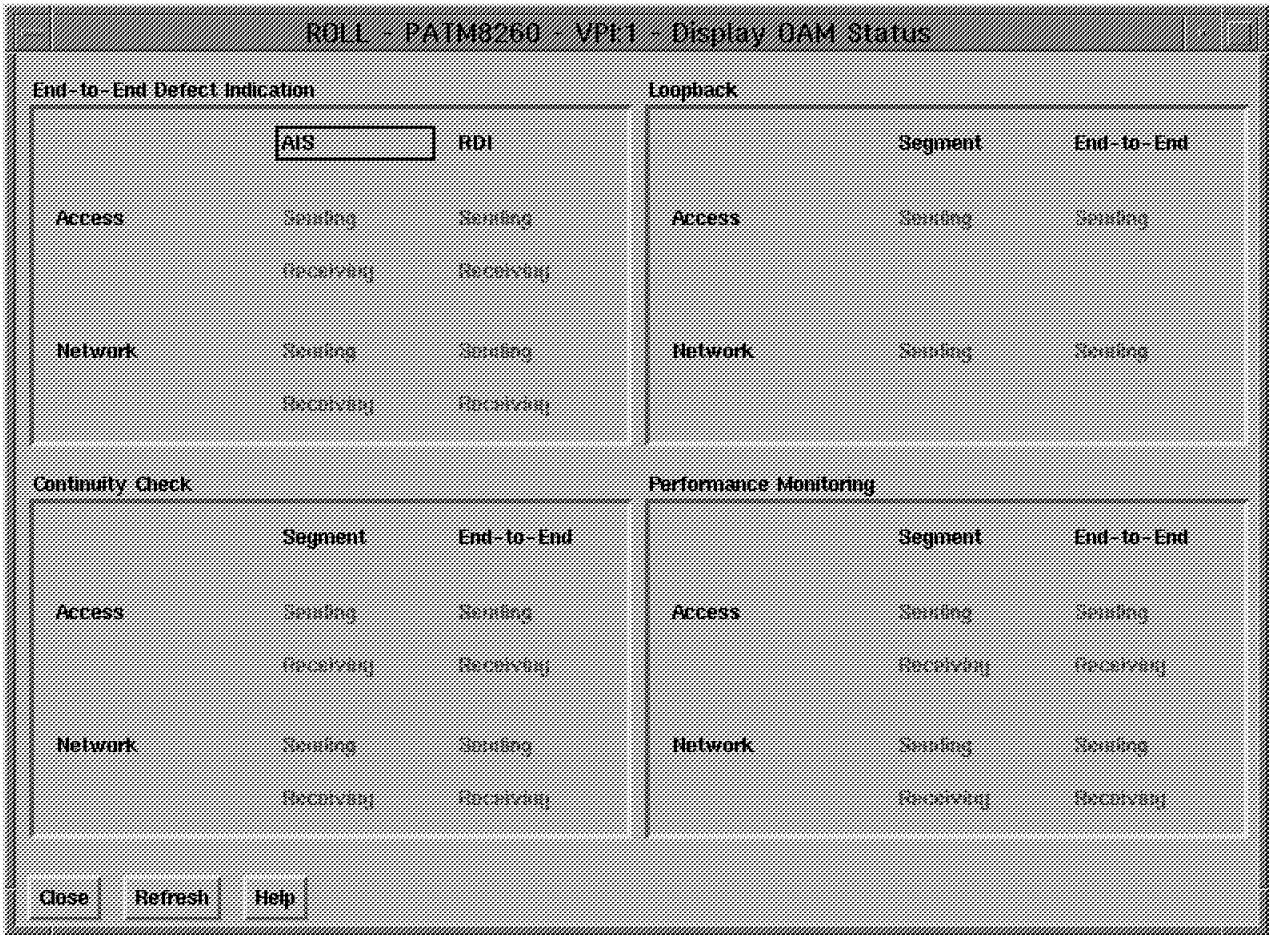
Figure 138. OAM Status Display

Continuity Check and Performance Monitoring are not active in Release 4.

The Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) signal status are shown in the End-to-End Defect Indication section of the display.

You may also start an OAM loopback test from the VP and VPC list as shown in Figure 137 on page 151. Test selection criteria includes the option to test a segment or end-to-end; the direction of the loopback needs to be specified as either access or network.

4.7.1.3 Path Management
From the window displayed in Figure 137 on page 151 you may select the **Path** option to do path management. Figure 139 on page 153 will be displayed after you select the **Path** option.
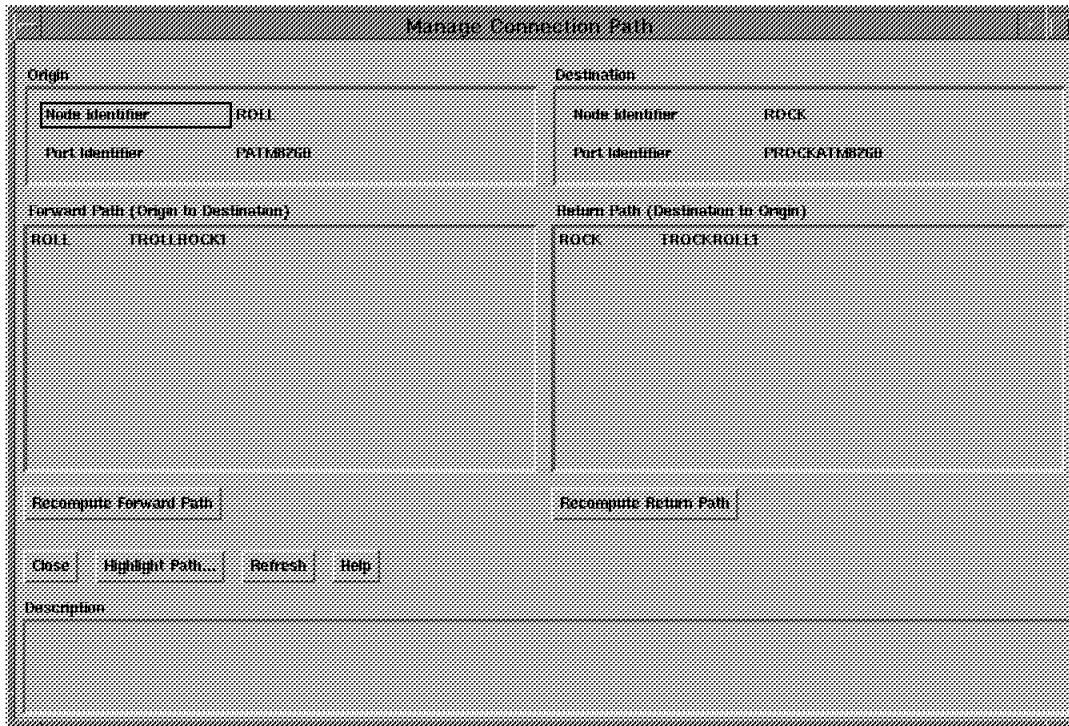
Figure 139. Manage Connection Path

From here you may select a number of options as follows:

- Recompute Forward/Return path

  If you had a path switched as a result of NDPS, you may recompute the forward and reverse paths. This may be useful if a trunk with better delay characteristics has become active since the NDPS path switch. You may also affect the setting up of new connections over the path that NDPS selected.

- Highlight Path

  This function highlights the paths taken by this connection (see Figure 133 on page 148).

4.7.1.4 ATM Performance Management

From the window shown in Figure 137 on page 151 you may also select the performance option which allows you to monitor performance aspects of the connection. You must first start the performance application by selecting the **Monitor** option from the window shown in Figure 133 on page 148 and selecting **Network Activity** from the pull-down list.

You may start various performance monitoring consoles from here. Figure 140 on page 154 shows the ATM Connection Performance Monitoring Console.

Figure 140. ATM Connection Performance Monitoring Console

After you select the performance monitoring option from the VP and VPC list display, the connection you selected there will appear as a resource on the ATM Connection Performance Monitoring Console as shown in Figure 140. You have the option to apply a package of recording parameters to the connection and display the results in a listed or graphical format. There are of course more functions in the management system; however the ones shown will be the facilities you are most likely to use.

4.7.2 Frame Relay to ATM Interworking Overview

The ITU-T Recommendation I.555 defines two types of interworking between frame relay and ATM:

1. Network interworking is when two frame relay devices communicate over an ATM network (FRF5).

2. Service interworking is when an ATM device communicates with a frame relay device and neither device knows that the distant end is of a different protocol (FRF8).

4.7.2.1 Network Interworking

The ITU-T Recommendation I.555 defines two scenarios for network interworking:

1. Scenario 1 connects two frame relay customer premises equipment (CPE) over an ATM network.

2. Scenario 2 connects a frame relay device with an ATM device through an ATM network.

In scenario 1, the use of the ATM network by the two frame relay CPEs is not known by end users. The network interworking function (NIWF) provides all mapping and encapsulation needed to ensure that the service provided to the frame relay CPEs is unchanged by the presence of the ATM transport network.

4.7.2.2 Service Interworking

Service interworking takes place when a frame relay CPE communicates with an ATM CPE. The frame relay CPE does not perform ATM-specific functions and the ATM CPE does not perform frame relay specific functions. All interworking functions are performed by the service interworking function (SIWF). Since multiprotocol encapsulation schemes are different over frame relay (RFC 1490) than over ATM (RFC 1483) some protocol translation may be performed by the SIWF.

The primary network design functional specifications are as follows:

- Interworking functions only run on the LSA3 adapter.

- The Nways Switch frame relay access agent only supports a 2-byte Q.922 core header (for example, 10-bit DLCI values).

- The network interworking and the service interworking functions are part of the frame relay access agent located in the frame relay port adapter.

- NIWF and SIWF comply with the corresponding FRF.5 and FRF.8 implementation agreements.

- A frame relay port can simultaneously support NBBS frame relay transport, NIWF, and SIWF. The mode of transport is selected at the frame relay PVC level.

- Connection multiplexing is limited to one-to-one mapping in both NIWF and SIWF.

- For both network and service interworking connections the frame relay access agent appears as an ATM access agent to its remote partners.

- ATM frame relay interworking connections are PVC only.

- CBR, VBR, and UBR traffic types are supported.

- Only standard frame relay traffic parameters are supported for configuring interworking connections. The use of NBBS traffic parameters is restricted to connections configured for NBBS transport.

- The SIWF supports higher layer protocol conversion (for example, RFC 1490 to RFC 1483 conversion). These protocols are also supported (IP, IPX, SNAP, X.25, Q.933, bridged PDU and FRF.9 PDUs).

- Frame relay ATM interworking is also available in frame relay over ISDN mode.

- Bandwidth adaptation is not supported in frame relay ATM interworking.

The following figures are examples of network configurations using network interworking and service interworking.
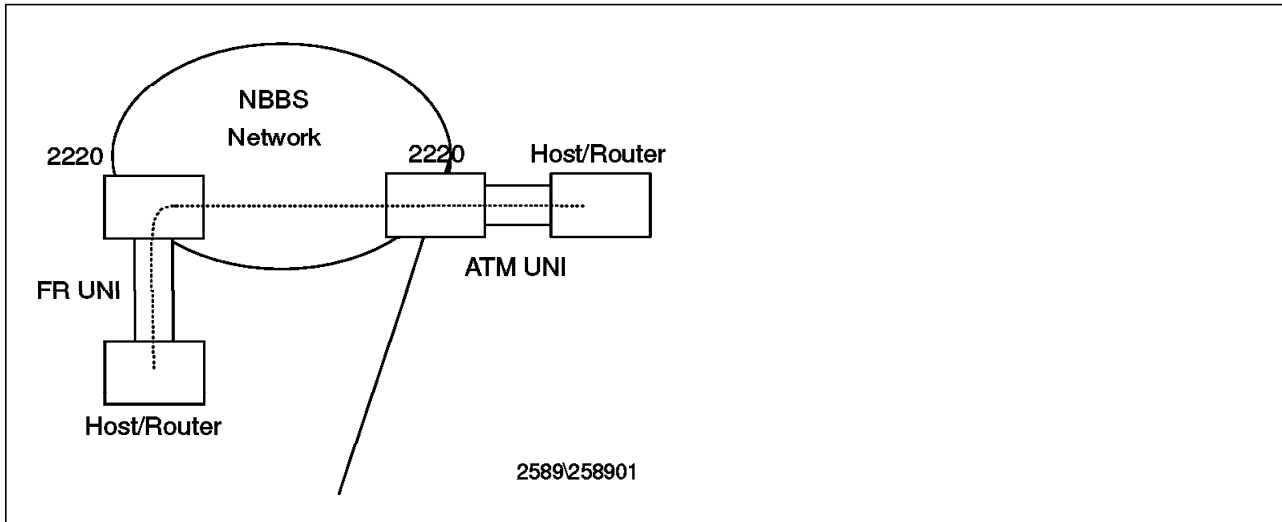
Figure 141. An Example of NIWF Configuration.. This example of NIWF configuration shows a network configuration where network interworking is used to connect frame relay terminal equipment through heterogeneous networks. In this case, compliance with FRF.5 allows interoperation with various manufacturers' equipment.
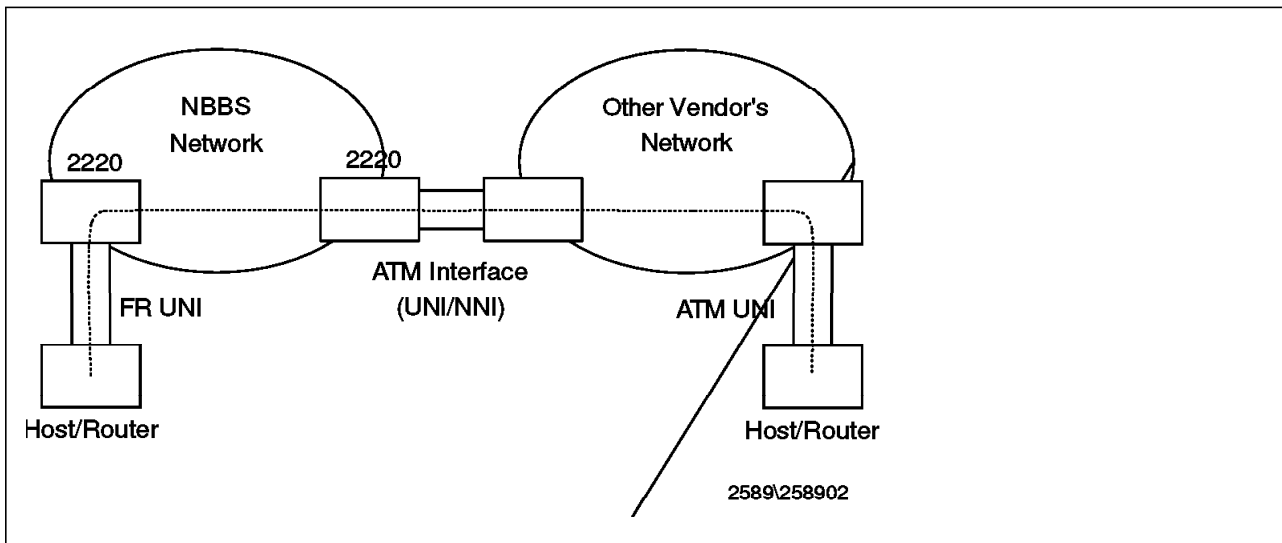

Figure 142. An Example of SIWF Configuration.. This example shows service interworking in use. An IP router is connected to an NBBS network through a frame relay UNI. A Web server supporting Classical IP is connected to the same network through an ATM UNI. From the IP point of view, they appear adjacent.
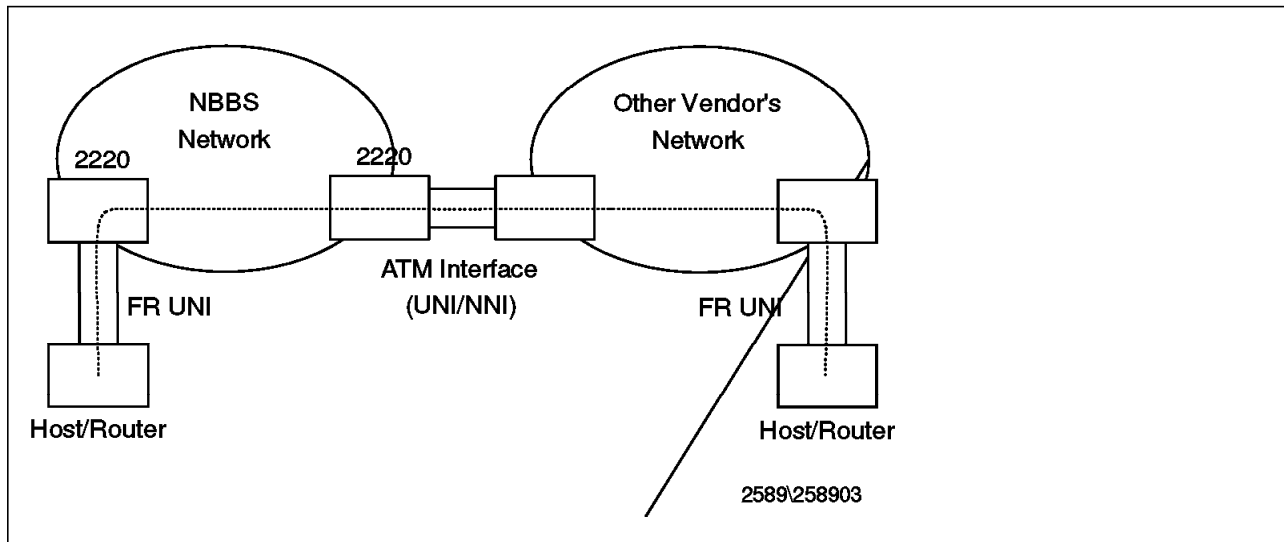
Figure 143. Another Example of SIWF Configuration.. Since the SIWF is compliant with the FRF.8 standard the frame relay DTE or the ATM DTE could be connected to a different manufacturer's equipment.

4.7.2.3 Network Versus Service Interworking

Although it appears that service interworking has a broader range of applications than network interworking, it should be noted that service interworking is limited to the set of higher layer protocols supported by RFC 1483 and RFC 1490. However, network interworking is transparent to higher layer protocols.

4.7.3 ATM Switch Virtual Channel (SVC) Overview

The Nways Switch currently provides PVC support. The new SVC support allows DTEs to setup and tear down connections by using signalling. SVC specifies the procedures for dynamically establishing, maintaining and clearing a connection. This support can be used in the following customer requirements:

- Switched ports defined as Interim Interswitch Signalling Protocol (IISP)

- Switched ports defined as UNI public or private DTEs

- Switched ports defined as UNI public or private DCEs

- Switched ports defined as Q.2931 DTEs

IISP also called PNNI Phase 0, provides signalling between switches using static routing. This allows for multivendor interoperability.

The Nways Switch can be used as an ATM private network to which DTEs can attach. When supported ILMI allows automatic address registration of DTEs.

The Nways Switch allows ATM ports defined as UNI public to interconnect with ATM public or private networks.

The Nways Switch allows ATM ports defined as Q.2931 to interconnect with ATM public networks.

Chapter 5. Voice Access Services

This chapter describes the Nways Switch voice access services. However, Q.SIG voice support is not covered in this redbook. It is available with Version 2 Release 2 and above. For information on Q.SIG voice support, refer to *2220 in the Voice World*, SG24-2123.

5.1 Voice Overview

The Pulse Coded Modulation (PCM) access agent provides transport for multiple 64 kbps PCM voice channels between NBBS nodes. The connection usage spans from tie-line type services to call rerouting and sophisticated centralized call centers using CCS transport modes.

The interfaces supported are digital; however, an external channel bank could be used to support analog connections. T1/E1/J1 interfaces are supported and voice connections are transported as Circuit Emulation Services (CES) connections.

It is the role of the voice access agent to process signalling and voice time slots received from the attached PBX, to establish an NBBS connection with the appropriate QoS and transport the voice calls over that NBBS connection.

The Voice Server Adapter (VSA) may also process a voice call depending on the functions configured, VSA processes compression, silence removal and echo cancellation type functions.

Both Channel Associated Signalling (CAS) and Common Channel Signalling (CCS) are supported. The Nways Switch does not interpret or process dial information in any of its operating modes. Connections are of the type generally referred to as *nailed channels*.

Time Slot 0 (TS0), the alarm and synchronization time slot, is not passed through the NBBS network; it terminates in the port adapter. TS0 is used to ensure multiframe alignment between the PBX and the 2220.

5.1.1 Common Channel Signalling Transparent Mode

CCS transparent (no interaction with signalling protocols) mode can be used to support a PBX T1, E1, or J1 line attachment. The signalling is passed transparently by the NBBS network using any selected channel. This mode supports up to 24 channels (time slots) on T1 lines and 31 channels on E1 lines. (One time slot is used for signalling.) It provides a permanent logical link between two PBXs, which can be mapped on one or several NBBS connections.

In the transparent mode, all channels on a given port must go to the same destination. This means that if you have connections to three remote PBXs, you need three interfaces between the local PBX and local 2220.

When using CCS transparent, mode the PBXs connected together have no awareness of the 2220 network and have the same functionality they would have with a direct connection between them. This is not dependent on the use of any specific signalling protocol.

Transparent mode supports two different configuration options:

Clear Channel

With clear channel the link is configured to either carry all time slots on a single NBBS connection, or on several NBBS connections in order to present more granular bandwidth demands to the network. No compression on any of the time slots is possible. This mode is illustrated in Figure 144.
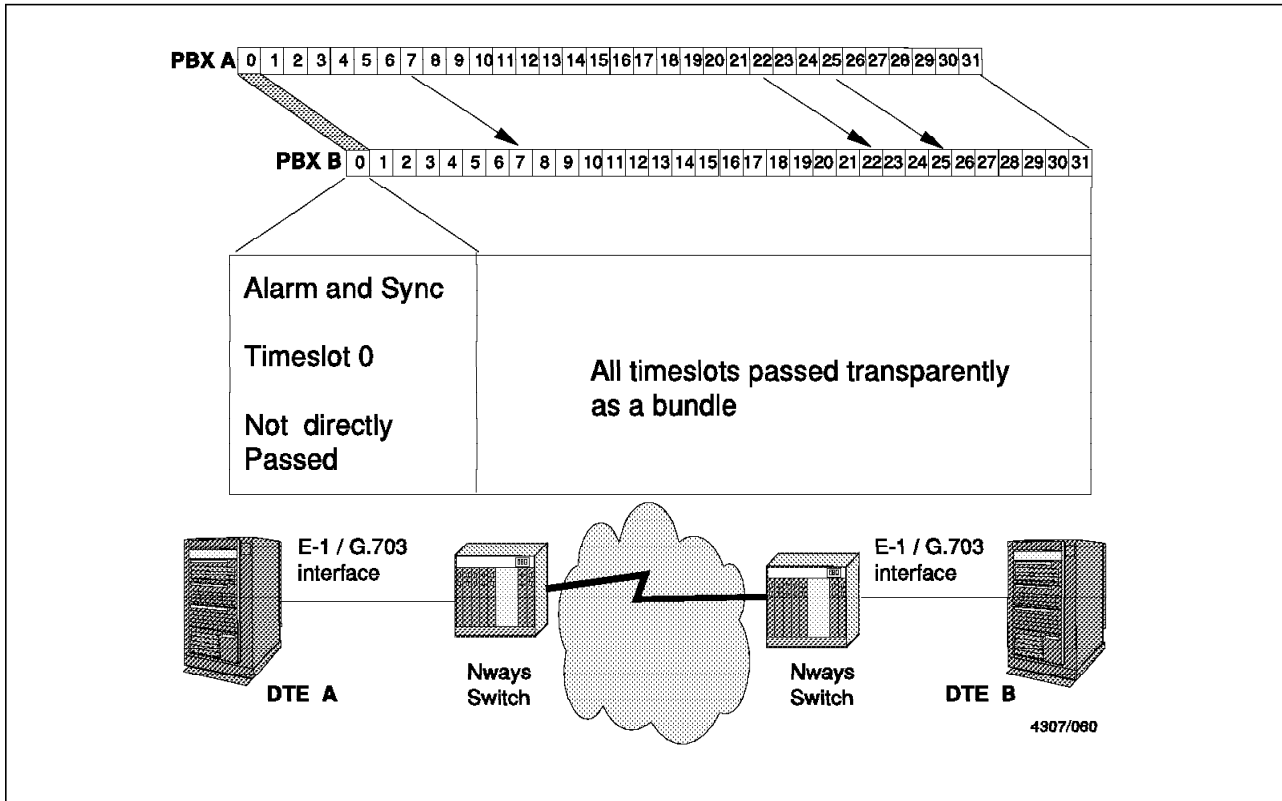

Figure 144. Transparent Mode CCS - Clear Channel

Mono Channel

Mono channel is used to transport a number of voice channels from one PBX link to another without interacting with the signalling. This mode is illustrated in Figure 145 on page 161.

All of the voice calls that appear at a particular PBX interface (PBX A in Figure 145 on page 161) are passed to the corresponding time slots in the associated interface of the remote PBX (B in Figure 145 on page 161). In particular, the time slots carrying the PBX signalling information are passed transparently through the Nways Switch network.

It should be noted that although Figure 145 on page 161 shows the CCS signalling channel as being TS16, this time slot is not fixed and in many PBXs it is configurable. As long as both ends of the connection use the same time slot, there is no fixed rule for CCS.
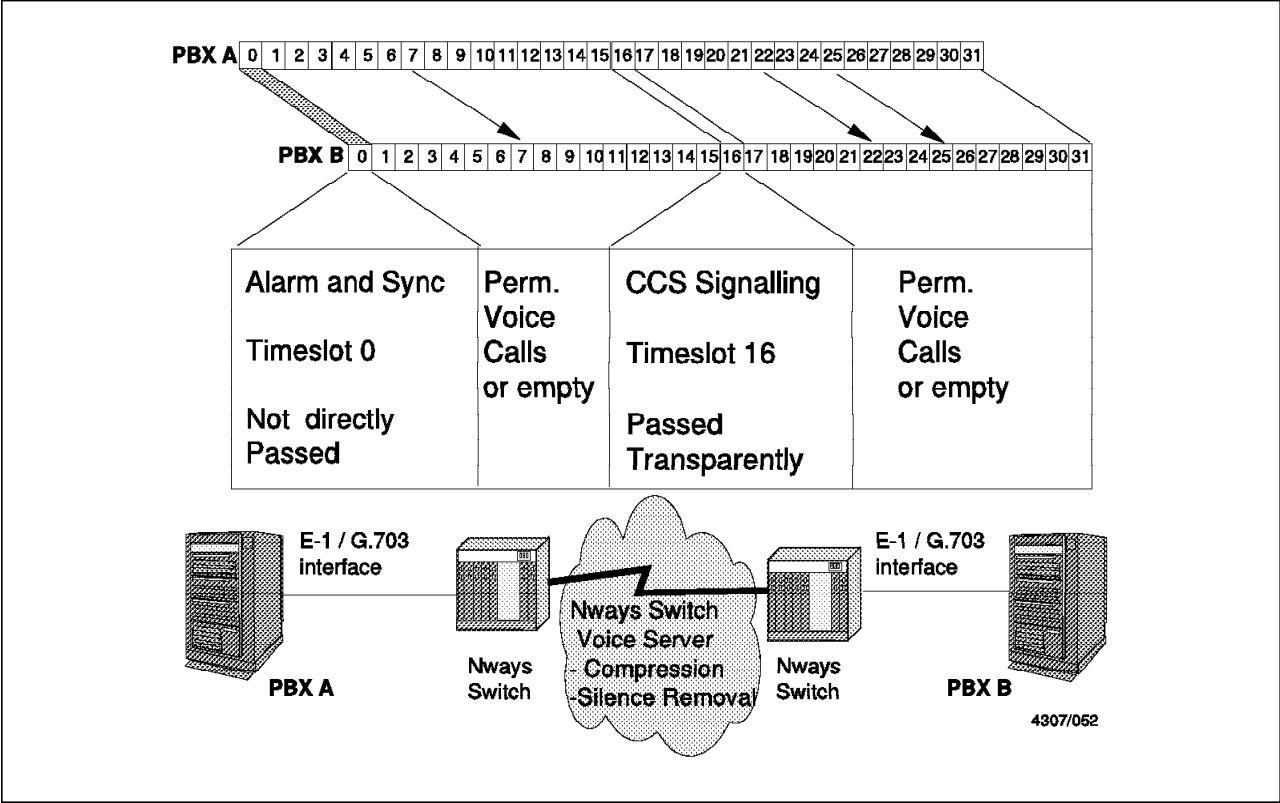
PBX A 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

PBX B 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

| Alarm and Sync

Timeslot 0

Not directly
Passed | Perm.
Voice
Calls
or empty | CCS Signalling

Timeslot 16

Passed
Transparently | Perm.
Voice
Calls
or empty |

E-1 / G.703 interface — PBX A — Nways Switch — Nways Switch Voice Server - Compression -Silence Removal — Nways Switch — E-1 / G.703 interface — PBX B

4307/052

Figure 145. Transparent Mode CCS - Mono Channel

Mono channel allows each individual time slot to be separately transported by the Nways Switch network; that is, each time slot is mapped to a channel and has its own NBBS connection. In this way, specific time slots may be routed to the Voice Server Adapter and compressed. Not all time slots will necessarily be configured to support a speech channel, and the Nways Switch network only needs to provide a connection for time slots that are required to carry voice or signalling/synchronization information.

In this mode, the time slot supporting the signalling channel is not passed to the Voice Server Adapter; it passes through the network uncompressed.

5.1.2 Channel Associated Signalling

The Channel Associated Signalling (CAS) mode allows a single PBX link to communicate with several other PBXs. The signalling information corresponding to a given slot is carried through the NBBS network. The signalling information is extracted at the NBBS network entry and delivered to the destination port.

The CAS mode of operation is very efficient on bandwidth usage; the level of PBX functionality over E+M signalling lines is however very limited.

No specific configuration is needed for the signalling.

The CAS mode can be either:

Permanent

Connections between the PBXs are permanently activated. Voice server functions are available only on the mono-slot connections.

Dynamic This mode allows bandwidth savings by using the links only when needed. When an off hook (or seize) is detected, the connection is established for the corresponding channel. In the same way, when an on hook is detected, the connection is broken and the corresponding bandwidth is released.

Dynamic connections are available *only* on mono-slot connections; that is each time slot uses its own connection. Voice server functions are available for CAS dynamic mode.

Multislot connections cannot be dynamic; they must be permanent. To allow bandwidth savings in this case, the idle removal voice server function can be used, as explained in 5.2.1, "Idle Removal" on page 166.

5.1.2.1 CAS Permanent Mode

CAS permanent mode is reserved for voice T1/E1/J1 line attachments that use channel associated signalling. The key difference between this mode and transparent mode is that a single incoming PBX link can communicate with multiple remote PBX links. CAS permanent mode is used to transport a number of voice channels from one PBX T1/E1 line attachment to one or more others. As with transparent mode, the signalling information is transported unchanged.

CAS signalling is extracted from the multiframe of the input PBX link and independently sent to the appropriate position within the multiframe at the corresponding output link. There is a permanent connection between the associated voice links for each remote PBX destination.

The Nways Switch network allows the voice channels to be mapped to various PBXs around the network in a flexible manner.
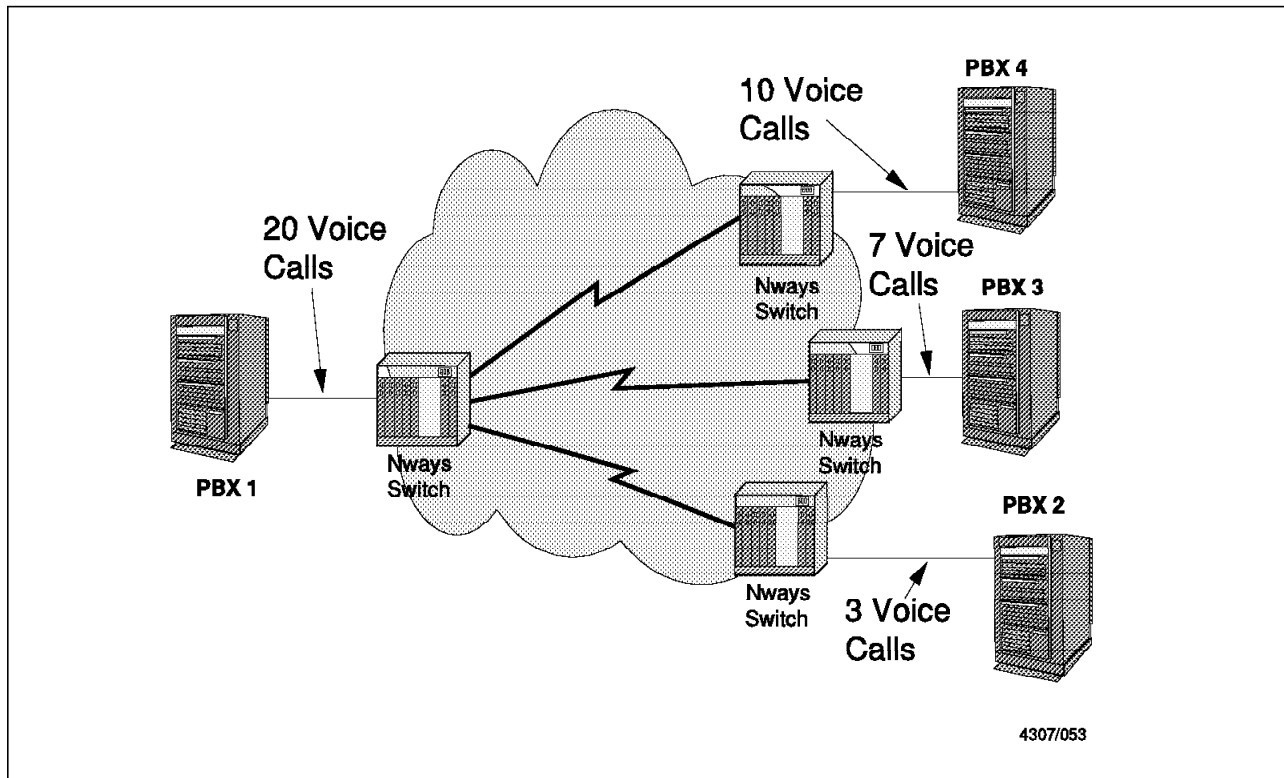
Figure 146. CAS Permanent Mode - Network View

For example, a central site PBX, such as PBX 1 in Figure 146, can be attached to the network by a single link. That link will support multiple voice channels (20 in Figure 146) which can communicate with multiple remote PBXs.

In this example, network PBX 1 has the following calls:

- Three calls that go to PBX 2
- Seven calls that go to PBX 3
- Ten calls that go to PBX 4

Each of these calls uses CAS signalling. The signalling required by the remote PBXs is reconstructed by the access agents on the remote Nways Switches. The G.704 multiframe view of these calls appears in Figure 147 on page 164.
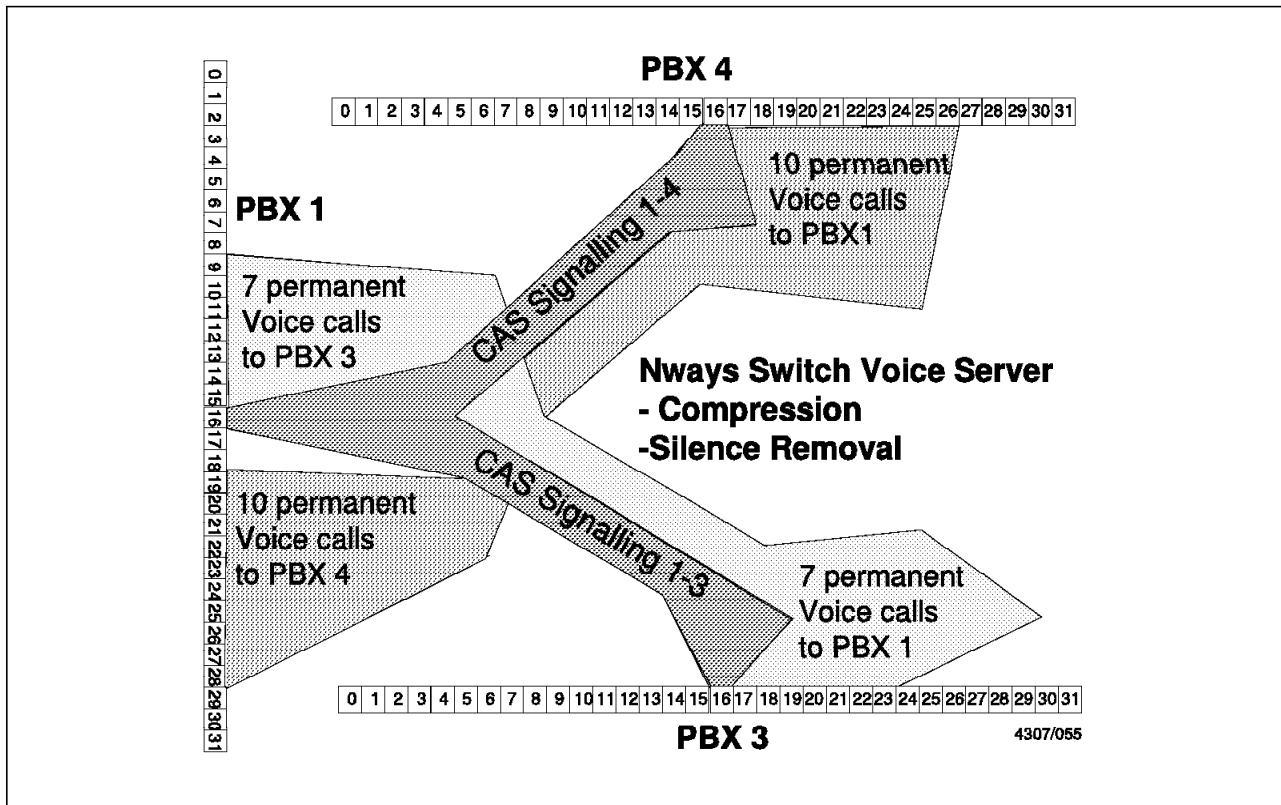
Figure 147. CAS Permanent Mode - Multiframe View

In Figure 147, the CAS 1-4 connection represents NBBS connections carrying the appropriate CAS signalling between the Nways Switch nodes. At each node, the voice access agent creates a CAS signalling message that matches the signalling required by these ten voice calls.

CAS signalling provides support for four signalling bits, known as A,B,C,D. Very few CAS protocols use more than bits A and B; indeed, if one observes the state of a CAS signalling channel on a PBX link for an extended period, it will be seen that very few bit transitions occur even on bits A and B. A consequence of this is that the 64 kbps bandwidth taken by the signalling channel at the PBX interface is considerably more bandwidth than is required to pass this signalling across the network. Since the voice access agent extracts the PBX signalling state changes and passes only those across the Nways Switch network, it is able to significantly reduce the amount of bandwidth needed to support the signalling messages.

The bandwidth required by the associated voice calls is permanently allocated by the Nways Switch network, but (as with transparent mode - mono channel) it may use the Voice Server Adapter functionality.

5.1.2.2 CAS Dynamic Mode

CAS dynamic mode transports a number of voice channels from one PBX link to another. In this mode, the Nways Switch network allows bandwidth to be dynamically allocated and freed on a channel-by-channel basis, as indicated by the signalling from the attached PBX.

While there is a permanent association between the time slots on the participating PBXs, the bandwidth that is required by these time slots is only

allocated when the Nways Switch voice access agent detects a PBX *seize* signal on the associated voice channel. When the access agent detects the seize, it creates a network connection to transport the corresponding voice channel. To minimize the call establishment time, the access agent transmits the seize request to the remote PBX in parallel with its allocation of voice-channel bandwidth.

If the voice access agent detects that it cannot complete a voice connection on a particular time slot, it will generate *remote release* and *busy back* signals to indicate that a seize is currently not possible.

The E&M Wink Start CAS protocol is supported by the Pulse Code Modulation Voice access agent in CAS dynamic mode.

Note: If the PBX does not support E+M wink start, you should use the CAS permanent mode operation.

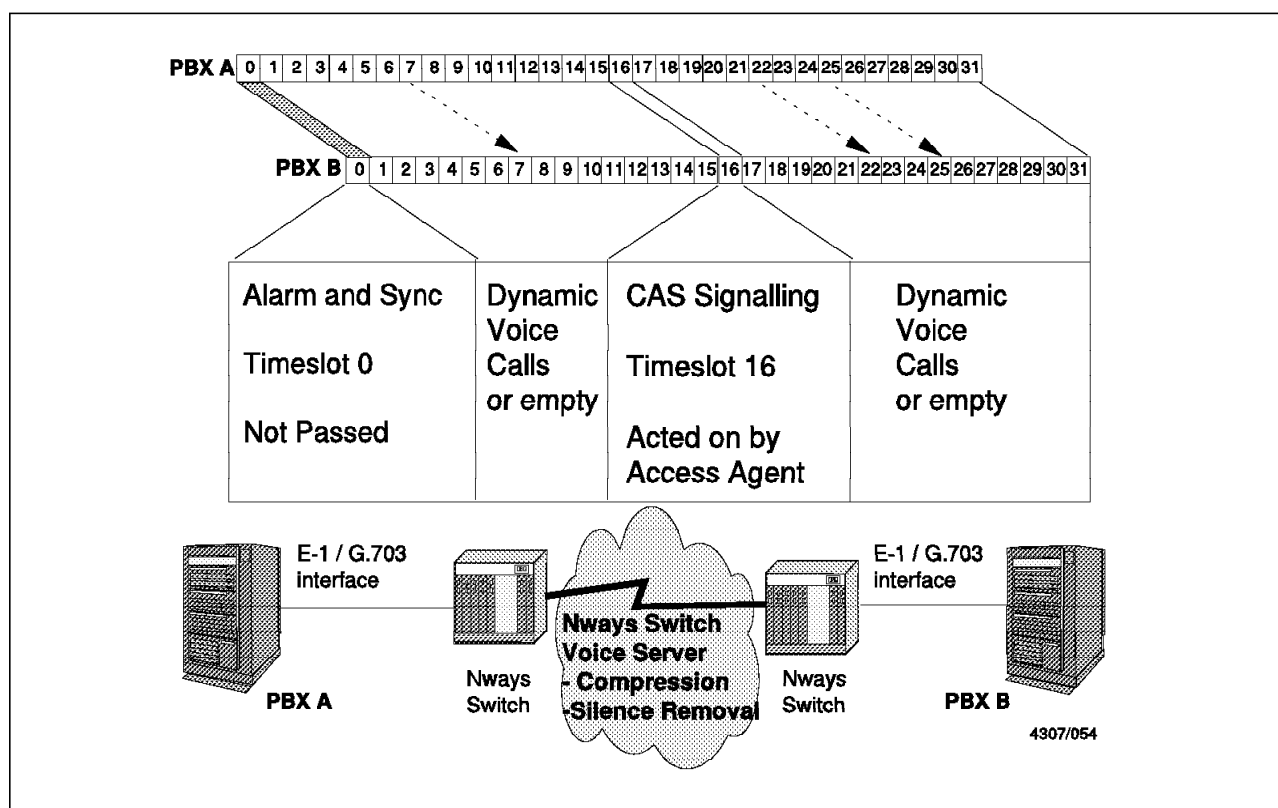The multiframe view of CAS dynamic mode is shown in Figure 148.

Figure 148. CAS Dynamic Mode - Point-to-Point View

Like CAS permanent mode, CAS dynamic mode supports one-to-many connectivity between different PBXs. Figure 149 on page 166 shows a network of four PBXs using this mode. Calls can pass between all of them, and bandwidth for those calls is only allocated when it is required.
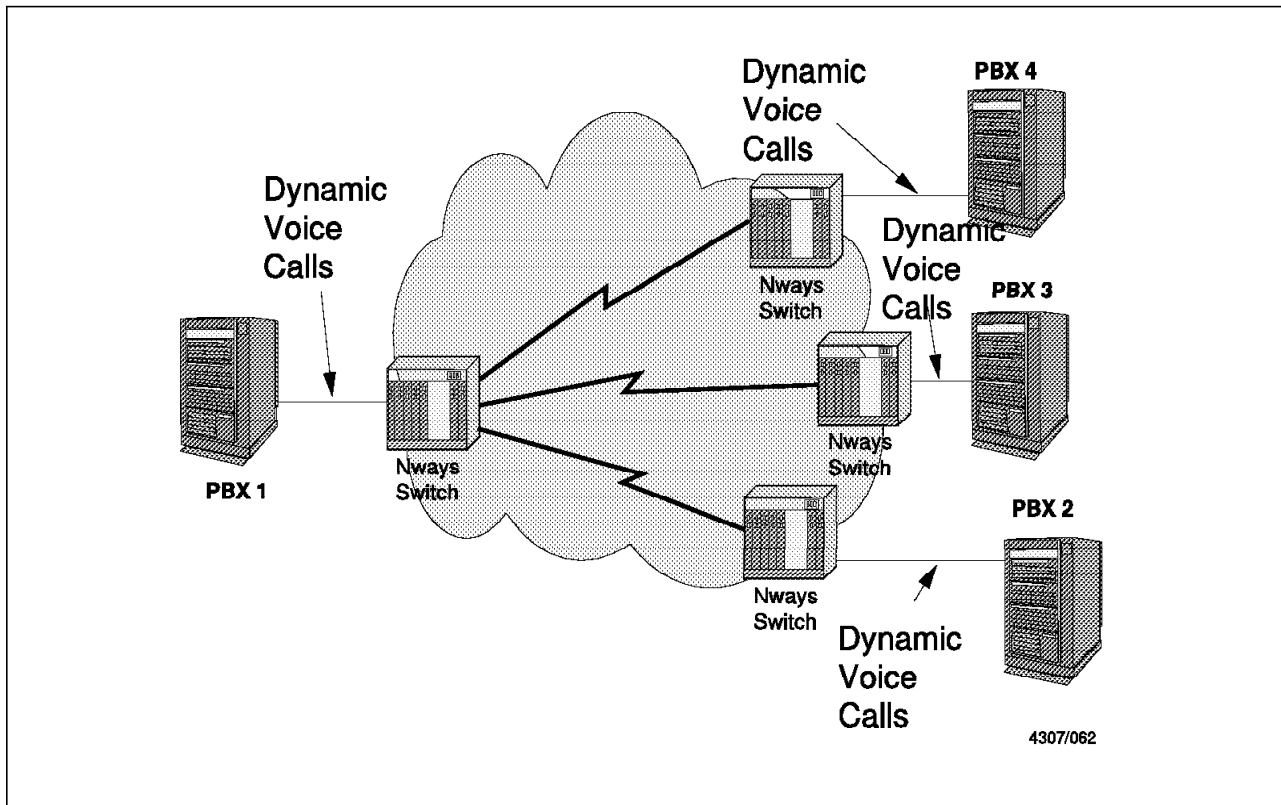
Figure 149. CAS Dynamic Mode - Network View

5.2 Voice Server Functions

The following functions are available through the use of voice servers:

- Voice compression
- Voice activity detection (for silence removal)
- A-Law and Mu-Law conversion
- Digital echo cancellation
- Fax detection, modulation and demodulation
- Idle removal

Note: It is not recommended to chain voice compression on several links. For example, when several PBXs are used together, compression should be used on only one leg of the overall connection.

5.2.1 Idle Removal

The purpose of the idle removal function is to stop transmission of packets through the NBBS network when the idle character is sent by a PBX during more than 60 milliseconds. This idle character is identified at the receive side of the NBBS network and transmitted to the remote PBX.

The idle removal processing is stopped as soon as one non-idle character is received from the local PBX. The voice quality is not affected by this function.

Note: There is no need to define the idle character to play back, since an internal NBBS protocol transfers the appropriate pattern from one side to the other of the network each time the function is activated.

The idle removal function applies for every connection processed by the voice server, including GSM compression, digital echo cancellation, and voice activity detection. It is particularly efficient for CCS mode which sets up NBBS connections permanently.

When idle characters are removed, the bandwidth in the NBBS network is maintained. This guarantees that as soon as a voice call is set up, the bandwidth is available to transport voice packets through the network. The bandwidth that is not used during idle periods is available for non-reserved traffic or NBBS red packets. This also decreases the delay and the Bit Error Rate for non-real-time traffic and NBBS control information.

The idle removal function is automatically applied when a voice server is used for a connection (no option).

5.2.2 Voice Compression

Voice compression is provided using the Fast-Pitch Group Speech Mobile (FP-GSM) algorithm, an algorithm that provides the same voice quality as the standard GSM algorithm but consumes less processing resources. The FP-GSM algorithm can compress a 64 kbps voice signal to 15 kbps.

To ensure high-quality transmission of dual tone multi-frequency (DTMF) signals, these signals are detected at compression, transported as coded information and reconstructed at decompression.

Adaptive differential pulse code modulation (ADPCM) is also supported.

5.2.3 Silence Removal

Silence removal detects periods of inactivity on a speech path and transmits no voice traffic for that period. By combining silence removal with FP-GSM compression, the bandwidth required for a speech channel can be reduced to as little as 10 kbps.

5.2.4 A-Law/Mu-Law Conversions

The method used by PBXs and other speech-related equipment for turning an analog voice signal into a digital bit stream uses the well-known coding algorithm called Pulse Code Modulation (PCM.). A part of the algorithm is a routine for taking a particular amplitude and mapping it to a discrete reference level. There are two standards that exist for performing this mapping, known as A-law and Mu-law companding.

Conversion is required to allow interworking between PBXs in the USA that use Mu-law companding, and those in Europe that use A-law companding. Since the FP-GSM algorithm used by the Nways Switch can map to and from PCM companding of both types, it allows a speech call to pass between A-law and Mu-law systems by providing the intermediate conversion that is necessary.

5.2.5 Fax/Modem Detection, Modulation and Demodulation

This is necessary because a compressed speech path will typically interfere with the transmission of facsimile traffic and other modem-based signals. If the Nways Switch detects that a modem/fax machine needs to use a particular speech path that has compression/silence removal in place, it will demodulate the fax/modem signal and transmit the data at 9.6 or 2.4 kbps through the voice

connection. The compression/silence removal function will be disabled on the particular connection. Bandwidth reservation *will not* be increased as the amount of bandwidth allocated to a compressed connection is enough to cater for the data transmission.

Once the fax call has completed the compression and other voice server functions will be restored. Prior to Release 4 the compression was disabled and a bandwidth increase requested to 67 kbps. The fax signal was then transported transparently.

5.2.6 Digital Echo Cancellation

Digital echo cancellation provides the Nways Switch with the ability to remove any echo that has been introduced into a speech path as a result of four-wire to two-wire conversion at the local PBX. It can compensate for a local delay of up to 32 ms.

5.2.7 Voice Server Adapter (VSA) Capacity

Each Voice Server Adapter has integrated *digital signal processors* that perform the various functions described above. The capacity of the Voice Server Adapter can be extended with the addition of Voice Server Extension modules. There are two Voice Server Extension modules available for the Nways Switch:

- VSE1
- VSE2

Table 16 summarizes the number of voice calls that can be supported by the Voice Server Adapter when it is used on its own and when it is used with these extension modules to provide both Compression and Digital Echo Cancellation (DEC) functions:

Table 16. Voice Calls Supported by Different VSA/VSE Combinations		
VSA/VSE Combination	**FP-GSM Compression with or without Silence Removal**	**FP-GSM Compression with Silence Removal plus Digital Echo Cancellation**
VSA	20	8
VSA plus VSE1	80	32
VSA plus VSE2	140	56

5.3 Quality of Service for CES Voice Traffic

Quality of Service (QoS) is selected according to the type of traffic and the way you want the connection to be handled by the NBBS network. The predefined QoS parameters are described in this section.

There are different predefined QoS parameters. The choice of QoS depends on the type of traffic (voice or data) and the characteristics of the connection. The characteristics are:

- Nondisruptive Path Switching (NDPS).
- Real-time priority 1 or 2 traffic (RT1, RT2) which correspond to the circuit emulation classes 1 and 2 (CE1, CE2). The two classes are:

- RT1: Minimizes the end-to-end delay but requires more bandwidth than RT2.

- RT2: Requires less bandwidth than RT1 but increases the end-to-end delay. This is the CE2 class you could use for compressed voice.

- High priority (HPRI), which gives a priority to connection activation.

The following sections describe the different options.

5.3.1 Nondisruptive Path Switching (NDPS)

Nondisruptive path switching ensures that when a path or Nways Switch fails in the NBBS network, the connections with NDPS option are rerouted onto another path, provided that a path with the required bandwidth characteristics is available. The connection initiator Nways Switch is responsible for rerouting the connections. When the option is not selected, the connections are not reestablished.

Notes:

1. Many connections requiring NDPS at the same time induce a large amount of control traffic in the network. This can create important rerouting delays in the network.

2. NDPS is not supported for CAS dynamic mode.

3. NDPS is not supported for any compressed call.

5.3.2 Real-Time Classes and Logical Queues (RT1, RT2, NRT, Non-Reserved)

A Networking BroadBand Services path uses four logical queues in each transit node for managing packet transmission and ensuring a proper quality of service. For voice only, RT1 and RT2 are used:

Real-time class 1 (RT1) queue
Used for real-time applications requiring very low delay and very low jitter, such as constant bit rate data or voice. Provides lowest delay and jitter.

Real-time class 2 (RT2) queue
Used for real-time applications that can support slightly more delay and jitter, such as some constant bit rate data or voice. Provides better bandwidth optimization than RT1 at the cost of a greater delay. You should use this option for compressed voice connections.

5.3.3 High Priority (HPRI)

If a path fails, it is possible that bandwidth no longer exists to support all the existing connections. If high priority is selected, *bandwidth preemption* ensures that this connection is given first access to the available bandwidth. The other connections get bandwidth only if it is available. This option is based on two parameters, the *holding priority* and the *requesting priority*:

- The requesting priority allows you to preempt low priority connections already established for call setup or NDPS.

- The holding priority allows the connection to be preempted by other connections.

Once activated, the traffic on a connection is handled according to its traffic class (RT1 or RT2). Bandwidth preemption has no effect on the way the traffic itself is handled.

Table 17 shows the QoS values for voice traffic. The names of the CES QoS begin with QOSCESVOICE for voice traffic.

Table 17. Predefined QoSs for CES Voice Connections				
QoS Name	Non-Disruptive Path Switching (NDPS)	Real-Time Class 1 (RT1)	Real-Time Class 2 (RT2)	High Priority (HPRI)
QOSCESVOICECE1NDPS	X	X		
QOSCESVOICECE1		X		
QOSCESVOICECE2NDPS	X		X	
QOSCESVOICECE2			X	
QOSCESVOICECE1NDPSHPRI	X	X		X
QOSCESVOICECE1HPRI		X		X
QOSCESVOICECE2NDPSHPRI	X		X	X
QOSCESVOICECE2HPRI			X	X

5.4 Bandwidth and Delay Characteristics

General potential connection parameters required by the voice access agent are Quality of Service (QoS) and voice-specific potential connection parameters as shown below.

Table 18. Voice-Specific Potential Connection Parameters	
Parameter	Meaning
Compression type	None, compression with or without silence removal
Connection mode	Permanent or dynamic
Digital echo cancellation	None, internal or external

5.4.1 Equivalent Capacity Reservation

There is no need to specify the peak, average or burst parameters for the voice access agent. These values are determined by the access agent based on whether compression and/or silence removal are requested. The resulting reserved bandwidth (equivalent capacity), by function, is:

Uncompressed   69 kbps

Compression (GSM)   15 kbps

Compression (ADPCM)   39 kbps

Compression and silence removal (GSM) 10 kbps

Compression and silence removal (ADPCM) 29 kbps

End-to-end delay requirements depend upon whether access to the public switched telephone network is required and whether echo cancellation is

available. The voice access agent assigns voice connections either to the RT1 or to the RT2 delay priority.

Table 19. Maximum End-to-End Delay for Voice Traffic

Access to Public Network	Without Echo Cancellation	With Echo Cancellation
Required	Delay priority: RT1 Max delay: 2 ms	Delay priority: RT1 Max delay: 22 ms
Not required	Delay priority: RT1 Max delay: 20 ms	Delay priority: RT2 Max delay: 395 ms

5.5 Adapter and LIC Support for Voice

PBX connections are supported on the following interfaces:

1. **E1**

   - Code - HDB3

   - Physical interface - ITU-T G.703

   - Frame Format - ITU-T G.704 with or without CRC, ITU-T G.706 support for frame alignment/CRC procedure

   - Number of lines/LIC - LIC515/516 = 4 interfaces, LIC545/546 = 8 interfaces

2. **T1**

   - Code - B8ZS and AMI

   - Physical interface - DS1/DSX1

   - Frame Format - D4(SF), D5(ESF)

   - Number of lines/LIC - LIC514 = 4 interfaces, LIC544 = 8 interfaces

3. **JJ20**

   - Code - CMI

   - Physical interface - JJ20

   - Frame Format - NTT-I interface format

   - Number of lines/LIC - LIC517 = 4 interfaces

5.5.1 E1 and T1 Framing Characteristics

Table 20 gives a summary of the framing characteristics for voice connections on E1 and T1 interfaces.

Table 20 (Page 1 of 2). E1 and T1 Framing Characteristics			
Line Type	**Framing**	**CAS**	**CCS**
E1	G.704 superframe	• Time slot 16 is reserved for signalling • A, B, C, and D bits are supported	No dedicated time slot for signalling. TS16 is generally used, but is not mandatory.

Table 20 (Page 2 of 2). E1 and T1 Framing Characteristics			
Line Type	**Framing**	**CAS**	**CCS**
T1	D4 superframe	A multiframe contains 12 frames made of 24 8-bit slots and: • No frame is reserved for signalling • A and B bits are supported by using the eight bit in frame 6 (bit A) and in frame 12 (bit B)	No dedicated time slot for signalling. TS24 is generally used, but is not mandatory.
	D5 extended superframe	A multiframe contains 24 frames made of 24 8-bit slots and: • No frame reserved for signalling • A, B, C, and D bits are supported by using the eight bit in frames 6 (bit A), 12 (bit B), 18 (bit C), and 24 (bit D).	

5.6 Voice Services Configuration

The configuration that we used is depicted in Figure 150. We used a number of E1 lines to connect PBXs in CCS and CAS mode.

We used an LSA3 adapter and a four port (E1) LIC516 on each 2220 to connect three E1 links to each Siemens PBX. The links were configured as follows:

- Line 1

  Time slots 1-5 were configured in mono mode with compression and silence removal. Time slot 16 was configured without any VSA functionality as it was used for the CCS signalling channel. This configuration resulted in six NBBS connections.

- Line 2

  All the time slots were configured in one channel for CCS functionality and transported transparently without any VSA facilities. This resulted in one NBBS connection.

- Line 3

  Line 3 was configured for CAS dynamic transport and time slots 1-5 from one PBX were mapped to time slots 1-5 on the other PBX to provide five tie lines. This configuration used compression and silence removal. Up to five NBBS connections were used depending on the number of active calls.
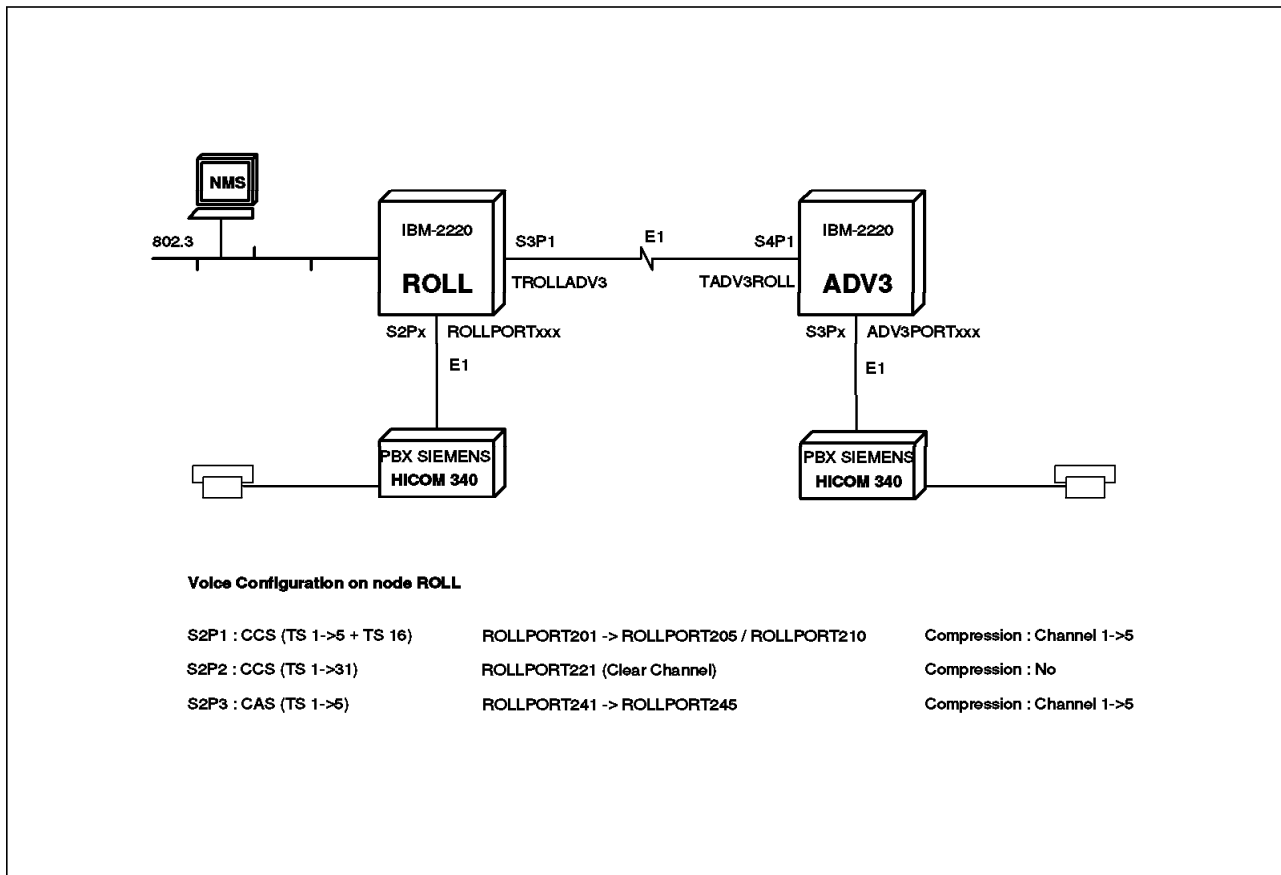
Figure 150. Physical Voice Configuration

5.6.1 CCS Mode Physical Configuration

The definition flow for CCS mode configuration is as follows:

- Configure adapter and LIC for port service.

- Configure line interface.

- Configure VSA and VSE.

- Configure ports.

- Configure the potential connections on the initiator switch only after the previous definitions have been completed on both switches.

5.6.1.1 PCM Voice Adapter Configuration

From the NCT select the node followed by the rack you are configuring and the window in Figure 151 will be displayed. Now you select the slot in which you have the TPA adapter that you wish to configure by double-clicking on the empty triangle below the slot.
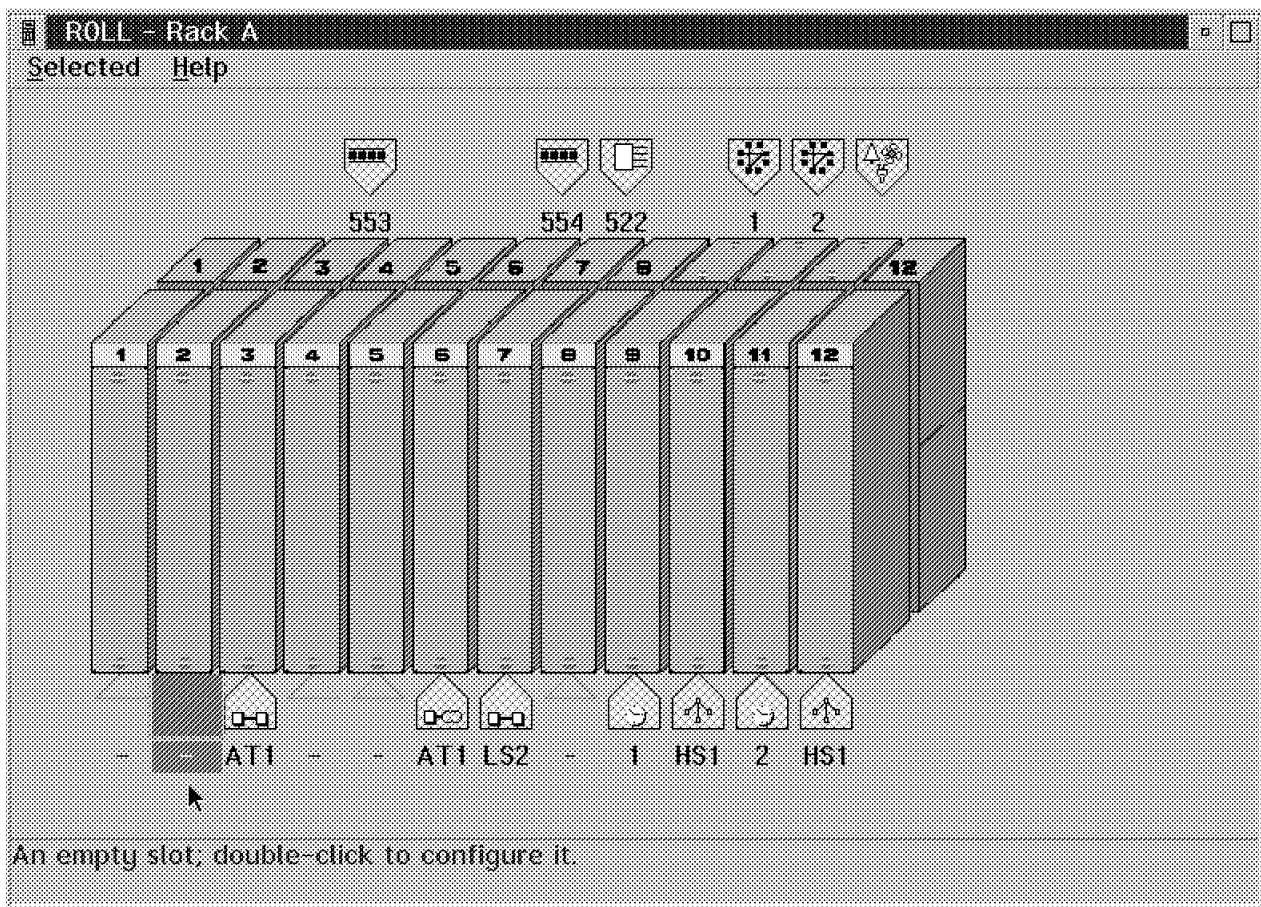
Figure 151. Selecting Adapter Configuration
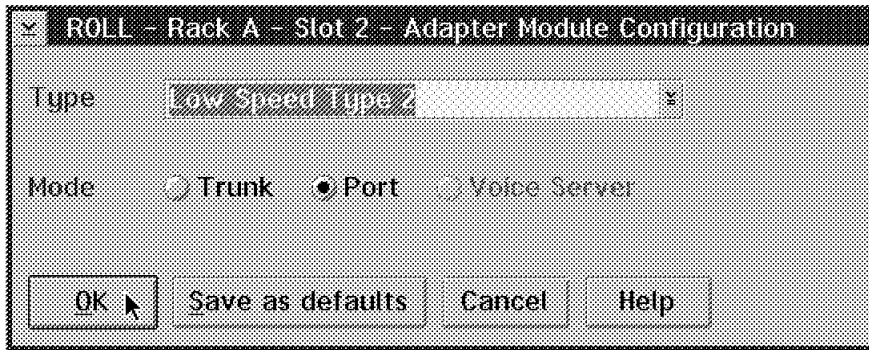
Figure 152. Selecting the Adapter Options

The window in Figure 152 will now be displayed. After selecting the port mode and the relevant type of adapter click on the **OK** button. This is all that is needed to configure the adapter.

The rack will once again be displayed (see Figure 151 on page 175). The adapter has been updated and an empty icon appears on the backplane for slot 2 (not shown in Figure 151 on page 175).

5.6.1.2 Configuring the LIC
We now define the Line Interface Coupler (LIC) by selecting the empty icon above slot 2. You are now able to select the LIC type (see Figure 153).
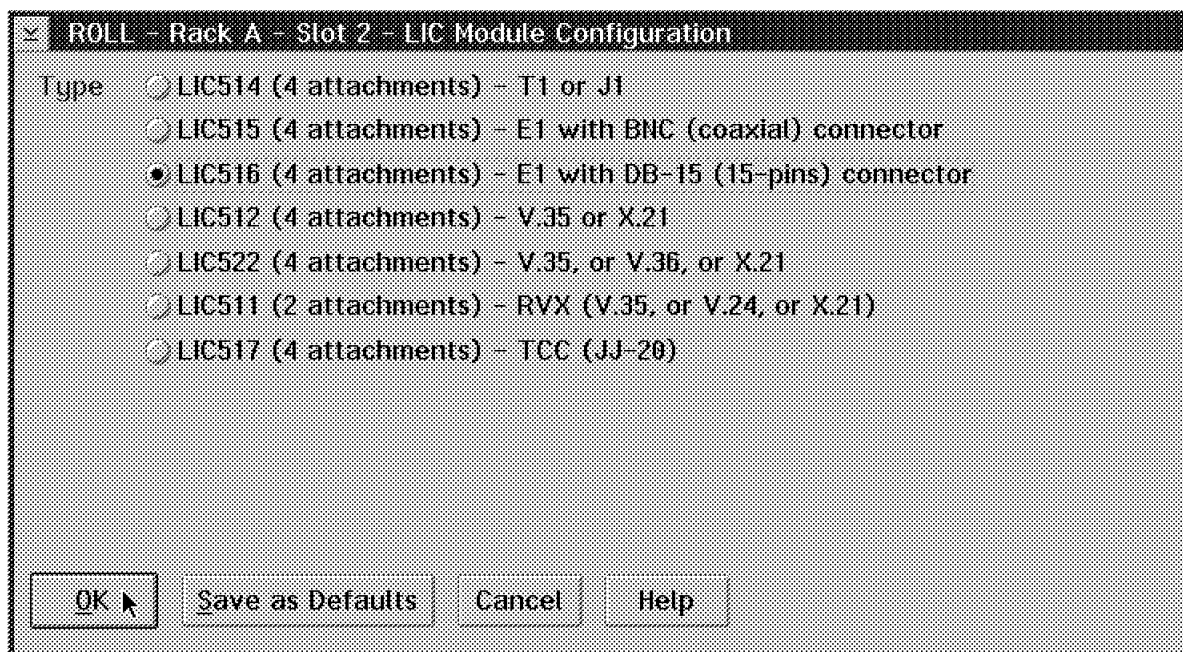
Figure 153. Configuring the LIC Type

In our example the LIC used was a LIC516 which has four E1 lines. Select the LIC type and click on **OK**.

The window showing the rack as in Figure 159 on page 181 is again displayed. From here double-click on the LIC and Figure 154 on page 177 is displayed.

5.6.1.3 CCS Mono Mode Line Configuration
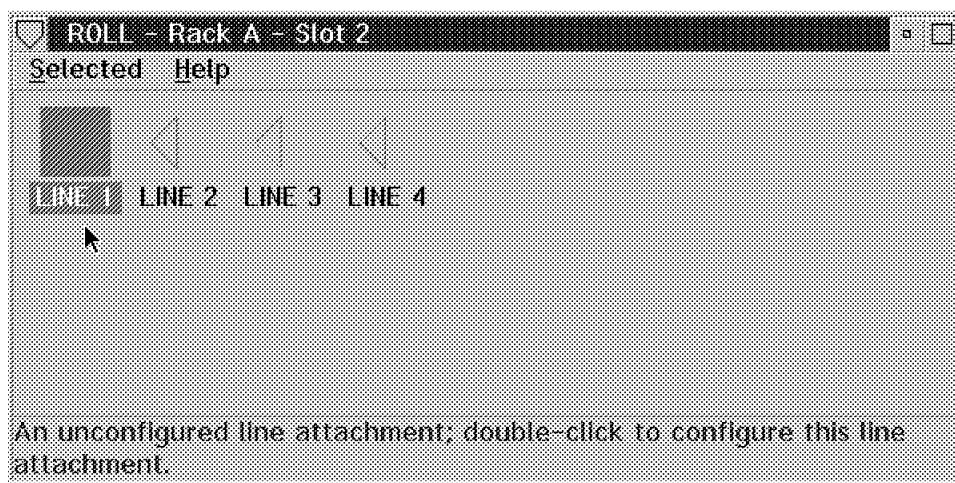
Figure 154. Select a Line to Configure

You will now select a line by double-clicking on its icon for configuration. As the LIC516 has four lines four icons are displayed. We select line 1 by double-clicking on its icon. You will see a screen similar to the one in Figure 155.
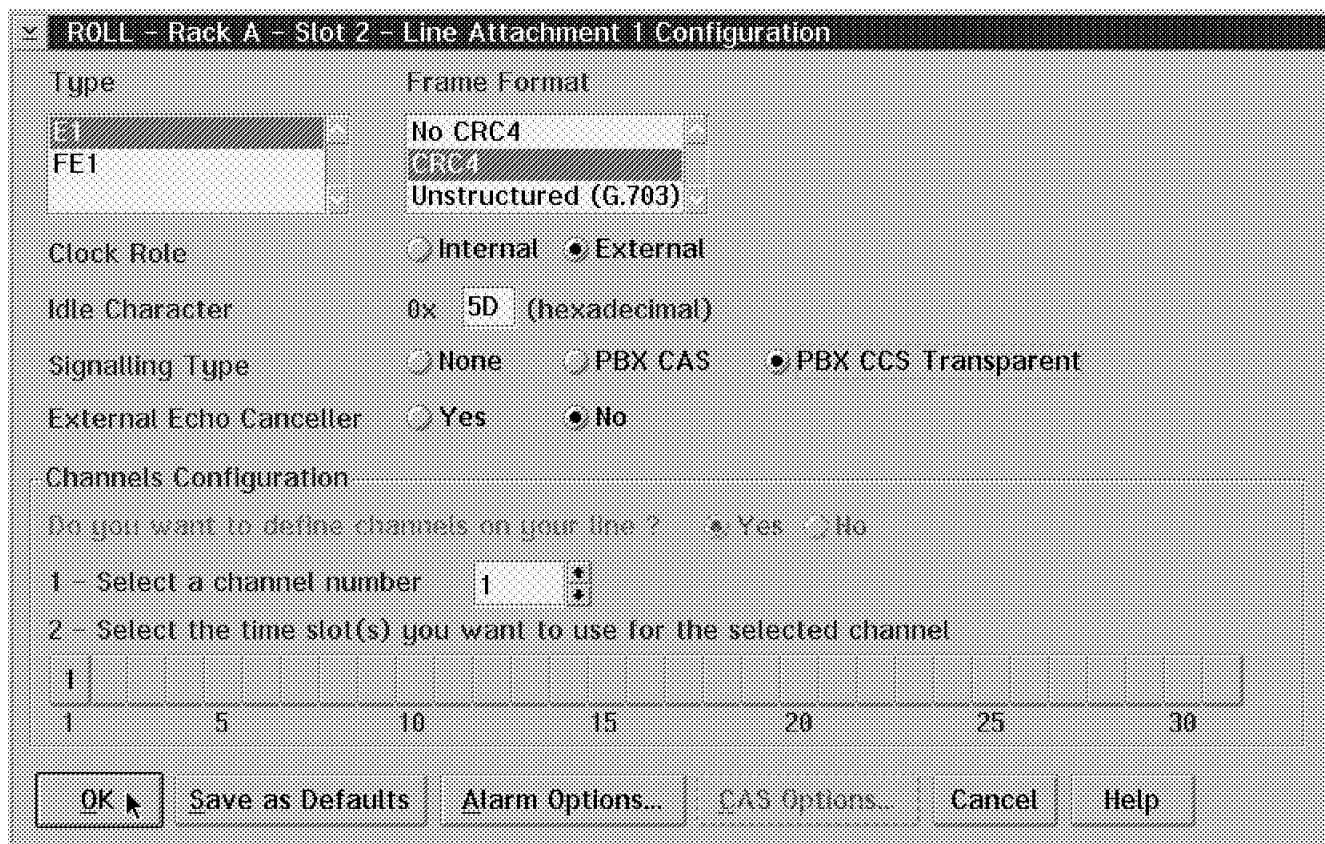
Figure 155. Line Attachment Configuration

This screen requires the following input:

- **Type**

  Type specifies the type of line you are configuring. In our case it is an E1 connection. (FE1 is fractional E1.)

- **Frame Format**

  You have the options shown in Figure 155 on page 177. You need to specify the same as that used by the PBX.

- **Clock Role**

  Clock role should be internal on one side and external on the other. In our case we selected to use external clocking on the 2220s; that is the clocking is derived from the PBX signal.

- **Idle Character**

  Enter the idle character used by the PBX. This is done to facilitate the idle removal function.

- **Signalling Type**

  For voice support you select either PBX CAS or PBX CCS Transparent. In our case we are going to configure CCS connections using this line.

- **External Echo Canceller**

  You can use an external echo canceller in which case you would click on **Yes**. In our configuration we use the VSA to do echo cancellation so we select the No option.

- **Channels Configuration**

  You may channelize an E1 or T1 connection by allocating an individual time slot to a channel number; for example, if Time slots 1-4 are allocated to channel number one this means that channel one is a 256 kbps channel. The time slots allocated to a channel do not have to be contiguous.

  For a *clear channel* operation the time slots would all have the same channel number.

  In order to use VSA compression and Digital Echo Cancellation (DEC) functions all time slots used must be allocated to unique channels; this is called *mono mode* operation. Time slot 0 is not available as an option as it is used for framing.

  You select a channel number and click on a time slot.

  In our example we configure a mono mode operation by allocating time slots 1-5 to channels 1-5 respectively; time slot 16 is allocated to channel 16 for signalling.

From here we select **Alarm Options**. Figure 156 on page 179 is displayed.
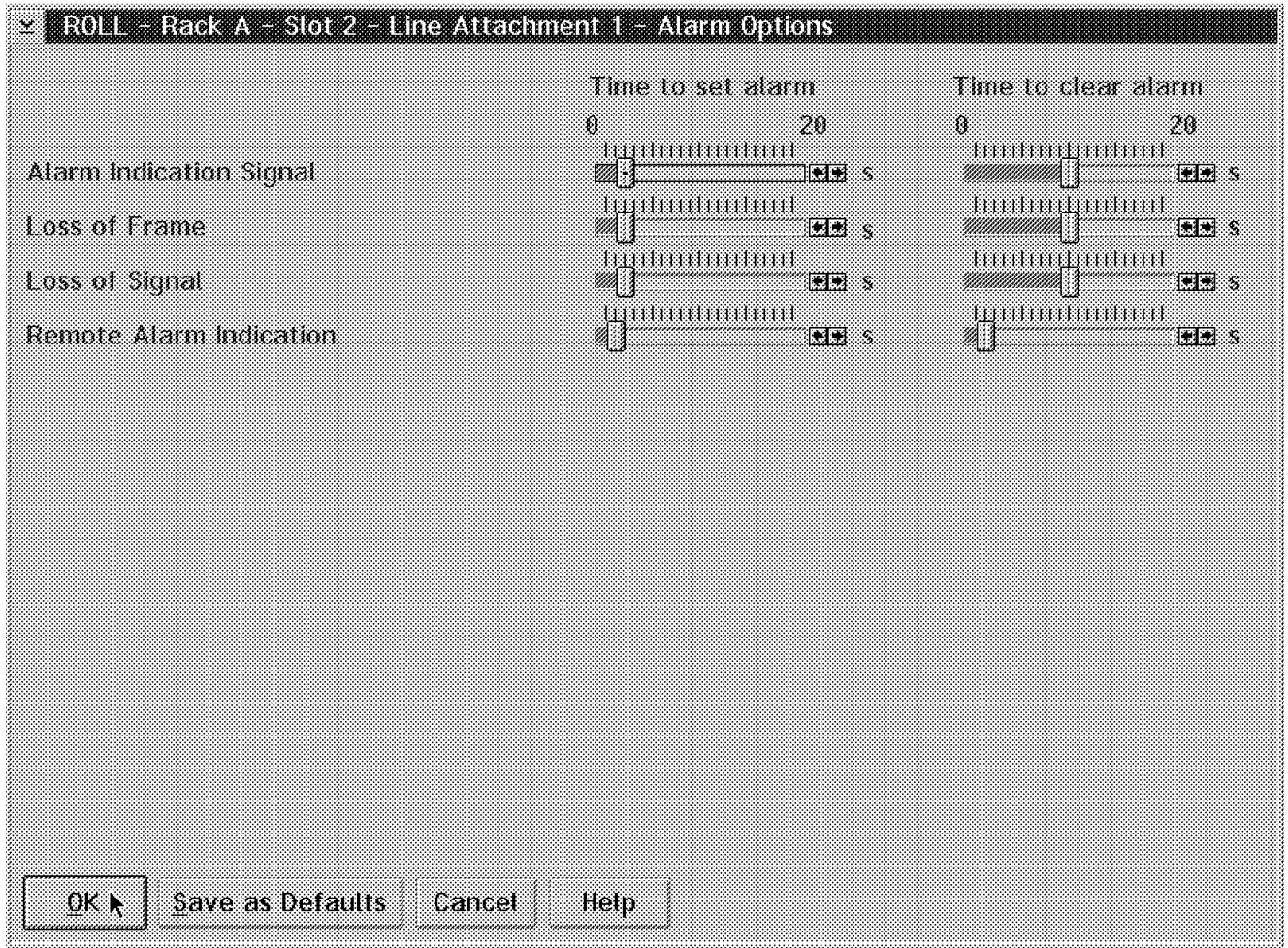
Figure 156. Alarm Options

This display allows you to change the time used by the Control Program to set an alarm after the type of indications shown. You also have the capability to change the time used to clear an alarm.

We recommend that you use the defaults unless you experience specific error conditions that might require you to change some of the options to aid in diagnosis of problems.

Click on **OK** and you will be returned to the display shown in Figure 155 on page 177.

5.6.1.4 CCS Clear Mode Line Configuration
We go through this process to define another line for CCS used in *clear mode*. Figure 157 on page 180 shows the line attachment configuration window for line 2.
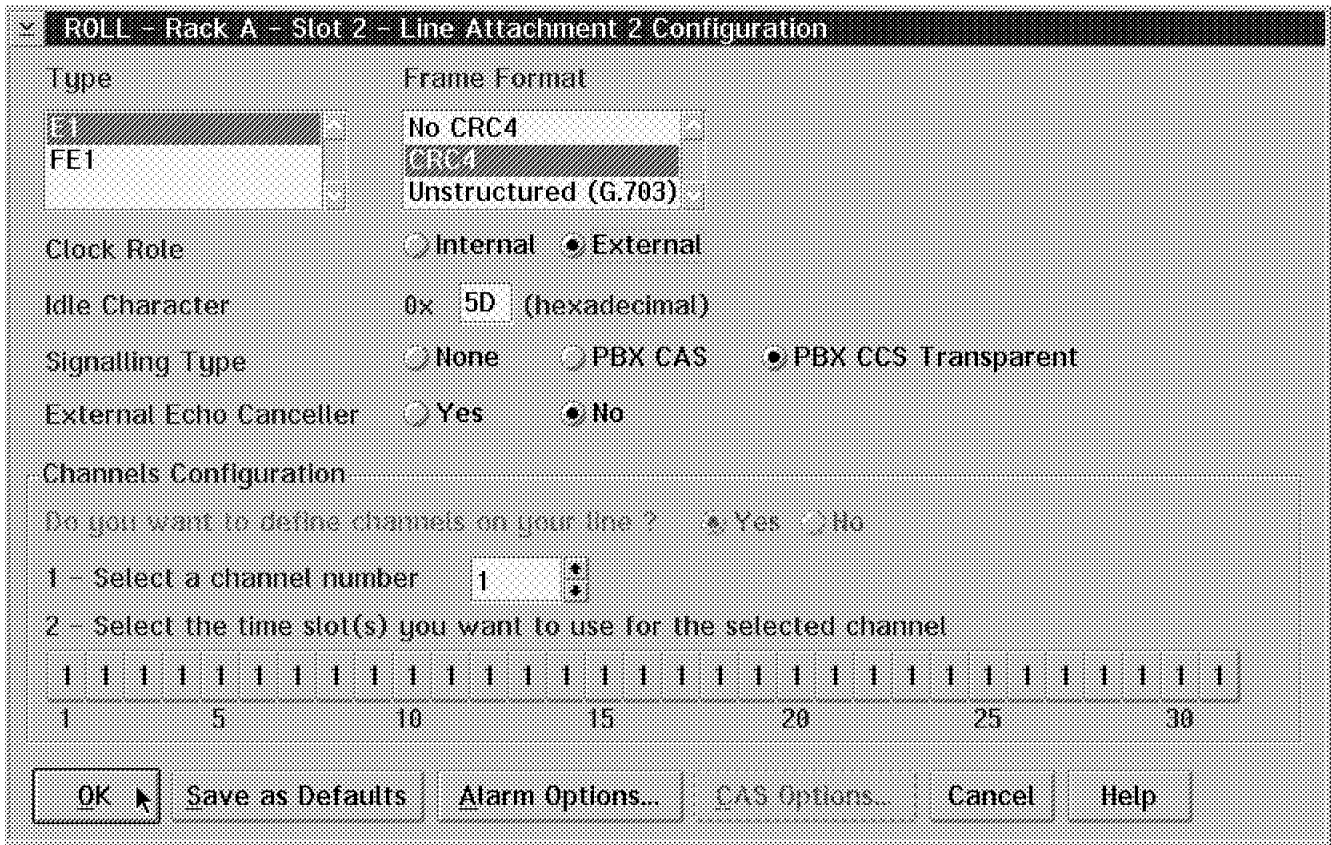
Figure 157. Line 2 CCS Clear Mode Configuration

The input fields are the same as those for mono mode operation except that all time slots have the same channel number. In this mode of operation VSA functionality cannot be used.

Click on **OK** until you are back on the rack display.

5.6.1.5 Voice Server Adapter and Extension Configuration
We now configure the Voice Server Adapter (VSA) and Voice Server Extension (VSE). Click on the adapter slot in which you have your VSA installed. Figure 158 is displayed and you select **Voice Server** for the type and mode.
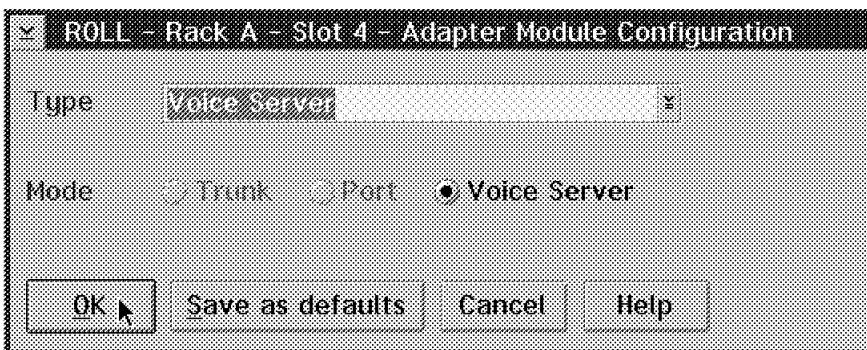
Figure 158. Voice Adapter Configuration

Click on **OK** and you will return to the now updated rack display as shown in Figure 159 on page 181. Slot 4 now shows the updated voice icon. The VS icon above slot 4 will only be updated once you have defined the VSE.
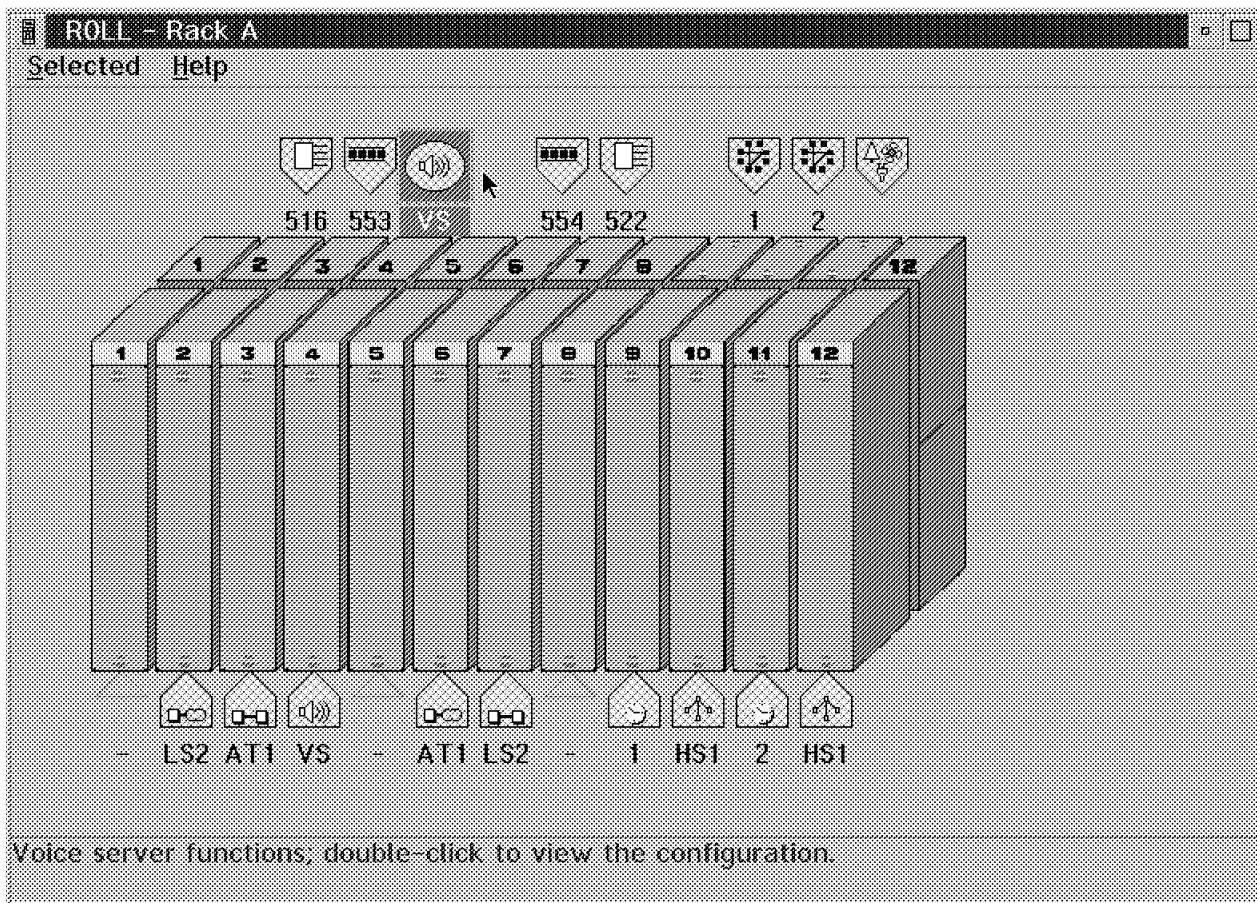
Figure 159. Rack Display with Updated Voice Icons

If you do not have a VSE, you must still go through one.

You configure the VSE by clicking on the empty icon on the backplane located at the top of slot 4. Double-click on this icon and Figure 160 on page 182 is displayed.
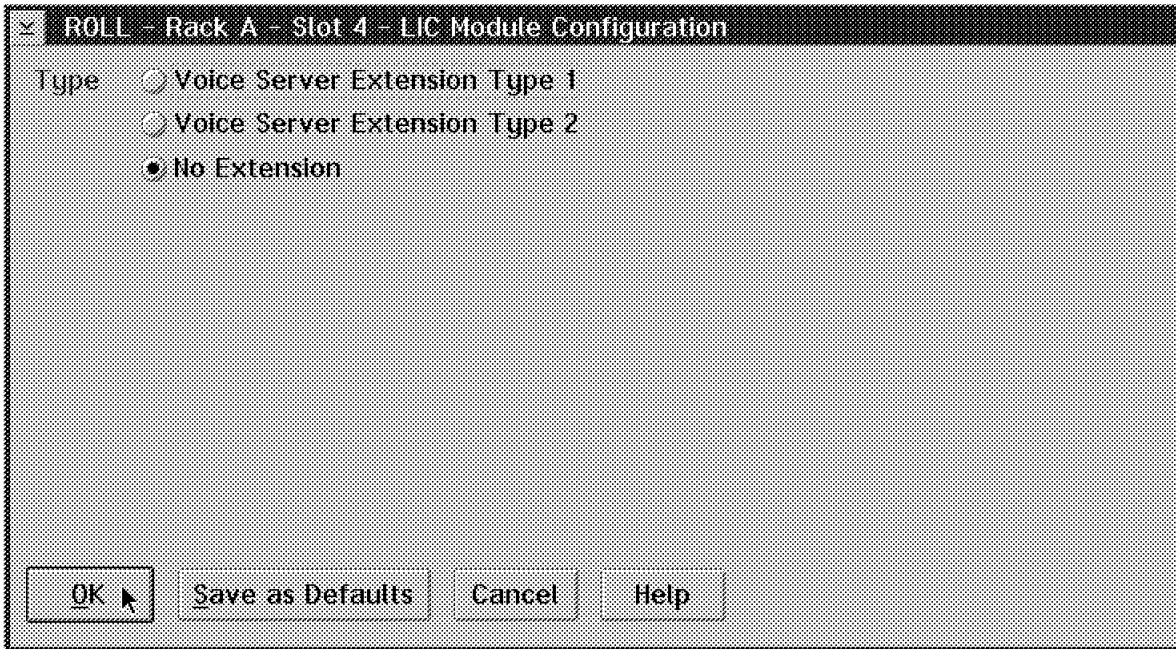
Figure 160. Defining a Voice Server Extension

> The definition consists of merely indicating the type of or lack of a VSE. Click on **OK** when you are done. This completes the voice server configuration.

5.6.1.6 CCS Port Configuration

> From the switch selection window select the **Ports** icon as shown in Figure 161.
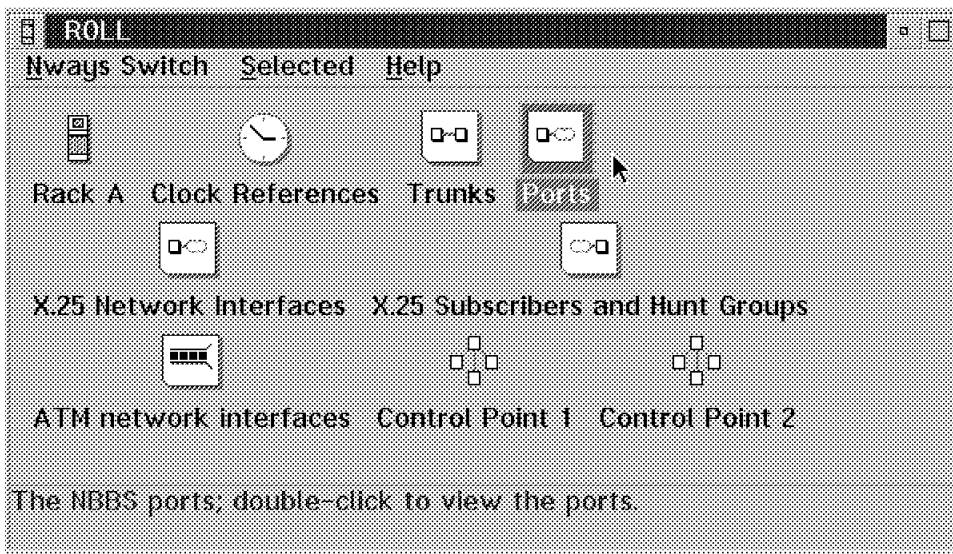
Figure 161. Select the Ports Icon

> Double-clicking on the **Ports** icon will display the ports list window as shown in Figure 162 on page 183. In this figure there are no ports displayed as none have been defined yet.
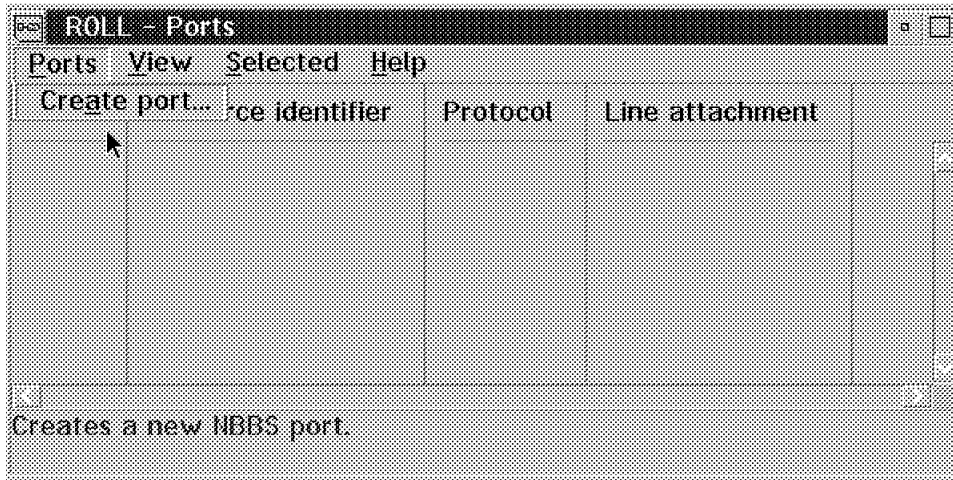
Figure 162. Ports List Window

Click on the **Ports** pull-down menu and select **Create port** from the action list as shown in Figure 162. The window shown in Figure 163 will now be displayed.
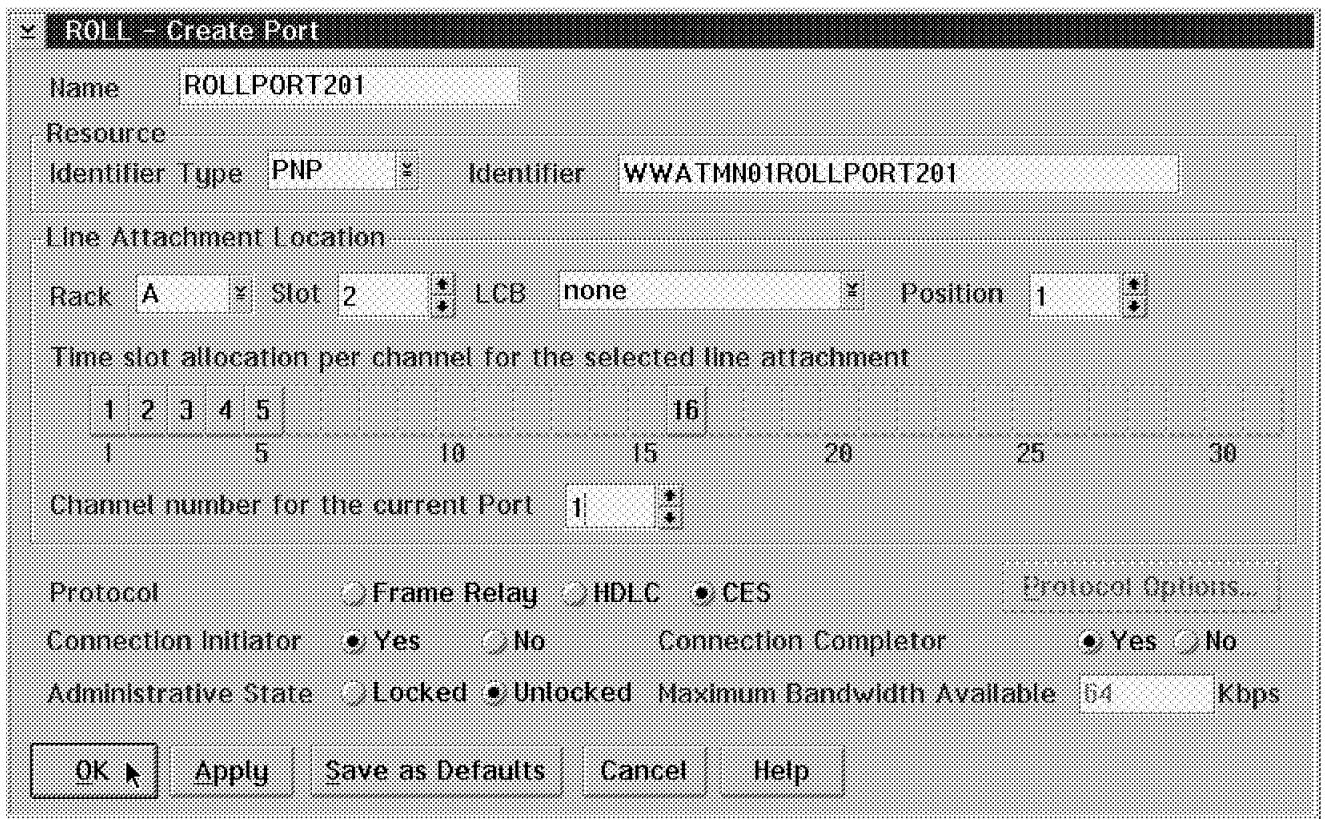
Figure 163. Create Port Window

A voice port is mapped to one of the channels defined on the line interface. Once you specify the line attachment location, the time slot allocation will be filled in for you. In our example we previously defined channels 1 to 5 and mapped these to time slots 1 to 5 respectively. Time slot 16 was allocated to channel 16 for transport of the signalling protocol. This is an example of the mono mode operation.

The port definition for clear mode operation is essentially the same as that for mono mode. However, you have only one port to define. Remember in the line definition that all the time slots were mapped to channel 1.

The port definition window requires the following input fields:

- **Name**

  Enter a port name up to 20 characters.

- **Resource Identifier and Type**

  Options for the Type field are as follows:

  - Private numbering plan (PNP) (up to 28 characters)
  - E.164 (15 digits from 0-9)
  - Network service access point (NSAP) (40 hex digits)

  The identifier is a name that conforms to the identifier type that you specified and must be a unique name in the network. You will reference this name when you define the potential connections.

- **Line Attachment Location**

  Enter the Rack, Slot and Line Position that this port is associated with and the Time slot allocation will be filled in automatically.

  You must now select a channel number to which this port is mapped.

- **Protocol**

  Select **CES** for voice support.

- **Connection Initiator and Completor**

  Select **Yes** for both these options.

- **Administrative State**

  Select **Unlocked** to enable the connection to be activated without operator intervention.

- **Maximum Bandwidth Available**

  This is not an option in channelized connections; it will display the bandwidth of the defined channel.

Since you will have multiple ports to define, click on the **Apply** button and then you can configure the next port. When all ports have been defined, click on the **OK** button to return to the ports list display which has been updated with the ports you have just defined.
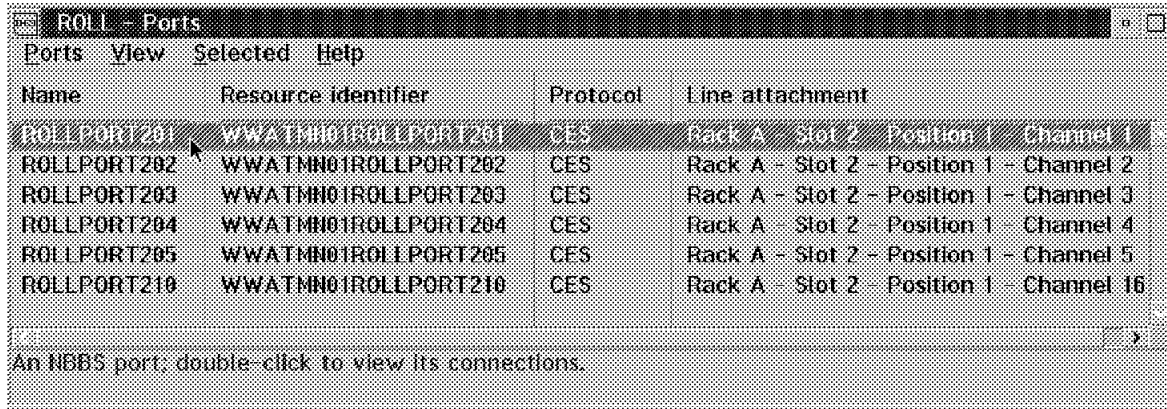
Figure 164. Updated Ports List

5.6.1.7 CCS Potential Connection

Before you configure the potential connections ensure that you have defined the lines and ports on both 2220 endpoints.

The last item we have to configure is the potential connection. Select a port from the ports list by double-clicking on a port name. The window shown in Figure 165 will now be displayed.
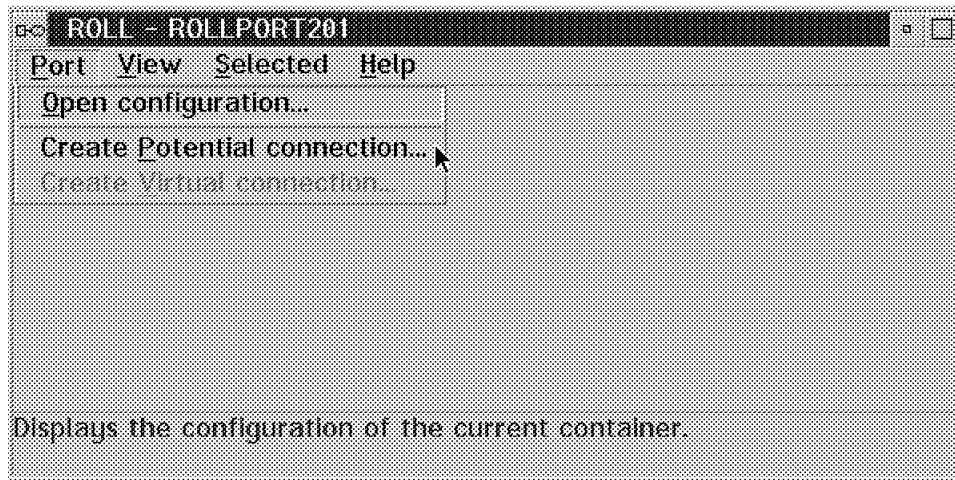

Figure 165. Create Potential Connection

From the window shown in Figure 165 click on **Port** and select **Create Potential Connection** as shown in Figure 165.

The window shown in Figure 166 on page 186 is now displayed. One potential connection will be created for each port.

For the CCS mono mode configuration you will have six ports as shown in Figure 164. Therefore, you must configure six potential connections.

In the CCS clear mode configuration, all the time slots were mapped to one channel which in turn was defined in one port. A single potential connection is all that is required for the clear mode operation. In this mode of operation you may not use VSA functionality.

Figure 166. Create Potential Connection

At the window seen in Figure 166 give the following parameters for a connection:

- **Name**

  Fill in a name for the potential connection.

- **Completor Side information**

  Enter the completor switch resource details.

- **Traffic Definitions**

  For voice this is always 64 kbps.

- **Traffic Type**

  Select **Voice**.

- **Voice Compression**

  Select compression if you have a VSA installed and you wish to compress this connection. Compression is only valid for mono mode operation and cannot be used for the signalling time slot (time slot 16 in our case).

- **Echo Cancellation**

  Select this if you require echo cancellation; this needs VSA functionality.

- **Silence Removal**

  This may be selected but requires VSA functionality.

- **Quality of Service**

  You may select from a list of QoS options. In our case we selected QOSCESVOICECE2NDPSHPRI for the mono mode operation. See 5.3, "Quality of Service for CES Voice Traffic" on page 168 for a detailed explanation of the QoS definition.

- **Connection Activation**

  For CCS clear and mono mode we select Permanent Mode as Yes and On External Event as No. This means that the connections will be activated on switch activation and will remain permanently active.

- **Administrative State**

  We set this to Unlocked.

- **Accounting**

  Select Yes if you want to collect accounting information.

Click on **OK** to complete the potential connection definition.
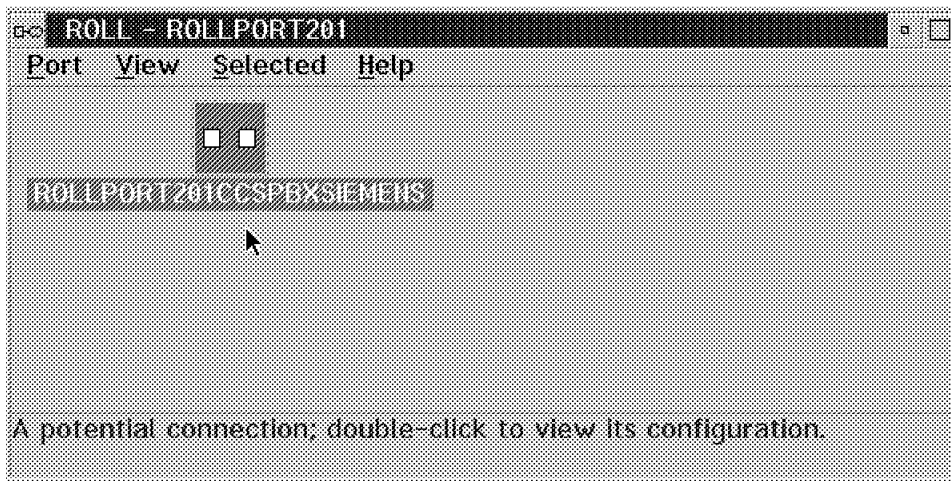
Figure 167. Potential Connection Icon

See Figure 167 for the window showing an icon representing the potential connection just configured.

This concludes the configuration of the CCS service. The adapters may now be loaded with the new code and restarted.

5.6.2 CAS Mode Configuration

The CAS mode configuration is essentially the same as that used in CCS mono mode definitions. We now take you through the differences between setting up the CCS and CAS environments.

The configuration flow is exactly the same as that for CCS, as follows:

- Configure adapter and LIC for port service.
- Configure line interface.
- Configure VSA and VSE.
- Configure ports.

- Configure the potential connections on the initiator switch only after the previous definitions have been completed on all switches.

5.6.2.1 CAS Physical Configuration

The adapter and LIC configuration is the same as in 5.6.1, "CCS Mode Physical Configuration" on page 175. We are in fact using the same adapter and LIC.

When configuring the line interface, the following changes will be made to the Line Attachment Configuration window (see Figure 168) when compared to the line configuration for CCS.
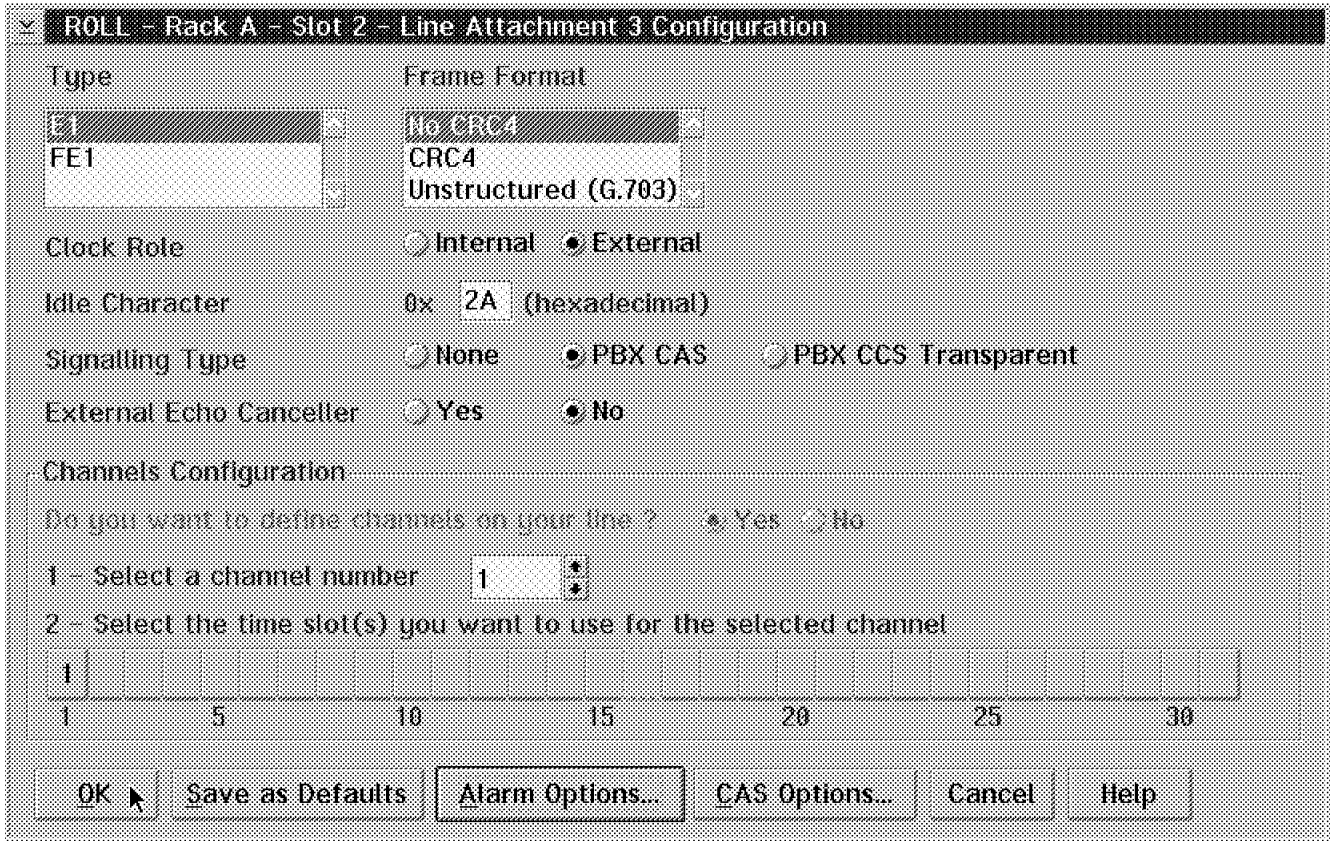

Figure 168. Line Attachment Configuration for CAS

- **Signalling Type**

  Select **PBX CAS**.

- **CAS Options**

  This push button is now enabled.

Note that time slot 16 is no longer available to be mapped to a channel. (If you look carefully, you will see that it is grayed out.) CAS time slot 16 is only used for passing the signalling bits (A, B, C and D). You will define a channel for each time slot.

Clicking on the **CAS Options** button will result in the window displayed in Figure 169 on page 189.
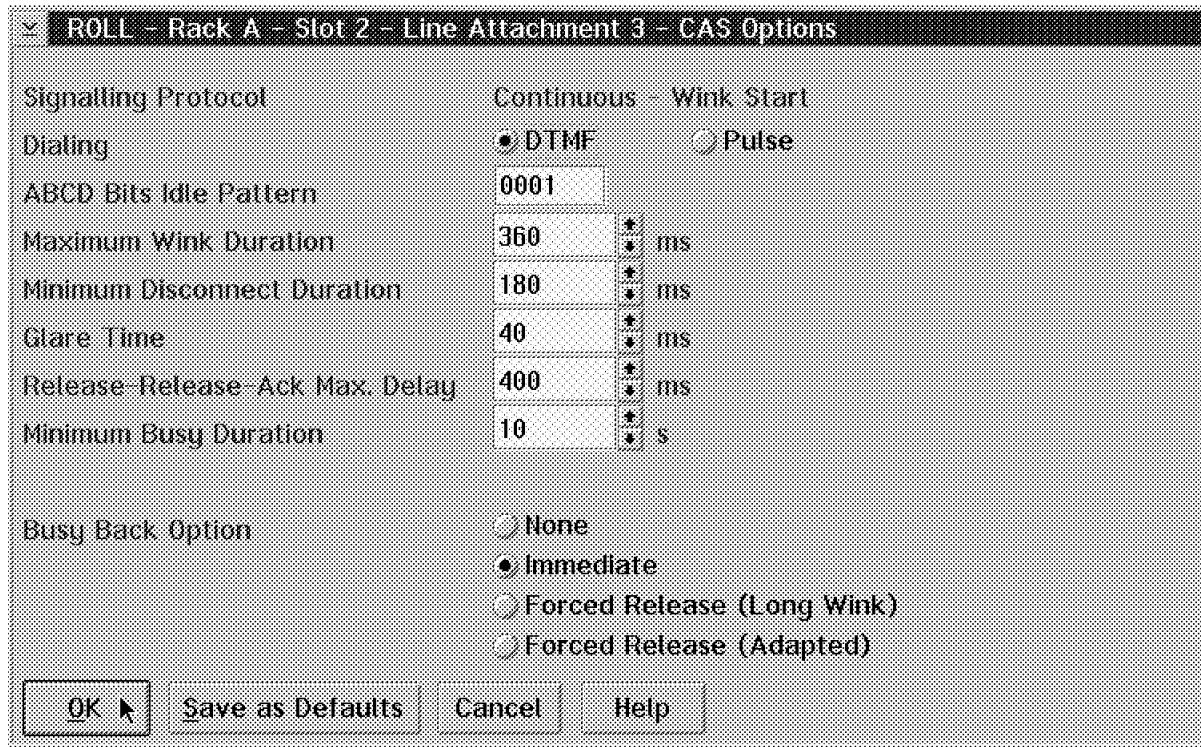
Figure 169. CAS Options

The input fields are as follows:

- **Signalling Protocol**

  The only CAS signalling supported on the 2220 switch is Continuous Wink Start.

- **Dialing**

  The options are Dual Tone Multi Frequency or DTMF. This is a dial frequency for push button phones. Pulse is an older signalling methodology. (Only one line per LIC may use Pulse.)

- The parameters for the remaining CAS options must be closely coordinated with the requirements and parameters set in the PBX.

Click on **OK** when all the options have been specified.

5.6.2.2 CAS Port Configuration
The process of port definition is the same as that for CCS (see Figure 170 on page 190). In our example we only defined five channels.
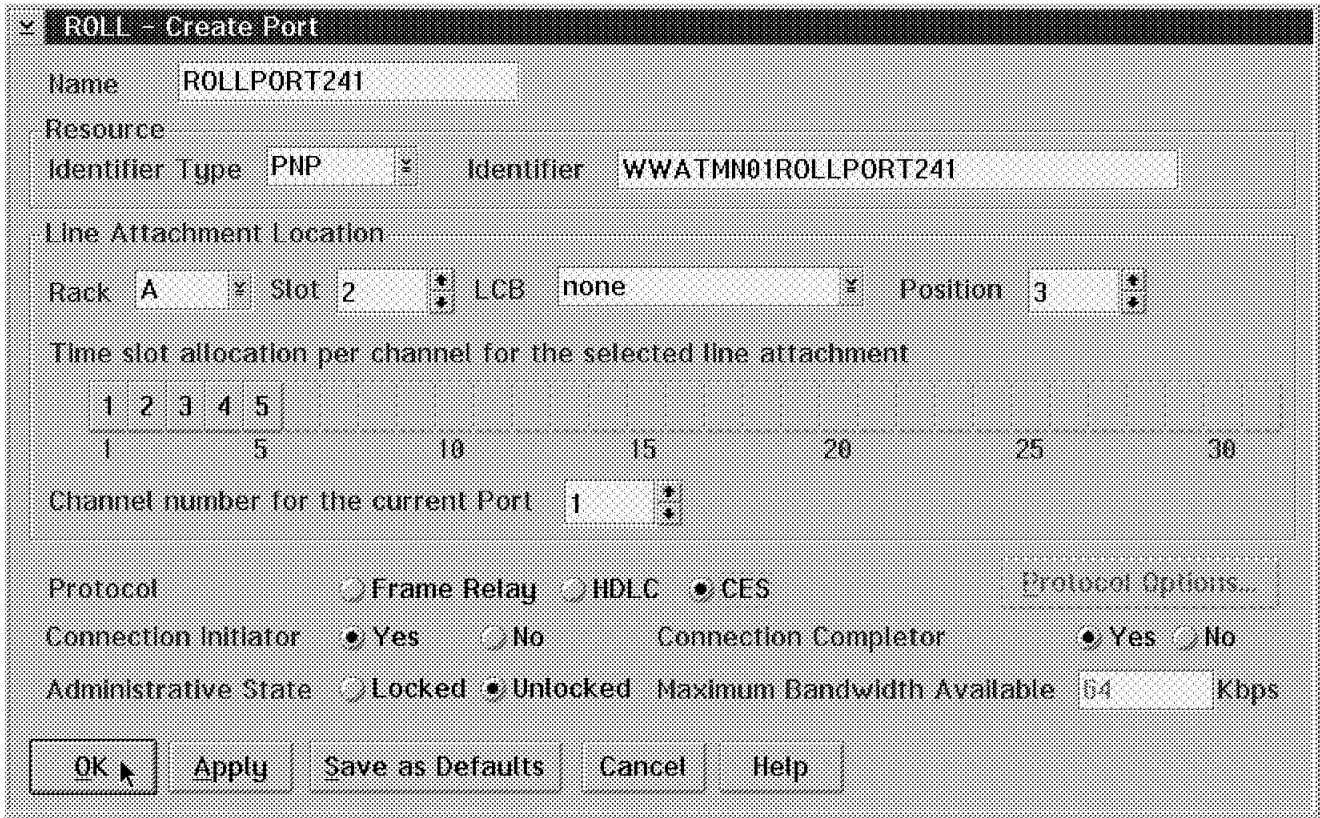
Figure 170. CAS Port Configuration

When you have completed your port definitions, you may click on **OK**. The port list will be displayed as shown in Figure 171.
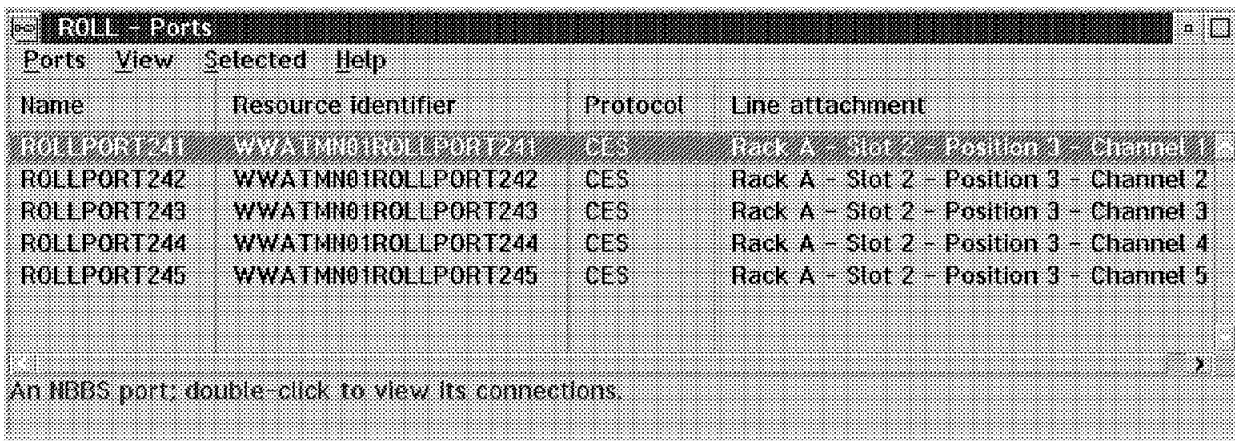

Figure 171. CAS List of Configured Ports

5.6.2.3 CAS Potential Connection Configuration

Select a port by double-clicking on the port. Figure 172 is displayed. Click on **Port** and then select **Create Potential Connection** from the menu list.
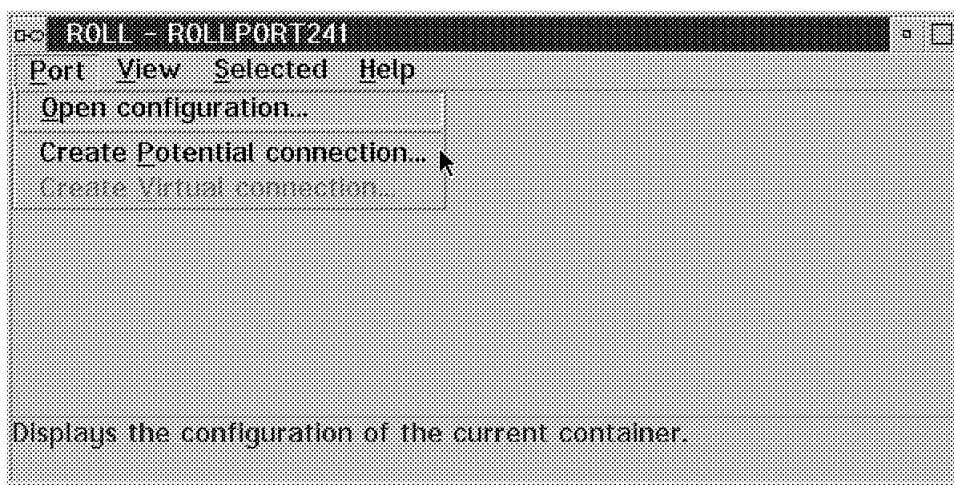

Figure 172. Select Create Potential Connection

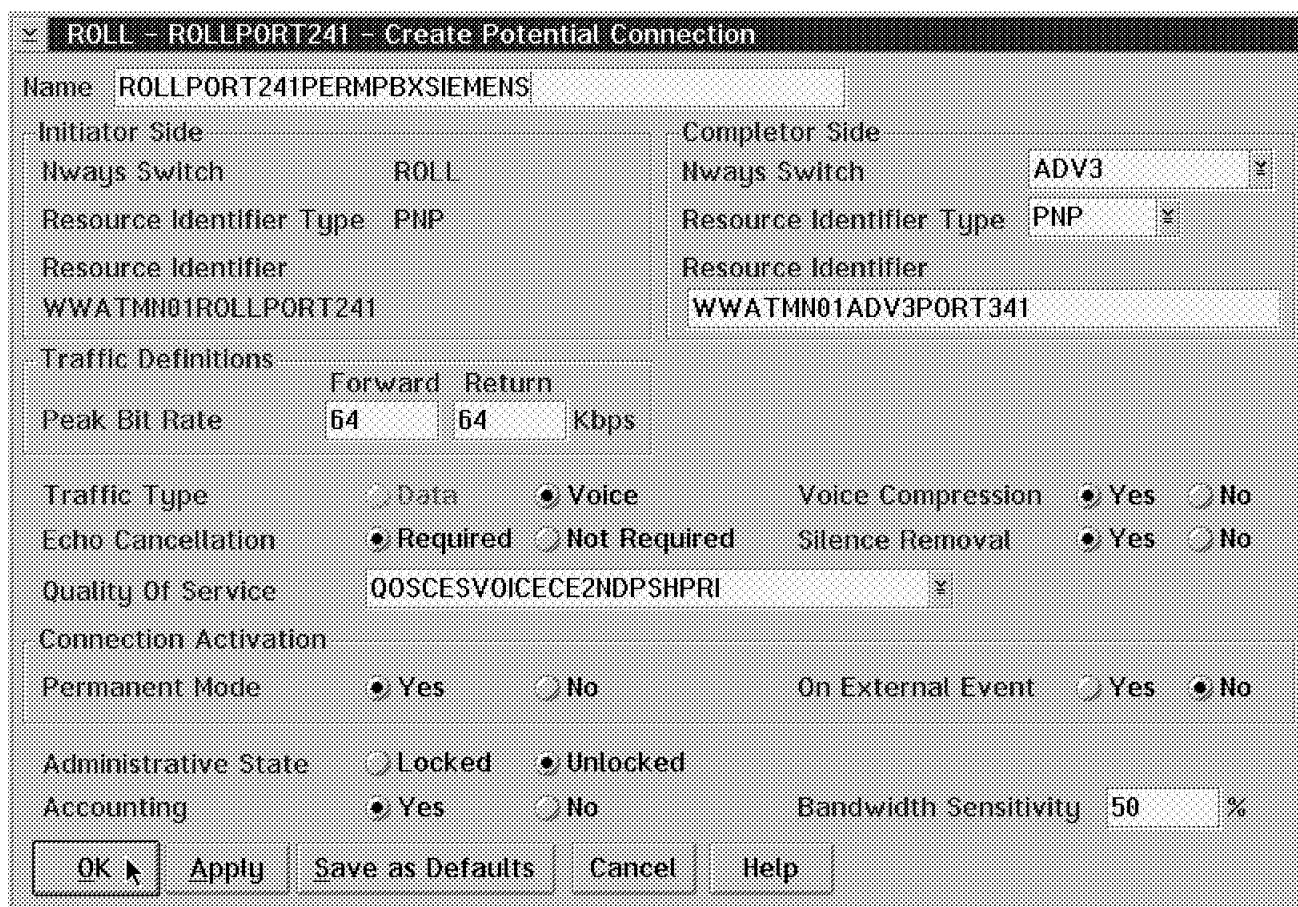The window used to create the potential connection is now displayed as shown in Figure 173.

Figure 173. Creating a CAS Potential Connection

All definitions with the exception of the Connection Activation options have the same meaning for both CCS and CAS:

CAS dynamic mode

Select Permanent Mode as No and On External Event as Yes. This defines a connection that is not permanently present and is initiated by some external event.

For CAS dynamic there is a QoS restriction that NDPS cannot be used.

CAS Permanent mode

Select Permanent Mode as Yes and On External Event as No.

This concludes the configuration; all that remains is to save the potential connection by clicking on **OK**.

5.7 Voice Management

Overall management of the 2220 via the Network Management Station (NMS) is described in Chapter 7, "Nways Switch Manager (NSM)" on page 231. We now discuss some specifics related to management of the voice connections.

Figure 174 on page 193 shows a graphical map of the switched network. Should you have a problem at this high level, the trunks or switches will change from green to yellow, red or blue.
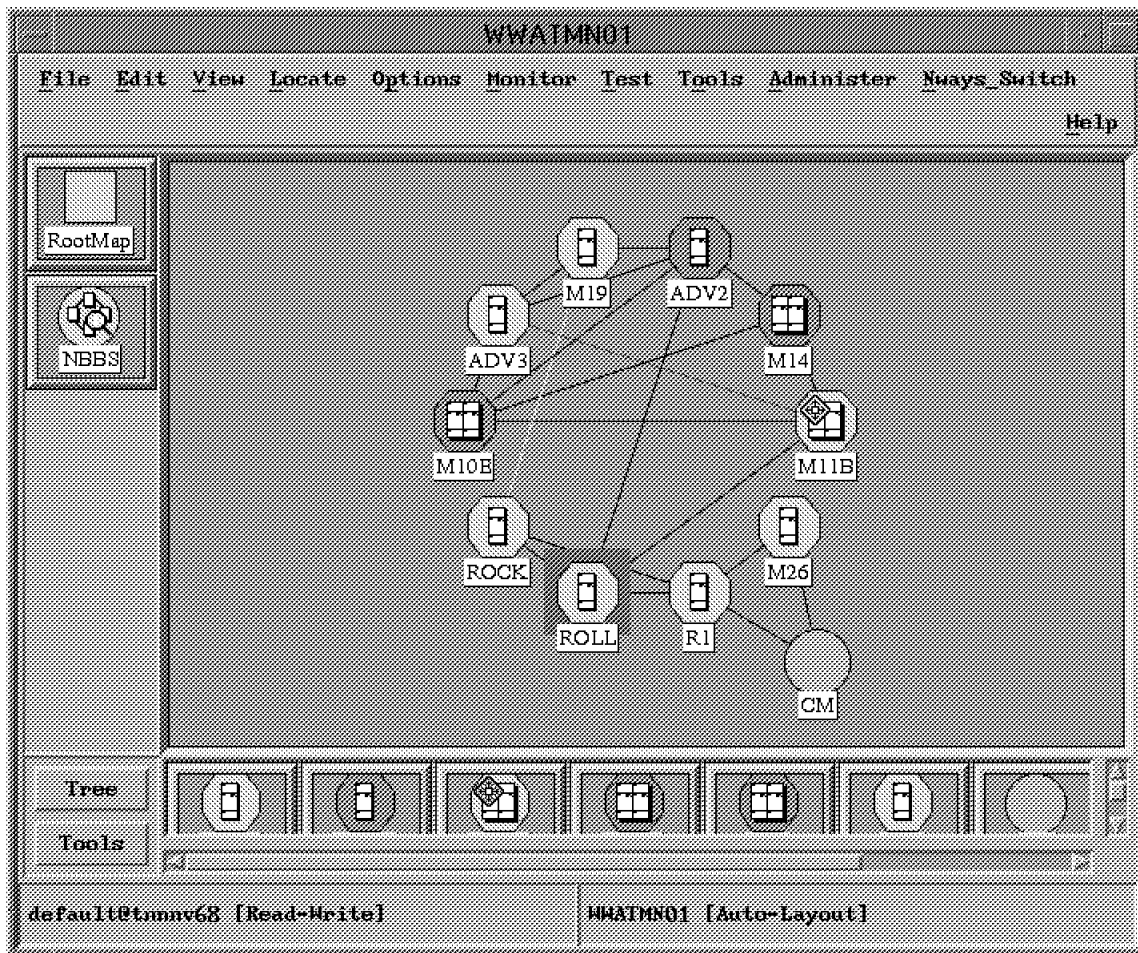
Figure 174. Graphical Map of 2220 Nodes and Trunks

5.7.1 Port Display

At the top of the window you find a number of actions; should you click on these and a pull-down menu will be displayed from which you may select specific actions to be performed on network objects.

In order to look at specifics related to a voice port, select the switch node and click on the Nways Switch item at the top of the window.

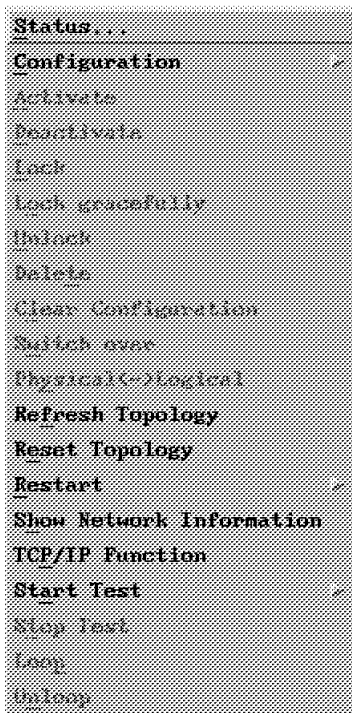The pull-down menu shown in Figure 175 on page 194 will now be displayed.

Figure 175. Nways Switch Action List

You may select any of the highlighted items. In our case we want to look at a voice connection so we select **Configuration**.

The list shown in Figure 176 is now displayed. Since voice connections use CES, we select the **CES Ports and Connections...** option.
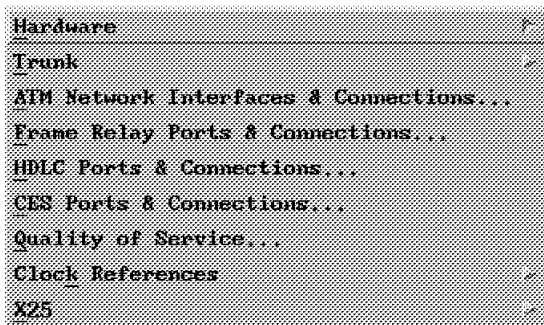

Figure 176. Select CES Ports and Connections

The node we selected in Figure 174 on page 193 was ROLL. The CES ports list for this node is now displayed (see Figure 177 on page 195).

Figure 177. CES Port List for Node ROLL

The port list displays the port name, status and physical location of the port hardware. From the list you may select one of three actions:

- CMIP status
- Configuration
- Monitoring

The Monitoring option allows you to activate and deactivate a port.

Select **Configuration**. Another pull-down menu will be presented, which allows you to display, modify or delete the port configuration. Use one of these options to do online configuration activities to this port.

Configuration functions are identical to those performed on the NAS except that from the Nways Switch Manager (NSM) the modifications may be done in an online manner without disrupting the entire node.

An additional item called Connections is also an option. Selecting this displays the connections associated with the selected port. Such a connection is shown in Figure 178 on page 196.
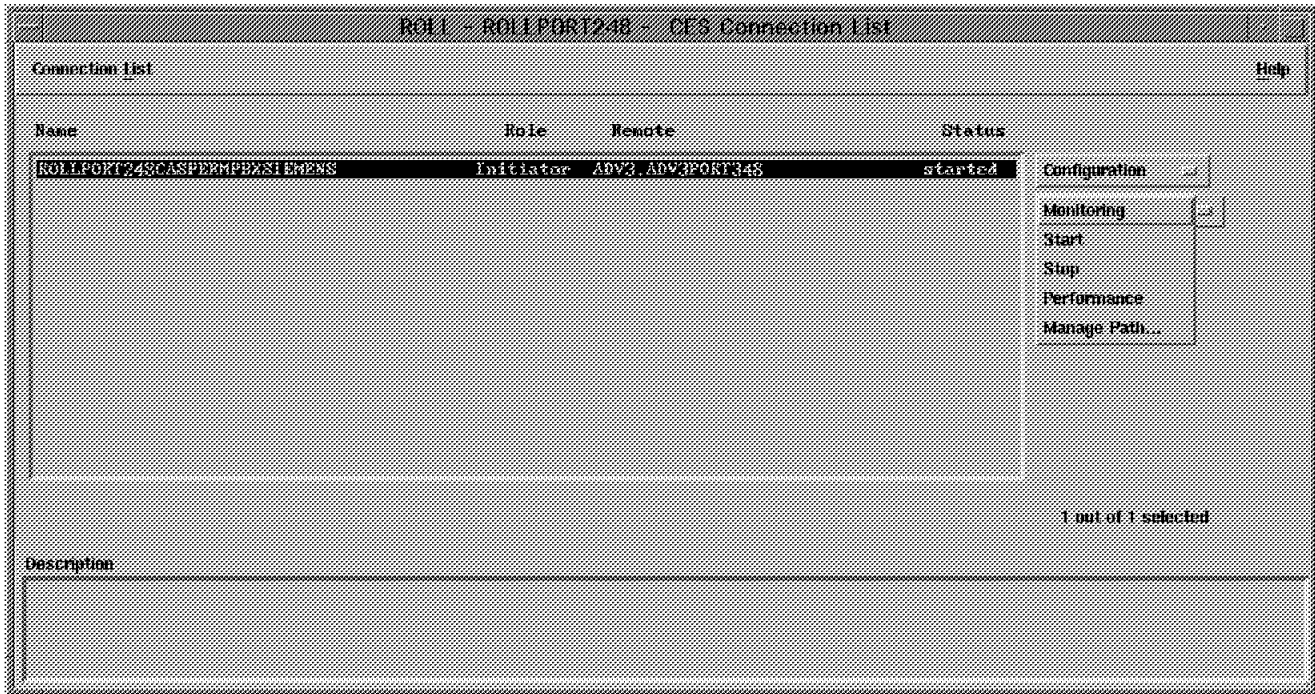
5.7.2 Voice Connection Management

Figure 178. Connection for ROLLPORT248

Select the **Configuration** option to modify, display or delete the connection's configuration.

If you display the configuration, the window shown in Figure 179 on page 197 will be presented. Note that the input fields are the same as those shown in Figure 173 on page 191 and are used to configure the connections using the NCT.

Figure 179. Connection Display/Modify on the NMS

Selecting **Monitoring** as shown in Figure 178 on page 196 will result in a menu list. You may stop and start the connections from here.

You may also select the **Manage Path** option. This will result in the window in Figure 180 on page 198 being displayed.
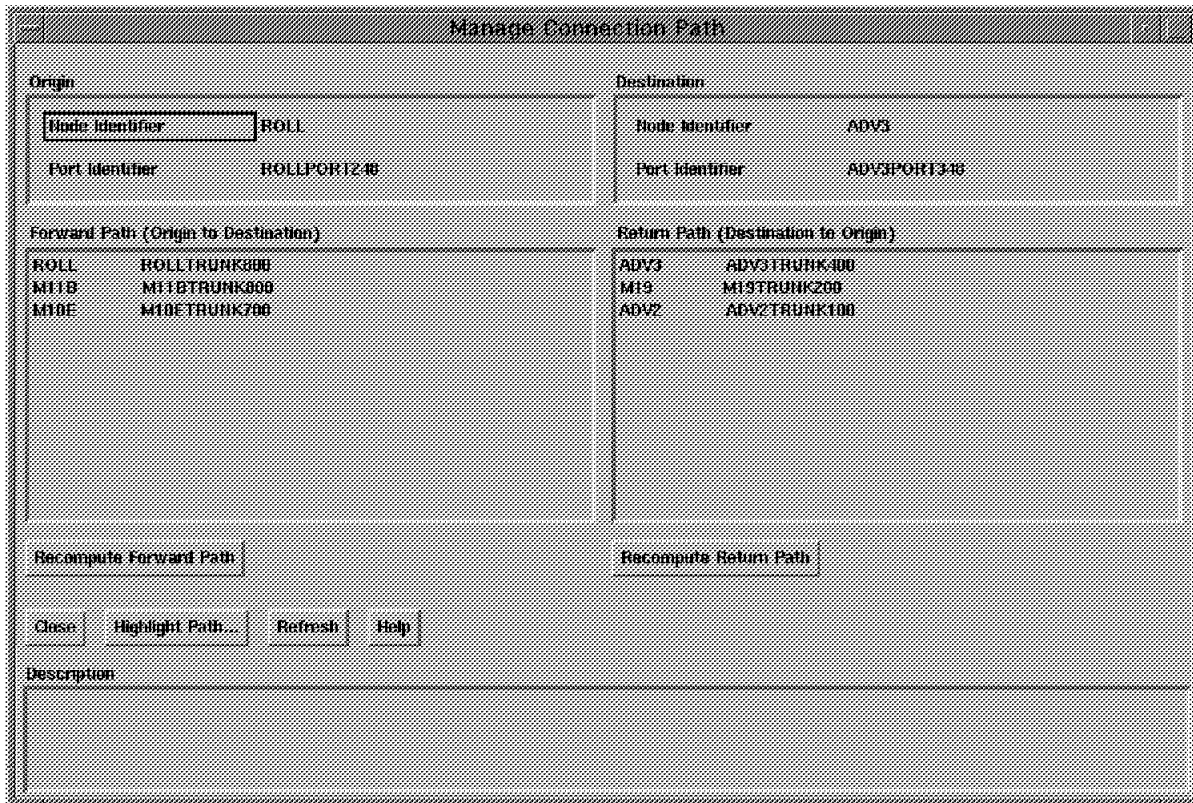
Figure 180. Manage Connection Path

From here you may select a number of options as follows:

- **Recompute Forward/Return Path**

  If you had a path switched as a result of NDPS, you may recompute the forward and reverse paths. This may be useful if a trunk with better delay characteristics has become active since the NDPS path switch.

- **Highlight Path**

  This function will highlight the paths taken by this connection on the display shown in Figure 174 on page 193.

From the window shown in Figure 178 on page 196 you may also select the performance option which allows you to monitor performance aspects of the connection. You must first start the performance application by selecting the monitor option from the window shown in Figure 174 on page 193.

For information on starting and using the performance application see Chapter 7, "Nways Switch Manager (NSM)" on page 231.

Chapter 6. NAS Operation

Each Nways Switch comes with a local operating station called the Nways Switch Administration Station (NAS). This console is used by the IBM service personnel to install the Nways Switch and may be used afterwards to create or change the configuration of Nways Switches or to perform operation actions.

In normal operations, the Nways Switch Manager (NSM) will most likely be the preferred console for operations because it is centrally located and the configuration changes are dynamically applied. It is also possible to perform similar operation actions from the NAS either locally for the Nways Switch to which it is attached or for a remote Nways Switch. The NAS controls only the hardware resources while the NSM can control both the hardware and the logical resources.

The Nways Switch Administration Station (NAS) is also where the software for the Nways Switch adapters resides, and so it has a backup disk with a procedure to restore the primary disk in case of a hardware problem.

If the configuration changes were made with the NCT (CCE), then the changes are automatically saved in the NCT (CCE) database. If the changes were made with NSM, the current configuration must be exported from the Resource Control window and then imported into the NCT (CCE) to save. When a new configuration from NCT (CCE) is imported by Resource Control, it goes into the "backup" database. When the NAS is restarted with the new alternate configuration, the "backup" database becomes the active or current database and the former active or current database becomes the backup.

The configuration changes are not automatically saved in the NCT database. When the configuration is complete, it needs to be exported if the changes were made from the NSM and then imported into the NCT. Whenever you are ready, you can load the Nways Switch with the new configuration. The backup database automatically becomes the active one, and the one that was active before becomes the new backup database.

6.1 Nways Switch Configuration Tool (NCT) Configuration Export

Since the configurations are always saved in a DB/2 relational database format, you can import and export them as you wish. We illustrate here what you need to do after your configurations are done. We use the N1 Nways Switch as an example.

Since the configuration is now built and saved in the NCT database, we need to export it to the NAS. From the NCT where you configured the Nways Switch, you need to go to the main panel and select the Nways Switch you want to export. Then select the **Selected** and **Export** functions as illustrated in the following:
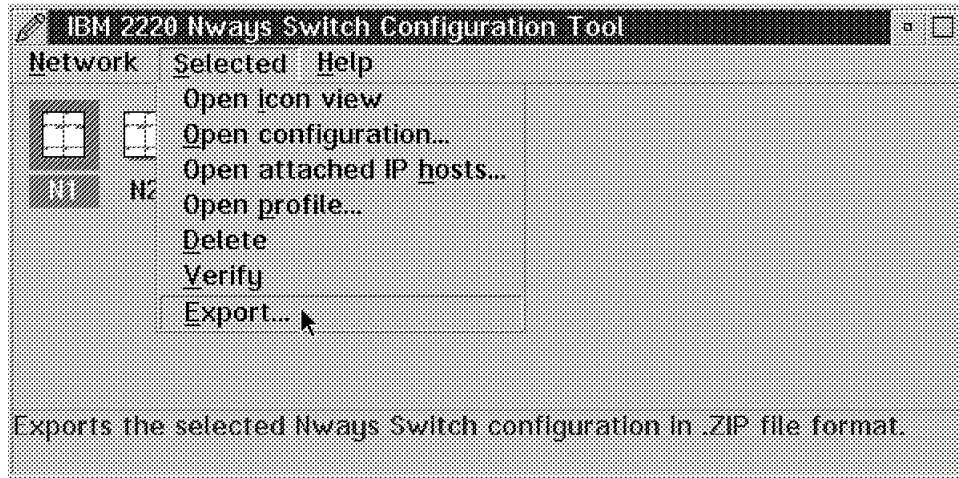
Figure 181. 2220 Nways Switch Configuration Tool

> **Recommendation**
>
> Before exporting the configuration, you may verify the configuration
> parameters of the selected Nways Switch by choosing the option **Verify**.
> Errors, if any, are then logged in a file. On the NAS, open the Nways Switch
> Configuration folder. Double-click on the **View Log File** icon to browse the
> error log.

When you select the export function it will extract all the records from the NCT
database and zip them in a file. This file can be saved to a disk, a diskette or a
special file where it can be read later by the NAS. Saving it to a diskette allows
you to mail the file to remote locations. You could also use FTP to transfer the
file to a remote location. The following illustration shows how to specify where
to export the configuration:
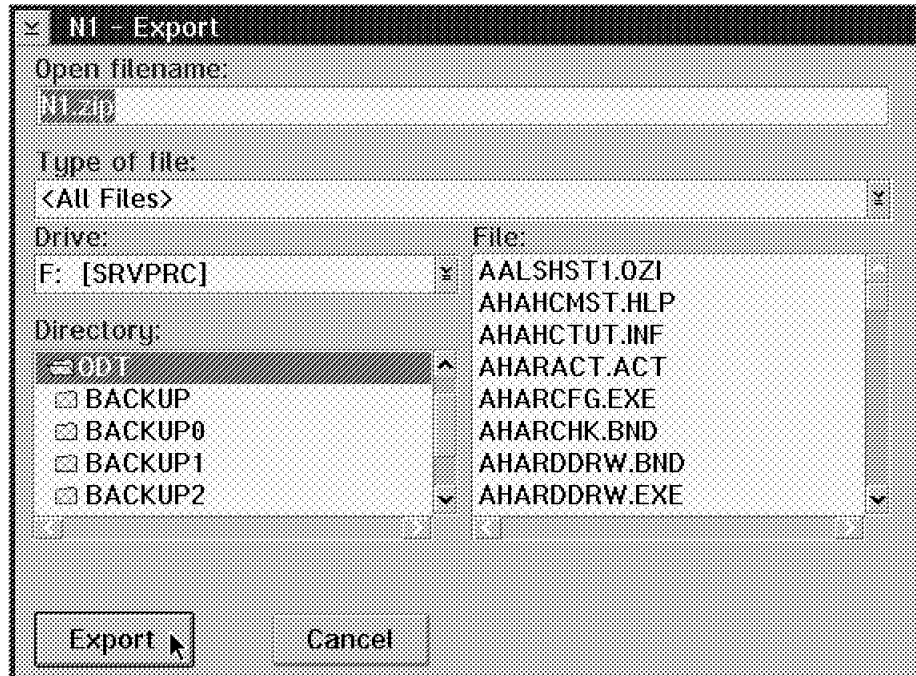
Figure 182. Export Nways Switch Configuration

By default, the export will name the file with its Nways Switch name. In our case the file will be N1.ZIP and will be placed on the F disk in the ODT subdirectory. You can also make a separate directory for configurations. When you select the **Export** button the following message appears:
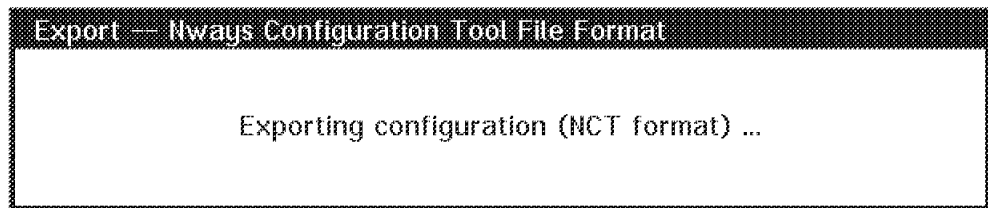
Figure 183. Export Nways Configuration Tool File Format

This will take a few minutes depending on the configuration size. You will get the following message when it is done:
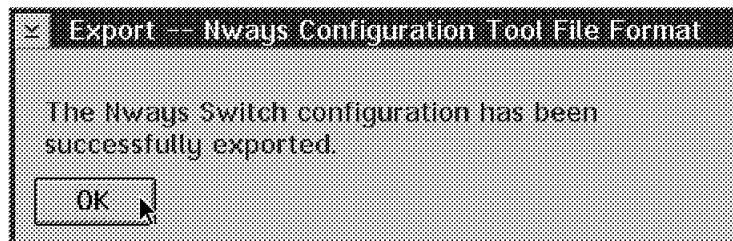
Figure 184. Export Acknowledgment Menu

6.2 NAS Configuration Import

The NAS will always read the configuration from the *same* location. This file is called IMCFG.ZIP and is located in the CONFIG subdirectory of the G disk. You may copy the newly created F:\ODT\N1.ZIP file to the G:\CONFIG\IMCFG.ZIP file with a standard OS/2 copy command, or you could directly export the configuration to this location instead of the ODT subdirectory.

When the correct configuration is in the G:\CONFIG\IMCFG.ZIP file, either by copying or exporting you then need to import it into the NAS database.
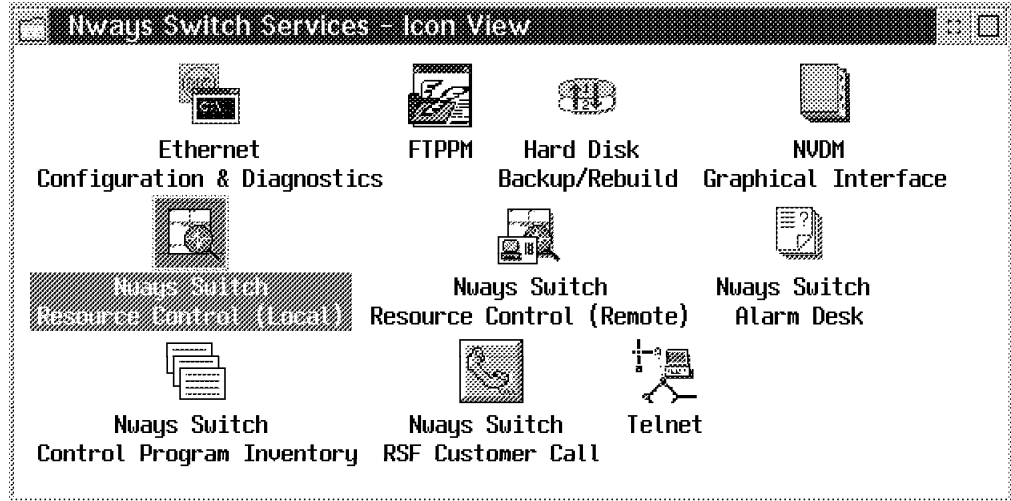
Figure 185. Nways Switch Services - Icon View

The import from the NAS Nways Switch Resource Control operator screen as follows:
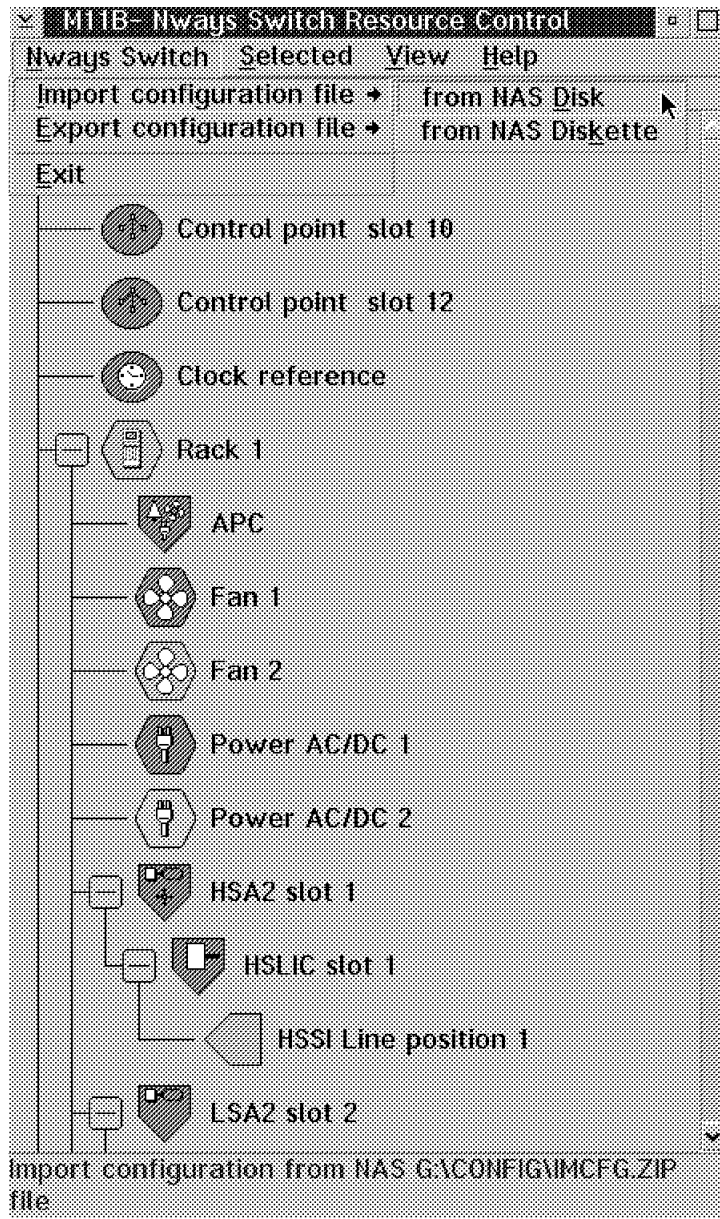
Figure 186. Import Configuration Screen

Select the **Nways Switch**, **Import Configuration File** and **from NAS Disk** options as shown in Figure 186. The import function will take several minutes depending on the configuration and will show the following message:
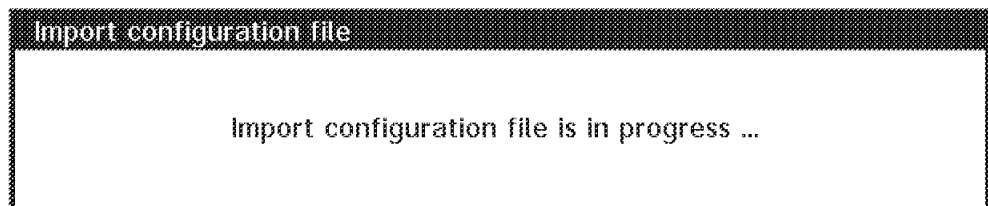
Figure 187. Import Configuration Screen Progress

When complete, you will get the following message:
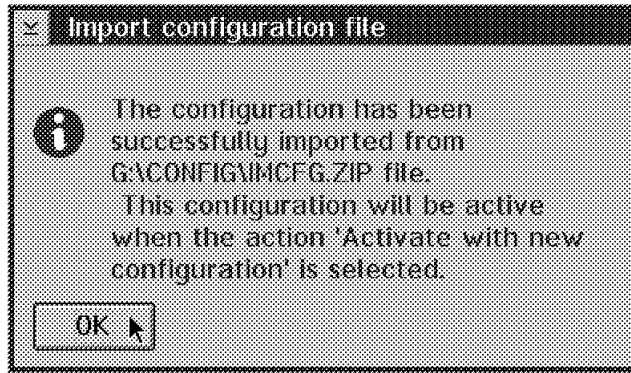
Figure 188. Import Configuration File

So far everything we did was nondisruptive to the Nways Switch. Whenever you are ready to activate the new configuration, you will select the Nways Switch on the Resource Control panel. In our case it was M11B as illustrated in the following:
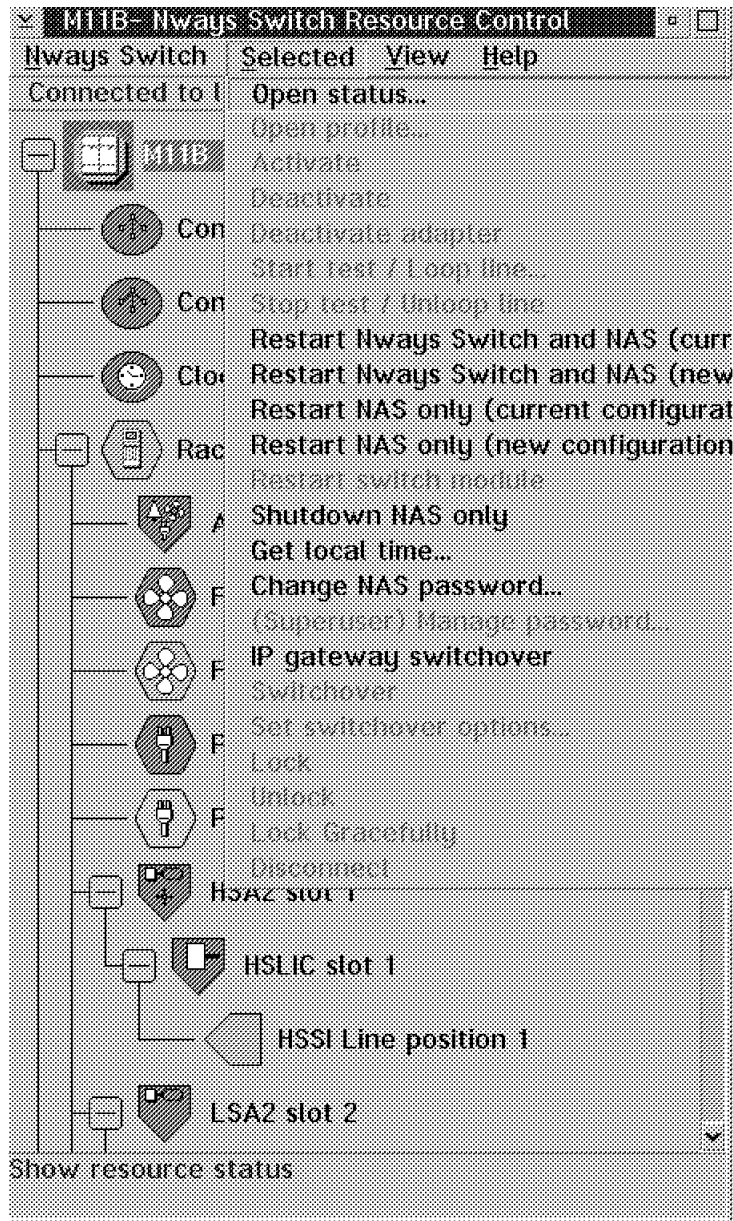
Figure 189. Restart New Configuration

You can either restart the Nways Switch or the Nways Switch Administration Station (NAS). In both cases these can be attached with the old or the new configuration. If you select **Restart NAS only (new configuration)** as we did, you will only affect traffic on the adapters that are being modified; the others will not be affected. Since this action will reboot the NAS, you will lose the NAS functions for the length of the IPL.

If you select the **Restart Nways Switch and NAS (new configuration)** option, then the whole Nways Switch will be loaded. This will disrupt traffic on the whole Nways Switch.

6.3 NAS Configuration Export

There are cases where you will need to export the active configuration in the NCT. For instance, if you make online changes as described in Chapter 7, "Nways Switch Manager (NSM)" on page 231, the changes being done in the active database will not appear in the NCT.

You can export the active configuration from the Nways Switch. To do that you need to go to the NAS Nways Switch Resource Control screen and select the **Export configuration file** and **Whole Nways Switch** options as follows:
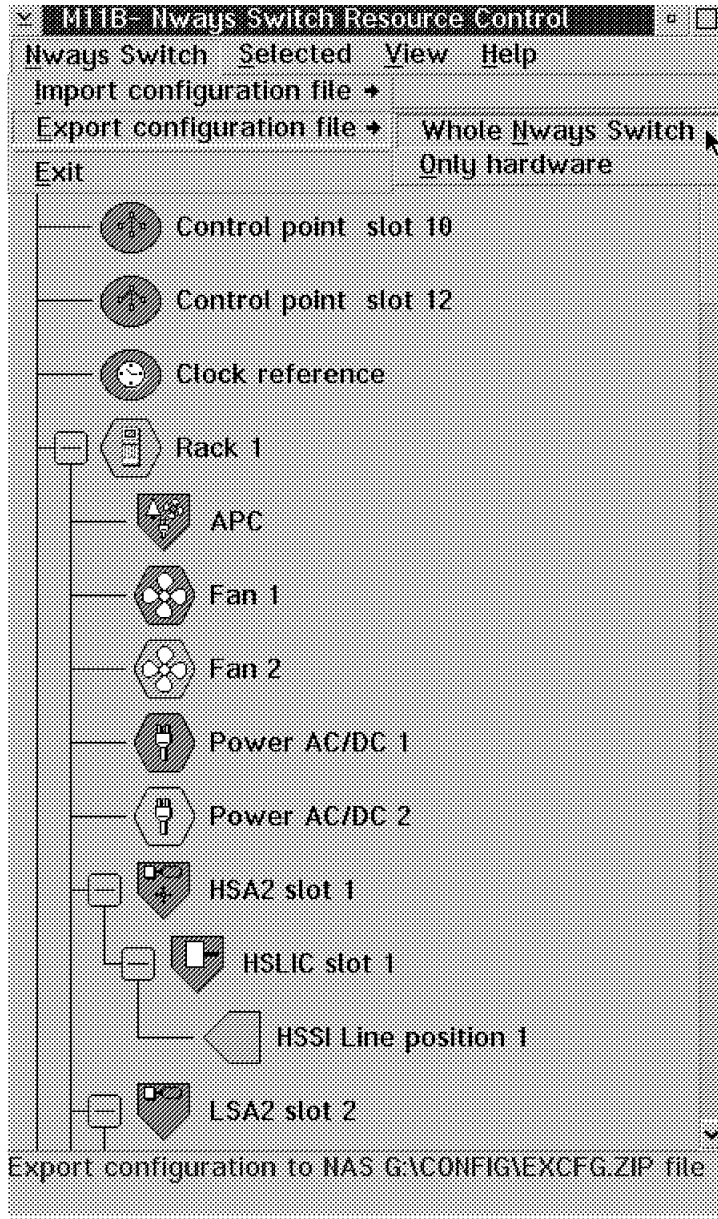
Figure 190. Export Configuration Screen - Whole Nways Switch

Selecting the **OK** button will start the export function and show the following message:
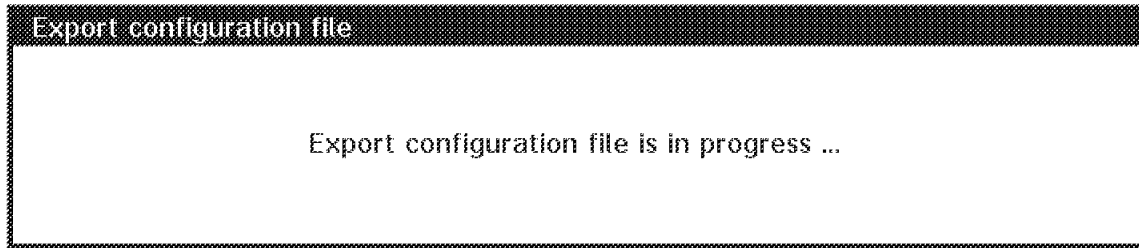
Figure 191. Export Configuration Started

This will export the current active configuration to a file called
G:\CONFIG\EXCFG.ZIP and will show the following message upon completion:

Figure 192. Configuration Exported Information Message

6.4 NCT Configuration Import

You can import a configuration file in the NCT. This file can be the
G:\CONFIG\EXCFG.ZIP file or any other valid ZIP configuration file (for instance a
diskette file coming from some other location).

From the NCT main screen, select the **Import new Nways Switch from** and
Nways Switch Configuration Tool file format... functions as follows:
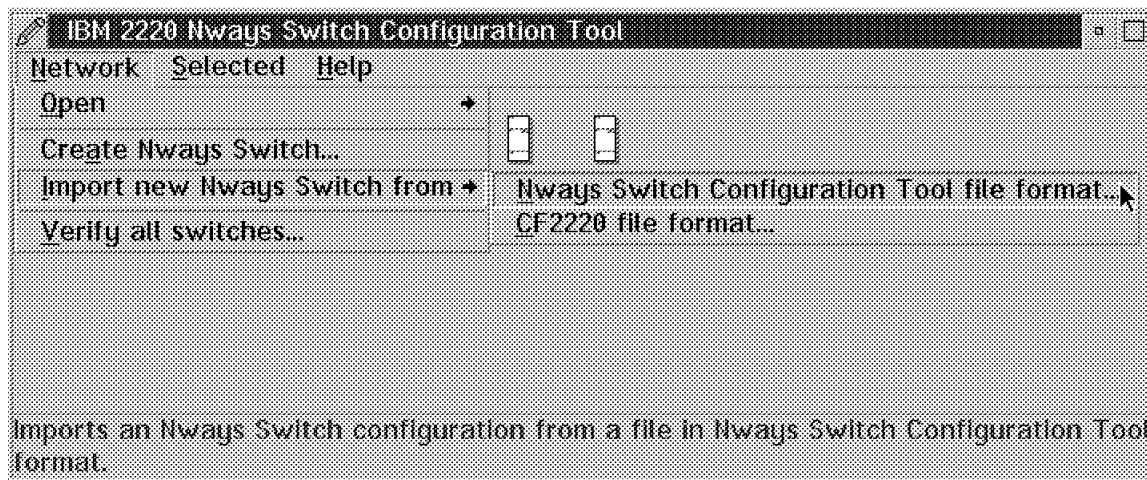
Figure 193. Import from Nways Configuration Tool File Format

This will allow you to select the file that contains the configuration you want to import into the NCT. The following example shows how to import the G:\CONFIG\EXCFG.ZIP file we exported earlier from the active NAS database:
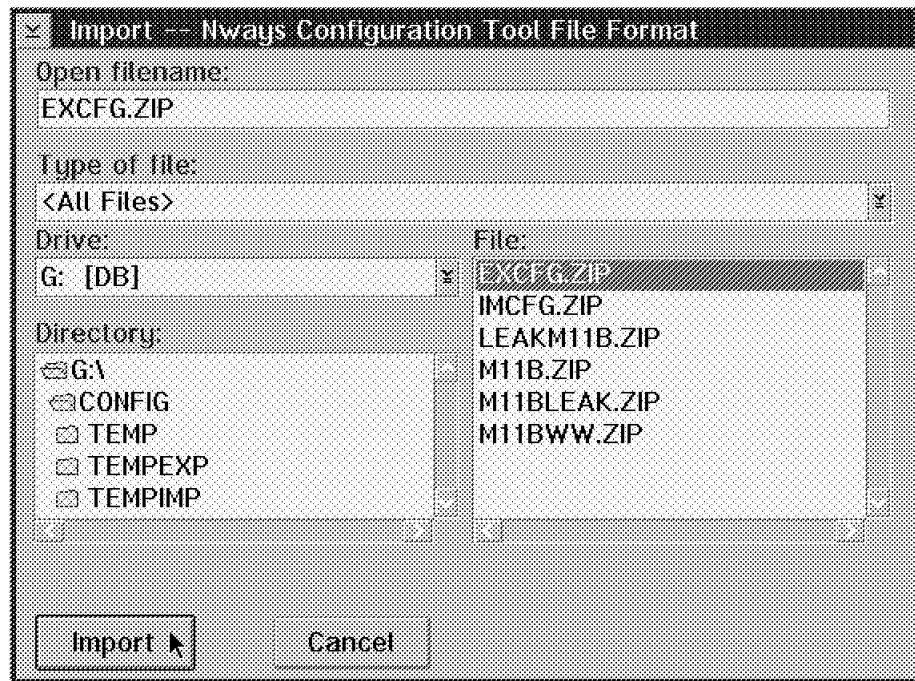
Figure 194. NCT Import from Nways Configuration Tool File Format

The system will check whether the file you want to import already exists in your NCT. If it does, you will have to delete the existing one before you can successfully import the new one.

6.5 Impact of NAS Failure

The NAS has an important role to play in the Nways Switch network operation, but, as important as it is, it is not a vital component of the network. Whenever the NAS goes down you will get the following result:

- No impact on the established traffic.

- Connection requests are still served except for manual connections.

- There is no network management information sent for this particular Nways Switch.

- There is no failure recovery possible for an adapter because its code is loaded by the NAS.

- The affected Nways Switch does not collect accounting information, but this accounting information is gathered by the Nways Switch at the other end of the active connections.

Even though the impact of a NAS failure is not vital to the network, it is still important to correct the situation as soon as possible.

There is a NAS failure detection mechanism in the system. Periodic liveness queries are sent by the Network Management Station (NMS). You may

customize how frequently you want the Network Management Station (NMS) to check all the NASs.

Once a liveness query has failed, the rediscovery process of that NAS is started. The affected Nways Switch icon will switch to blue on the Network Management Station (NMS), and it will start to poll the NAS. Once the NAS is back up, the Network Management Station (NMS) will discover it and resume liveness queries with that Nways Switch.

There are five categories of NAS failures as follows:

1. NAS software failure with a successful recovery
2. NAS software failure with a partial recovery
3. NAS software failure with no recovery
4. NAS disk failure
5. NAS hardware failure

6.5.1 NAS Software Failure with a Successful Recovery

In this case the NAS will try to reboot automatically and then re-synchronize with the adapters. If it is successful, then the Network Management Station (NMS) will, after some time, rediscover this Nways Switch and turn its icon green or yellow.

The time for the reboot plus the time for the Network Management Station (NMS) to rediscover the Nways Switch is highly dependent upon the configuration and may take several minutes.

6.5.2 NAS Software Failure with a Partial Recovery

If the Nways Switch Administration Station (NAS) cannot reboot but OS/2, TCP/IP and NVDM/A can, the Change Control Server (CCS) administrator will be able to reconnect to the NAS and request the backup code to become the active one.

6.5.3 NAS Software Failure with No Recovery

In the case where the NAS cannot reboot and there is no recovery, a service call will be placed for someone to go on site and investigate the problem. That person would restore the primary disk from the backup disk.

6.5.4 NAS Disk Failure

In the case of primary disk failure, a service call should be placed and the service person should bring an unformatted primary disk. Once on site, they will boot from the backup disk, format the primary disk, restore it and finally reboot from the new primary disk.

After the IPL is complete, your Change Control Server (CCS) administrator should download and activate the latest copy of the software if not already installed on the backup disk. Normally the primary disk is backed up every day automatically to the second disk. The default time is 1 a.m. This time can be changed by installing the NAS.

6.5.5 NAS Hardware Failure

As for any other hardware problem, a service call should be placed for problem resolution.

6.6 Degraded Mode Operation

There are components other than the NAS that may fail at one point or another, but, as is the case for the NAS, they all have a limited impact.

An adapter can fail in which case the NAS will automatically try to reload it. If unsuccessful, an alert will be sent to the Network Management Station (NMS) and the NAS will show the status of the adapter. This specific adapter could be replaced by a spare or a new one by local personnel since all these adapters are hot pluggable. As soon as the new adapter is plugged in, the NAS will automatically try to reload it.

Depending on the adapter that fails, the impact will be different. For instance, a port adapter failure will affect all devices connected to it. A trunk adapter failure will affect all the traffic going through it unless you are using the nondisruptive path switching and there is an alternative route available. In this case the network will automatically re-allocate the bandwidth and traffic.

Finally, the failing adapter may be a control point adapter. If you have a redundant model, the backup control point will automatically take over. If not, there is no impact on the established traffic. Again, in all these cases, a spare or new adapter or less critical one may be put in the place of the failing one and will automatically be recognized by the NAS; it will be reloaded with the appropriate software.

6.7 NAS Operation Commands

Even though the Network Management Station (NMS) will be the primary operation console, similar operation actions may be performed either locally or remotely from the NAS. The following two illustrations show our M11B Nways Switch Resource Control screen:
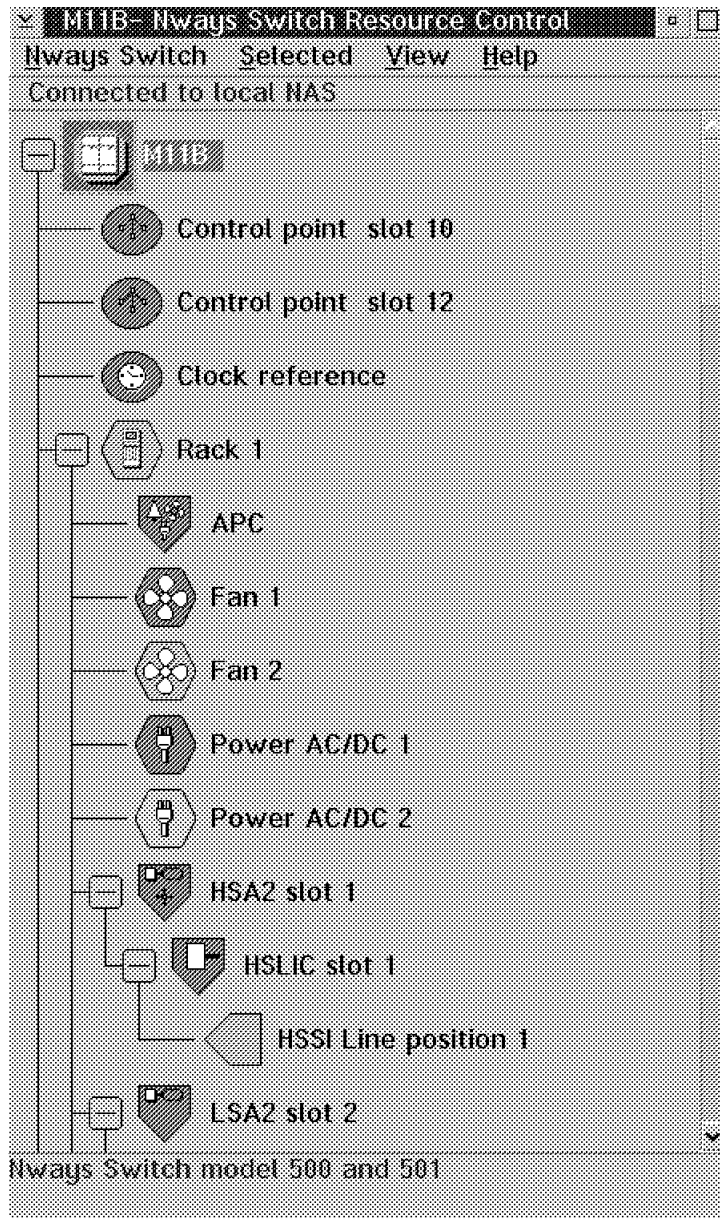
Figure 195. Connected to Local NAS

In the previous screen you can see the M11B Nways Switch icon with the two control points, the clock reference and the rack icons. Under the rack icon you can see the alarm and power control cards, the two fans, the two power supplies and finally all the adapters, LICs and lines.
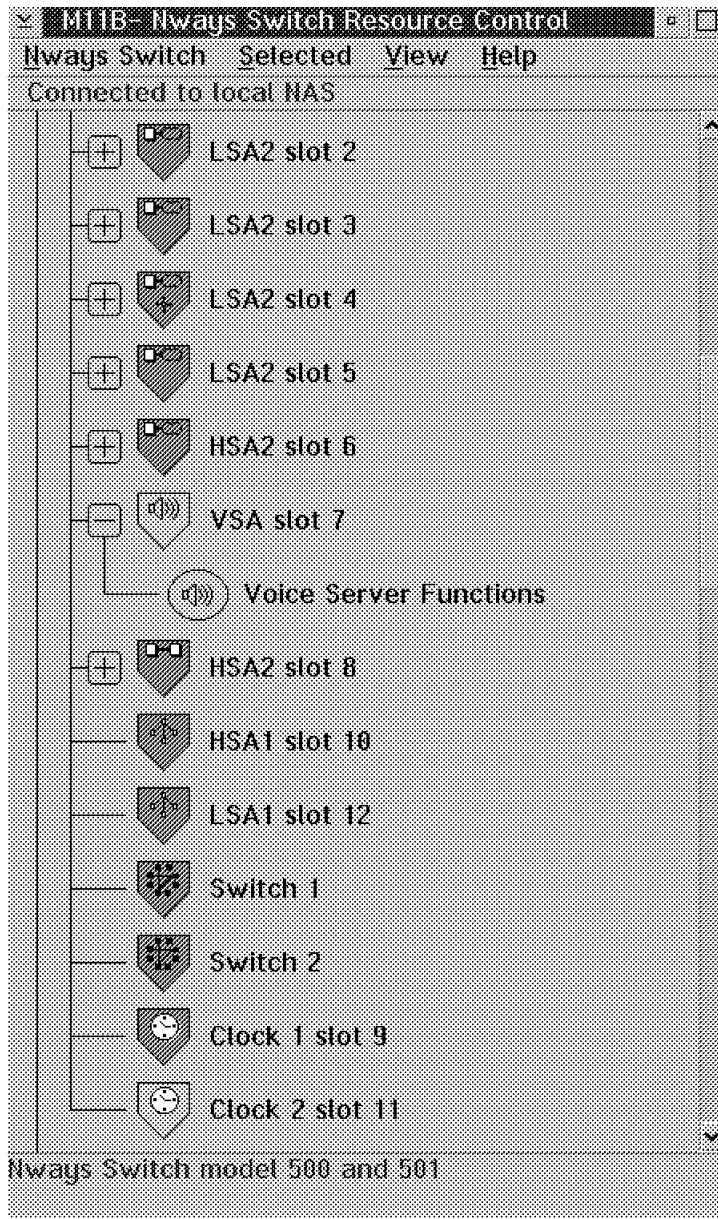
Figure 196. Nways Switch Resource Control

Figure 196 shows the rest of our adapters, LICs, and lines, as well as our two switches and clock cards. The following colors are used to indicate the status of an object represented by an icon:

- Green means that everything is normal and the resource is operational.

- Yellow means a marginal status and the resource is partially available.

- Red means a critical status and the resource is unavailable.

- Blue means the resource is unknown.

6.7.1 Status Display

The way to display the resource is to select an icon and to click the right-hand mouse button. This will bring up a small menu next to the icon where you may select **Open** and **Status** as follows:
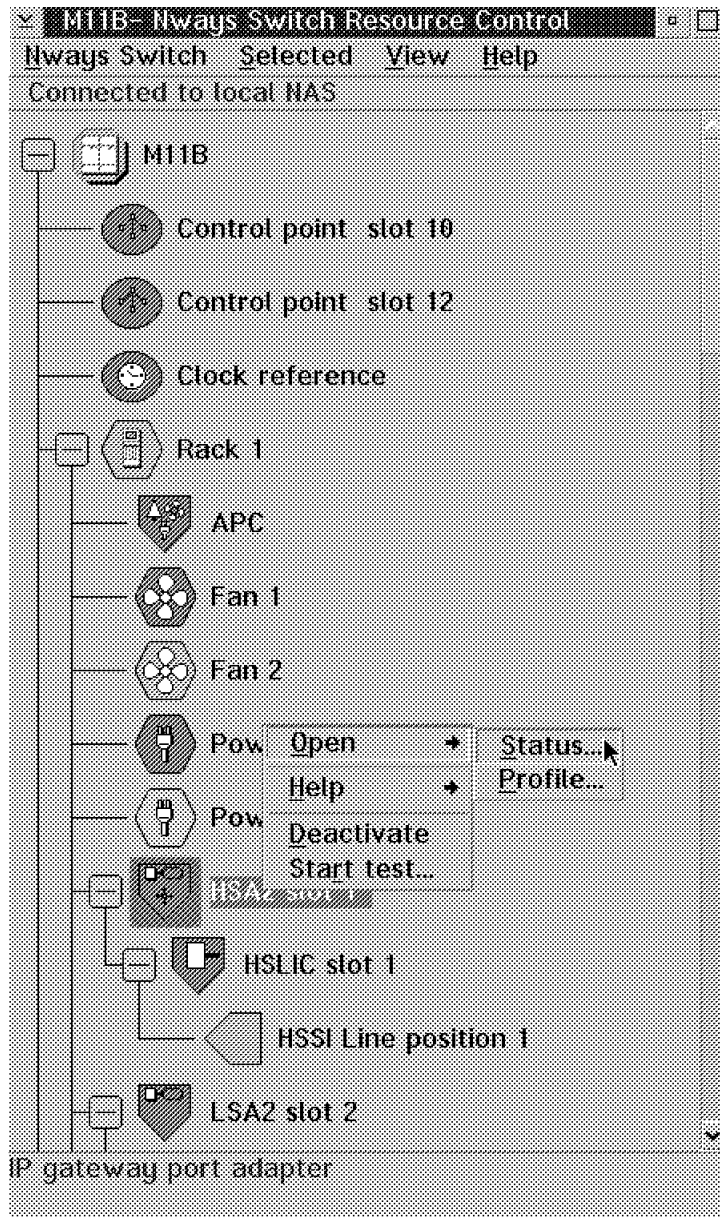
Figure 197. Show Resource Status

Selecting status will display another panel showing the current status of the device, as follows:
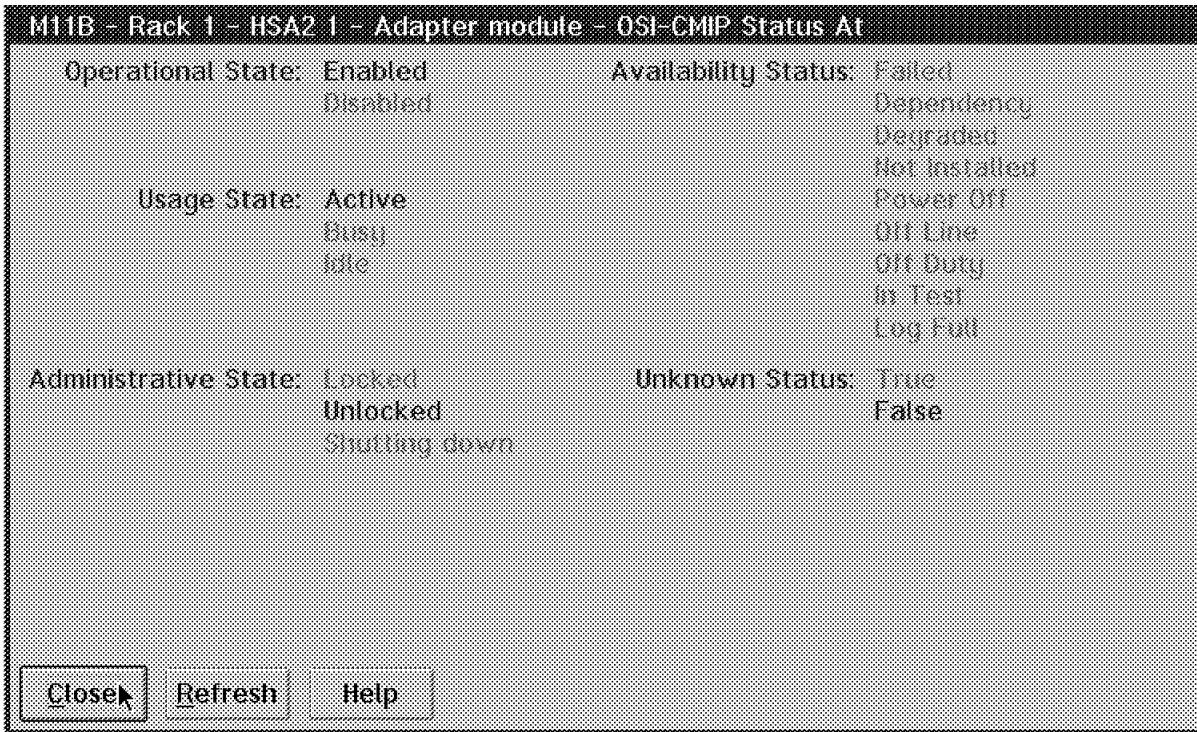
Figure 198. OSI-CMIP Status Attributes

As you can see, our device is currently Enabled, Active and Unlocked. For more information about the various status meaning please select the **Help** button.

If you select the **Profile** option instead of Status, you will get the following panel where you may see some useful information on the hardware and software of the adapter itself:
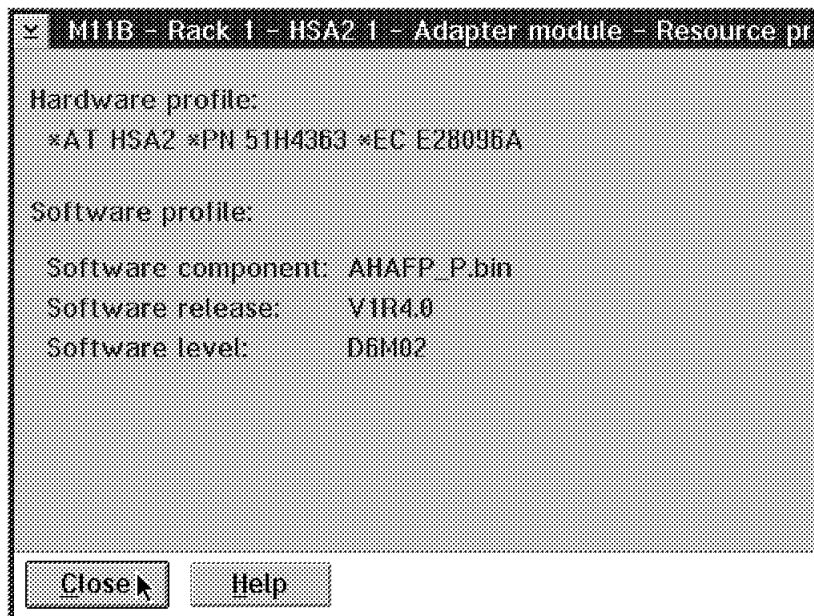
Figure 199. Resource Profile

6.7.2 Module Activation and Deactivation

There may be cases where you will need to deactivate a module. To do that you must again select the appropriate icon and click on the right-hand mouse button which will bring up a small menu next to the selected module. Select the **Deactivate** option.
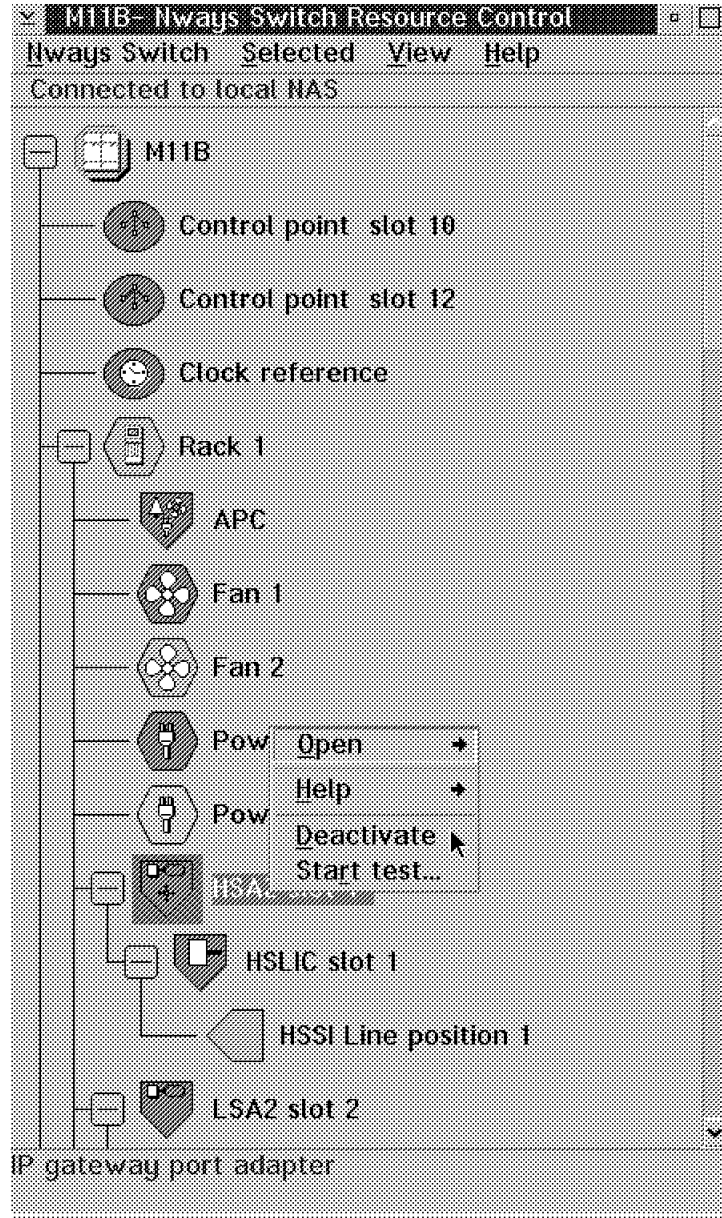
Figure 200. Show Resource Information

Because this action will impact the traffic on the module, the system will issue the following warning message before it deactivates the module:
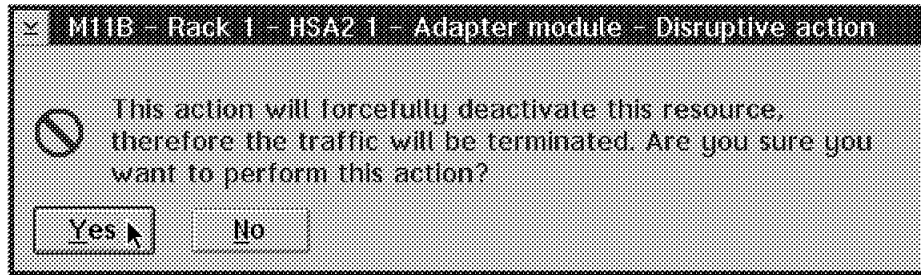
Figure 201. Disruptive Action

If you select the **Yes** button, the system will proceed with the deactivation of the module and will issue the following message:
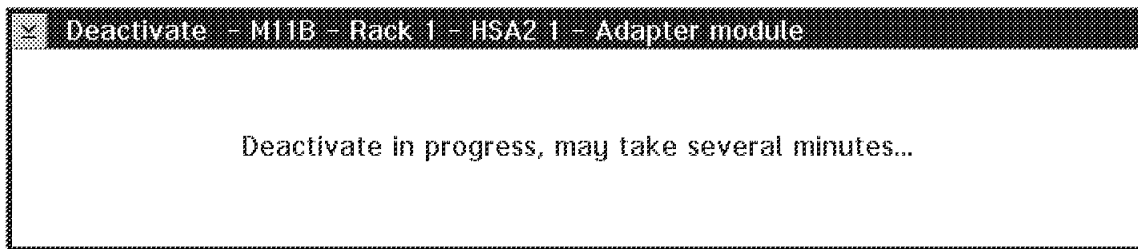
Figure 202. Deactivation Message

When it is done, the color of the icon will be changed to indicate the current status (yellow). When ever you want to activate a module that is inactive, you may issue the activate command as indicated in the following illustration:
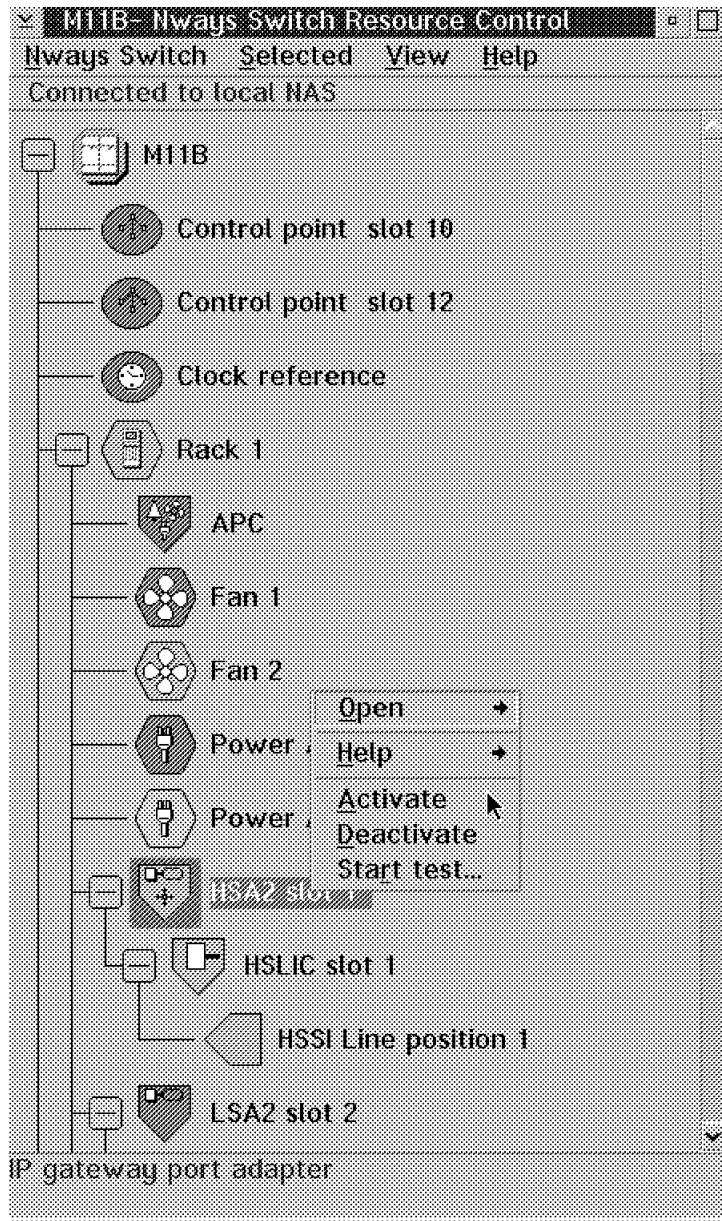
Figure 203. Show Resource Information

The following message is then displayed:
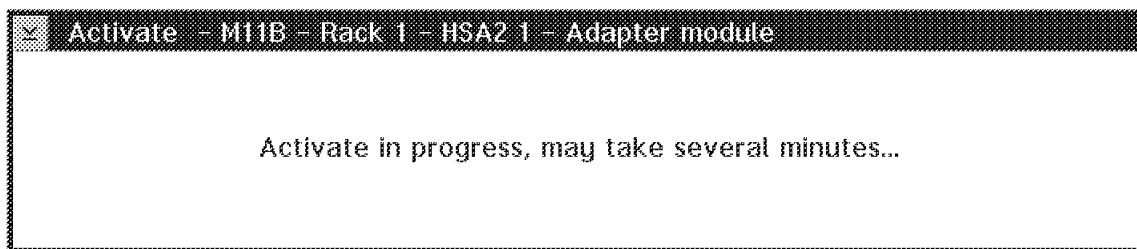
Figure 204. Activation Message

When the action is complete, the color of the icon will be changed to green to indicate a normal status.

6.7.3 Module Testing

Several tests are possible on the adapters (with or without a wrap plug). These tests will help in problem determination. Whenever you need to perform such a test, you must start it as indicated in the following:
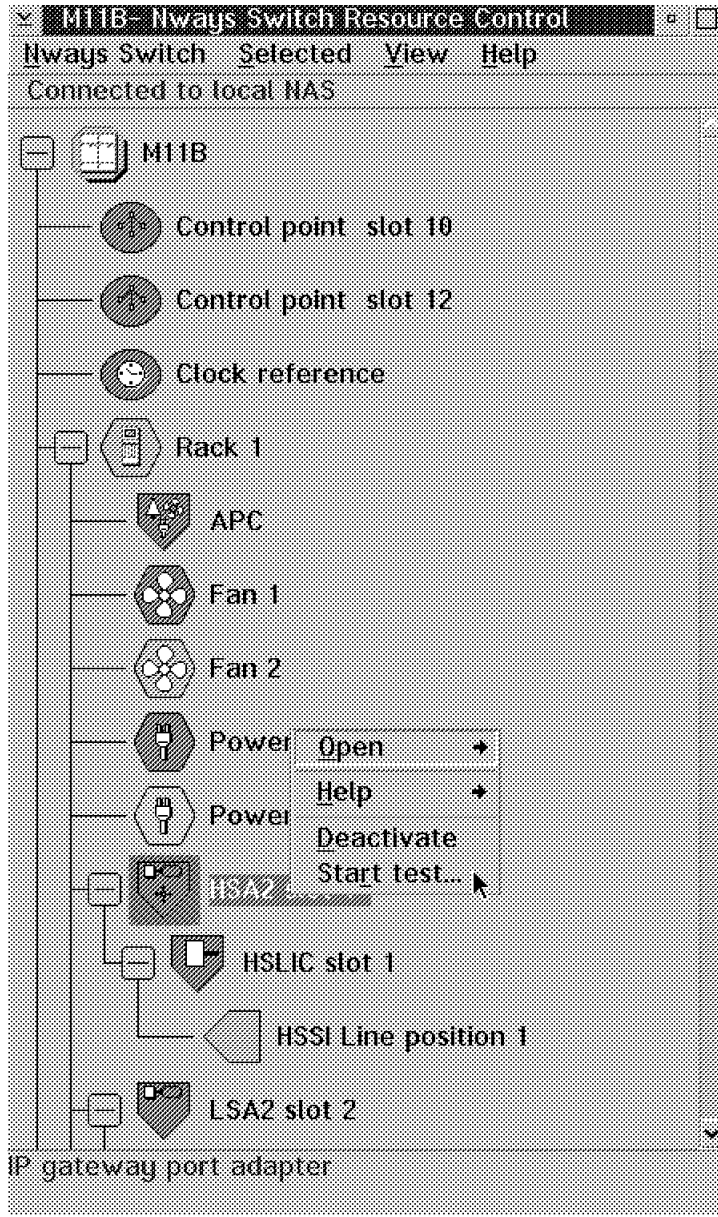
Figure 205. Module Testing

The system will then offer you a choice of tests and ask for some parameters as indicated in the following:
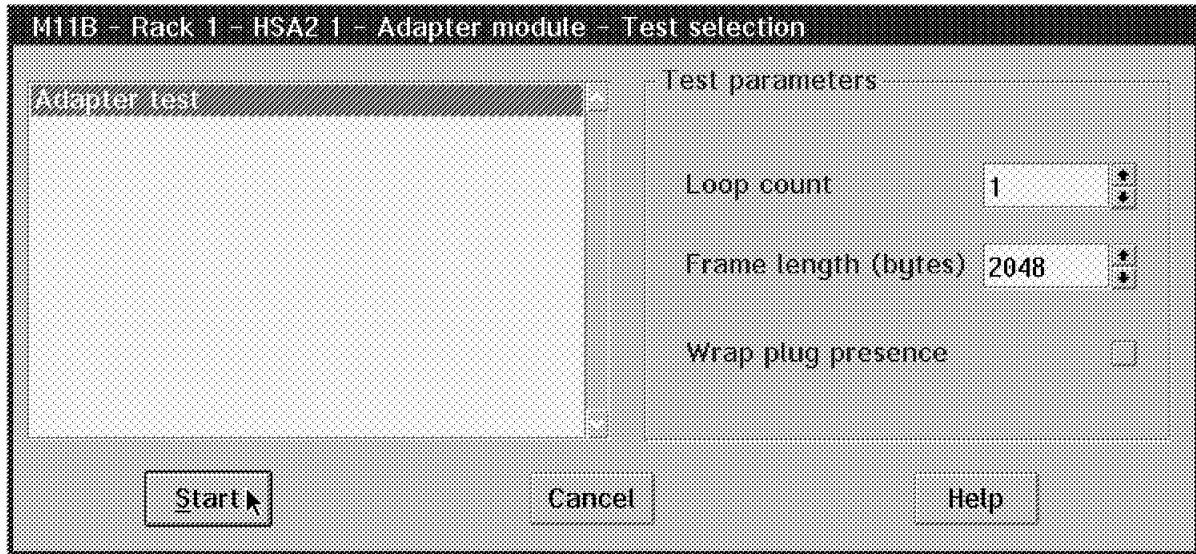
Figure 206. Test Selection

In this specific example, the only test available was an adapter test which we selected. You also need, for this specific test, to indicate the number of times you want the test to run as well as whether or not you are using a wrap plug during the test. After you select the **Start** button, the system will issue the following warning message twice to indicate that the test will affect the traffic on this specific module:
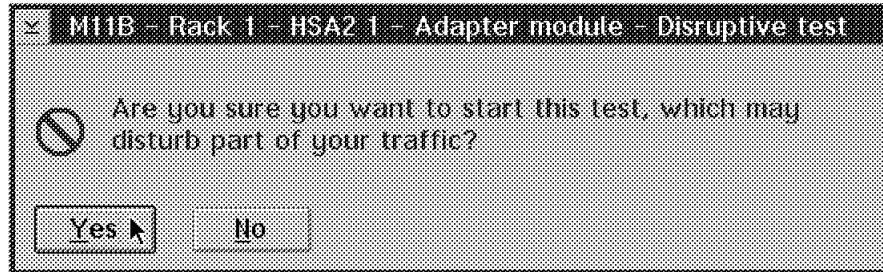
Figure 207. HS Adapter Slot 1 Disruptive Test

The system will then open the following Test Event Desk window where you see the status as well as results of the test being performed:

Resource	Status	Loop count	Error count. Not used for Runalls	Local date and time	
HSA2 slot 1	Started	0		1996/12/02 14:57:07	

Figure 208. Test Event Desk

Whenever you are done with the testing, you may stop the tests as follows:
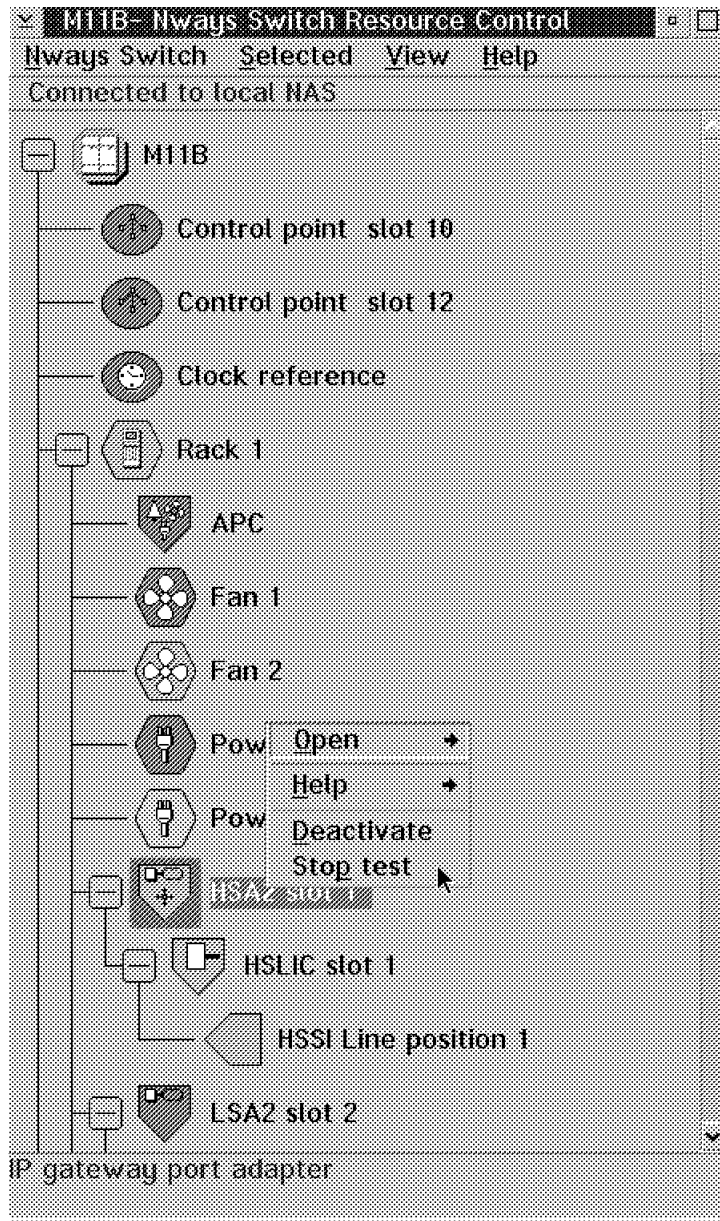
Figure 209. Show Resource Information

Whenever the action is complete, the system will issue the following message:
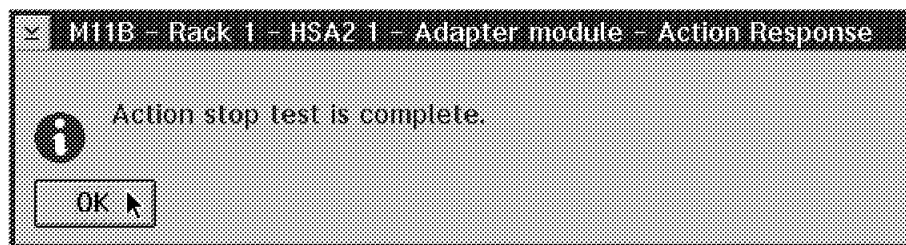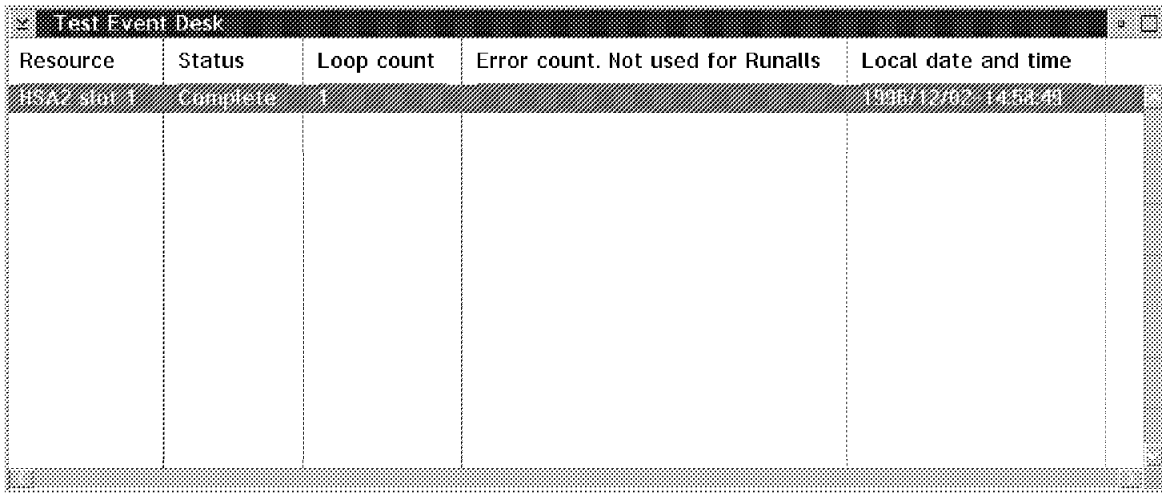
Figure 210. HS Adapter Slot 1 Action Response

When the test was started, the system opened a Test Event Desk panel where you can see the status and results of the test. The following illustration shows

the result of our test that ran once (as we asked) and where no error was detected:

Resource	Status	Loop count	Error count. Not used for Runalls	Local date and time
HSA2 slot 1	Complete	1		1996/12/02 14:53:49

Figure 211. Test Event Desk

6.7.4 Module Locking

You may need to gracefully stop traffic on a module. To do this you may issue the lock command for that purpose. This will prevent new traffic from being sent on the adapter, and wait for the one under way to resume. Then it will update the color of the icon to yellow. Whenever you want to lock a module, you can select the **Lock** option as follows:
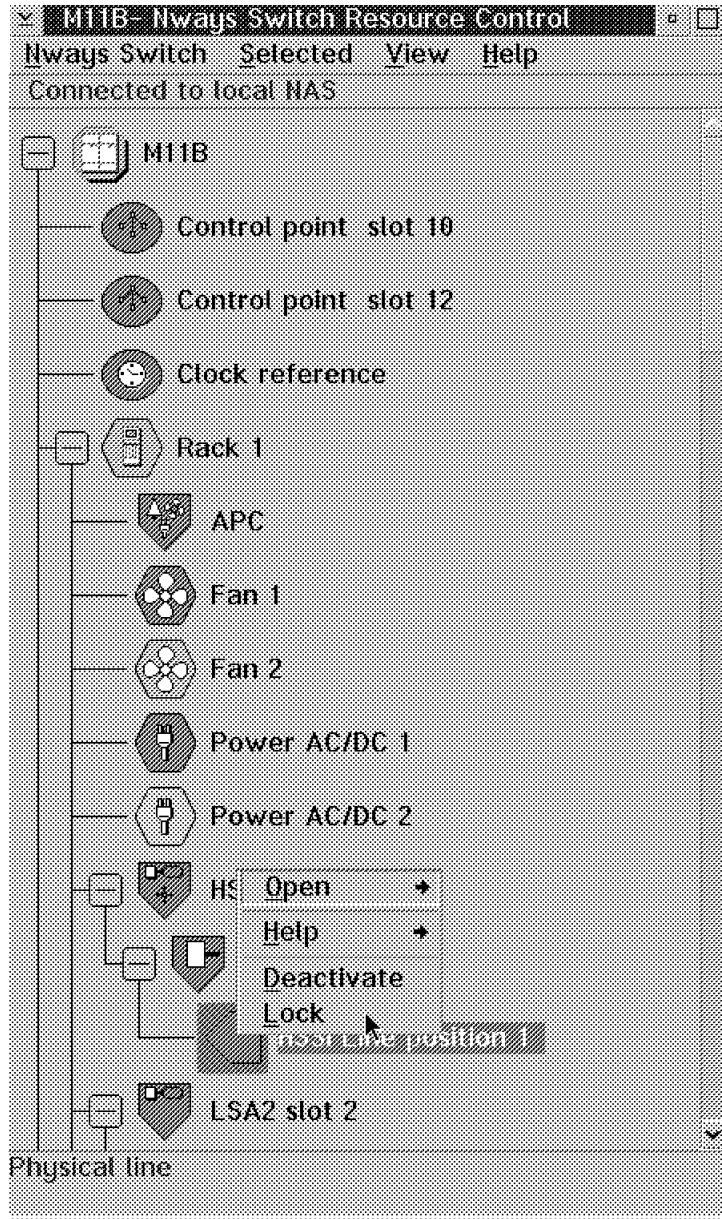
Figure 212. Select Lock

When the action is complete, the system will issue the following message:
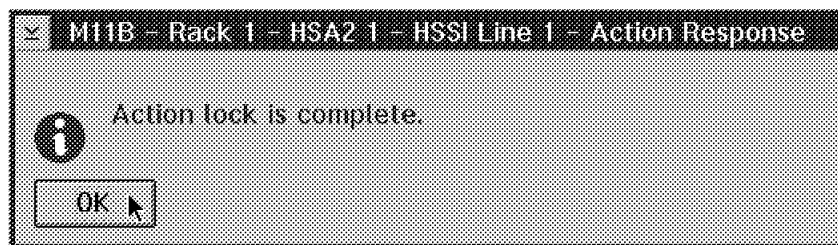
Figure 213. Action Lock Is Complete

Once a module has been locked, you may unlock it with the unlock command that is issued just as the lock was.

6.7.5 Module Switchover

Whenever there is a problem with an adapter that is redundant, the system will automatically switch over to the standby adapter. You may want, for preventive maintenance reasons, to manually force a switchover.

There is a switchover command available for every redundant adapter that you can select. Here for instance, we illustrate how we switched from switch 1 to the backup switch. The following illustration shows the status of the switch 1 module as being the one providing services:
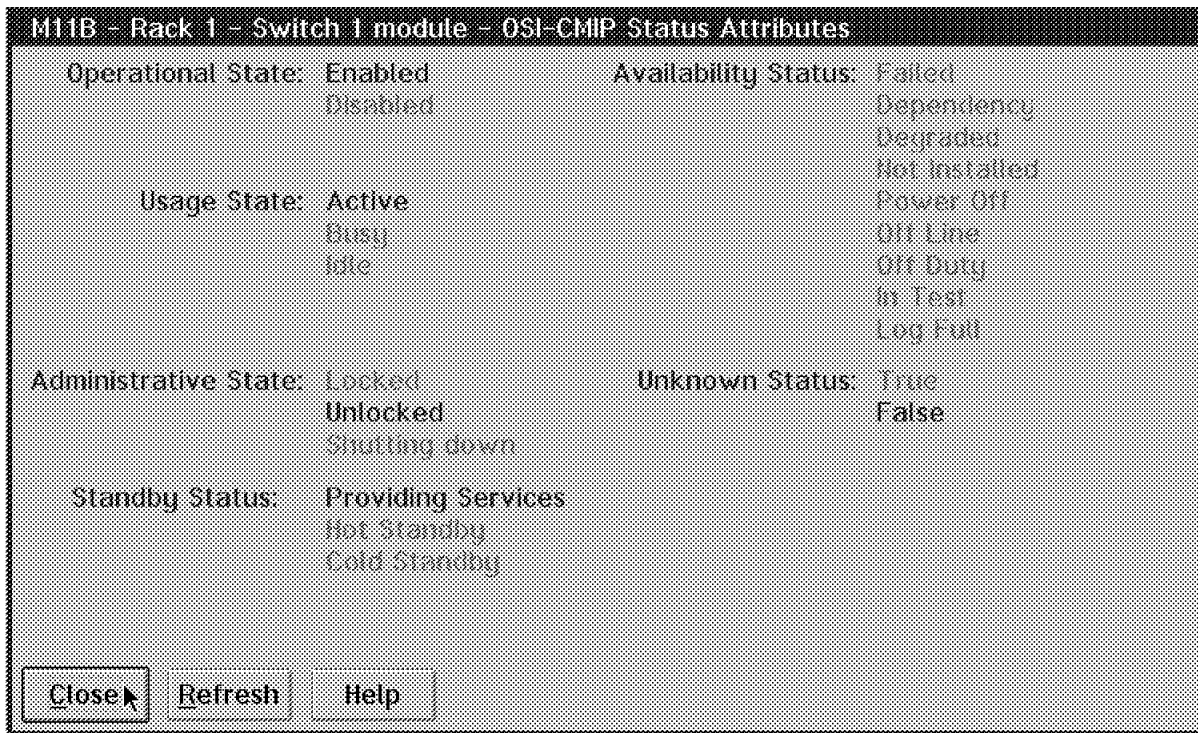
Figure 214. Status of Switch 1 Module

We then selected the **Switchover** option as follows:
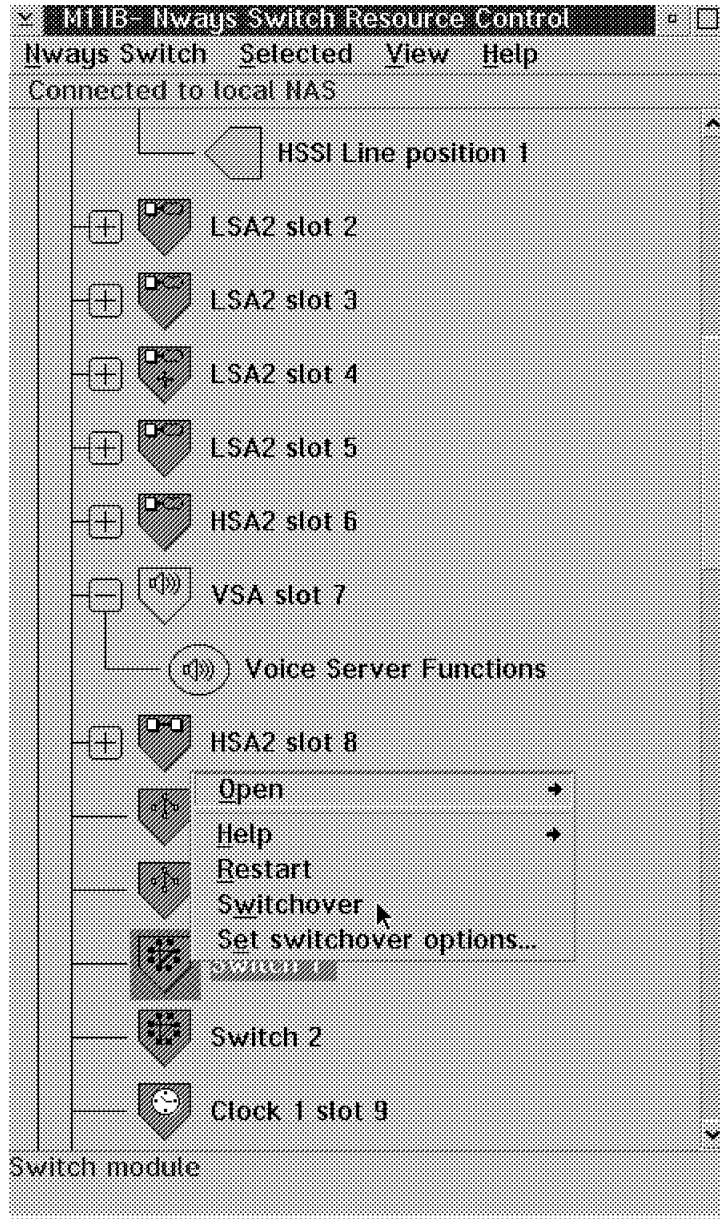
Figure 215. Selecting the Switchover Command Option

Once the switchover action is complete, you get the following message:
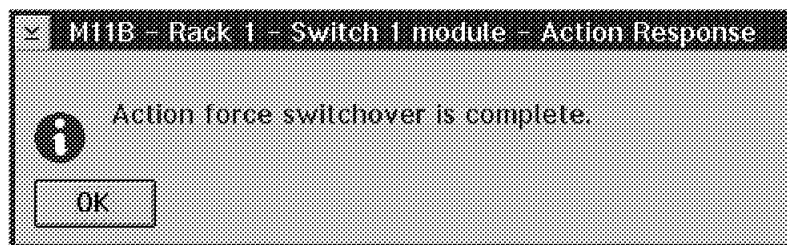
Figure 216. Switch 1 Action Response

You can now see that the new status of our module is Hot Standby:
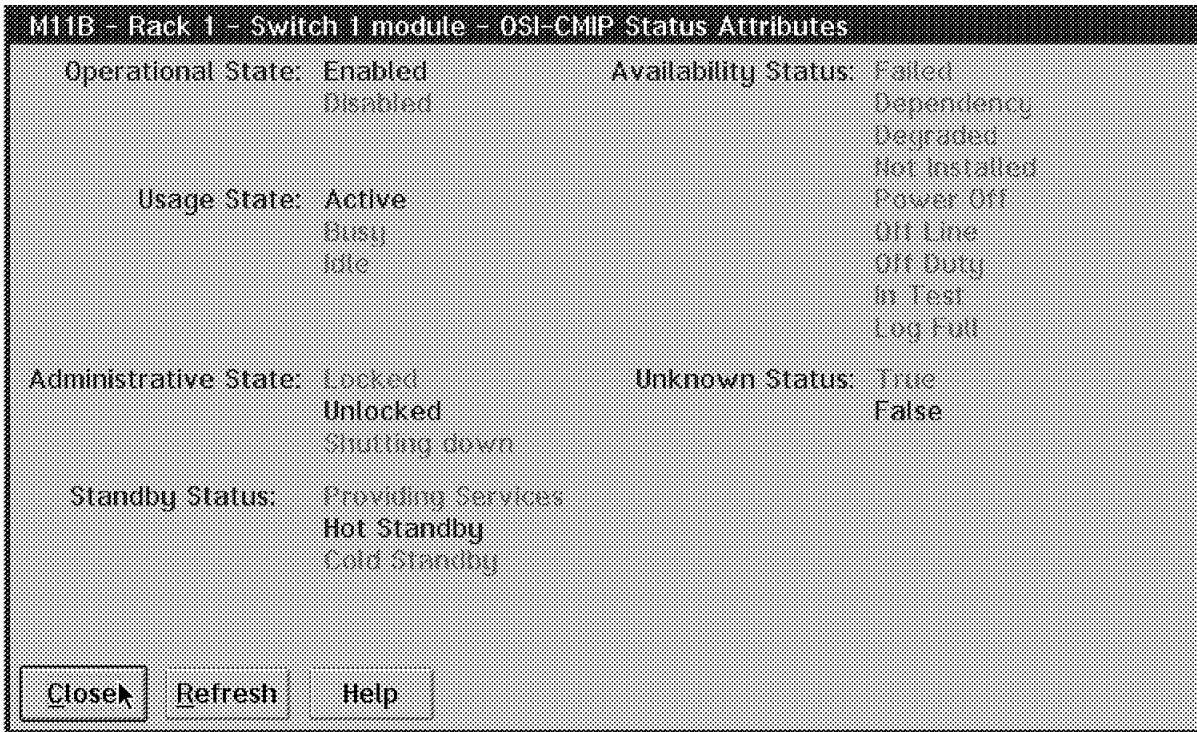
Figure 217. Hot Standby Status

Because of the importance of the switch itself, you can see in Figure 215 on page 225 an added option that allows you to set some options for the switchover. This will display a panel that allows you to authorize or inhibit the switchover as illustrated in the following:
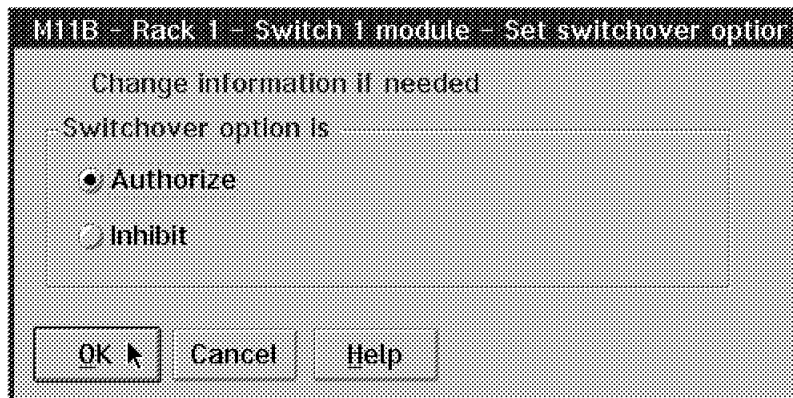
Figure 218. Set Switchover Options

6.8 NAS Security

Three NAS access levels are assigned as follows:

1. **NAS users**: The persons who use the NAS functions locally or remotely. The NAS users are authorized to change their passwords.

2. **Superuser**: The person who manages the NAS passwords. The superuser is authorized to log on remotely and to change the NAS user and superuser passwords.

3. **IBM NSC**: IBM asks your authorization and NAS user password, and logs on with a password (computed from your NAS password) that gives access to advanced service facilities. IBM cannot change passwords.

6.8.1 Change NAS Password

This function is available locally or remotely. If you want to change the NAS user password, select **Change NAS Password** on the Nways Switch Resource Control window:
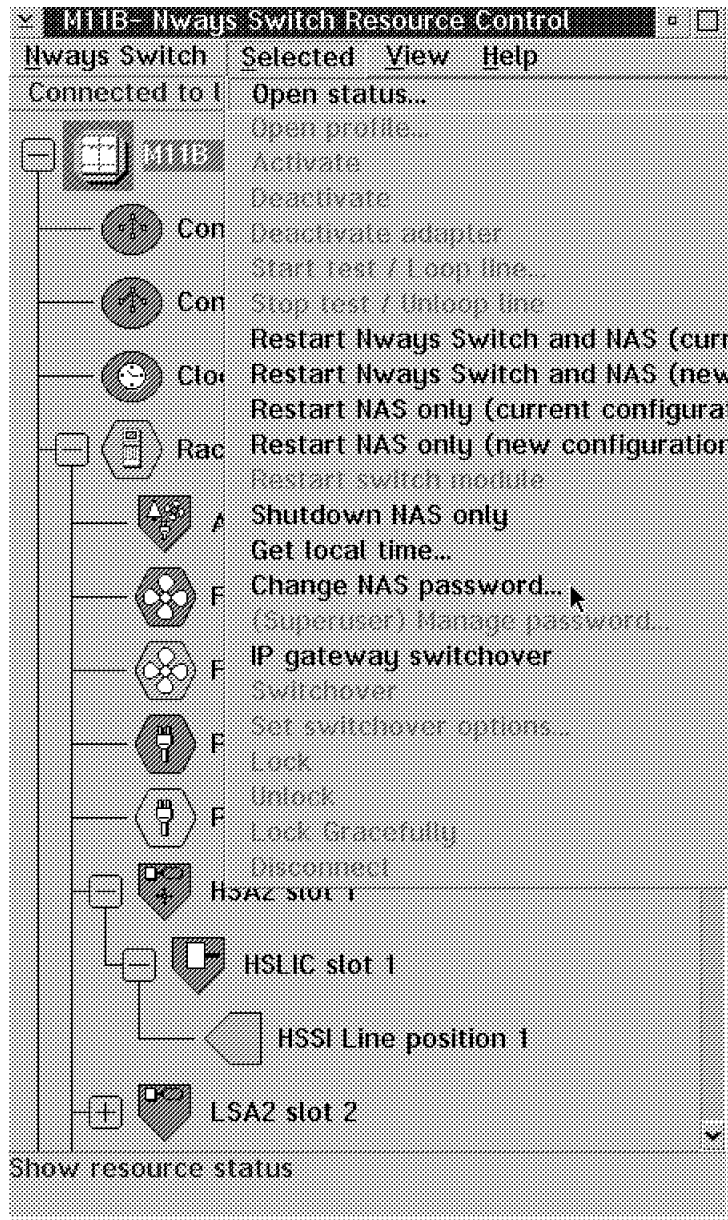
Figure 219. Changing NAS Password

This will display the following panel that allows you to change the password for the user *clipper* (default value that cannot be changed):
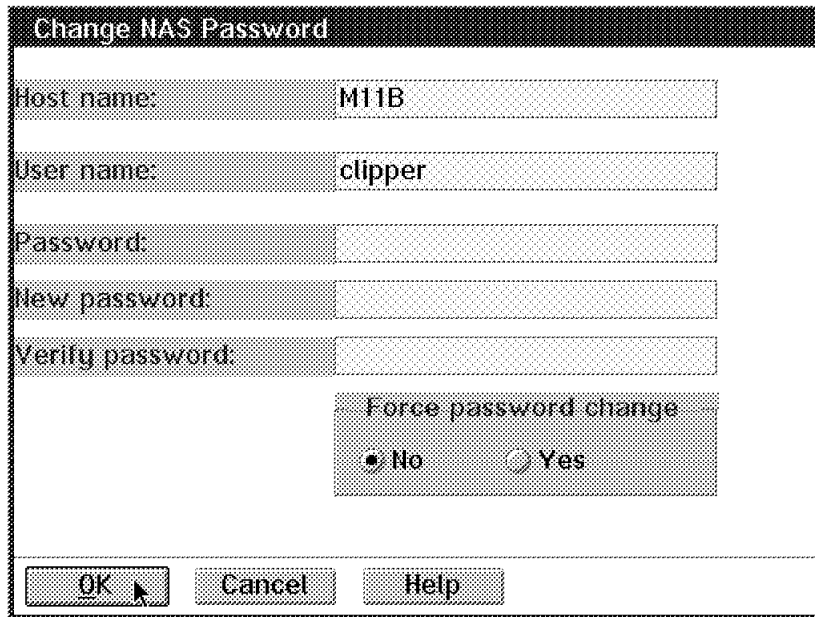
Figure 220. Change NAS Password Menu

6.8.2 Changing Superuser Password

If you are superuser, initialize the NAS passwords from a user remote console as follows:

1. Log on to a remote NAS (see 6.9, "Remote Logon" for more details). Fill in the user name with clipper (mandatory) and with the default password *soleil*.

2. In the Resource Control main window, select **Change NAS password**. You will change the password for the user clipper. When Change NAS Password is run for the first time, a warning message indicates that new user names are created (*suprusr* and *ibm2220*) with their associated default passwords. Also the superuser function for managing the passwords becomes available.

3. Now you can select the **(Superuser) Manage Passwords** function. Change the password for *suprusr* (mandatory). The old default password is *suprpwd*.

You are now allowed to manage NAS user and superuser passwords.

6.9 Remote Logon

You may, at some point, want to remotely log on to another Nways Switch NAS. In order to do this, you must double-click on the **Nways Switch Resource Control (Remote)** icon in the Nways Switch Services folder as follows:
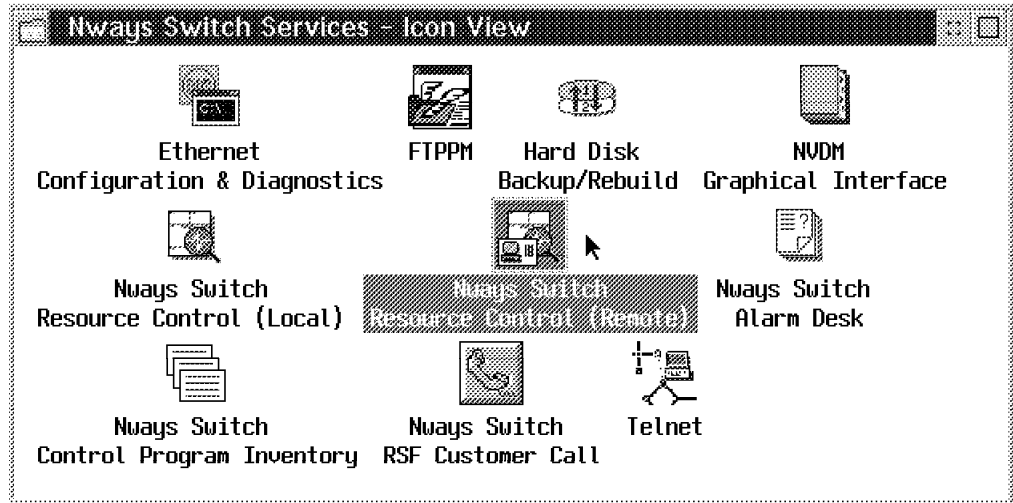
Figure 221. Nway Switch Services Icon View

The following example shows how, from the M11B Nways Switch NAS, we were able to remotely log on to the M10E Nways Switch NAS.

Note: You can do this only if the host file in C:\mptn\etc has been modified with the name and address of the Nways Switch.
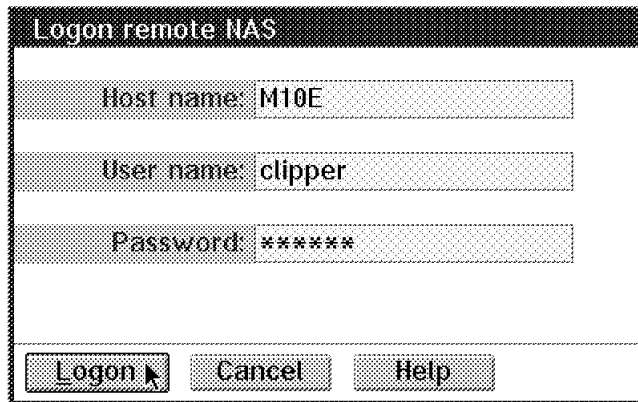
Figure 222. Log on Remote NAS

As soon as you are logged on, you will get the following message:
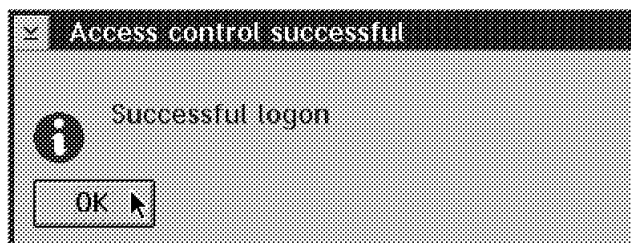
Figure 223. Successful Login

You will be able to see the M10E Nways Switch resource control panel as follows:
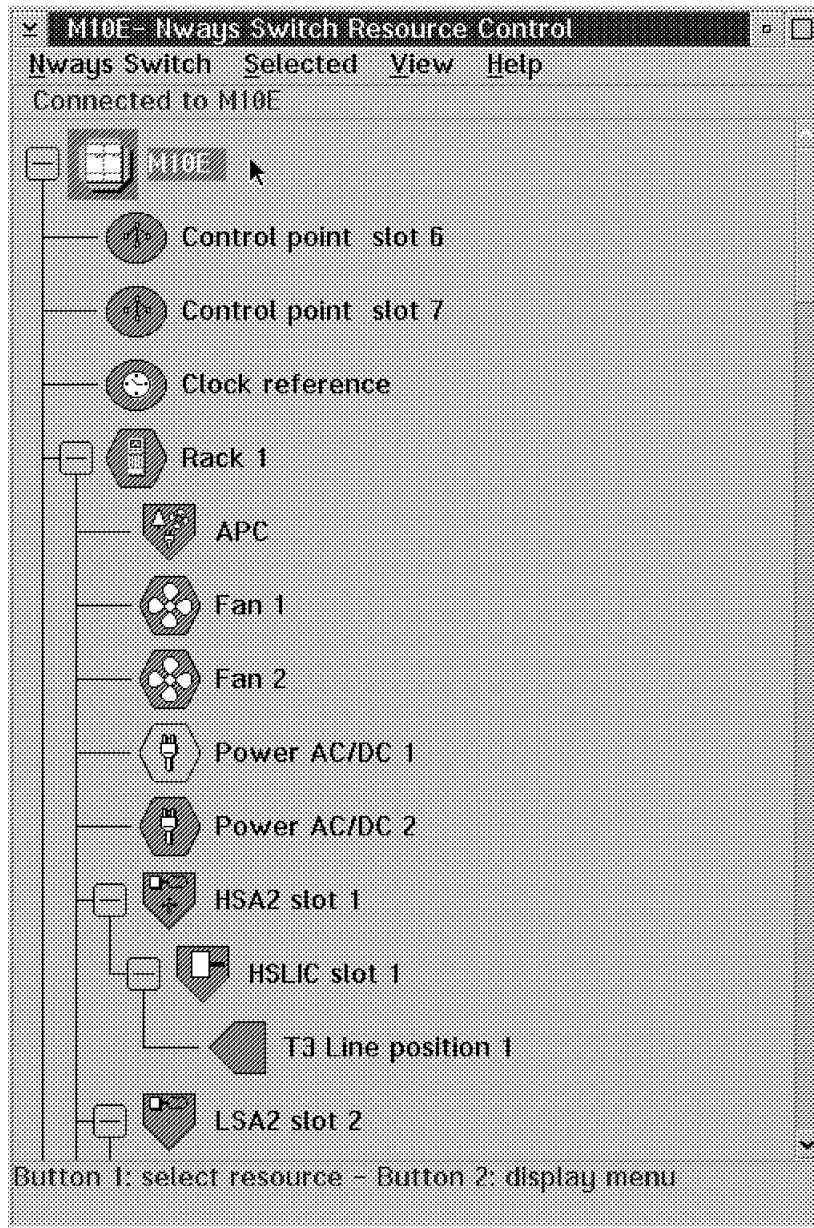
Figure 224. Showing Connected to M10E

You may then run the same commands as on your local Nways Switch. You may log off at any time by double-clicking on the top left-hand corner; the system will ask you to confirm as follows:
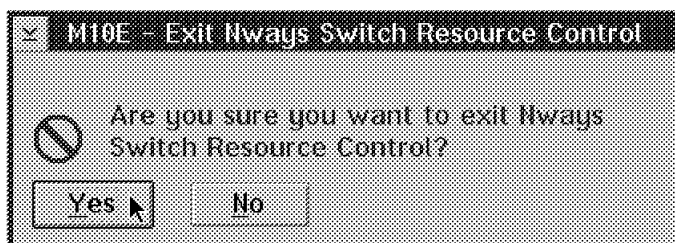
Figure 225. Confirmation on Exiting Nways Switch Resource Control

Chapter 7. Nways Switch Manager (NSM)

This section covers the Nways Switch Manager (NSM) for AIX.

7.1 Introduction

The Nways Switch Manager (NSM) for AIX program runs on top of TME 10 NetView for AIX or TMN/6000 1.3, and includes three programs to manage the resources of your network:

- Nways Switch Manager - To manage Nways Switches
- Router and Bridge Manager (RABM Version 2)
- Alert Manager

Nways Switch Manager allows you to manage the Nways Switches through a set of CMIP-based management functions. It provides a graphical user interface through which you can perform numerous management functions for your network resources.

The Nways Switch Manager (NSM) uses the OSI Common Management Interface Protocol and Common Management Interface Services (CMIP/CMIS).

Before using the program, be sure you feel confident with the TME 10 NetView for AIX graphical user interface, which is based on OSF/Motif and X Window System standards. Otherwise, refer to the related publications listed below. Consult the bibliography included at the end of this book for other related publications on this subject.

7.1.1 Starting the Nways Switch Manager (NSM) for AIX

To start the Nways Switch Manager (NSM), you have to enter nv6000.

Note: You could also start Nways Switch Manager (NSM) by entering startMA. This command file performs an UNSET on the LIBPATH before launching nv6000.

For further information, refer to the NetView for AIX or TMN/6000 documentation:

- *NetView for AIX V4R1 Installation and Configuration*, SC31-8163

7.1.2 The Submaps

The Nways Switch Manager (NSM) is not just one window where the application is running. The product is using a number of different windows on top of the TME 10 NetView for AIX or TMN/6000 1.3. Here those windows are called submaps. Some of those submaps are general, some are product-specific. In the following sections we give a short introduction to all the different submaps the Nways Switch Manager (NSM) can use.

7.1.2.1 The Root Submap

This submap is displayed when NetView for AIX is started, unless otherwise specified. The NBBS symbol indicates that the Nways Switch Manager is installed and running.
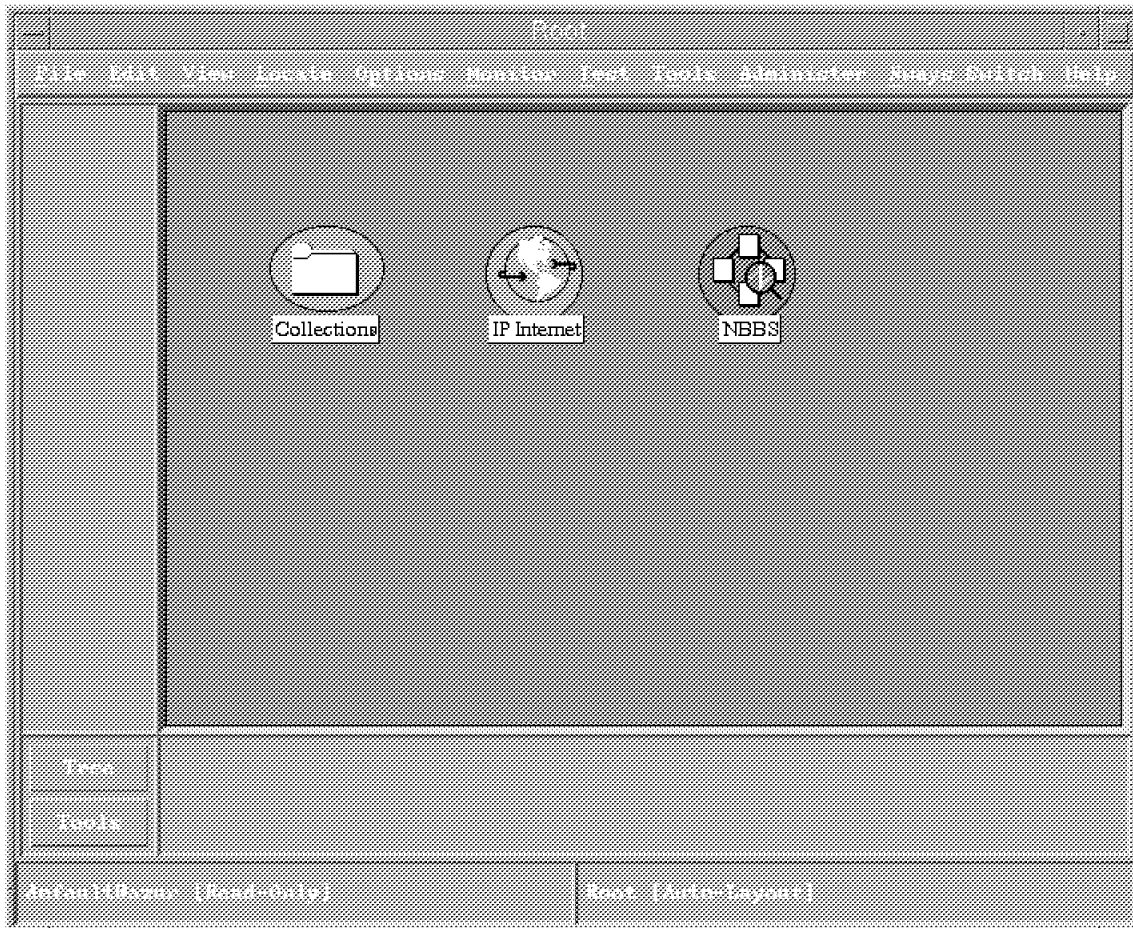
Figure 226. The Root Submap

The NBBS color conveys the collective status of the NBBS network that is managed by the current Nways Switch Manager (NSM). Double-clicking on the **NBBS** symbol displays another submap, referred to as the domain submap.

Several actions can be performed from the root submap by selecting pull-down menu options.

7.1.2.2 The Domain Submap
This submap is displayed after double-clicking on the **NBBS** symbol in the root submap.

Figure 227. The Domain Submap

This submap shows all the NBBS networks that are managed by the current Nways Switch Manager (NSM). Double-clicking on the **NBBS network** symbol displays another submap, referred to as the network submap. Several actions can be performed from the domain submap by selecting pull-down menu options.

7.1.2.3 The Network Submap
This submap is displayed after double-clicking on the **NBBS network** symbol from the domain submap.
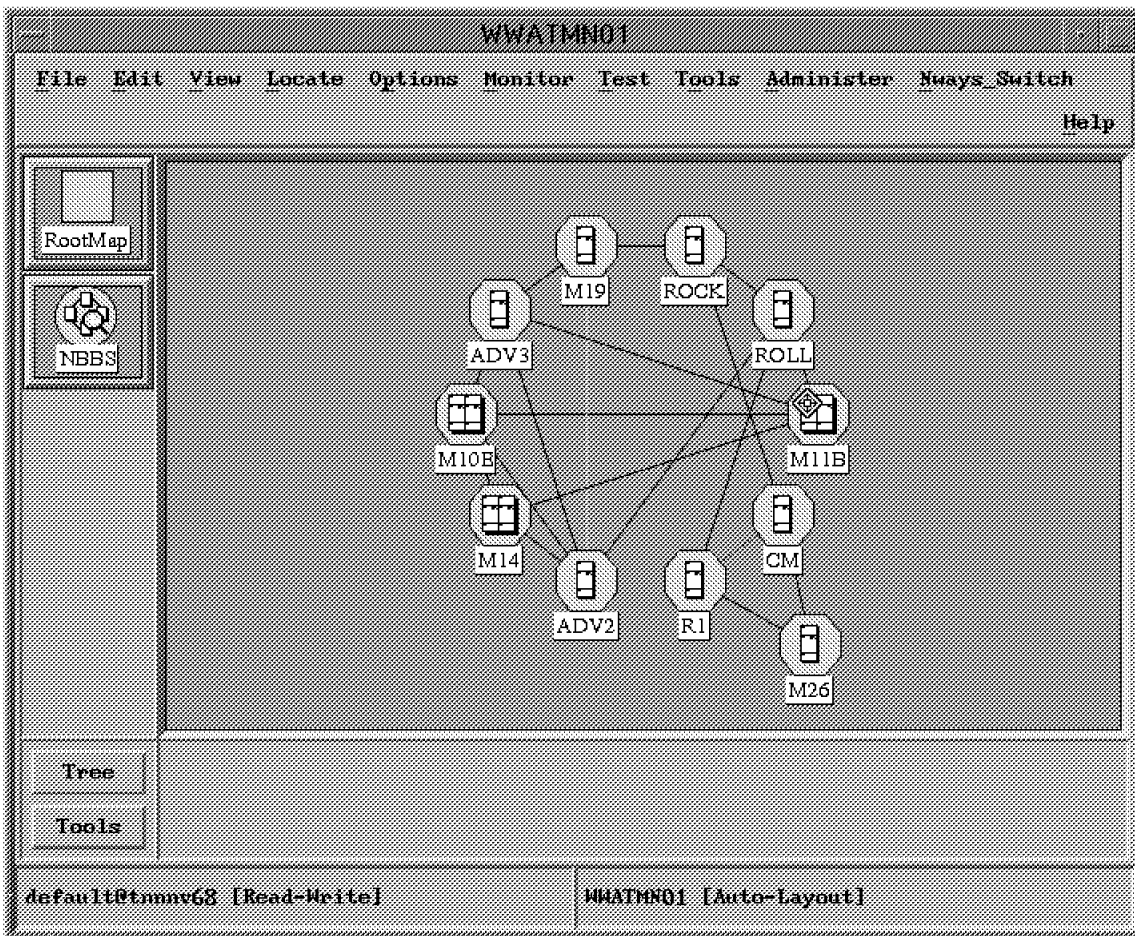
Figure 228. The Network Submap

This submap shows the nodes and trunks of the NBBS network previously selected.

Several actions can be performed from the network submap by selecting resources and pull-down menu options.

7.1.2.4 The Node Submap

This submap is displayed after double-clicking on the either node symbol from the network submap.
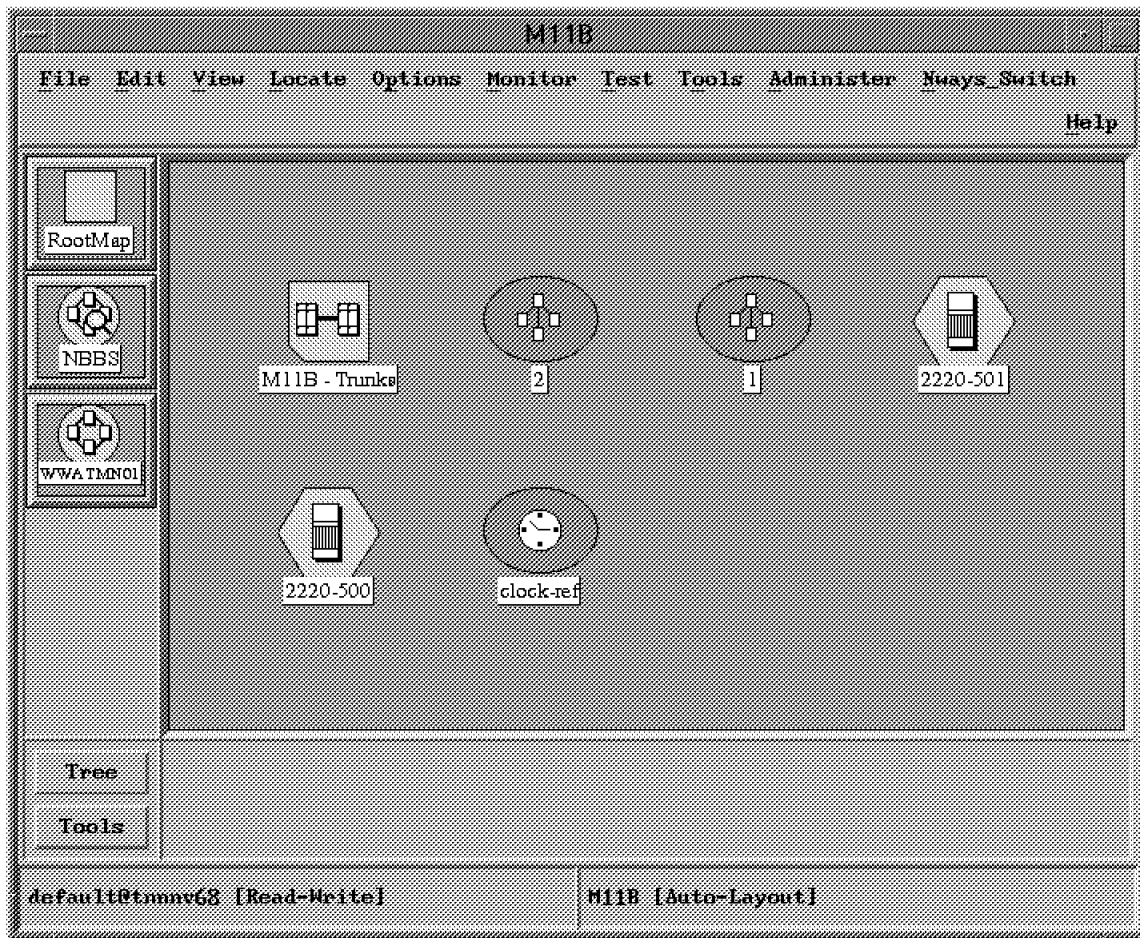
Figure 229. The Node Submap

This submap shows the trunks, the racks, the control points and the clock references of the node previously selected from the network submap. Several actions can be performed from the node submap by selecting resources and pull-down menu options.

7.1.2.5 The Rack Submap

This submap is displayed after double-clicking on the rack symbol from the node submap.
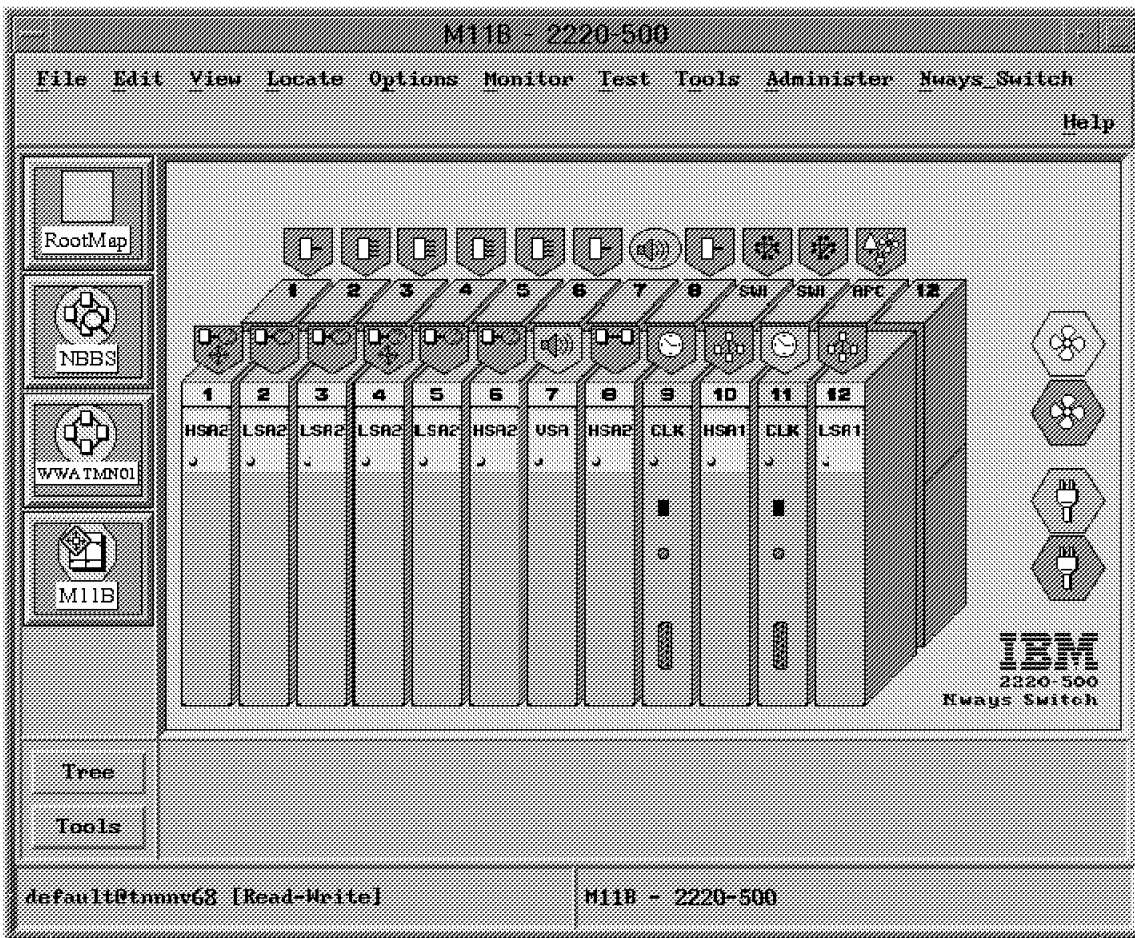
Figure 230. The Rack Submap

This submap shows the modules and other devices of the Nways Switch. Several actions can be performed from the rack submap by selecting resource(s) and pull-down menu options.

7.1.2.6 The LIC Submap

This submap is displayed after double-clicking a configured LIC from the rack submap.
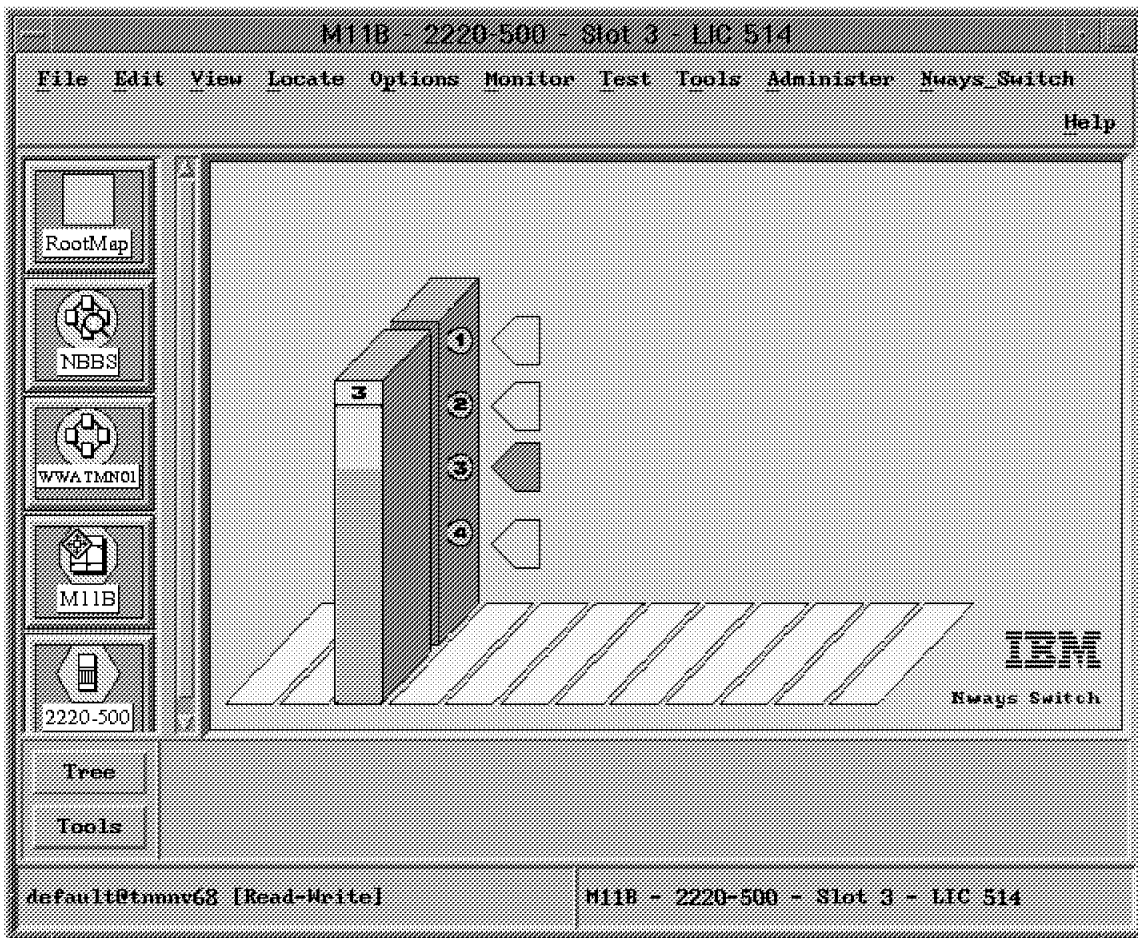
Figure 231. The LIC Submap

This submap shows the resources attached to the selected LIC. Several actions can be performed from the node submap by selecting resources and pull-down menu options.

7.1.2.7 The LCB Submap

This submap is displayed after double-clicking on the LCB symbol from the specific LIC submap.
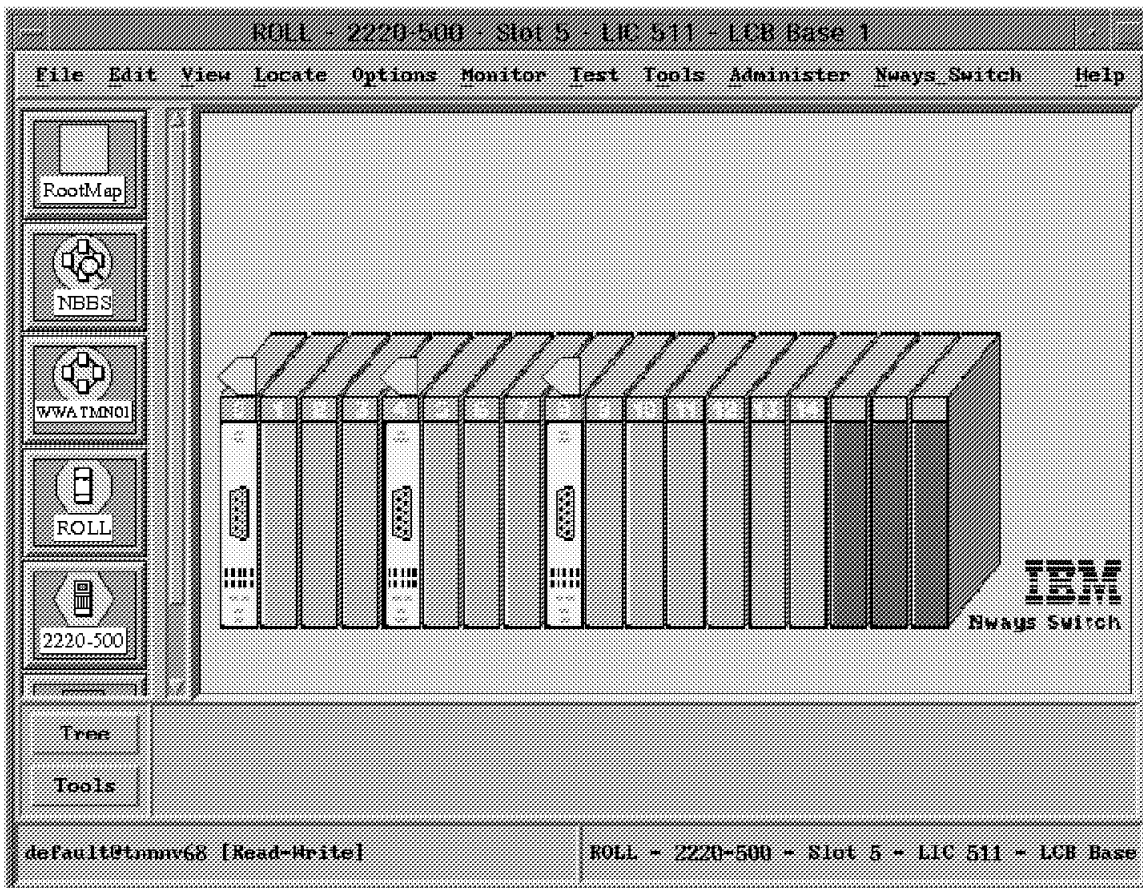
Figure 232. The LCB Submap

This submap shows the lines available from the selected LCB or pair of LCBs.

Several actions can be performed from the LCB submap by selecting resources and pull-down menu options.

7.1.3 Icons Used in the Nways Switch Manager

The purpose of this topic is to show you the icons used to represent physical and logical resources of the Nways Switch. Note that some of the resources depicted below are not discussed in this book. Also, keep in mind that when using the Nways Switch Manager (NSM), you can at any time display the legend from the Help pull-down menu. The legend gathers all the symbols used by NetView and the applications running under NetView.

500_Rack.ico

501_Rack.ico

Power.ico

Fan.ico

Line Connection Box
(LCB).ico

Switch
Module.ico

Control Program (CP)
Adapter Module.ico

Clock
Module.ico

APC
Module.ico

Trunk
Adapter Module.ico

Trunk-CP
Adapter Module.ico

Voice Server
Adapter Module.ico

Voice Server
LIC Module.ico

Port
Adapter Module.ico

Port-Gateway
Adapter Module.ico

ATM
LIC Module.ico

Line.ico

1 interface
LIC Module.ico

2 interfaces
LIC Module.ico

4 interfaces
LIC Module.ico

8 interfaces
LIC Module.ico

Figure 233. Icons Used to Show Physical Resources of the Nways Switch

Protocol.ico

Network.ico

500_Node.ico

501_Node.ico

Control Program (CP)
Function.ico

Clock References
Function.ico

Voice Server (VS)
Function.ico

Logical Trunk
Container.ico

Logical
Trunk.ico

Logical Port
Container.ico
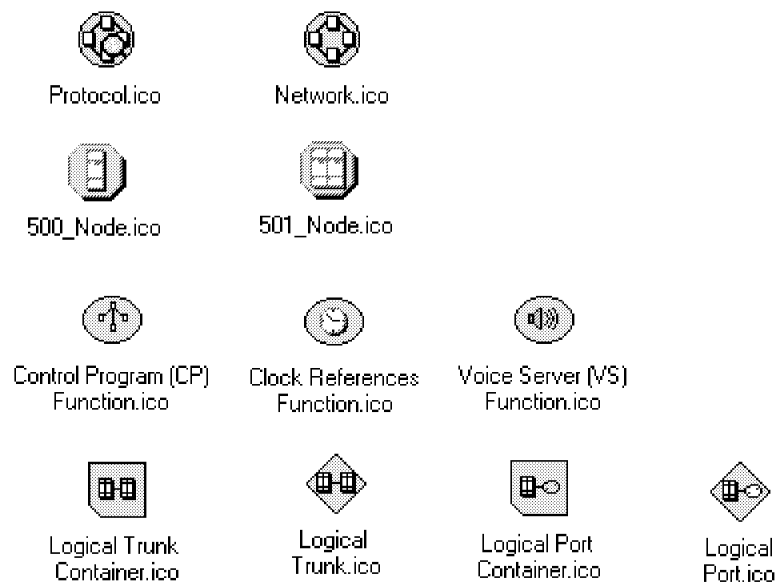
Logical
Port.ico

Figure 234. Icons Used to Show Logical Resources of the Nways Switch

7.1.3.1 Colors Used for the Icons

Four statuses can be visualized through the color of the symbol. These are:

- Normal (green)
- Marginal (yellow)
- Critical (red)
- Unknown (blue)

7.2 Managing the Physical Resources

This section focuses on managing resources such as adapters, LICs, lines and trunks.

7.2.1 Managing the Adapters

A TPA (Trunk/Port Adapter) carries out Networking BroadBand Services. Each TPA is associated with a Line Interface Coupler (LIC). A Voice Server Adapter (VSA) can be associated with a Voice Server Extension (VSE). Managing an adapter includes:

- Activating or deactivating
- Configuring
- Deleting its configuration
- Displaying status information

7.2.1.1 Activating/Deactivating an Adapter

Activating an adapter runs tests and loads the appropriate code in order to make it available for use. When deactivated, the adapter is no longer available to provide network services; however, diagnosis can be run on it. This function is disruptive. To activate/deactivate an adapter:

1. Display the Node submap.

2. From this submap, depending on where the rack that you want to activate/deactivate is installed, select the **Base Rack** or the **Expansion Rack**.

3. From the Base Rack submap or Expansion Rack submap, select the adapter. This is done by clicking on the icon pointing to the adapter number.
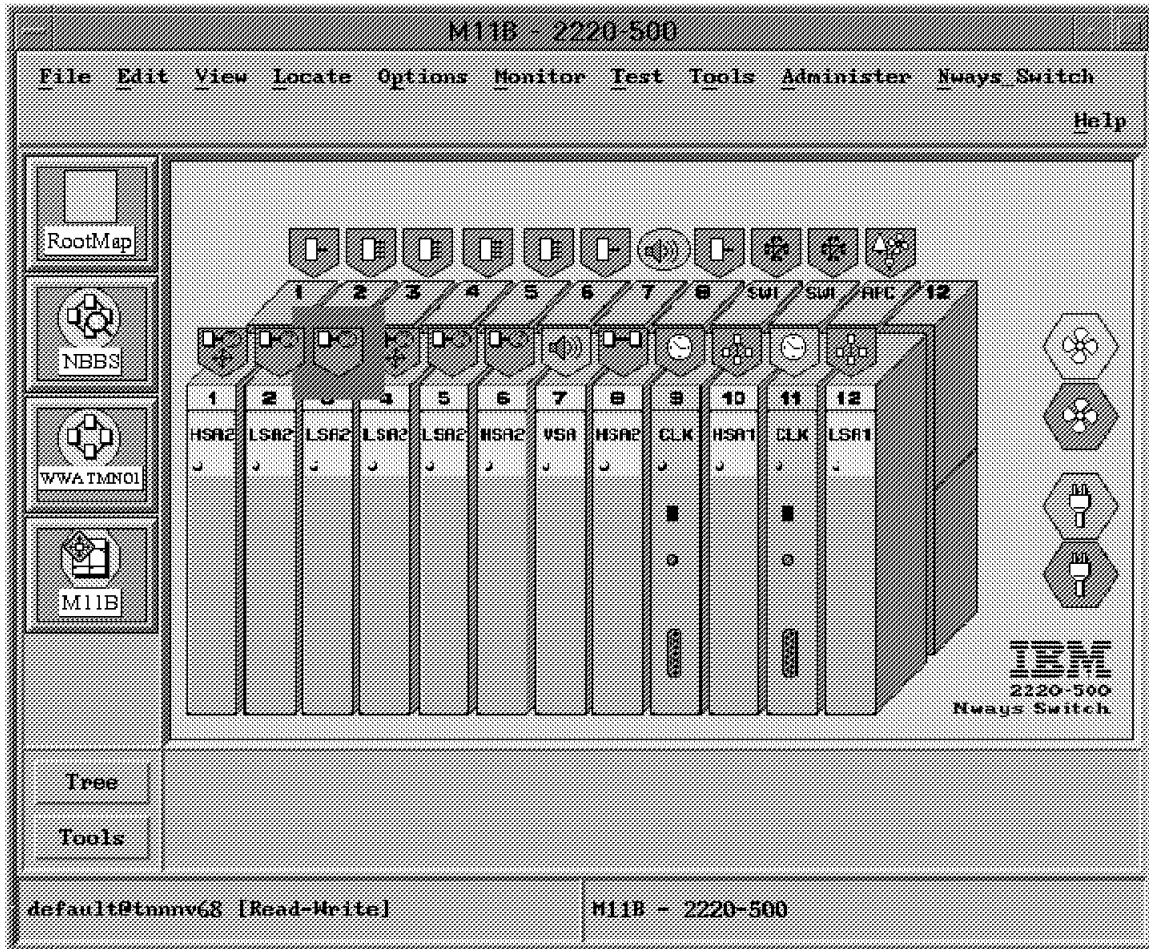
Figure 235. The Adapter Submap

4. Click on **Nways Switch-> Activate** or the **Nways Switch-> Deactivate**.

   Note that if the adapter is active, only the Deactivate option is selectable and vice versa.

7.2.1.2 Configuring an Adapter
This step involves adding the adapter to the map and then specifying the appropriate configuration parameters. To do this:

1. From the NBBS Node submap, select either the base or the expansion rack, depending upon where the adapter is installed.

2. Click on **Nways Switch-> Configuration-> Hardware-> Create-> Adapter module**.

3. Fill in the necessary fields in the configuration window.

7.2.1.3 Displaying or Modifying an Adapter Configuration
To display or change the configuration parameters for an adapter:

1. From the NBBS Node submap, select either the base or the expansion rack, depending upon where the adapter is installed.

2. From the Base Rack submap or the Expansion Rack submap, select the adapter.

3. Click on **Nways Switch Switch-> Configuration-> Hardware-> Display** or **Nways Switch Switch-> Configuration-> Hardware-> Modify**.

7.2.1.4 Deleting an Adapter Configuration

To delete an adapter configuration, you should first deactivate it in order to prevent the loss of network traffic flowing through it. When deleting the configuration of an adapter, you lose, at the same time, the configuration of all the resources associated to this adapter (including the LICs, lines, ports or trunks).

The configuration deletion is not disruptive for the node. It can be done without stopping the node operation. You may need to delete the configuration of an adapter, for example, when replacing the existing adapter with an adapter of a different type:

1. From the NBBS Node submap, select either the base or the expansion rack depending where the adapter is installed.

2. From the Base Rack Submap or the Expansion Rack submap, select the adapter.

3. Choose the **Nways Switch-> Deactivate** option.

4. Choose the **Nways Switch-> Clear Configuration** option.

7.2.1.5 Displaying the Status of an Adapter

Displaying the status of an adapter is used to display information about the adapter's operability and availability:

1. From the NBBS Node submap, select either the base or the expansion rack depending on where the adapter is installed.

2. From the Base Rack submap or the Expansion Rack submap, select the adapter.

3. Click on **Nways Switch-> Status**. The CMIP status window is displayed (see Figure 236 on page 243).
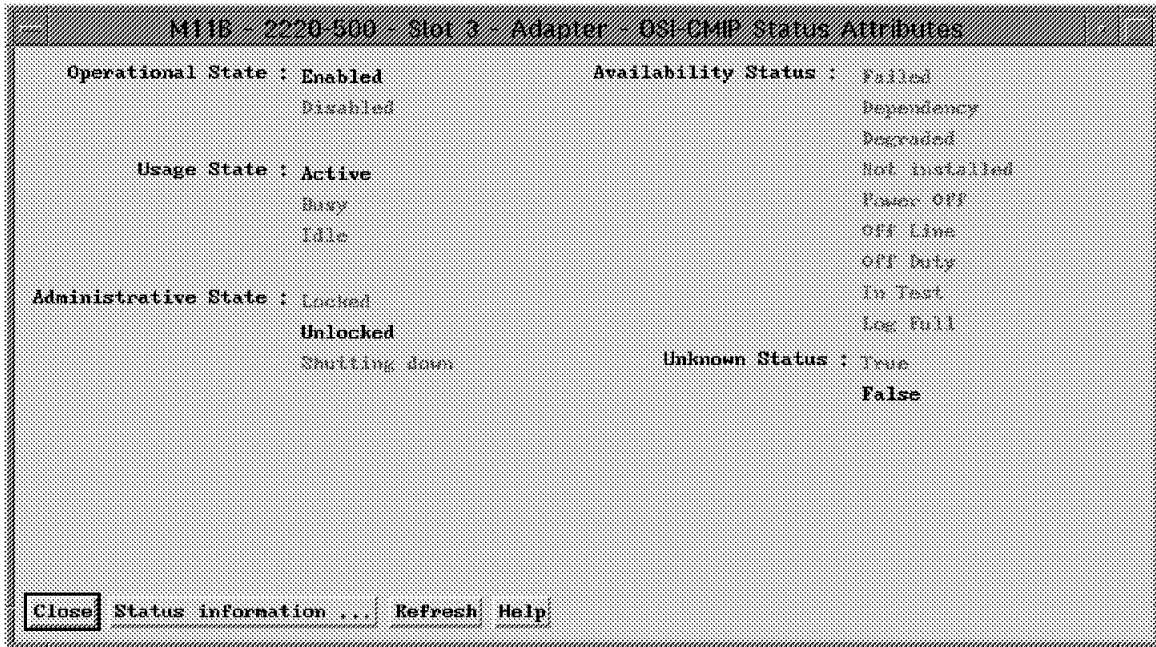
Figure 236. The CMIP Status Window

4. You can display the adapter's status window (see Figure 237) by selecting the **Status information** push button in the first window.
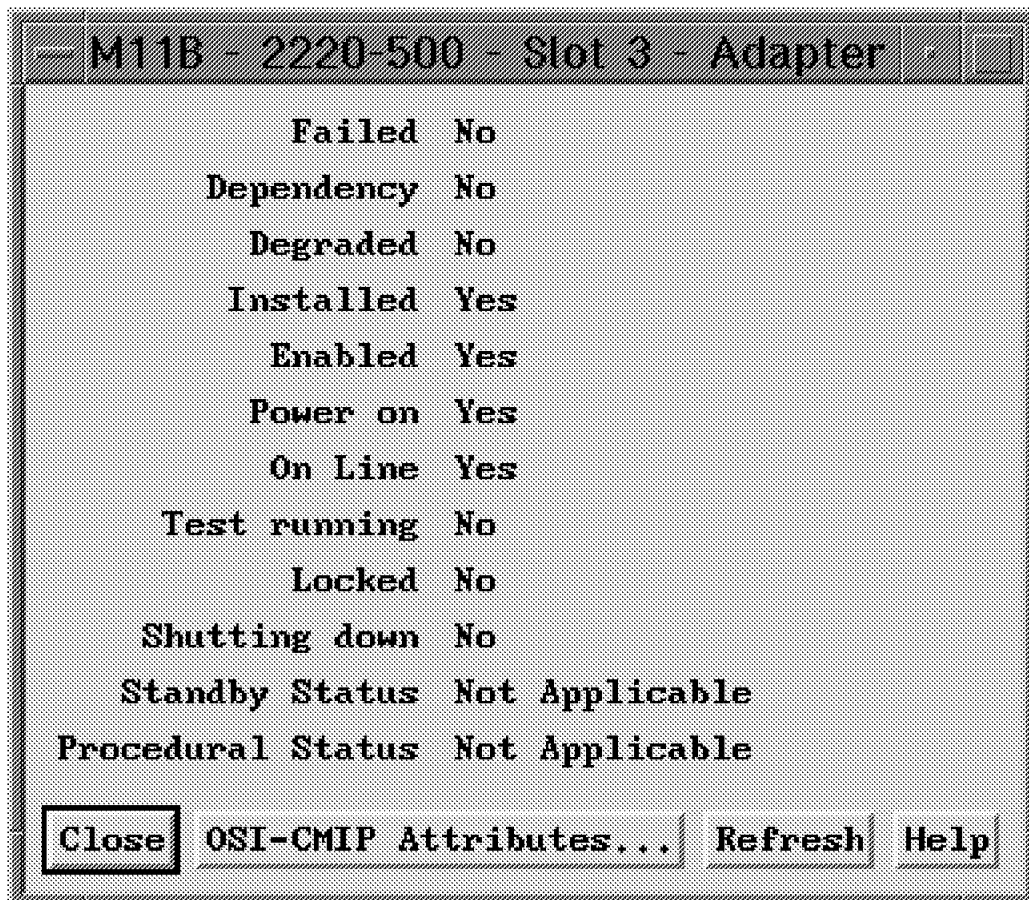
Figure 237. The Status Window

7.2.2 Managing the Line Interface Couplers (LICs)

The line interface coupler (LIC) connects to a port or trunk adapter and attaches lines, which can support specific communication line protocols.

Managing a LIC includes:

- Activating or deactivating it
- Configuring it
- Deleting its configuration
- Displaying status information about it

7.2.2.1 Activating/Deactivating a LIC

Activating a LIC consists of running tests and loading code in order to make it available for use. When deactivated, the LIC is no longer available for providing network services. However, diagnostics can be run on it. This function is disruptive.

Activating a LIC:

1. Display the Rack submap.

2. Select the desired LIC.
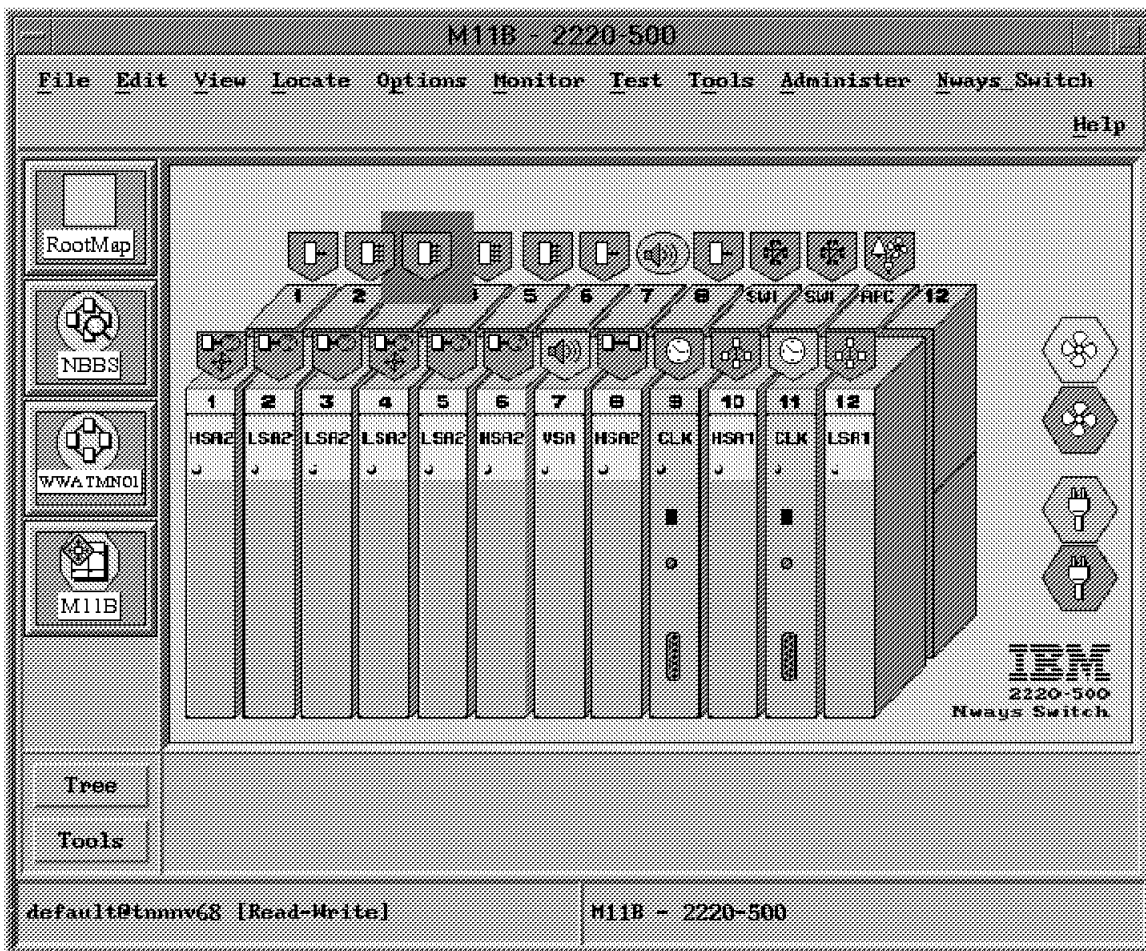
Figure 238. The Rack Submap

3. Click on the **Nways Switch-> Activate**.

Deactivating a LIC:

1. Display the Rack submap.

2. Select the desired LIC.

3. Click on **Nways Switch-> Deactivate**.

7.2.2.2 Configuring a LIC

Configuring a LIC consists of specifying the type of line to be attached to it. You must first configure the adapter to which the LIC is attached. Then, depending on the adapter type, you can configure the LIC:

1. Select an adapter symbol from the Rack submap.

2. Click on **Nways Switch-> Configuration-> Hardware-> Create-> LIC module**.

3. Fill in the necessary fields in the configuration window.

7.2.2.3 Displaying or Modifying a LIC Configuration

To display or change the configuration parameters for a LIC:

1. From the NBBS Node submap, select either the base or the expansion rack, depending upon where the LIC is installed.

2. From the Base Rack submap or the Expansion Rack submap, select the LIC.

3. Click on **Nways Switch Switch-> Configuration-> Hardware-> Display** or **Nways Switch Switch-> Configuration-> Hardware-> Modify**.

7.2.2.4 Deleting a LIC Configuration

To delete the configuration of a LIC, you should first deactivate it in order to prevent the loss of network traffic flowing through it. When deleting the configuration of a LIC, you lose the configuration of all the resources attached to it, including the lines, ports and trunks.

The configuration deletion is not disruptive for the node; it can be done without stopping the node operation. You may need to delete the configuration of a LIC for example, when replacing an existing LIC with a LIC of a different type:

1. From the Base Rack submap or the Expansion Rack submap, select the LIC.

2. Click on **Nways Switch-> Deactivate** in order to disable the LIC.

3. Click on **Nways Switch-> Clear Configuration** to delete the LIC.

7.2.2.5 Displaying LIC Status

Displaying the LIC status to display information about the LIC's operability and availability:

1. Display the Rack submap.

2. Select the desired LIC.

3. Click on **Nways Switch-> Status**.
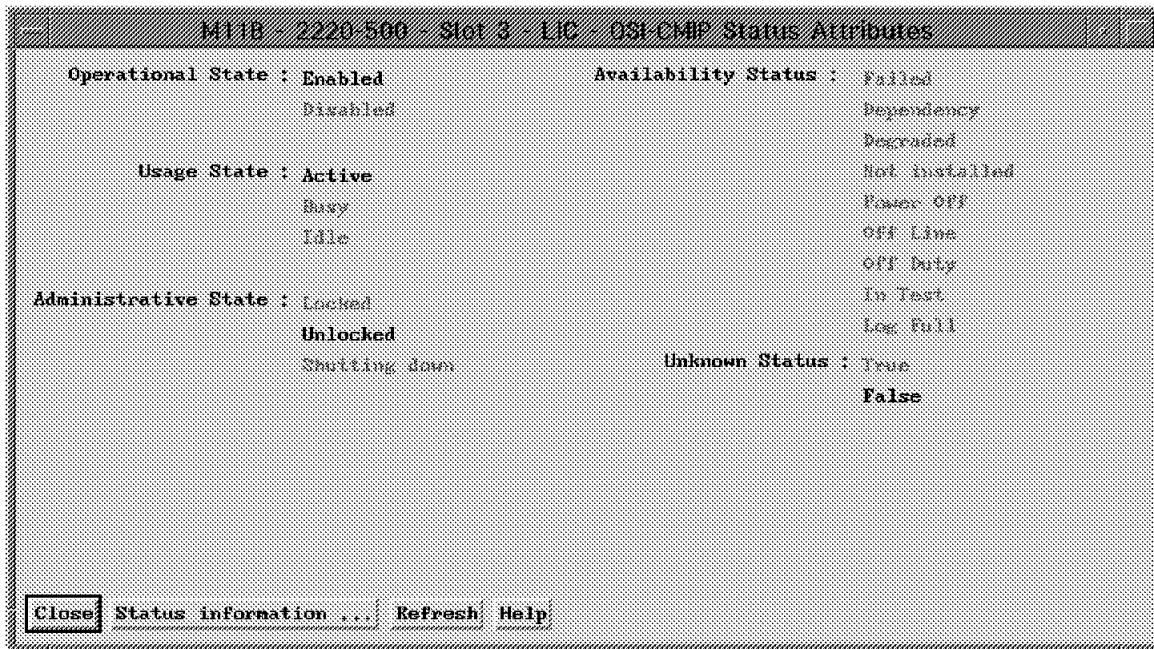
Figure 239. The LIC Status Window

7.2.3 Managing the Communication Lines

Lines are attached to the LICs and are connected to the user communication devices.

Managing a line includes:

- Activating or deactivating it
- Configuring it
- Deleting its configuration
- Displaying its status
- Locking/unlocking a line

Depending on the line status, some of these functions may not be available. For example, if a line is active, only the Deactivate function is selectable.

```
┌─ Selecting a Line ──────────────────────────────────────────────────┐
│                                                                     │
│  • When connected to a LIC, the line can be selected from the LIC submap.  │
│                                                                     │
│  • When connected to an LCB, the line can be selected from the LCB   │
│    submap.  You must first select the desired LCB from the LIC submap in  │
│    order to display the LCB submap.  Then, you can select the desired line  │
│    from the LCB submap.                                             │
│                                                                     │
└─────────────────────────────────────────────────────────────────────┘
```

7.2.3.1 Activating/Deactivating a Line

Activating a line consists of running tests and loading code in order to make it available for use. When deactivated, the line is no longer available for carrying data; however, diagnosis can be run on it. This function is disruptive.

To activate a line:

1. Display the LIC or the LCB submap.
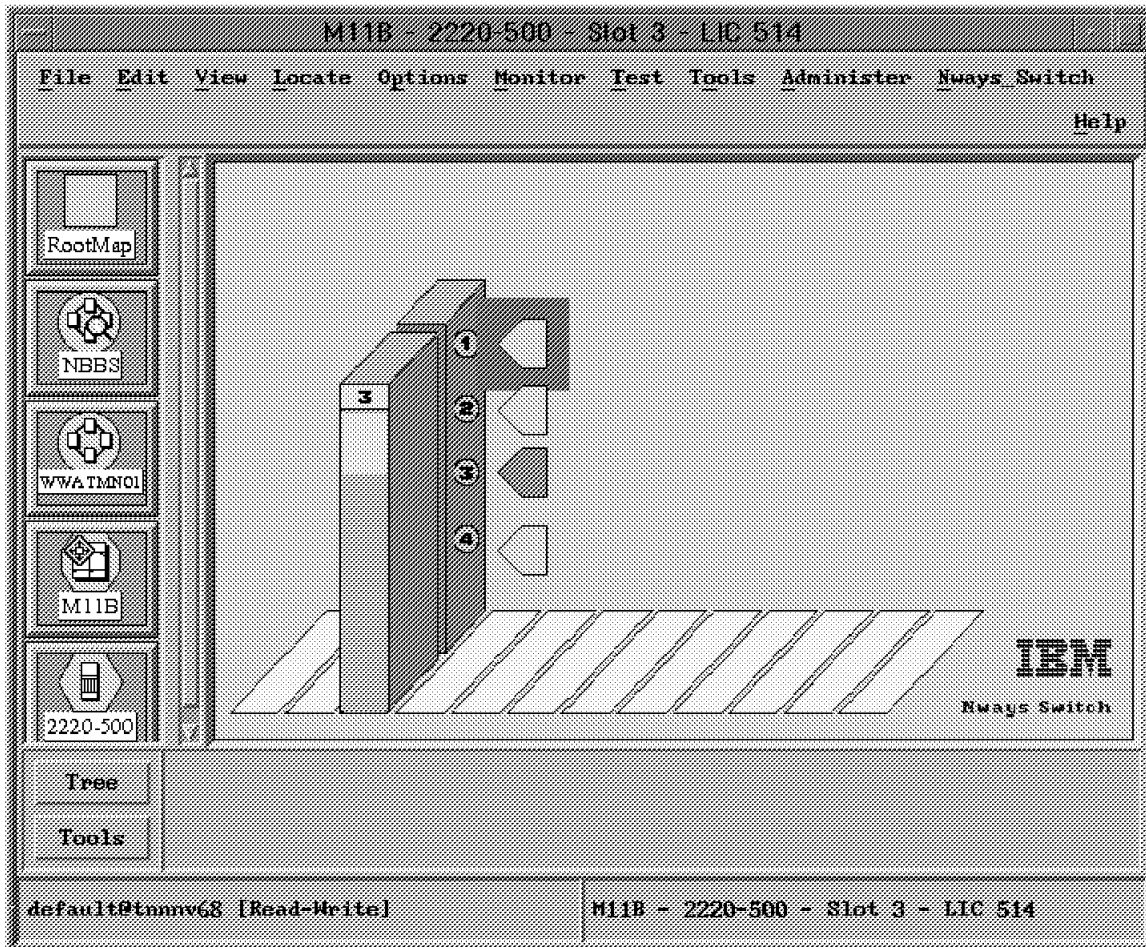
Figure 240. The LIC Submap

2. Select the desired line.

3. Click on **Nways Switch-> Activate**.

To deactivate a line:

1. Display the LIC or the LCB submap.

2. Select the desired line.

3. Click on **Nways Switch-> Deactivate**.

7.2.3.2 Configuring a Line

Configuring a communication line consists of defining several parameters, such as clocking, speed, and interface type. These configuration parameters vary with the line type. To configure a line:

1. Select a LIC symbol from the Rack submap or an LCB symbol from the LIC submap.

2. Click on **Nways Switch-> Configuration-> Hardware-> Create-> Line**.

3. Specify the configuration parameters.

7.2.3.3 Displaying or Modifying a Line Configuration

To display or change the configuration parameters for a line definition:

1. From the NBBS Node submap, select either the base or the expansion rack, depending upon where the line is installed.

2. From the Base Rack submap or the Expansion Rack submap, select the LIC.

3. From the LIC or LCB submap select the line.

4. Click on **Nways Switch Switch-> Configuration-> Hardware-> Display** or **Nways Switch Switch-> Configuration-> Hardware-> Modify**.

7.2.3.4 Deleting a Line Configuration

To delete a line configuration, you should first disable the line in order to prevent the loss of network traffic flowing through it. The configuration deletion is not disruptive. It can be done without stopping the node operation.

You may need to delete a line configuration when replacing an existing line with a line of a different type as follows:

1. From the Base Rack submap or the Expansion Rack submap, select the LIC.

2. From the LIC or LCB submap, select the line.

3. Click on **Nways Switch-> Deactivate** in order to disable the line.

4. Click on **Nways Switch-> Clear Configuration** to delete the line.

7.2.3.5 Displaying Line Status

Displaying line status is used to display information about the line's operability and availability as follows:

1. Display the LIC or the LCB submap.

2. Select the desired line.

3. Click on **Nways Switch-> Status**.
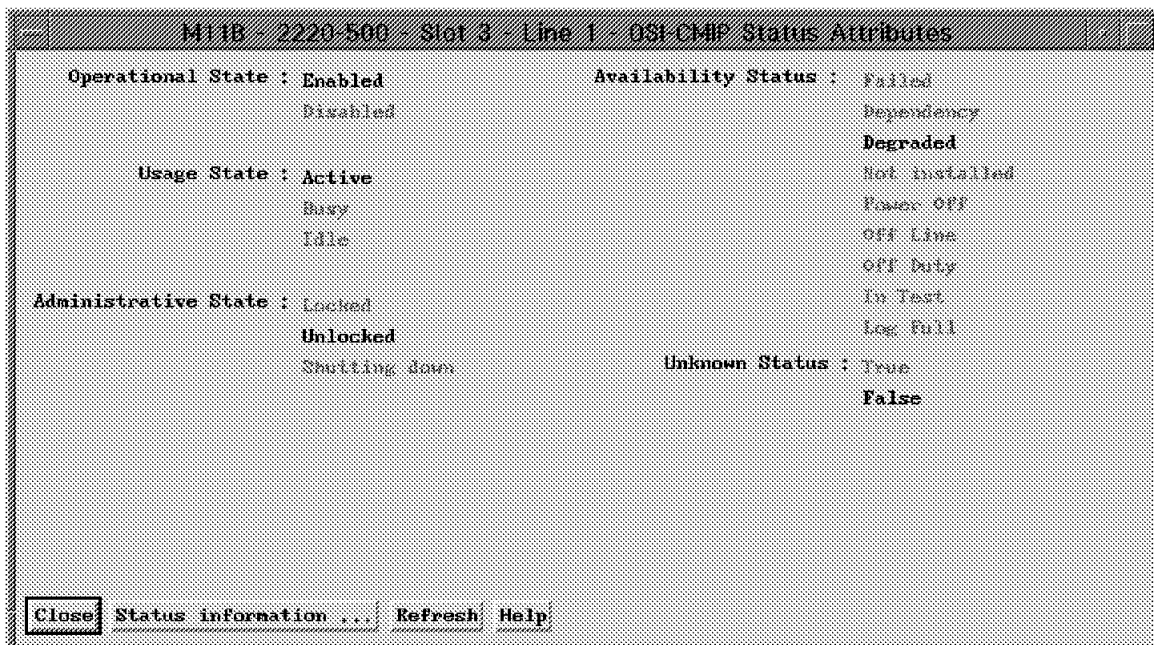
Figure 241. The Line Status Window

7.2.3.6 Locking/Unlocking a Line

When using the Lock function, the line is no longer available for traffic. Its administrative state changes to Locked.

When using the Unlock function, the line becomes available for traffic. Its administrative state changes to Unlocked.

To lock a line:

1. From the LIC or LCB submap, select the line.

2. Click on **Nways Switch-> Lock**.

To unlock a line:

1. From the LIC or LCB submap, select the line.

2. Click on **Nways Switch-> Unlock**.

7.2.4 Managing the NBBS Trunks

An NBBS trunk is the logical interface between two Nways Switches.

In an NBBS network, an Nways Switch connects to another Nways Switch through a physical communication line. This communication line is associated to a logical NBBS trunk.

The trunk management includes:

- Displaying trunk information
- Displaying trunk status
- Activating/deactivating a trunk
- Configuring a trunk
- Deleting a trunk
- Displaying or modifying a trunk configuration
- Locking and unlocking a trunk
- Monitoring trunk performance

7.2.4.1 Activating/Deactivating a Trunk

You can either enable or disable an NBBS trunk. Disabling a trunk can be done for maintenance purposes.

To activate a trunk:

1. Select the desired trunk from the Network submap.
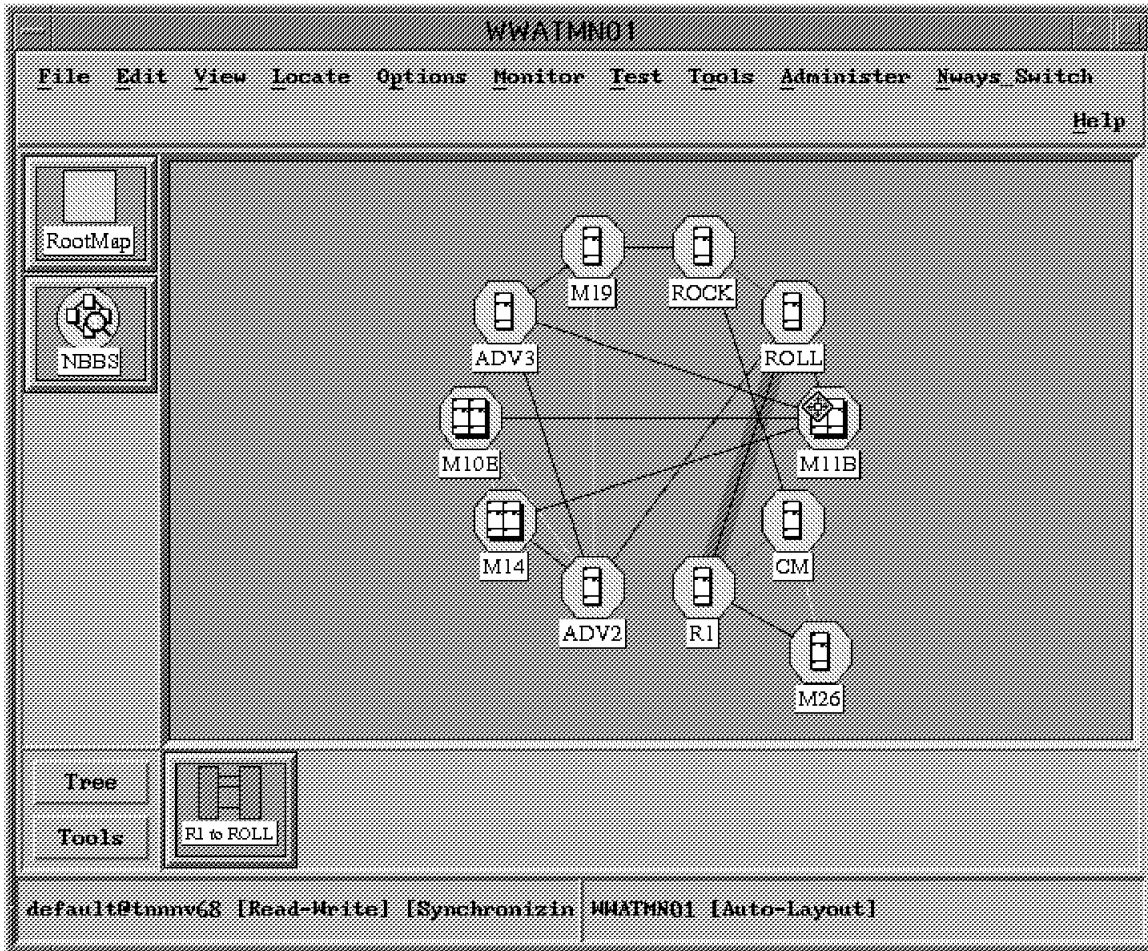
Figure 242. The Network Submap

> **Note:** There may be multiple trunks between two nodes (parallel trunks). In this case, double-click on the trunk to get the detail window and select the trunk that you want to work with from the detail window.
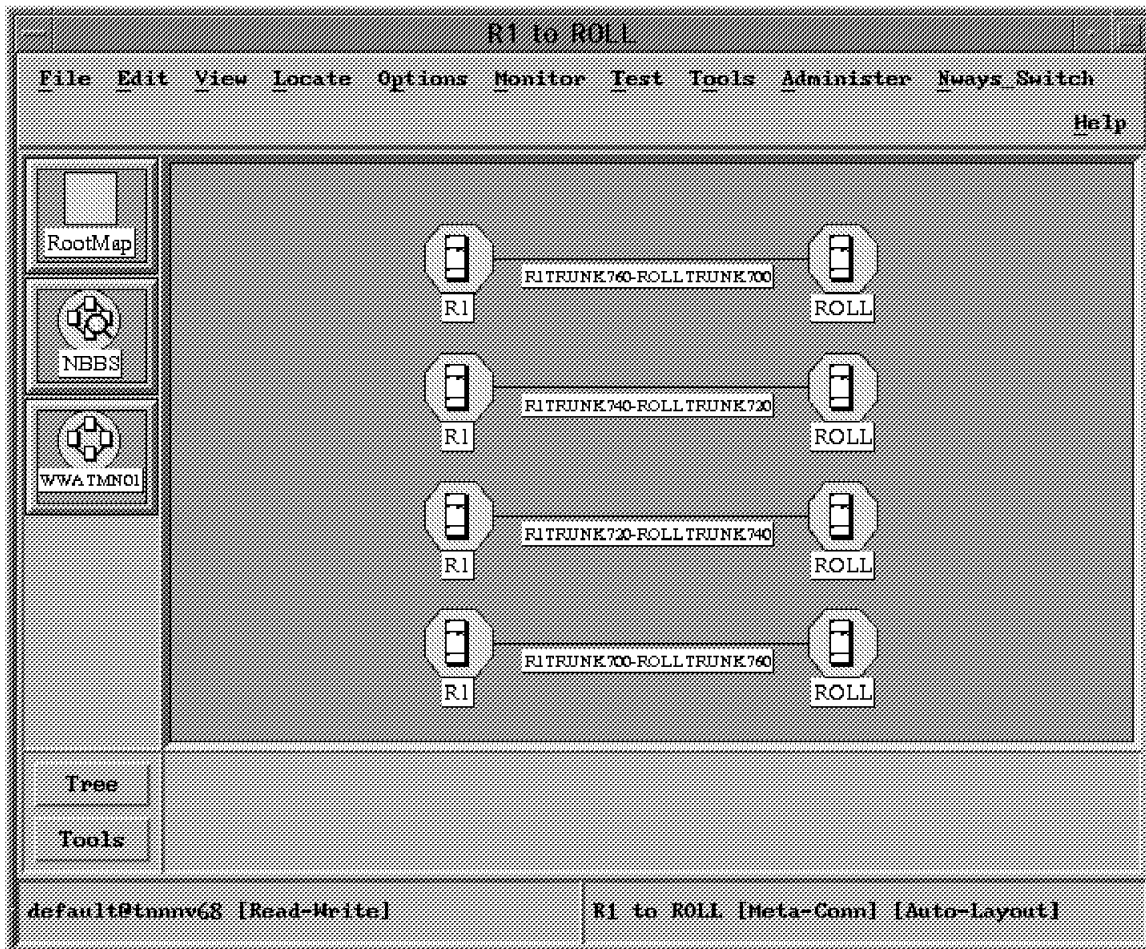
Figure 243. The Trunk Detail Window

2. Click on **Nways Switch-> Activate**.

To deactivate a trunk:

1. Select the desired trunk from the node submap.

2. Click on **Nways Switch-> Deactivate**.

7.2.4.2 Configuring a Trunk
Configuring a trunk is used to create an NBBS trunk and configure it.

1. From the node submap click on the trunk icon.

2. Click on **Nways Switch-> Configuration-> Trunk-> Create**.

7.2.4.3 Displaying or Modifying a Trunk Configuration
Displaying or modifying a trunk configuration is used to display or modify the configuration parameters:

1. Select a trunk from the trunk submap.

2. Click on **Nways Switch-> Configuration-> Trunk-> Display** or **Nways Switch-> Configuration-> Trunk-> Modify**.

7.2.4.4 Deleting a Trunk

When a physical link no longer exists or has changed between two Nways Switches, the logical trunk associated with the physical link must be deleted. Before deleting it, be sure to first disable it using the Deactivate function:

1. Select the desired trunk from the Node submap.

2. Click on **Nways Switch-> Deactivate**.

3. Click on **Nways Switch-> Delete**.

7.2.4.5 Displaying Trunk Status

Displaying trunk status is used to display information about the trunk's operability and availability:

1. Select the desired trunk.

2. Click on **Nways Switch-> Status**.

7.2.4.6 Locking/Unlocking a Trunk

Unlock a trunk to allow data traffic to flow through it. Lock a trunk to prevent the use of it.

To unlock a trunk:

1. Select the desired trunk from the Node submap.

2. Click on **Nways Switch-> Unlock**.

To lock a trunk:

1. Select the desired trunk from the Node submap.

2. Click on **Nways Switch-> Lock** or **Nways Switch-> Lock Gracefully**.

3. Click on **Lock** to immediately stop using the trunk.

4. Click on **Lock Gracefully** to stop using the trunk once it has completed carrying data traffic. Its state changes to *shutting down*.

7.2.4.7 Monitoring the Trunk Performance

For information on monitoring the performance of trunks and ports please refer to *Using the Nways 2220 Performance Tools*, SG24-5304.

7.3 Managing Access Services

Management of access services is detailed in the chapters dealing with specific access services:

- Nways Switch ATM Services

- Nways Switch Voice Services

- Nways Switch Frame Relay Services

- Nways Switch X.25 Services

7.4 Managing the Quality of Service (QoS)

A Quality of Service (QoS) guarantees minimum levels of performance for network connections by specifying the traffic characteristics.

QoS management is restricted to display all the different Quality of Service entries.

7.4.1 Display a QoS

The Quality of Service (QoS) table guarantees the defined levels of performance for network connections. There are a set of predefined QoS tables for different protocols and options available. Each connection is associated with a QoS table:

1. Select a node from the Network submap.

2. Click on **Nways Switch-> Configuration-> Quality of Service**.

Figure 244. The Quality of Service (QoS) List

3. Select a QoS entry from the list.

4. Click on **Display**.

   Using this window you can view the characteristics of the selected Quality of Service (QoS) for the specific node.

Figure 245. Display Quality of Service

The following is an explanation of the QoS parameters:

- Name - This identifies the QOS.

- Bandwidth Adaptation - This provides the possibility to automatically adjust the bandwidth according to the network needs. Bandwidth adjustment is designed to provide quick increases in bandwidth when the user exceeds initial commitments and slow decreases when the greater amount of bandwidth is no longer required. When set to yes, automatic bandwidth adjustment will be performed. Otherwise, the initial bandwidth parameter values will be used.

- Bandwidth Reduction - This is the possibility to reduce, according to the network needs, the requested bandwidth characteristics at connection setup time for a given preemption priority level. This parameter is also used if, in case of a bandwidth increase attempt, the required bandwidth is not available.

  - Yes means that you accept a lower-than-desired bandwidth; therefore, the current bandwidth (and path) remains.

  - No means that you do not accept a lower-than-desired bandwidth; therefore the connection is terminated.

  The bandwidth reduction value is computed according to the resources available in the network; therefore it cannot be predetermined.

- Connection Security - There is no external encryption supported.

- Delay Priority Traffic Class - This specifies the delay category and depends on the traffic type. This QoS parameter is related to delay sensitivity, which is the sensitivity to network latency. This latency is the time between origin submission and destination delivery. Four traffic type priorities are available:

- Circuit Emulation Class 1 - real-time applications are highly delay-sensitive and require very low delay.

- Circuit Emulation Class 2

- Non-real-time

- Best effort

When the traffic type is frame relay or HDLC, the traffic delay priority must be non-real-time.

When the traffic type is CES and the traffic mode equals data, the traffic delay priority must be Circuit Emulation Class 2.

When the traffic type is CES and the traffic mode is voice, the traffic delay priority must be Circuit Emulation Class 1 or Circuit Emulation Class 2.

- Max Number of Hops - This is the maximum number of links in a connection route. It is used during the route computation for the path selection.

- Holding Priority and Requesting Priority - These parameters are related to the path preemption. NBBS provides high availability of the network to as many users as possible.

  Since the alternate links may be highly utilized during peak hours, the need arises to ensure that, after a failure, the most important network connections are rerouted even if it requires preemption of less important connections. The importance of a connection is expressed by its holding priority and its requesting priority:

  - The holding priority is the preemption priority of a network connection once it is established. This priority determines which connections may preempt a network connection.

  - The requesting priority is the preemption priority of the network connection being established with respect to the existing network connections. This priority determines which connections may be preempted to set up the new connection.

    To sum up, when the available bandwidth is less than needed, the new connection requesting priority is compared against the existing connection holding priority. The higher priority connection wins. In normal operation, the holding priority is intended to be higher than the requesting priority.

- Maximum End-to-End Transfer Delay/Cell Transfer Delay (ATM) - This is the maximum delay for data transfer across the network (network latency). Above this delay, the connection is not activated. This is determined by specific connection requirements and traffic types. For example, voice and video require very short network transfer delay.

  When the traffic type is frame relay or HDLC, the transfer delay must be greater than or equal to 200 ms.

  When the traffic type is CES and traffic mode is data, the transfer delay must be within 1 ms and 100 ms.

  When the traffic type is CES and traffic mode equals voice:

  - If the Traffic Delay Priority class is Circuit Emulation Class 1, the transfer delay must be within 1 ms and 25 ms.

  - If the Traffic Delay Priority class is Circuit Emulation Class 2, the transfer delay must be within 1 ms and 250 ms.

- Cell Delay Variation (ATM) - This is the Cell Delay Variation Tolerance (CDVT) or delay jitter. The delay jitter is the undesirable variations in the arrival time of the transmitted cells.

- Nondisruptive Path Switching - This function allows a network connection path to be switched to an alternate physical path that supports its resources and QoS requirements. This happens in case of:

  – Intermediate link or node failure

  – Path preemption

  – Connection setup failure

  This is nondisruptive and therefore is transparent to the users.

- Packet Loss Ratio/Cell Loss Ratio (ATM) - This is the number of cells or packets lost during transmission divided by the number of calls or packets transmitted.

7.5 Managing the Network Topology

The network topology displays:

- The resources that belong to the network

- The relationship between these resources

The network topology provides for a graphical display of nodes and links and is dynamically updated to show current network status.

Topology and network configuration management includes:

- Adding a network to the domain

- Deleting a network from the domain

- Looking for the network, node and trunk status

- Modifying a network gateway node

- Updating the topology

7.5.1.1 Integrated Topology Display

Integrated Topology Display is a feature that is provided to bridge information gathered by Nways 2220 topology and the standard NSM IP topology map (IPMAP). Based on a configuration file, where the 2220 interconnections with other networking devices must be defined, this feature provides a NetView GUI end-to-end topology display. The following is also true:

- Network topology is divided into interconnected subnetworks.

- A subnetwork contains one or more 2220s.

- Zooming into a subnetwork provides information between 2220 nodes and the attached networking devices such as the 2210 router.

- A seamless navigation is provided between this new topology application and the legacy applications.

7.5.2 Adding a Network to the Domain

When you add a network to the management domain, you must give a short description of the network. The short description consists of:

- The network name

- The gateway name

- The domain name

Here is how to do it:

1. From any submap and without selecting any symbol, click on **Administer-> Define NBBS Management Domain**. This displays the NBBS Network list.
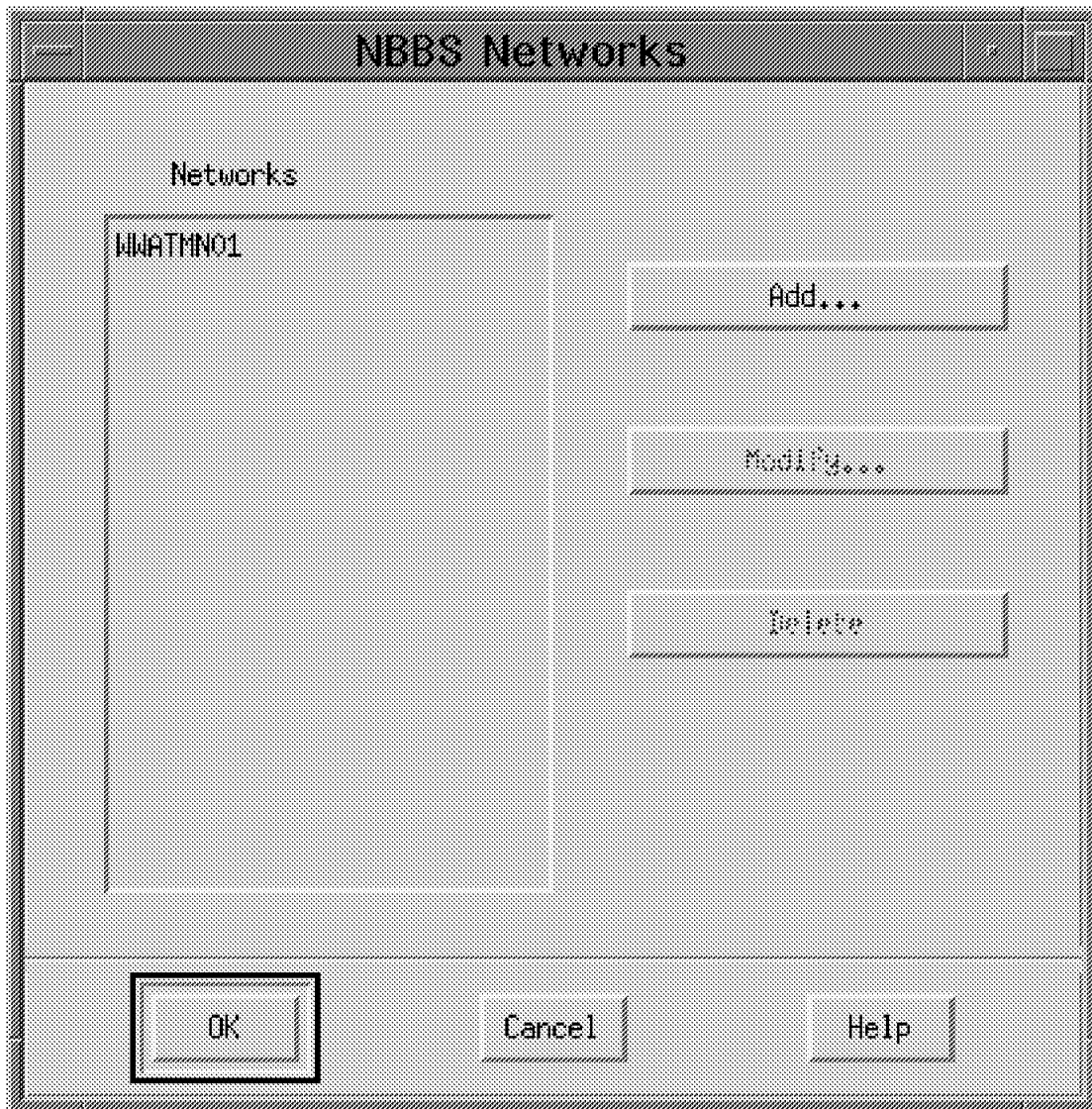
Figure 246. The NBBS Networks Window

2. Select the **Add** push button.

3. Enter the required information in the next screen.

4. Select the **OK** push button.

7.5.3 Deleting a Network from the Domain

When a network no longer belongs to a domain, it must be deleted from the network list. This can be done from any submap, as follows:

1. Click on **Administer-> Define NBBS Management Domain** without selecting any object. This displays the NBBS Network list.

2. Select the desired network.

3. Select the **Delete** push button.

7.5.4 Modify a Network Gateway Node

Use this function to modify the network gateway information. The gateway node is the node where the gateway adapter is installed. The gateway adapter connects the Nways Switch Administration Station (NAS) to the Network Management Station (NMS).

1. From any submap, select **Administer-> Define NBBS Management Domain** without selecting any object. This displays the NBBS Network list.

2. Select the desired network.

3. Select the **Modify** push button.
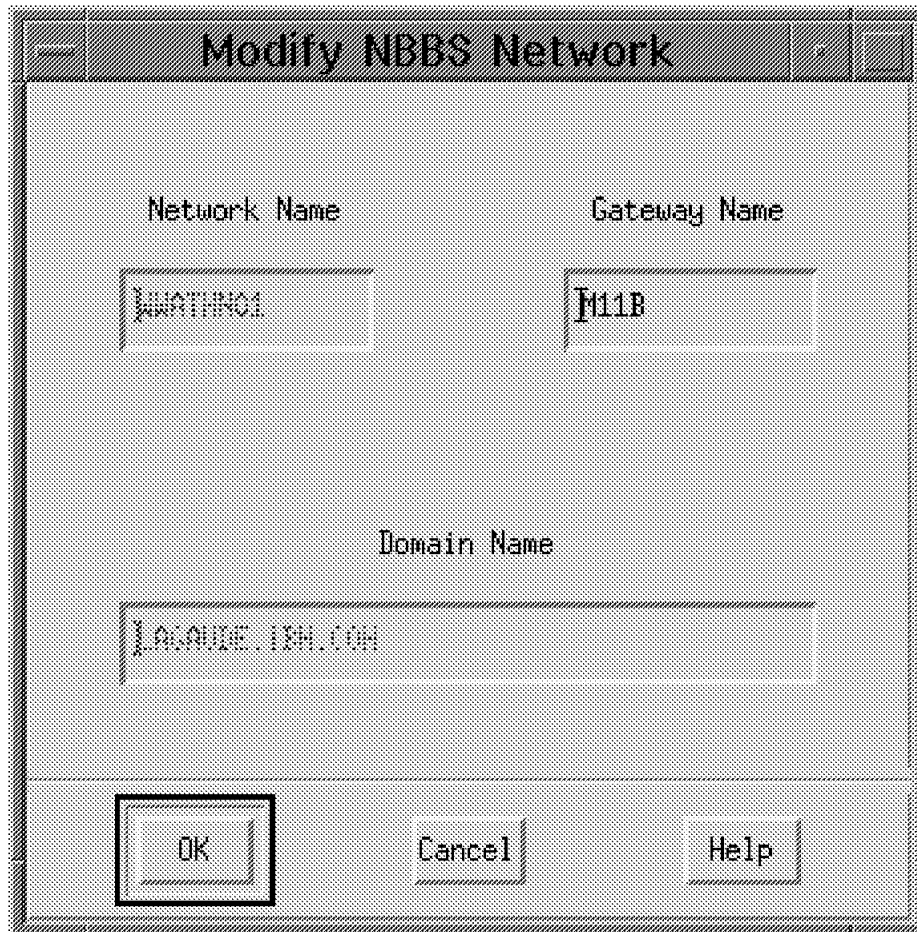
Figure 247. The Modify NBBS Network Gateway Node Window

4. Change the gateway name.

7.5.5 Refresh Network Topology

Update the topology for more than one network:

1. Select the desired networks from the Domain submap.

2. Select **Nways Switch-> Refresh Topology Network**.

Update the topology for one network:

1. From the (desired) network submap, click on **Nways Switch-> Refresh Topology Network**.

7.6 Working with the TCP/IP Communication Function

This function is used to define, modify or delete IP addresses for the TCP/IP gateway function:

1. From the Network submap select the Nways Switch gateway node.

2. Select **Nways Switch-> TCP/IP function** option.
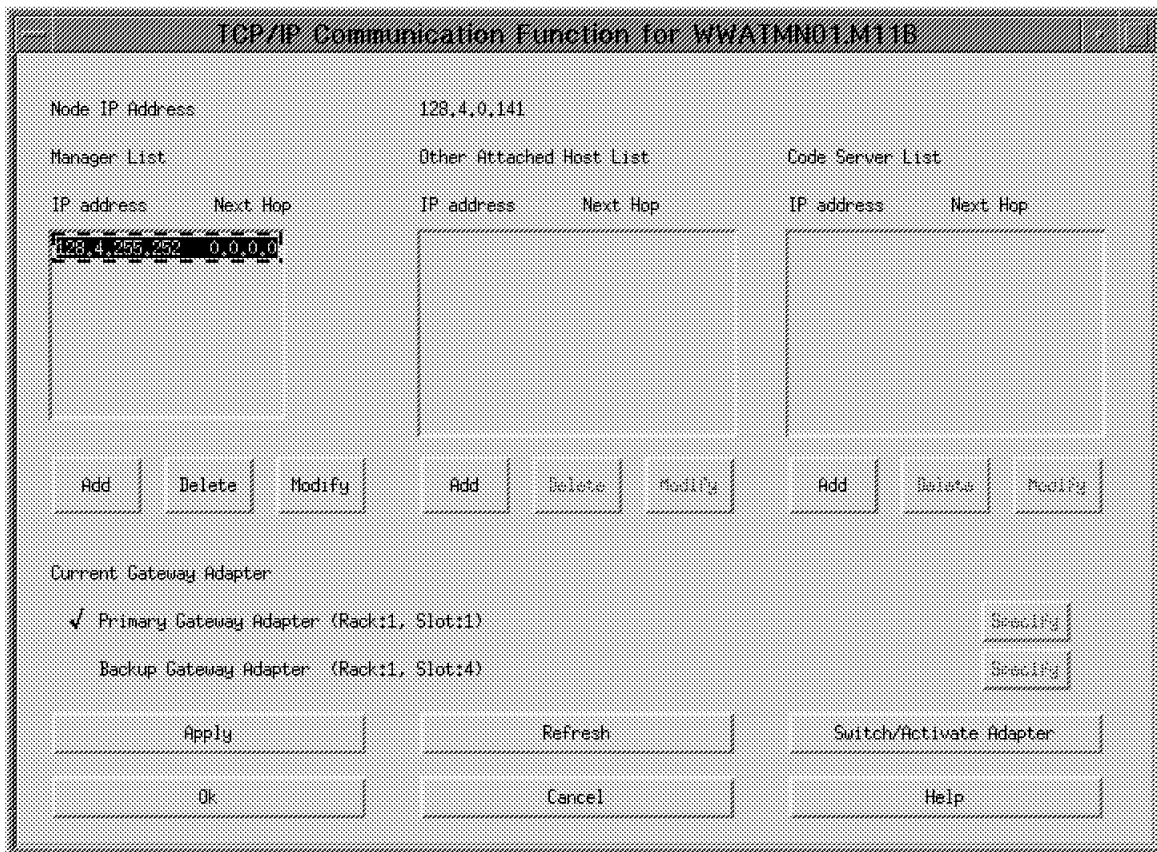
Figure 248. TCP/IP Communication Function

There are three lists with IP host addresses:

- Manager List: IP address of the Network Management Station (NMS)

- Other Attached Host List: IP address of remote consoles or default router

- Code Server List: IP address of the Change Control Server (CCS)

The positions of the current and the backup gateway adapter (when defined) are shown. The current one is checked. The possible choices are:

- Add displays a window in which you can add a host IP address and the next hop endpoint IP address.

- Delete erases the selected list entry.

- Modify (after selecting an entry from a list) brings up a window in which you can modify the host IP address and the next hop endpoint IP address.

- Specify, when no gateway is defined, brings up a window in which you can specify the location of the gateway adapter.

- Apply saves the changes.

- Refresh refreshes the screen after saving changes.

- Switch/Activate Adapter either activates the gateway or, if a gateway is active, switches from the current to the backup gateway adapter.

7.6.1 Network Cold Restart Procedure

The Network Cold Restart Procedure allows you to restart a whole Nways 2220 network from the network management station. It performs the following functions from the command line:

- Network shutdown by locking gracefully all the network interfaces defined in the network

- Schedules a 2220 re-IPL command on each node

- Waits 35 minutes (minimum time before all nodes have completed their re-IPL

- Unlocks all the network interfaces to enable the restart of all the permanent PVCs

The above functions are performed on a best effort basis. This means that if any error occurs, the error is logged but the process is not stopped.

Table 21. NSM and AIX Versions and Releases		
NetView	AIX 4.2.1	AIX 4.3
NetView V4.1	Yes	Yes
NetView V5.0	Yes	Yes
TMN V2.2	Yes	No

Note: AIX 4.1 is not supported.

NSM Version 2 supports the Nways Switch Control Program V1R5, V2R2 and V2R3.

7.6.2 Frame Relay to ATM Interworking Management

Frame relay to ATM interworking connections are managed the same way as frame relay or ATM connections. Management facilities provided are:

- On line configuration including display, creation, deletion and modification of connections. Parameters are frame relay oriented at the initiator side and ATM at the completion side. Configuration is handled on an end-to-end basis which means a single configuration operation updates two sides of the connection.

- Connection monitoring including start and stop operation, manage path facilities as well as ILMI and DLCI status display.

- Backup management on an ISDN link is allowed and managed the same was as for frame relay connections.

- Performance monitoring allows the retrieval of counters both at the source and destination.

- Accounting is supported.

7.6.3 ATM SVC Network Management

The following are new functions that have been added to the management application for SVC support:

- Lock, unlock, shutdown of the ATM network interface

- List of the DTE addresses attached to the ATM network interface

- List active ATM SVC connections

- Stop an ATM SVC (start is automatic and cannot be done manually)

- Display ATM SVC path as well as recompute path facilities

- Performance monitoring is supplied at the network interface level providing global counters for all SVCs

The restrictions that apply to ATM SVC management compared to ATM PVC are as follows:

- Only the display and delete functions are provided for an ATM SVC network interface.

- It is not possible to create or modify any ATM SVC network interface from the network management station.

- These actions are supported by the NCT2.

- OAM management is not supported for ATM SVC connections.

- Accounting is not supported for ATM SVC connections.

Chapter 8. Nways Switch Router Interoperability - Scenario 1

This chapter describes an IBM 6611 router and Nways Switch interoperability configuration in our lab. It includes screen images of the actual configuration of the two Nways Switches we used. Please refer to Appendix A, "Nways Switch Scenario 1" on page 319 for details on the router configuration we used.

Please Note!

Our machines use the Nways Switch Configuration Tool (NCT) Version 1 Release 2. Depending on the version that you are using, the screen format may vary. Whenever your screen is different from the one illustrated in this redbook, please use the Help function of the NCT. The IBM 6611 has been withdrawn from marketing.

8.1 Router Frame Relay and HDLC Scenario

In order to illustrate the frame relay and HDLC interoperability between routers and Nways Switches, we connected IBM personal computers (labeled VP1 and VP2) to two 6611 routers called R1 and R2 (each with a token-ring card). These routers were then connected, via two V.35 ports each, to the Nways Switch. The first port was defined as a frame relay connection and the second port was defined as HDLC. Both these ports were defined at a line speed of 512 kbps. A single E1 trunk line connects the two Nways Switches.

8.2 Scenario Physical Setup

The following illustration shows the physical setup of the environment.
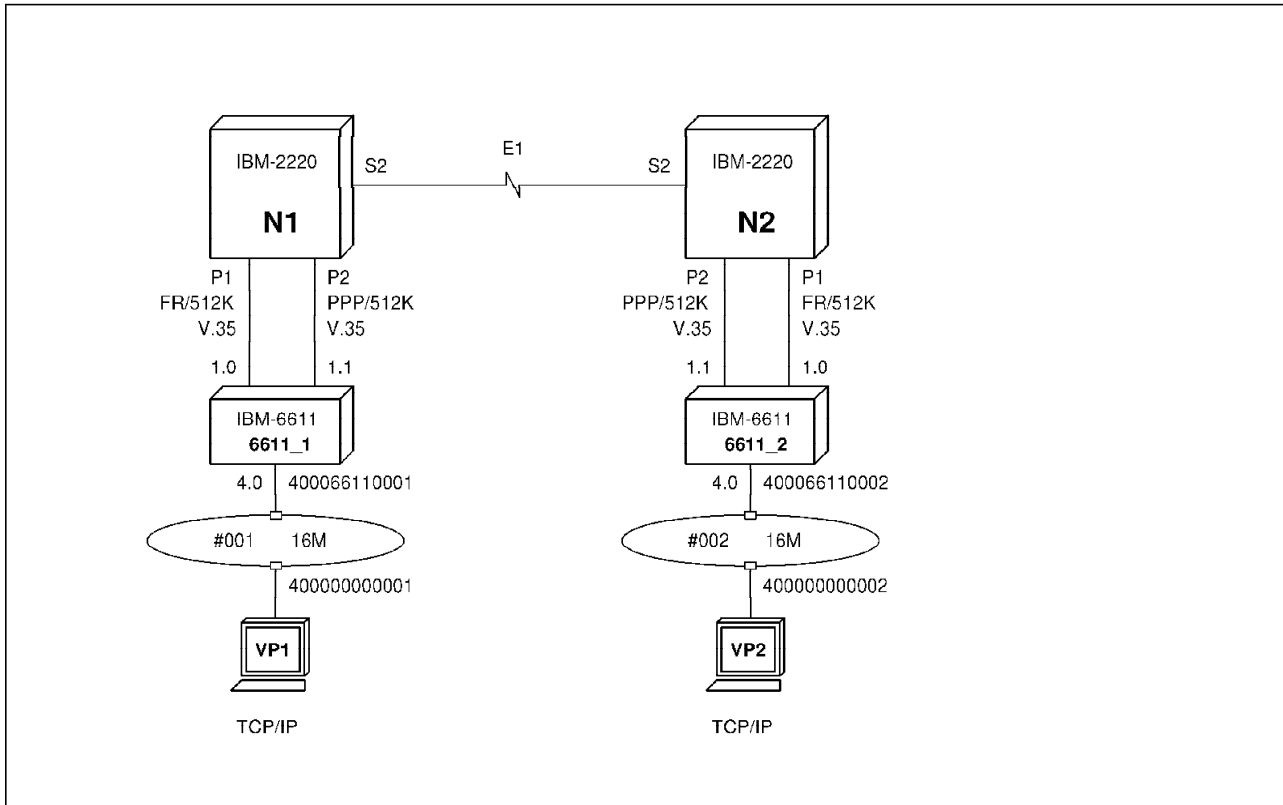
Figure 249. Frame Relay and HDLC Scenario Physical Illustration

The DLCI we used was 21 for the Nways Switch N1 and 20 for the Nways Switch N2. Port one, labeled P1 on both Nways Switches was used for the frame relay connection, and port two labeled P2 on both Nways Switches was used for the HDLC connection.

8.3 Scenario Logical Setup

The following illustration describes the logical or protocol view of the network. For more details on the configuration of the routers we used in this example, please see Appendix A, "Nways Switch Scenario 1" on page 319.
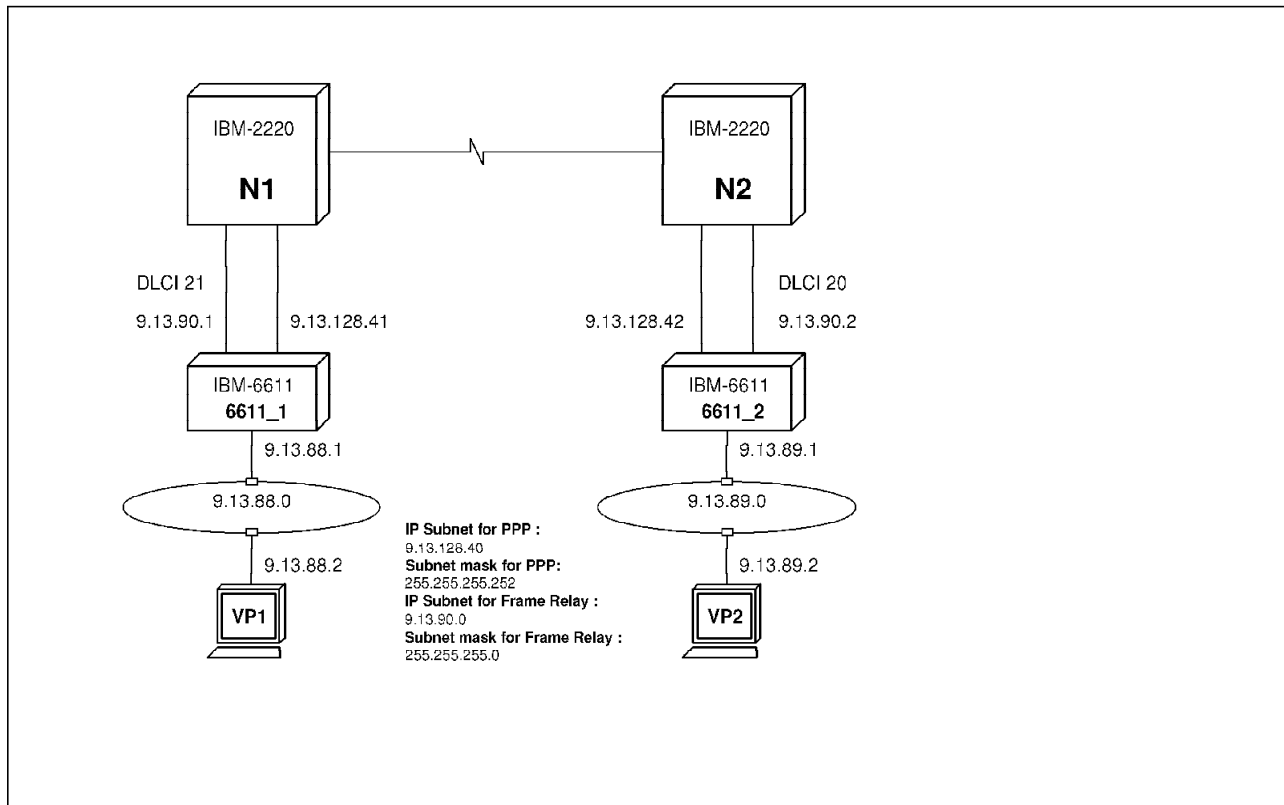
Figure 250. Frame Relay and HDLC Scenario Logical Protocol Illustration

8.4 Nways Switch Machine Description

For our test we used a non-redundant Nways Switch Model 500 with dual power supplies. Both Nways Switches have the same physical configuration.

The port adapter is a Low-Speed TPA Type 1 placed in slot 5. A LIC512, in slot 5, provides two V.35 connections to the IBM 6611 router.

8.5 Port Adapter Physical Line Definition

After having created with the Nways Switch Configuration Tool (NCT) the Nways Switch and the trunks, we define the physical lines that are used for our two router ports. But before we do this, we need to define the adapter we will use. To begin, we define the port adapter in slot 5. By double-clicking on the empty triangle beneath slot 5 the following screen comes up. We define a Low-Speed Adapter Type 1 (LSA1) as a port (see Figure 251 on page 266).
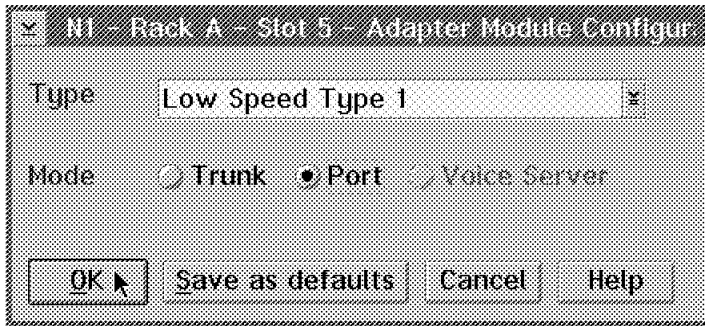
Figure 251. Adapter Module Configuration

You should use a LIC512 to support V.35 lines. Double-click on the triangle in the back of adapter position number 5 and this will bring up the following screen. Select the **LIC512** option as follows and select the **OK** button to proceed.
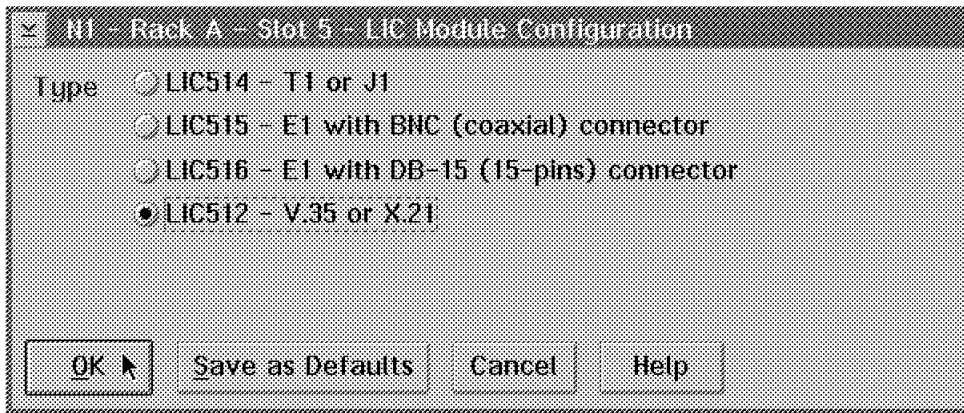
Figure 252. LIC Module Configuration

This will bring you back to the rack menu where you will see all of your adapters. The only thing left to do here is to define the two physical ports on the V.35 LIC512 labeled VX. To do that, double-click on the **VX** icon as follows:
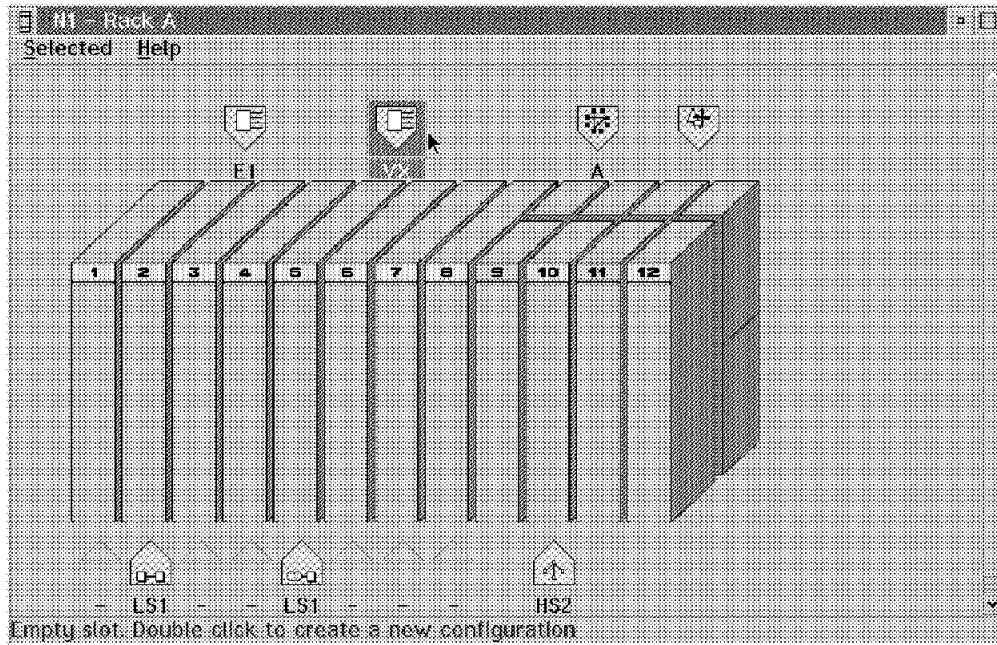
Figure 253. N1 Rack A

We chose to use the line positions 1 and 2. Double-click on the first empty triangle to get the following screen:
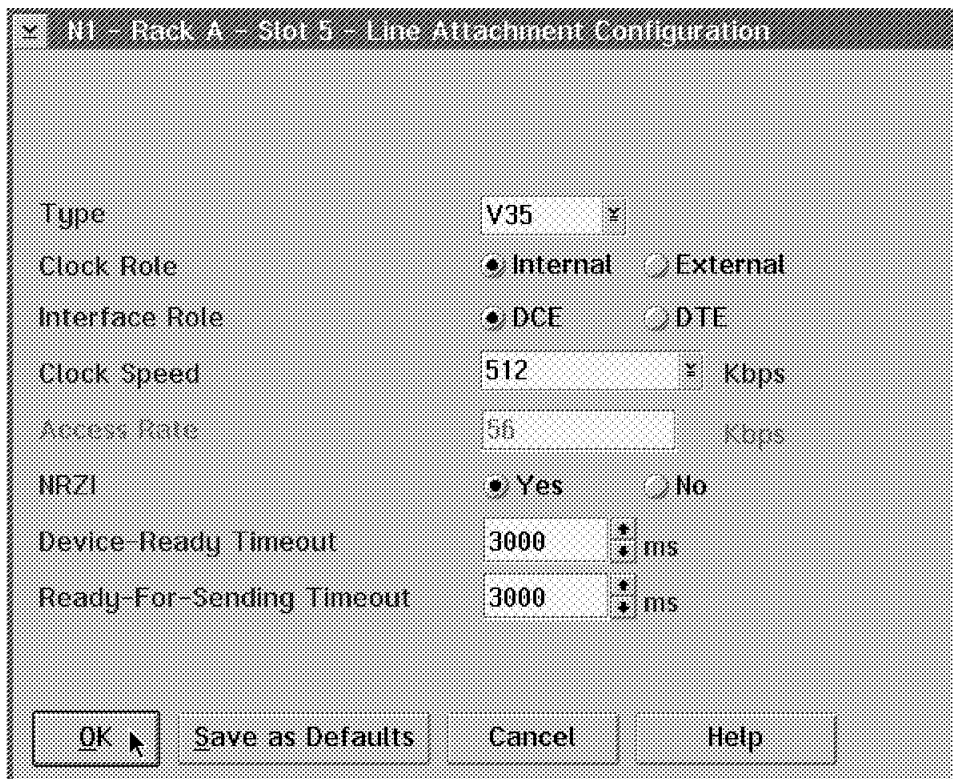
Figure 254. Line Attachment Configuration

We decided to define both lines as V35 Type. You should specify the Clock Role as Internal, the Interface Role as DCE, the Clock Speed as 512 kbps and the

NRZI option as Yes. The rest of the options may default as in the example. Since we plan to have other similar Line Attachment Configuration definitions, we select the **Save as Defaults** option which will save the Type, Clock role, Interface role, Clock Speed, NRZI, Device-Ready Timeout and Ready-For-Sending Timeout values for the next line. This will save some time for the subsequent line definitions. After selecting the **OK** push button we are able to define a second similar line by double-clicking on the second position empty triangle. Notice that the options we had saved for the first line definition are automatically filled in.

Since the NCT does some validation on the physical hardware, it is preferable to define the physical hardware configuration for all the Nways Switches first before proceeding to the port configuration.

8.6 NBBS Port Definition

You may now proceed to define the NBBS ports. Double-click on the **Ports** icon on the following menu:
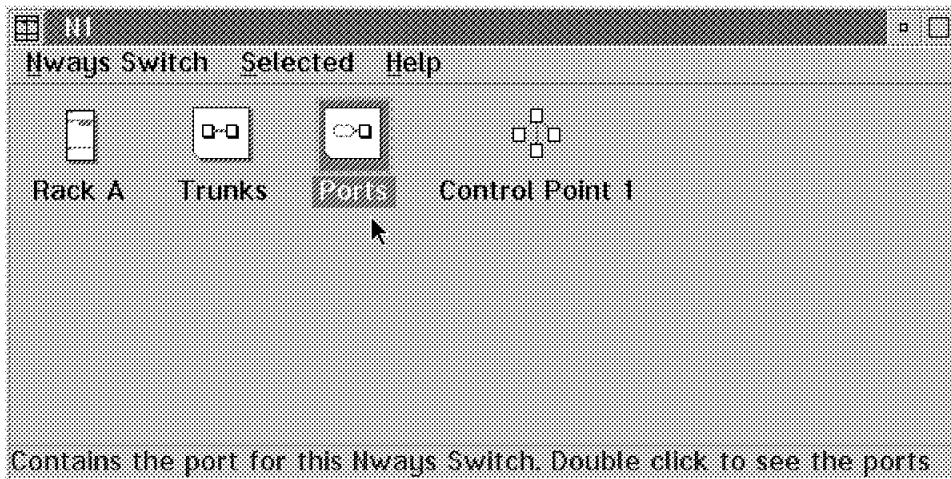
Figure 255. Port Configuration

Like you did for the trunks before, you should select the **Ports** and **Create port...** options as follows:
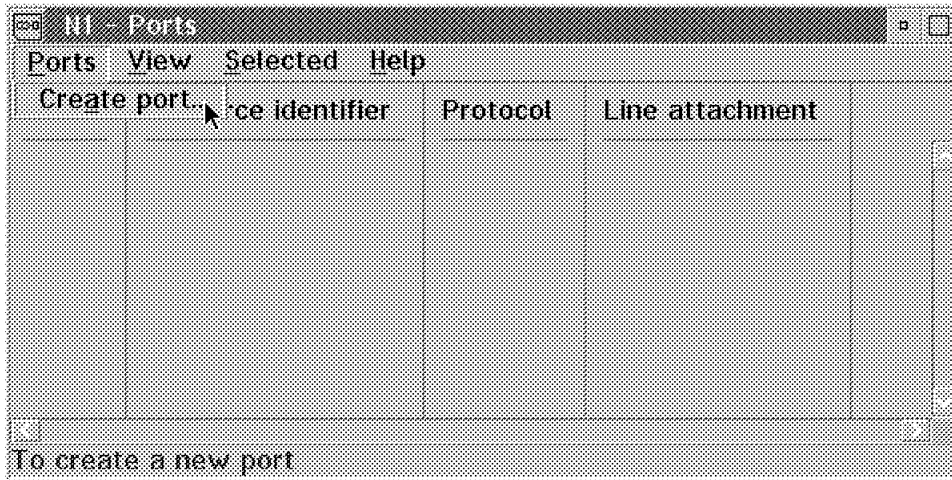
Figure 256. Create a New Port

This will bring up the following configuration menu where we have specified the name N1S5P1 for our port.
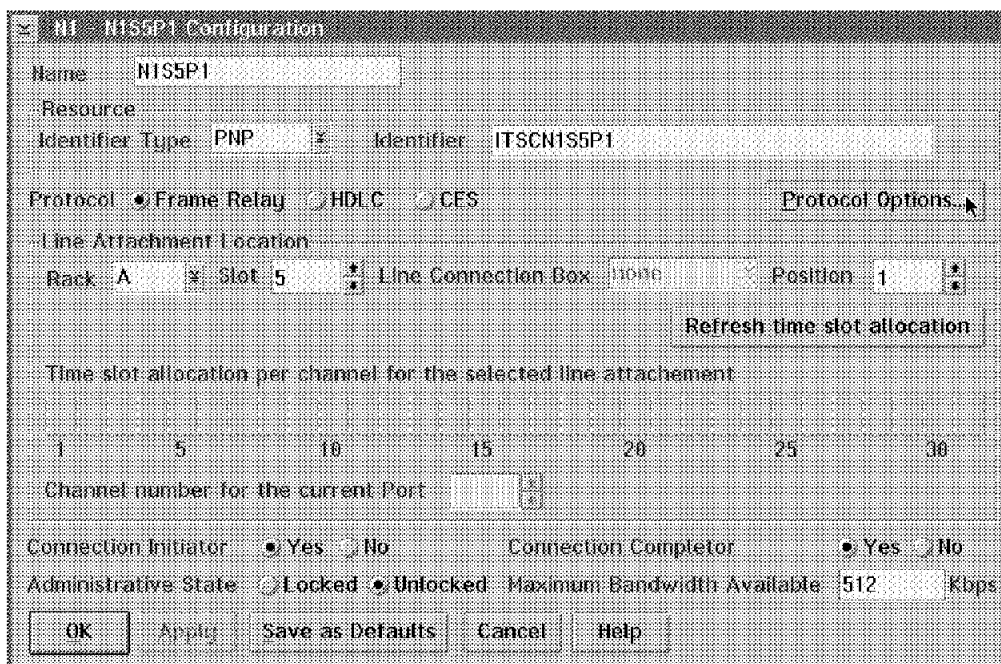
Figure 257. N1 - N1S5P1 Configuration

Notice the naming convention we have used. It tells us that it is the first port of slot 5 for Nways Switch N1. You will use your own naming convention of course.

As soon as you press the Enter key or select one of the options, you will notice that the Nways Switch Configuration Tool (NCT) will automatically, in the Identifier field, prefix the name you gave to this connection by the network name ITSC which you defined. Therefore, the port identifier is now ITSCN1S5P1 in our example.

Since this will be our frame relay port, we have selected Frame Relay as the protocol.

Notice that for the identifier type we have used the Private Numbering Plan (PNP) naming convention type, which is the default value. This allows us to use our own naming convention. We need to tie this port definition to a physical line attachment location that we defined earlier. In our case, we want this frame relay logical port definition to be tied to the physical line definition in rack A, slot 5 and position 1.

The field Time slot allocation per channel for the selected line attachment is used when the physical communication line supports the Time Division Multiplexing (TDM) option. This option divides the physical line into several groups of time slots, and a logical port is associated to each group of time slots (to each channel). This option is only available for the T1 and E1 lines if you have defined them as channelized. Since we are defining this port on a V.35 adapter, the TDM option is not available.

We also specified the Connection Initiator and Connection Completor as Yes. This means that this port can be a connection initiator and, as such, is responsible for setting up the connection. A port that multiplexes connections, as a frame relay port does, may be configured both as a connection initiator and completor which is what we did.

The Locked and Unlocked selections under Administrative State allow us to describe whether we want traffic to start flowing automatically or wait for an operator intervention. Whenever you select **Refresh time slot allocation** the NCT will update the Maximum Bandwidth Available field. If TDM is not supported, it defaults to the maximum clock speed you specified during the line physical definition (see Figure 254 on page 267). Otherwise it would correspond to the number of subchannels at 64 kbps (56 kbps in the case of 8-bit stuffing).

Make sure you select **Protocol Options**, as we did, if you want to modify the default protocol options. (The protocol option can only be set for frame relay.) This will bring up the following window:
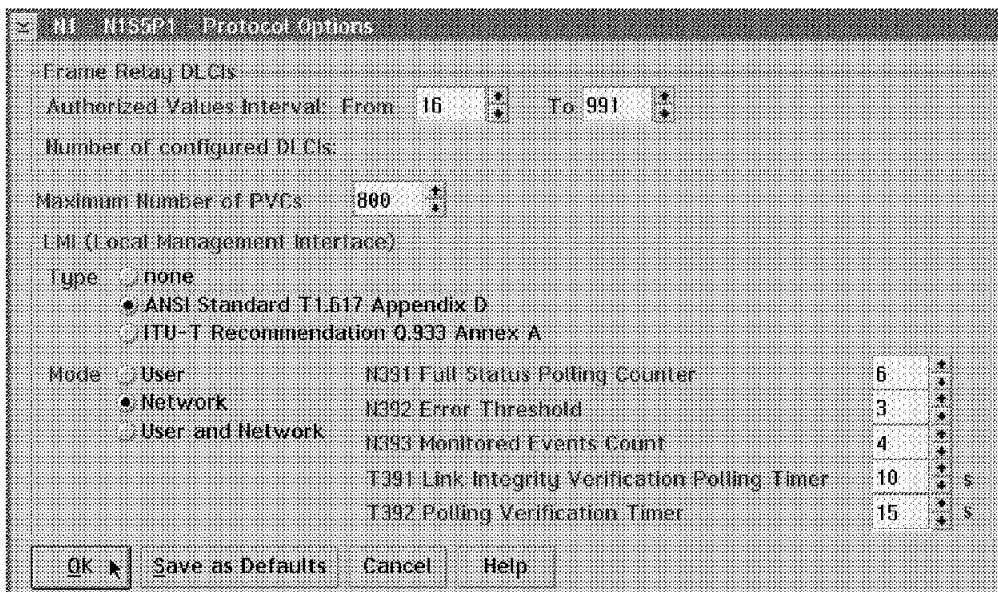
Figure 258. Protocol Options

Most of the fields in this window are self-explanatory and therefore we do not explain them in detail. You may refer to the online help or a frame relay document to explain this terminology in detail.

Another redbook called *IBM 2220 Nways Switch: Concept and Products*, SG24-4307 covers in greater detail the frame relay parameters of the product.

In our case, we chose to use the ANSI Standard T1.617 Appendix D for the Local Management Interface (LMI) and we let all the other values default. Select the **OK** button to proceed.

By selecting the **Ports** and the **Create port...** options, we create another port as follows for our HDLC connection:
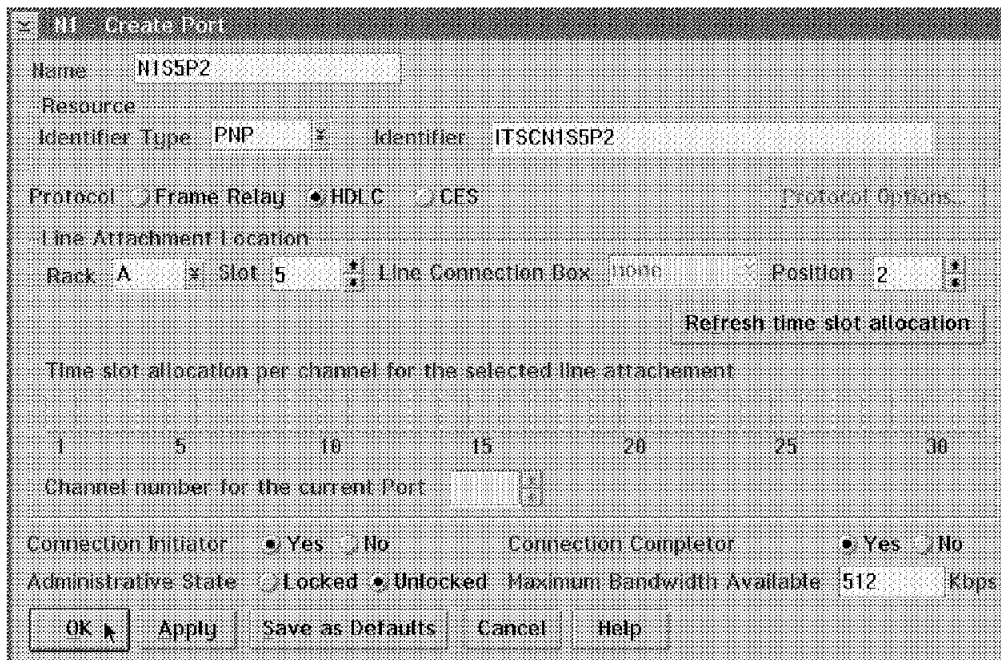
Figure 259. Create Port

Here, since we are defining the second port, we used the name N1S5P2 and selected HDLC as the protocol. Again the NCT filled in the Identifier field so we specified the port position to be in rack A, slot 5 and position 2. The NCT verified that this port was indeed a good selection, and we selected the **OK** push button to finalize our choices. Now you should define the similar ports on the N2 Nways Switch.

8.7 Frame Relay Connection Explanation

On an Nways Switch, a frame relay connection between two partners is identified by a Virtual Circuit Number (VCN). In order to establish the path through the network over this Virtual Circuit Number (VCN) it is necessary to define a Potential Connection (PCO) in the entry Nways Switch called the Initiator Side (N1 in our case) and a Virtual Connection (VCO) in the Nways Switch called the Completor Side (N2 in our case).

We define a Potential Connection (PCO) from the N1 Nways Switch to the N2 Nways Switch. The DLCI we use in this Potential Connection (PCO) definition

used locally only to help the Nways Switch locate its partner (the IBM 6611 R1 router in our case).

A Virtual Connection (VCO) is defined later on the N2 Nways Switch using the same Virtual Circuit Number (VCN) we used for our Potential Connection (PCO) definition. It is very important to use the same Virtual Circuit Number (VCN) because this is how the two partners are matched. You define, in this Virtual Connection (VCO), the DLCI used by the N2 Nways Switch to locally identify its IBM 6611 R2 router partner.

Note that the DLCI we use has to match the one used in the router definition, but both routers could use the same DLCI number. This is because the DLCI number has local significance only. When the network reserves the resource for the connection, it uses the parameters set in the Potential Connection (PCO).

In the Potential Connection (PCO), the user has to define the Quality of Service (QoS). This definition will be for both the forward and return path of the connection. In order for the network to identify the connection as unique, the user will have to specify a Virtual Circuit Number (VCN). The Virtual Circuit Number (VCN) value has to match both the Potential Connection (PCO) and the Virtual Connection (VCO).

Of course, in the Potential Connection (PCO), the user will specify the bandwidth parameters required for the connection. The set of parameters defined for a connection (virtual circuit) is dependent on the type of frame relay mode.

8.8 Frame Relay Connection Definition

Before you proceed with the Potential Connection (PCO) and Virtual Connection (VCO) definitions you must make sure you have defined all ports for this configuration. This is because NCT checks this. If you have followed our instructions so far, you have already defined the NBBS ports you will use.

In order to define our connections, we first select the port we want to work on by double-clicking with the left mouse button on the N1S5P1 port, as shown below:
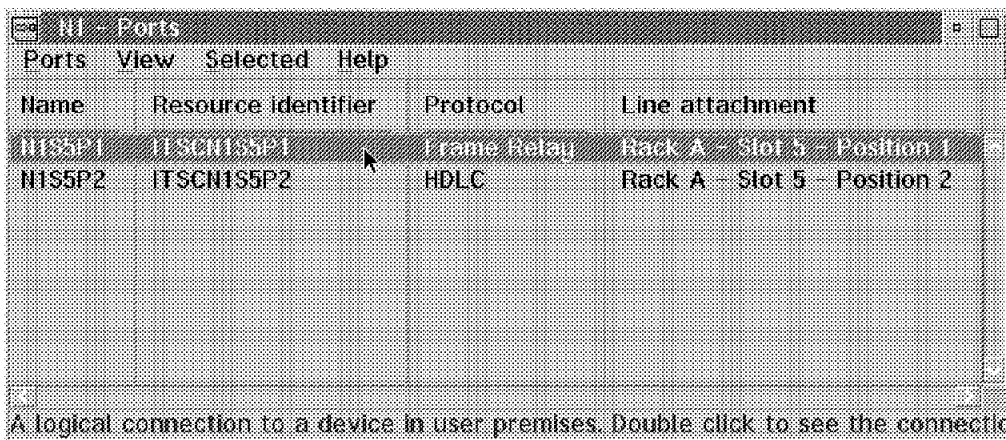
Figure 260. Ports

To create our Potential Connection (PCO), we need to first select the **Port** option followed by the **Create Potential Connection** option as shown in the following illustration:
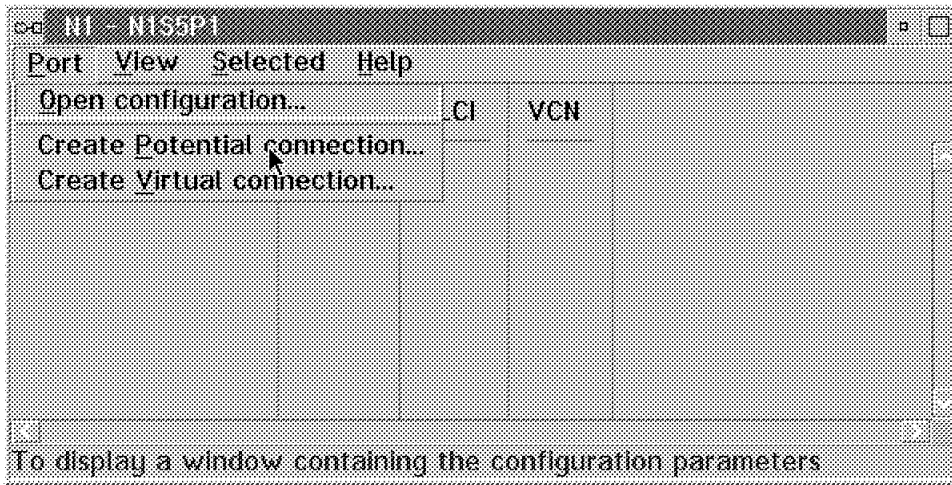
Figure 261. N1S5P1

This brings up the following window where we are able to define the Virtual Circuit Number (VCN) as well as the virtual circuit name.
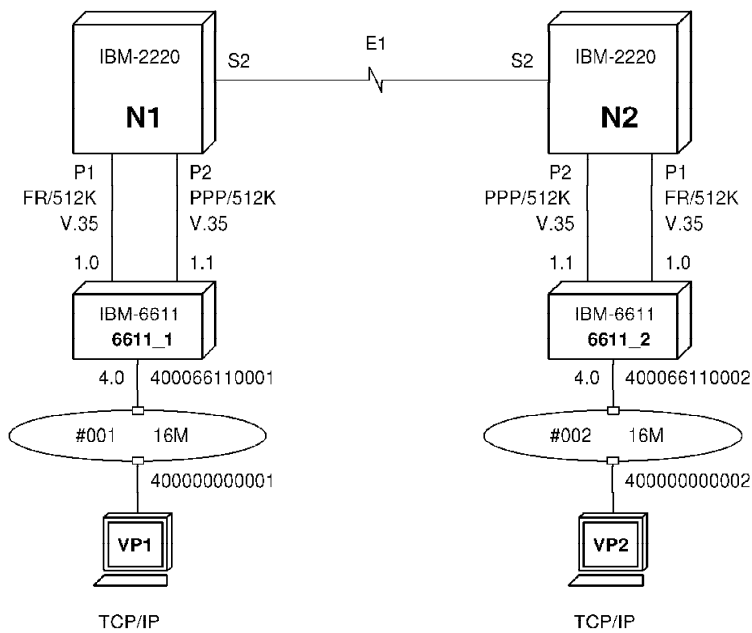
Figure 262. PORT1FR21 Configuration

The allowable range for the Virtual Circuit Number (VCN) is from 0 to 65,535 and must be the same at both the Initiator and Completor side. We have selected the Virtual Circuit Number (VCN) 10. The name that we have selected is PORT1FR21. This naming convention tells us that this will be a Potential Connection (PCO) definition on our first port and for DLCI 21. Again, you may

change this naming convention but it helps to have one that fully describes what the name represents.

On the Initiator side, the NCT already filled in the Nways Switch, Resource Identifier Type and Resource Identifier fields for us. Because of our naming convention we are able to verify that this is indeed for the N1 Nways Switch of the ITSC network and we want the initiator to be on slot 5 and position 1. We selected the Resource Identifier Type as PNP and the only thing we have to define is the DLCI. As we mentioned earlier, this DLCI has local significance only and is used to identify the specific frame relay connection for our R1 6611 router, but it must match the DLCI we used in our router definition.

On the Completor side, we have to tell the system where our partner is and for that we fill in the Nways Switch Configuration Tool (NCT) with the specific Nways Switch. This is where predefining all Nways Switches is helpful because we see all of them in the list and we can select the one we want. We still can manually input this field if we have not previously defined the other Nways Switch. In our case, since we want to talk to the port in slot 5 position 1, we used ITSCN2S5P1. Because of our naming convention, we know exactly in what network, what Nways Switch, what port slot and what physical location our completor device is connected.

In the Traffic Definition section, we have to describe the characteristics of our traffic. This traffic could be defined as regular frame relay traffic or as the added NBBS value. In our case, because we are defining our own private frame relay network, we have chosen to define this connection as NBBS. The Peak Bit Rate is already predefined for us using the Clock Speed value we defined earlier when we created that line in our LIC. You can change that peak rate value if you wish. We have then defined our Mean Bit Rate as 256 kbps in both directions. This specifies what you want the average rate to be over a relatively long period of time. This parameter is similar to the Committed Information Rate (CIR) which is a frame relay parameter. We have left the Mean Burst Length default at ten milliseconds, which is the average duration for which a user can submit data to the network at the peak rate. This parameter is similar to the Committed Burst Size (Bc) which is a frame relay parameter.

Chapter 3, "Nways Switch Frame Relay Services" on page 73 covers in detail the frame relay components of the product.

Each Potential Connection (PCO) has a Quality of Service (QoS) class assigned to it. This Quality of Service (QoS) class is used by the system to reserve a certain amount of bandwidth for your connection. The amount of bandwidth reserved depends on the connection's traffic characteristics as well as the Quality of Service (QoS) you choose.

In the system, there are already many different Quality of Service (QoS) names that you can select. This simplifies the QoS selection process. If you click on the right arrow next to the QOS item you will see a list of names. In our case, because we are using this Potential Connection (PCO) for frame relay and we want it to use the nondisruptive path switching algorithm, we have selected the QOSFRHDLCNDPS value. For the startup mode we have selected Permanent, which means the connection is automatically built at the same time the resource is initiated. User Requested means the connection is built whenever a user or a program requests it. We specified the Administrative State as Unlocked, which means the traffic may flow as soon as the connection is established. We do not

wish to gather accounting information yet and thus we specified Accountable as No.

The parameter called Bandwidth Sensitivity states the minimum percentage size change in the bandwidth required before logging an accounting record that indicates a connection traffic variation. In our case, since we have elected not to gather accounting data for this connection, this parameter does not apply.

Once this is done and you have clicked on **OK**, you will have to build the corresponding virtual connection and the system will issue the following message asking you whether or not to build it for you. This is where predefining all of your Nways Switches comes in handy because if your adapter definition for the partner exists, you may let the system define the virtual connection for you. In our case we want to show you how it is done so we select **No**.
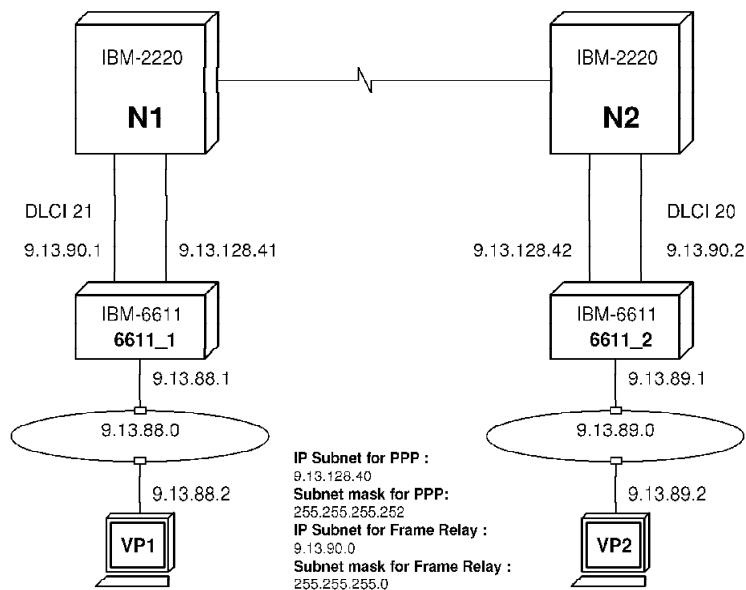
Figure 263. Construct a Virtual Connection

To define our Virtual Connection (VCO), we will first exit the N1 Nways Switch definition by double-clicking on the top left corner until we are back at the main Nways Switch Configuration Tool (NCT) window. There we will double-click on the **N2** icon, the **Ports** icon and then on the frame relay port **N2S5P1**. You may now select the **Ports** and **Create Virtual Connection** options. Assuming you have defined the physical port on the N2 Nways Switch, this will bring up the following menu:
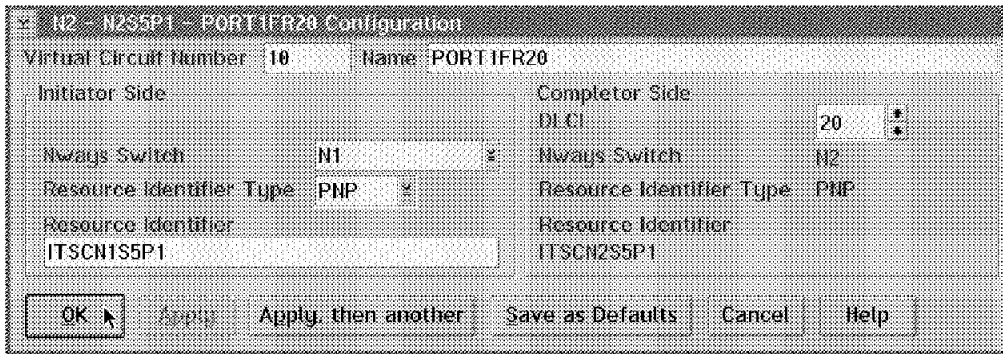
Figure 264. N2S5P1 to PORT1FR20 Configuration

In this window, you will see the Virtual Circuit Number and its name. You will also see, in the Initiator Side, that the resource called ITSCN1S5P1 on the N1 Nways Switch will be in session with the ITSCN2S5P1 Resource Identifier of the N2 Nways Switch. We have specified the DLCI as 20 for this particular 6611 router connection. Select the **OK** button to get the following window showing our new virtual connection:
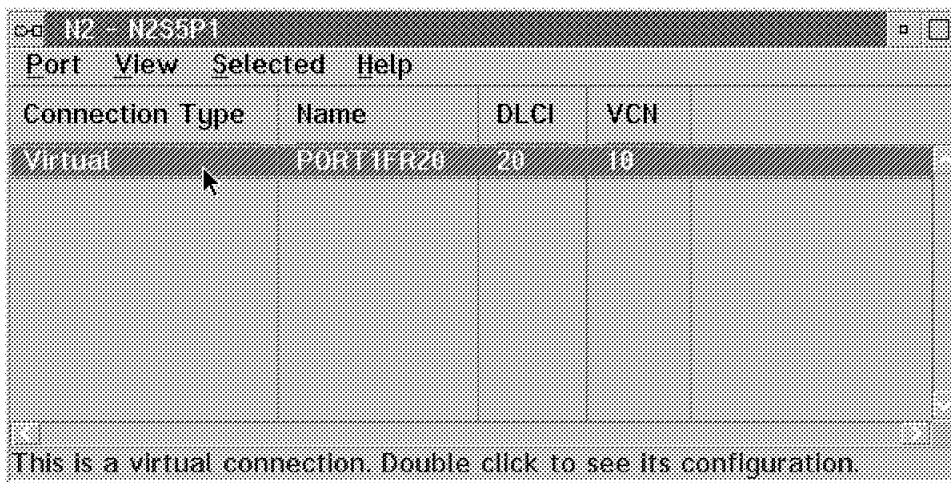
Figure 265. N2 - N2S5P1

Double-click on the top left corner until you are back at the main NCT screen.

8.9 HDLC Connection Definition

We now create our last Potential Connection (PCO) in this scenario for the HDLC port. To do this, we double-click on the **N1** Nways Switch and the **Ports** icon. We then double-click on the HDLC port named **N1S5P2** and we select **Port** and **Create Potential Connection**, which displays the following screen:
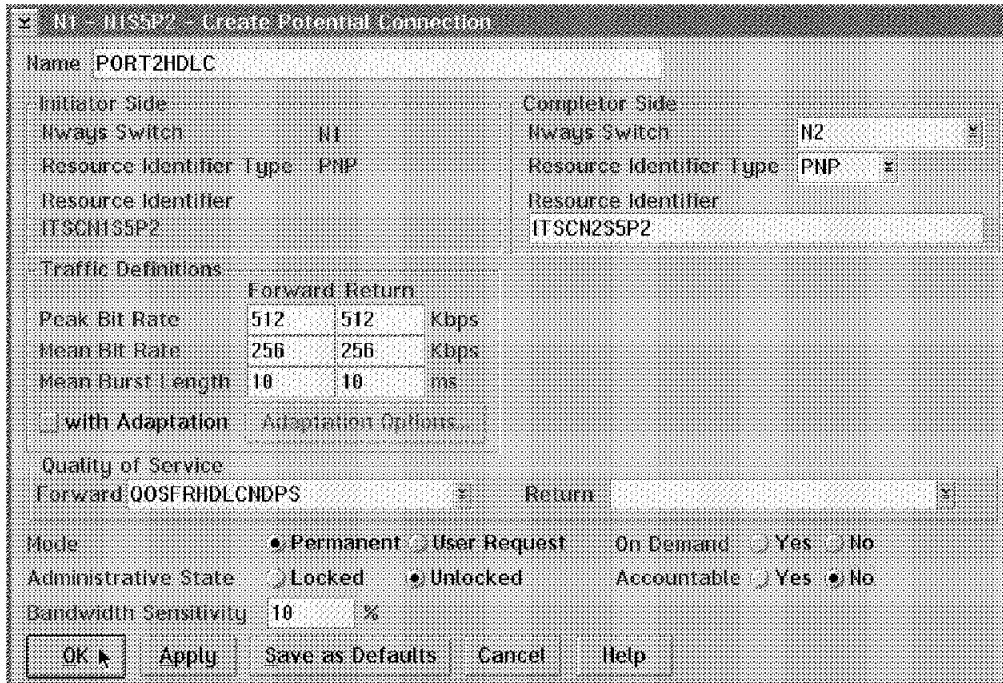
Figure 266. Create Potential Connection

This time we used the name PORT2HDLC and, as was the case for the frame relay Potential Connection (PCO) definition, the Nways Switch Configuration Tool (NCT) provided the information for the Initiator side. We then completed the information on the Completor side to define a connection from ITSCN1S5P2 in Nways Switch N1 going to port ITSCN2S5P2 on N2. This time, since it is not a frame relay connection, we can only specify NBBS parameters for the Traffic Definitions; we specified these the same as we did for the frame relay Potential Connection (PCO).

Once we exit this window, we get the following window showing our newly created Potential Connection (PCO):
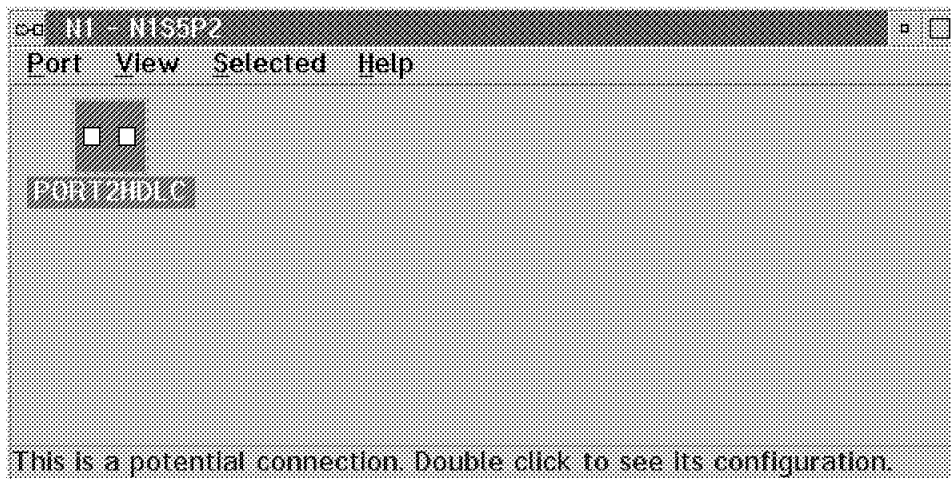
Figure 267. N1 - N1S5P5

Notice that for an HDLC connection we only need to define a potential connection and not a virtual connection.

This completes our scenario for IBM 6611 routers and Nways Switch interoperability.

Chapter 9. Nways Switch IBM 3745 Interoperability - Scenario 2

This chapter describes the details of how to configure an Nways Switch so it can interoperate with an IBM 3745 front end processor. For this scenario, we used the configuration described in Chapter 8, "Nways Switch Router Interoperability - Scenario 1" on page 263 and we added to it the following equipment:

- A third Nways Switch
- An IBM 3745 front end processor
- An IBM 3174 communication controller
- An Nways 2210 router

The purpose of this scenario is to show how to configure a meshed network when a third Nways Switch is added. This will provide alternate paths in case of trunk line failures. The second objective is to demonstrate how to integrate existing 3745 and 3174 controllers into an Nways Switch network. The third objective is to demonstrate how the Nways 2210 router can be integrated into our network.

This chapter includes screen images of the actual modifications we did into our existing configuration as well as details on the third Nways Switch we used. Please refer to Appendix B, "Nways Switch Scenario 2" on page 343 for the details on the 3745, 3174 and 2210 configurations.

9.1 3745 and 3174 Frame Relay Scenario

In order to illustrate frame relay interoperability between 3745, 3174 and Nways Switches, we connected the IBM 3174 controller to the N2 Nways Switch and connected an IBM 3745 FEP to the N1 Nways Switch. In both cases, these devices were added to the third port immediately following the ones used for the IBM 6611 routers in the previous example.

The network was improved by adding a third Nways Switch that we call N3 to provide an alternate route for our traffic. In the N1 and N2 Nways Switches, we added another trunk to provide connectivity to the N3 Nways Switch. For these trunks we used T3 links.

Finally, to demonstrate Nways 2210 connectivity, we added it in the first port of our N3 Nways Switch and defined connections for it on the N1 and N2 Nways Switches.

9.2 Scenario Physical Setup

The following illustration shows the environment:
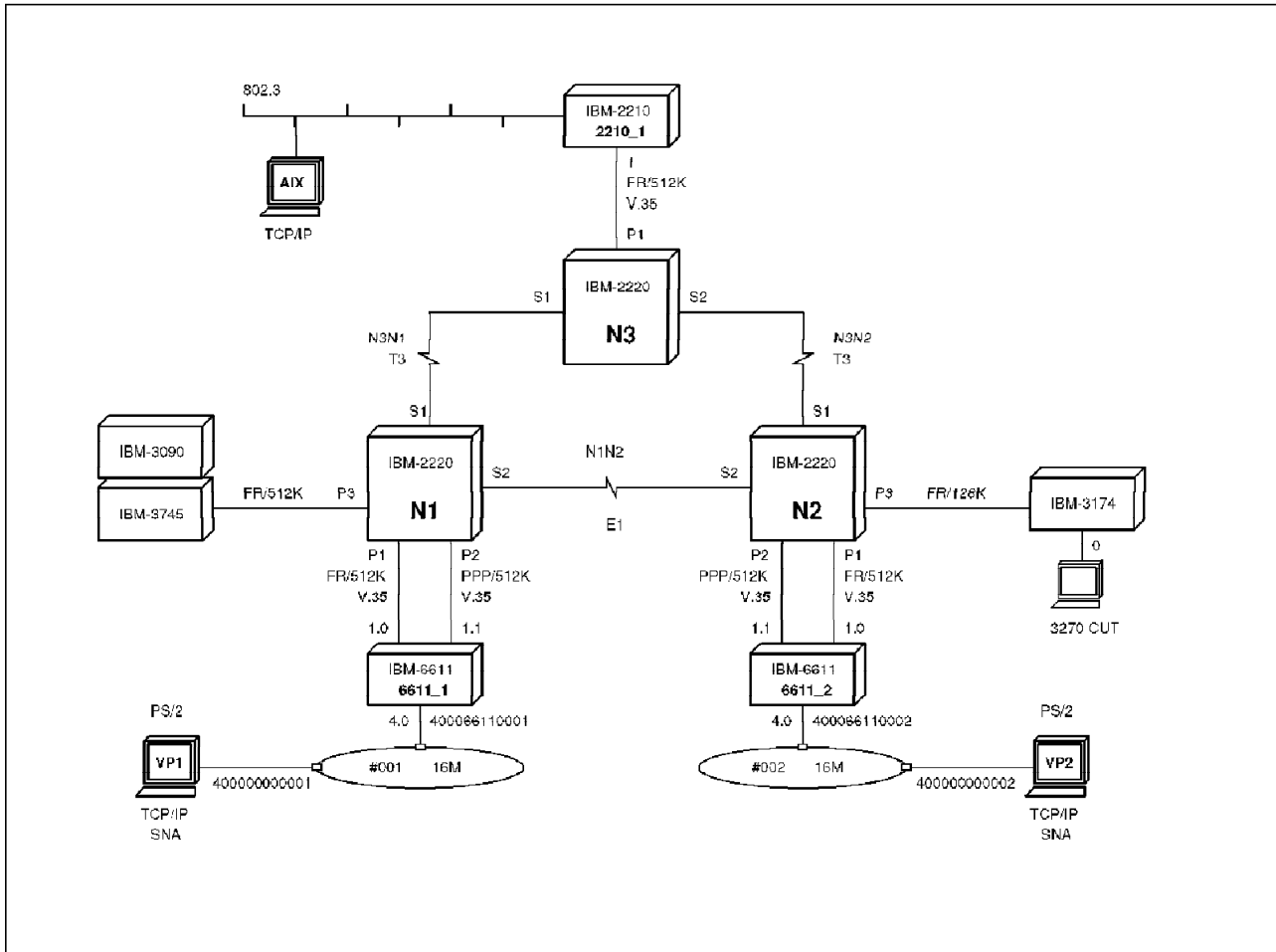
Figure 268. Frame Relay 3745 and 3174 Scenario Physical Illustration

Notice we kept the same naming convention as in the previous example. The new Nways Switch is called N3 and the 2210 router is called R3. To connect the 3745 and 3174 controllers, we used the Virtual Circuit Number (VCN) 30, and the DLCI we used was 30 for the 3745 and 31 for the 3174. To connect the Nways 2210 router to the N2 Nways Switch, we used the Virtual Circuit Number (VCN) 40 and the DLCIs 40 and 41. To connect the Nways 2210 router to the N1 Nways Switch, we used the Virtual Circuit Number (VCN) 50 and the DLCIs 50 and 51.

9.3 Scenario Logical Setup

The following illustration describes the logical or protocol view of the network:
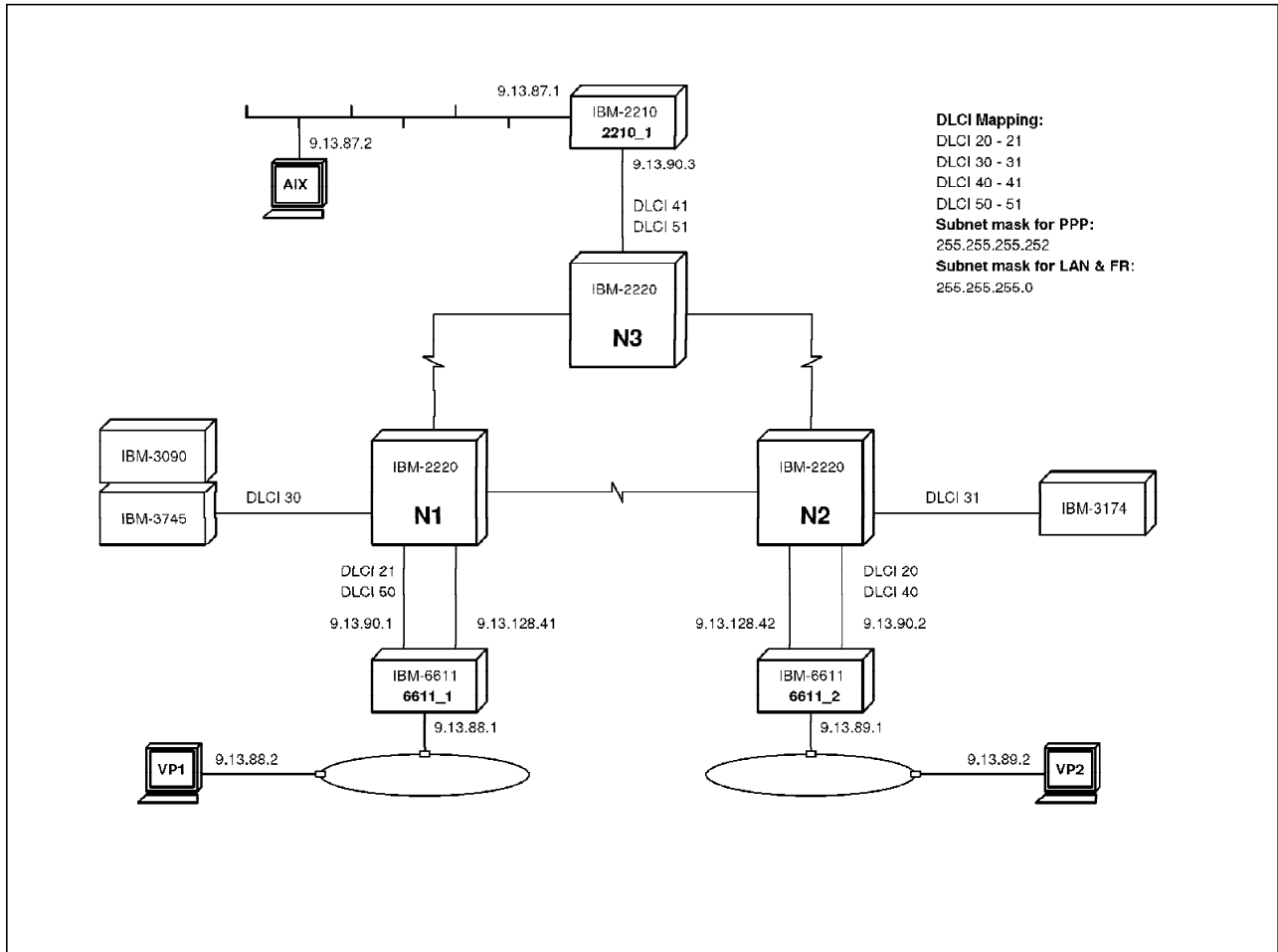
Figure 269. Frame Relay 3745 and 3174 Scenario Logical Protocol Illustration

9.4 N1 and N2 Nways Switches Machine Description

As you see we kept the same configuration as in the previous example and added a high-speed adapter with a corresponding LIC513 in both N1 and N2. The trunk adapter is a high-speed TPA Type 1 placed in slot 1.

		Control Panel			

Fan 2						Fan 1					
1	2	3	4	5	6	7	8	9	10	11	12
L S A 1	L S A 1	D u m m y	D u m m y	L S A 1	D u m m y	D u m m y	D u m m y	D u m m y	H S A 2	D u m m y	D u m m y

Power 2						Power 1					

Figure 270. Front View of Our N1 and N2 Nways Switch Setup for the FEP Scenario

The following image illustrates the rear view of our machine which is similar to the one in our previous scenario but with a LIC513 to provide the T3 trunk to the N3 Nways Switch connection. Our existing LIC512 provides one more V.35 connection to the 3745 in the N1 Nways Switch and the 3174 in the N2 Nways Switch.

Fan 1						Fan 2					
DCD	APC	10	9	8	7	6	5	4	3	2	1
DCD (−1)	APC	D u m m y	SWRD (−1)	D u m m y	D u m m y	D u m m y	L I C 5 1 2	D u m m y	D u m m y	L I C 5 1 5	L I C 5 1 3
DCD (−2)											

Power 1						Power 2					

Cable Side

Figure 271. Rear View of Our N1 and N2 Nways Switch Setup for the FEP Scenario

9.5 N3 Nways Switch Machine Description

The N3 Nways Switch, like the other two, is a nonredundant Model 500 with dual AC power supplies. For the N3 Nways Switch we have two high-speed adapters in positions 1 and 2 to provide the N1 and N2 Nways Switches trunk support, each one with a corresponding LIC513. We also have in position 5 a Low-Speed Adapter Type 1 (LSA1) with a corresponding LIC512 for port support. The control point function is in a High-Speed Adapter Type 2 (HSA2) placed in position 10 as shown in the following illustration:

Control Panel											
Fan 2						Fan 1					
1	2	3	4	5	6	7	8	9	10	11	12
HSA2	HSA2	Dummy	Dummy	LSA1	Dummy	Dummy	Dummy	Dummy	HSA2	Dummy	Dummy
Power 2						Power 1					
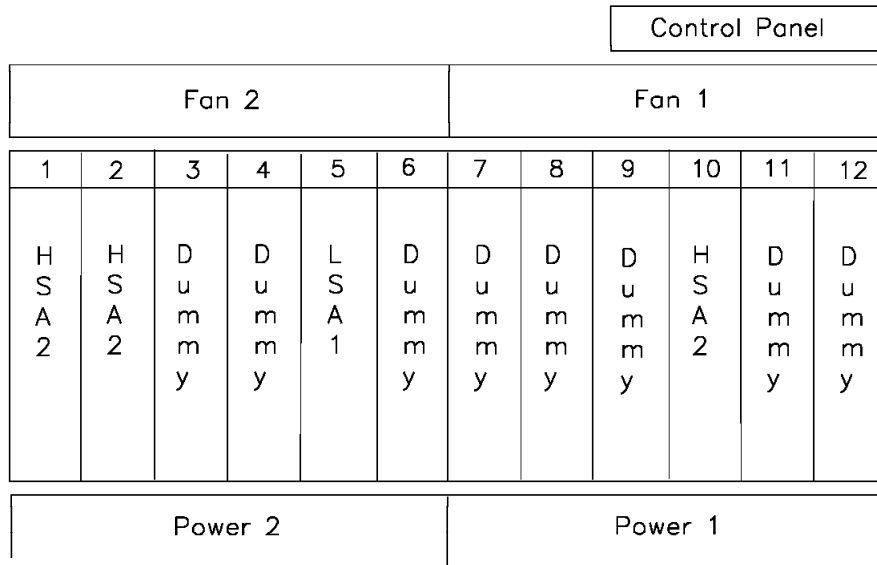
Figure 272. Front View of Our N3 Nways Switch Setup for the FEP Scenario

The following image illustrates the rear view of our N3 Nways Switch where you may see the two LIC513s which provide the T3 trunk to the N1 and N2 Nways Switches; you may also see the LIC512 which provides one V.35 connection to the Nways 2210.

DCD	APC	10	9	8	7	6	5	4	3	2	1
DCD (−1) / DCD (−2)	APC	Dummy	SWRD (−1)	Dummy	Dummy	Dummy	LIC512	Dummy	Dummy	LIC513	LIC513

Fan 1 | Fan 2

Power 1 | Power 2

Cable Side

Figure 273. Rear View of Our N3 Nways Switch Setup for the FEP Scenario

9.6 Nways Switch Configuration Tool (NCT) Definitions

For this scenario we only documented the new additions made and not the whole configuration. Please refer to Chapter 8, "Nways Switch Router Interoperability - Scenario 1" on page 263 for more information. Like we did for the first scenario, on each screen we put in as many details as possible. When an item is not specified, this means that you may use the default option provided by the NCT. We did our configurations using the same centralized Nways Switch Configuration Tool (NCT) on the Nways Switch Administration Station (NAS) as for the previous example. We had to do this in order to generate the correct IP host address for the N3 Nways Switch.

Please note

- Our machine is at the Nways Switch Configuration Tool (NCT) Version 1 Release 2. Depending on the version that you are using the screen format may vary. Whenever your screen is different than the one illustrated in this redbook, please use the help function of the Nways Switch Configuration Tool (NCT).

- Because it is impossible to provide all the details for every parameter that is available, we strongly suggest you use the extensive contextual online help provided with the configuration tool for any item not covered in this publication.

For these additions we used the same methodology as described in the first scenario, which is to do the following:

- Create all the Nways Switches first.

- Define all the hardware for a given Nways Switch before attempting to define the trunks and ports for that Nways Switch.

- Create a port or a trunk only after the physical hardware adapter for that trunk or port has been defined.

• Define the NBBS ports before attempting to define the connections.

9.7 Nways Switch Creation

The first task is to define the new N3 Nways Switch. We proceed as we did previously in 2.6, "Nways Switch Creation" on page 52. To create a new Nways Switch, select from the main screen of the Nways Switch Configuration Tool (NCT) the **Network** option followed by **Create Nways Switch**. Enter the same general description as before for this Nways Switch as follows:

• Select a Name. In our case we used N3.

• Select the type of machine. In our case it was an IBM 2220 Model 500.

• Select the options. In our case it was a nonredundant model with dual power supplies and no clock cards.

• Select the Control Point Adapter Location to be in slot 10.

• Select the IP Gateway Adapter Location to be in rack A and slot 5.

• Select the 128.1.0.0 IP Network Address previously defined.

• Select the Domain Name as TESTNET like we did for the other two Nways Switches.

• Select the Phone Number, and to enter the name and number of the contact person for questions concerning the Nways Switch.

9.8 Physical Rack Definition

The next thing that has to be done is to define the entire detailed physical configuration for the N3 Nways Switch. Please refer to 2.7, "Physical Rack Definition" on page 54 for more details on how to do this. Double-click on the **Rack** icon and verify that there is a High-Speed Adapter Type 2 (HSA2) defined for our control point.

9.8.1 Trunk Adapter Physical Line Definition

Here we illustrate the N3 Nways Switch first T3 trunk definition going to the N1 Nways Switch. We define this trunk on our N3 Nways Switches with a High-Speed Adapter Type 2 (HSA2) in slot 1 supporting a LIC513 for a T3 trunk line.

Create a High-Speed Adapter Type 2 (HSA2) in slot position 1 and an LIC513 for it in the back. Do not forget to specify the Mode as Trunk when you create the High-Speed Adapter Type 2 (HSA2). Double-click on the **T3** icon in the back of position 1 and you will get the following screen:
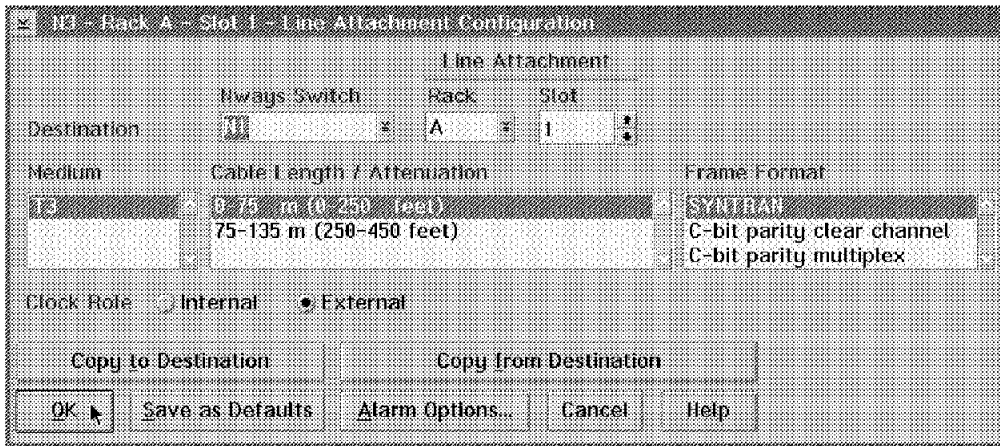
Figure 274. Line Attachment Configuration

> **Note:** Only C-bit parity clear channel will be supported.

We selected the correct rack and slot positions as well as N1 for our Destination. We have decided to use the default options for the other parameters. Since the N1 Nways Switch will provide the clocking on this specific trunk we have chosen the Clock Role as External. Select **OK**.

Proceed to define the second trunk going to the N2 Nways Switch. The second one will be exactly the same as the first except for the Destination and Line Attachment which will reflect the physical location of this adapter.

We have completed the trunk physical line definitions for the N3 Nways Switch. We now define the counterpart trunk physical line in the N1 Nways Switch. Double-click on the top left corner until you are out of the N3 configuration. We will be using a High-Speed Adapter Type 1 (HSA1) in the N1 Nways Switch, so we have created, in the N1 Nways Switch, a new High-Speed Adapter Type 1 (HSA1) with a LIC513 to support our T3 trunk line. Please refer to 2.7, "Physical Rack Definition" on page 54 for information on how to do this. Once you have done it you will get the following window for your N1 Nways Switch rack:
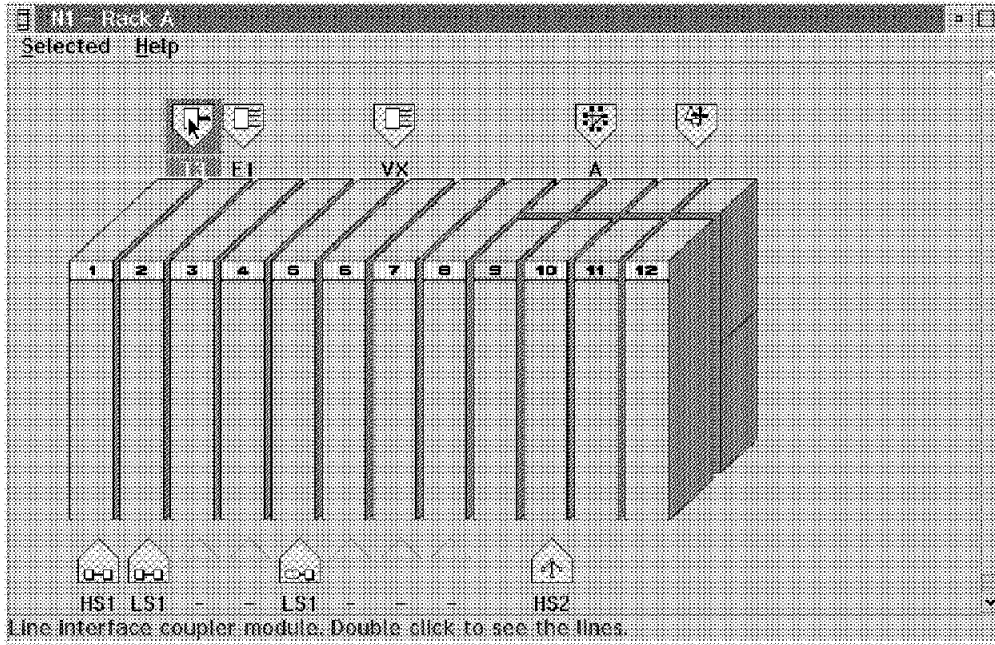
Figure 275. Node 1 Rack A

Double-click on the **T3** icon in the back of N3 slot position 1 and you will get the following screen:
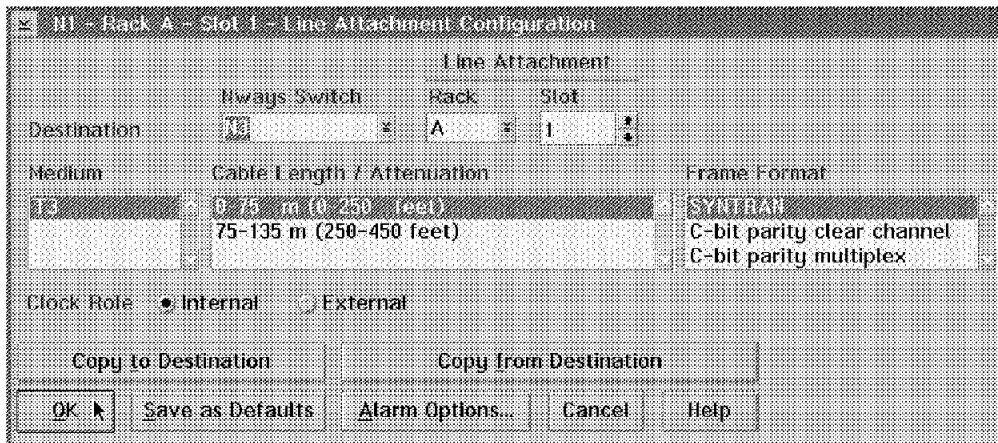
Figure 276. Rack A Slot 1 Line Configuration

Select the correct rack and slot positions as well as N3 for Destination. We have selected to use the default options for the other parameters and since the N1 Nways Switch provides the clocking on this specific trunk we have chosen the Clock Role as Internal.

Define a physical line in the N2 Nways Switch using the exact same parameters as for the N1 Nways Switch definition. Now that our trunk's physical lines are defined in all three of our Nways Switches, we can proceed with the new port physical line definitions.

9.8.2 Port Adapter Physical Line Definition

We proceed with the physical line definition in the N1 Nways Switch that will support our 3745 controller. In order to do this, we double-click on the **N1 Nways Switch** icon in the main Nways Switch Configuration Tool (NCT) screen. Then double-click on the **Rack A** icon. Since we will add this line after the two we already defined on the LIC512 in position 5, double-click on the **VX** icon and then double-click on the third line position illustrated by the empty triangle. This will bring us to the following screen:
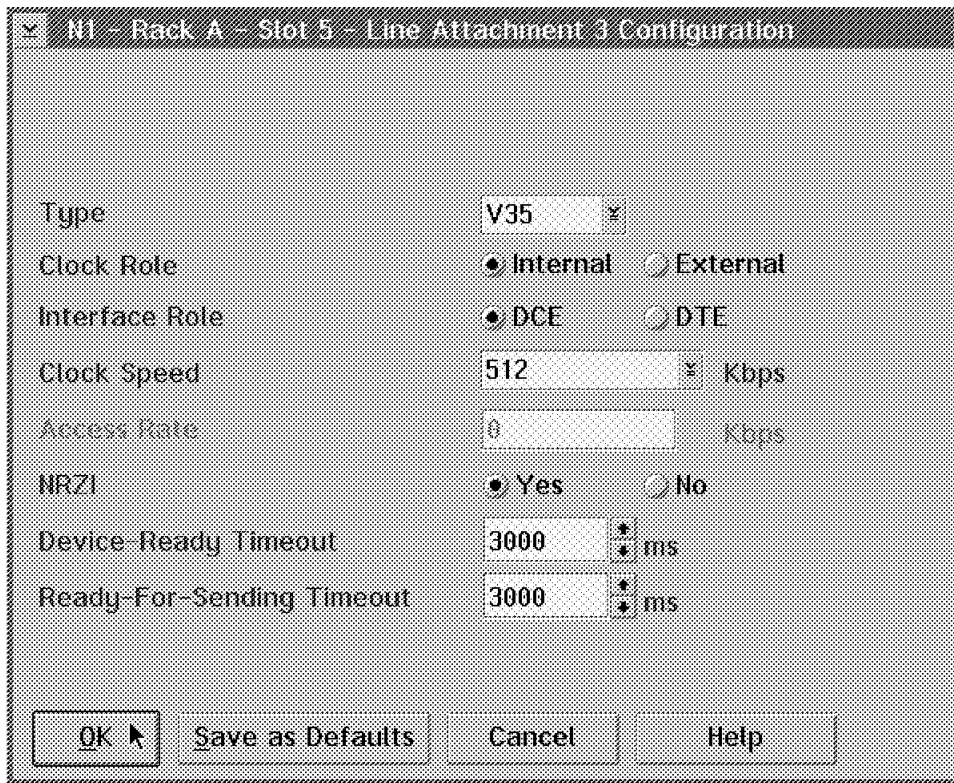
Figure 277. Configuring the Physical Interface of the N1 Port Adapter

Notice that in this case we have defined the port line that will support our 3745 with the Clock Role set as Internal and the Interface Role set as DCE since we want the Nways Switch to provide the clocking. We will use NRZI to match the 3745 definition.

We proceed with the physical line definition in the N2 Nways Switch that will support our 3174 controller. In order to do this we double-click on the top left corner until we are back at the Nways Switch Configuration Tool (NCT) main screen. Then double-click on the **N2 Nways Switch** icon in the main NCT screen and on the **Rack A** icon. Since we will add this line after the two we already defined on the LIC512 in position 5, we double-click on the **VX** icon and then double-click on the third line position illustrated by the empty triangle. This will bring us to the following screen:

```
┌─────────────────────────────────────────────────────────────────────┐
│ ▼  N2 - Rack A - Slot 5 - Line Attachment 3 Configuration            │
├─────────────────────────────────────────────────────────────────────┤
│                                                                       │
│                                                                       │
│                                                                       │
│   Type                         │ V35      ▼│                          │
│   Clock Role                    ○ Internal   ● External               │
│   Interface Role                ○ DCE         ● DTE                    │
│   Clock Speed                  │ 2048       ▼│ Kbps                    │
│   Access Rate                  │ 256        │ Kbps                     │
│   NRZI                          ● Yes         ○ No                     │
│   Device Ready Timeout         │ 3000      ▲▼│ ms                      │
│   Ready-For-Sending Timeout    │ 3000      ▲▼│ ms                      │
│                                                                       │
│                                                                       │
│  ┌─────────┐                                                          │
│  │ OK   ▶ │   Save as Defaults    Cancel        Help                  │
│  └─────────┘                                                          │
└─────────────────────────────────────────────────────────────────────┘
```
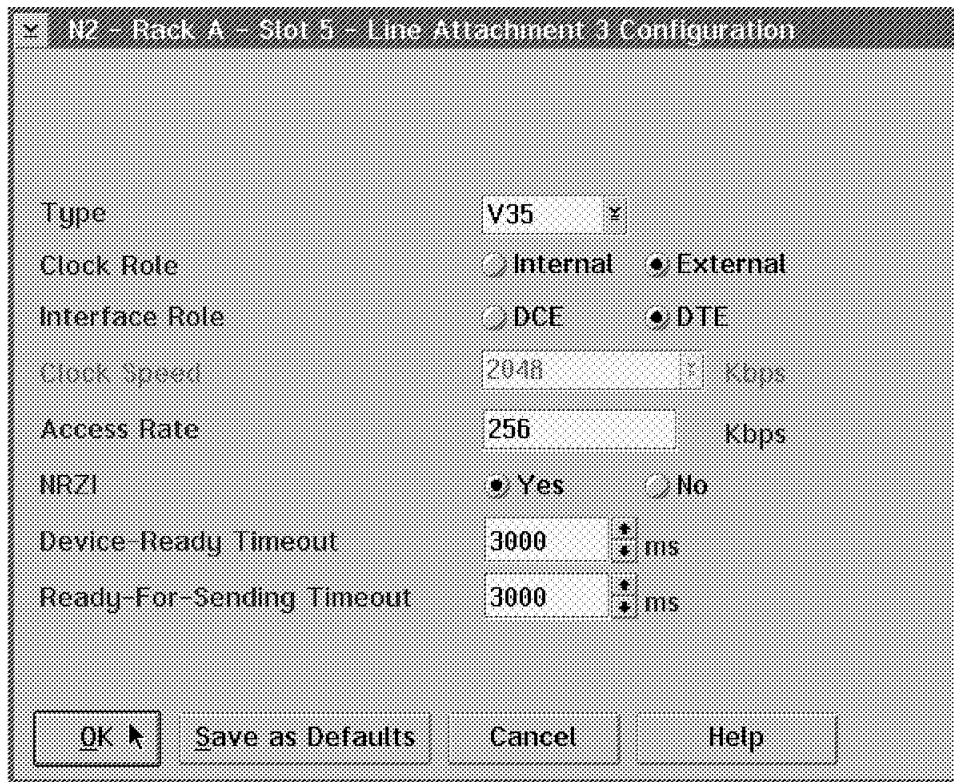
Figure 278. Configuring the Physical Interface of the N2 Port Adapter

Notice that in this case we have defined the port line that will support our 3174 with the Clock Role set as External and the Interface Role set as DTE since the 3174 was connected to our Nways Switch with a modem eliminator which provided the clocking. Since we defined it for the 3745 connection, we will also use NRZI and an Access Rate of 256 kbps.

We proceed with the physical line definition in the N3 Nways Switch that will support our Nways 2210 router. In order to do this, we double-click on the top left corner until we are back at the NCT main screen. Then we double-click on the **N3 Nways Switch** icon in the main Nways Switch Configuration Tool (NCT) screen and double-click on the **Rack A** icon. Since this adapter is not yet defined we will create it. In our configuration, we used a Low-Speed Adapter Type 1 (LSA1) and then a LIC512. Do not forget, when you create the adapter, to specify the Mode as Port. After selecting the **OK** button, we create a LIC512 in slot position 5. After creating the LIC512, we double-click on the new **VX** icon to get to the line definition screen. In our configuration, we used the first position to plug in our cable, so we double-click on the first line position illustrated by the empty triangle. This brings us to the following screen:
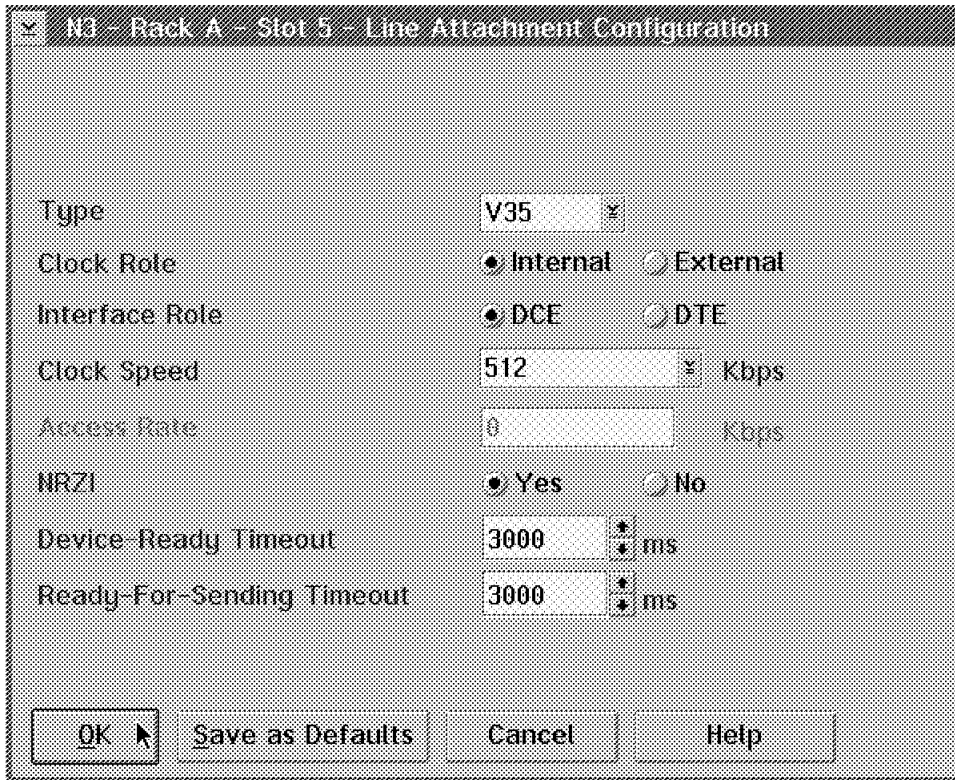
Figure 279. Configuring the Physical Interface of the N3 Port Adapter

Define the line as V35 Type with the Clock Role as Internal, the Interface Role as DCE, the Clock Speed as 512 kbps and the NRZI option as Yes. The other field can remain at their default values.

Once the previous steps are completed, the following rack screen will appear:
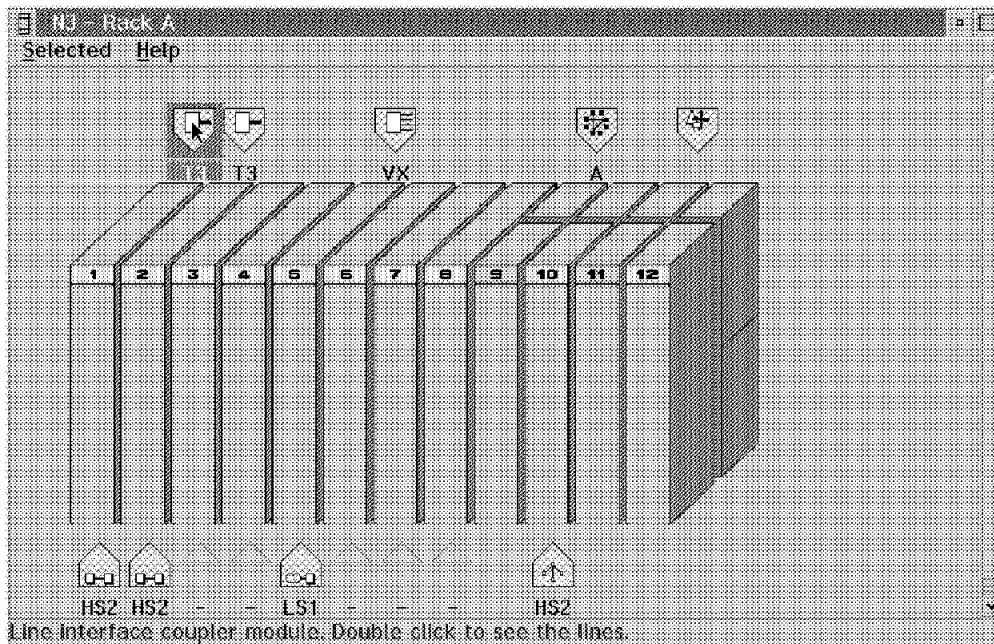
Figure 280. N3 Rack Configuration

This concludes the physical definition part; we can now proceed to the logical definitions.

9.9 NBBS Trunk Definition

After defining all the physical adapters, we need to define the new NBBS trunks and ports. We start with the N1 Nways Switch NBBS trunk definition between the N1 and N3 Nways Switches. From the main Nways Switch Configuration Tool (NCT) screen, double-click on the **N1 Nways Switch** icon and then its trunk icon. Select **Trunks** and **Create trunk** and you will get the following screen:
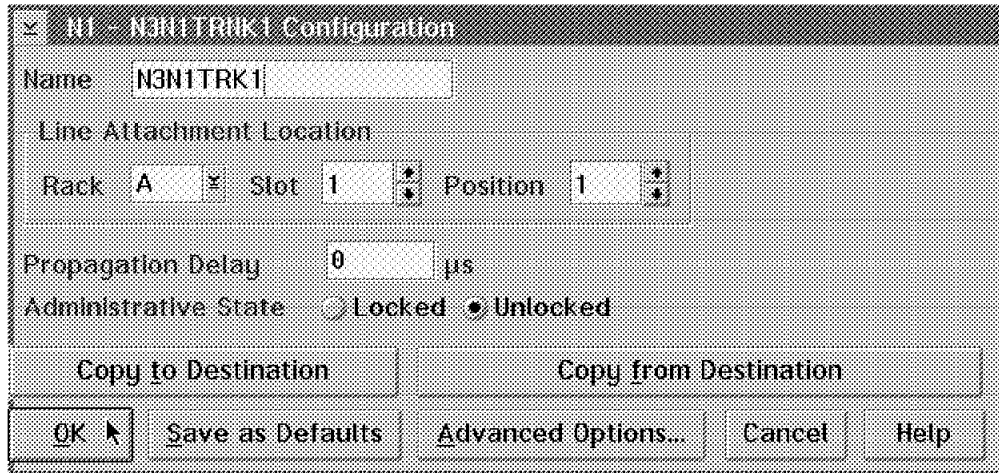
Figure 281. Creating the Trunk on N1

Since this is a trunk going from N1 to N3 and this is our first trunk logical definition between these two Nways Switches, we have used the name N1N3TRK1.

Whenever you define the NBBS trunks or ports, you have to relate them to a physical definition made earlier. This is done by specifying the rack, slot and position of the adapter. There is a validation check that takes place here to ensure that the physical definition of an adapter (with trunk code) is in that position.

You will notice there is a field called Propagation Delay. In our example, we have allowed it to default to zero. The value you may put in this field is what you want the average propagation delay in microseconds to be over that specific trunk line. The Nways Switch will take this value into account whenever it is allocating the bandwidth on this trunk.

The Administrative State describes what status the trunk will be in when it is started. One choice is to have it come up in a locked state. Locked means that the trunk is installed and available. However, the traffic is prohibited from flowing on it. The other choice is Unlocked where the traffic is allowed to flow as soon as the adapter is loaded. In our case, we have decided to have it come up as unlocked. Please note that we have used the same Advanced Options as in the previous scenario. Once you select **OK**, you will see the new NBBS trunk together with the previous ones as in the following screen:
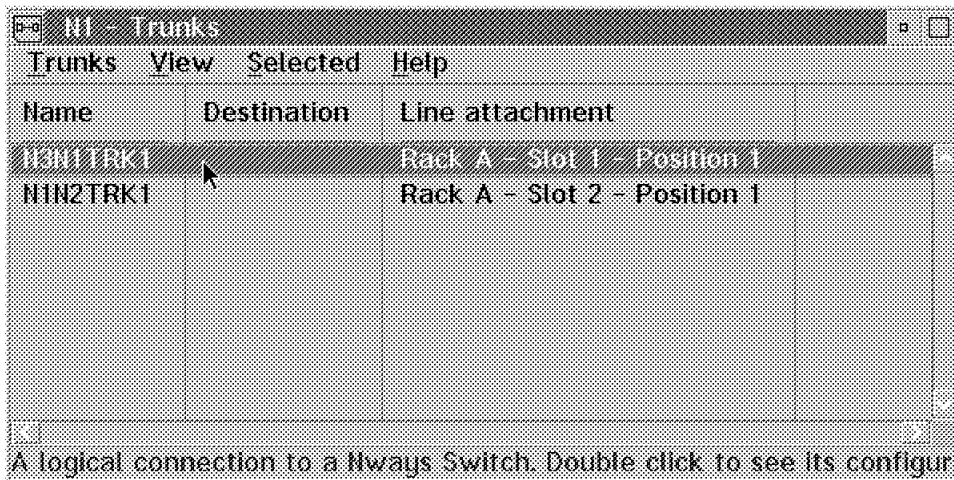
Figure 282. Viewing the Defined Trunks on N1

We will exit the N1 Nways Switch definition by double-clicking on the top left corner until we get to the basic screen. We defined the other end of our trunk in the N3 Nways Switch. In order to do this, double-click on the **N3 Nways Switch** and then on its **Trunk** icon. Select **Trunks** and **Create trunk** and you will get the following screen:
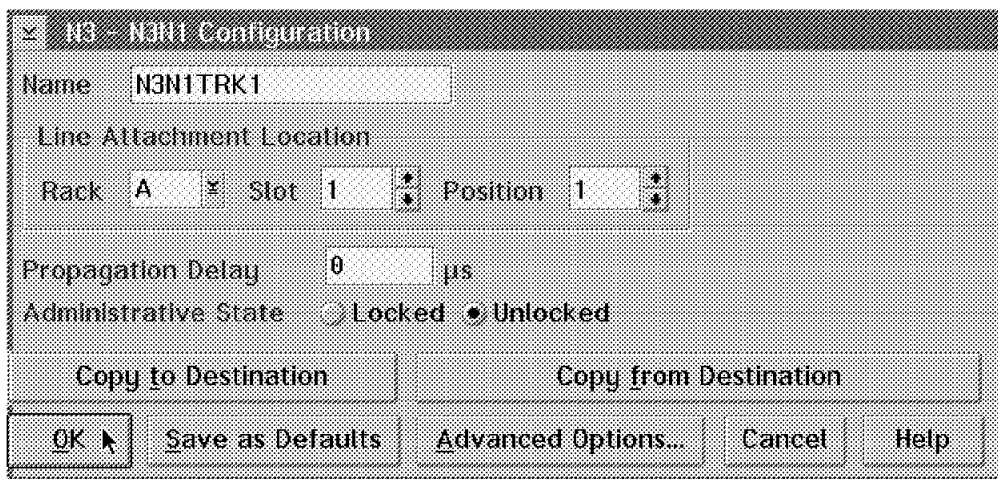
Figure 283. Creating the Trunk on N3

Since this is a trunk going from N3 to N1 and this is our first trunk logical definition between these two Nways Switches, we have used the name N3N1TRK1.

As we just did for the N1 Nways Switch, we will relate this logical definition to a physical definition made earlier. This is done by specifying the rack, slot and position of the adapter.

We will use the same values as before for the Propagation Delay and Administrative State.

Now that this is done, create the trunk between the N2 and N3 Nways Switches exactly as we did using the N2N3TRK1 and N3N2TRK1 names on the N2 and N3

Nways Switches respectively. Since we have already done this several times, we do not cover it in detail here. Once you are done with the N3 Nways Switch NBBS trunk definition, you will get a screen similar to the following which shows your two NBBS trunk definitions:
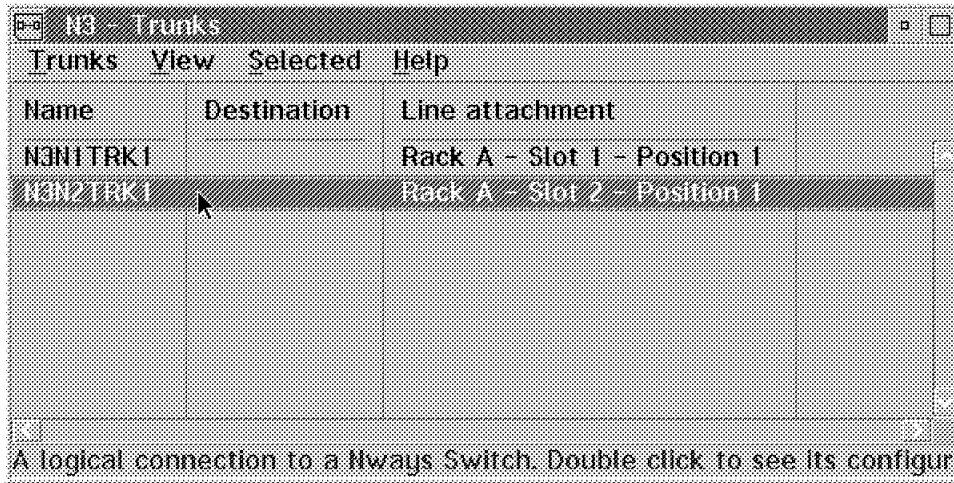
Figure 284. Viewing the Defined Trunks on N3

9.10 NBBS Port Definition

We now define the new NBBS ports. We start with the 3745 port definition on the N1 Nways Switch. Double-click on the top left corner until you get back to the basic screen. Double-click on the **N1** icon and the **Ports** icon. Then select the **Ports** and **Create port** options and you will get the following screen:
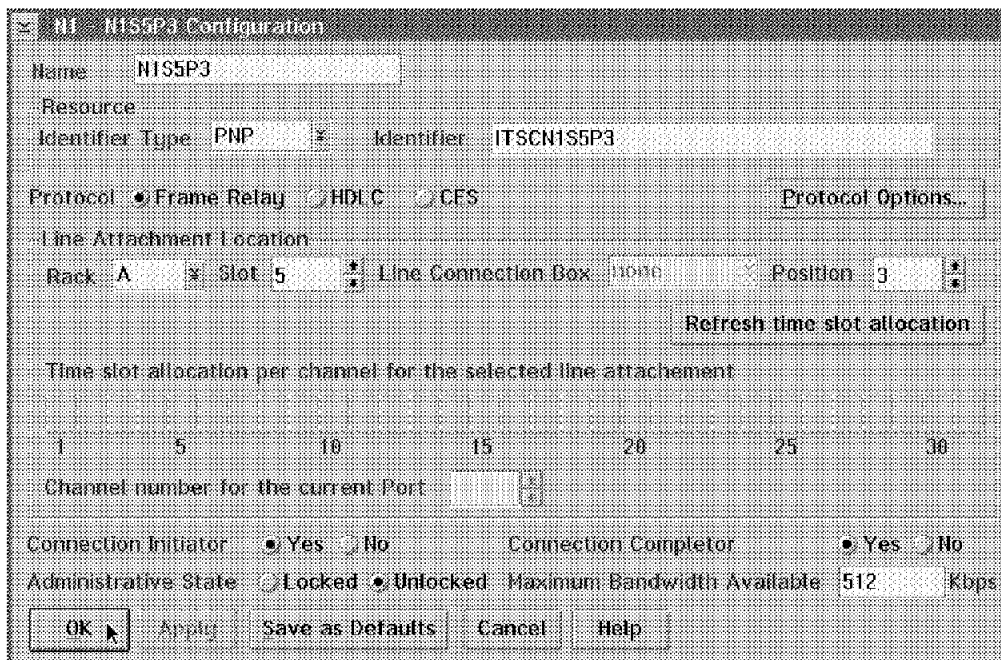
Figure 285. Defining the Port on N1

According to our naming convention, we name this port N1S5P3 to reflect the fact that it is the third port on adapter position 5 of our N1 Nways Switch. We select Frame Relay as the Protocol and the Private Numbering Plan (PNP) naming convention and tie this port definition to the correct physical Line Attachment Location which is Rack A, Slot 5 and Position 3.

We keep the Connection Initiator and Connection Completor as Yes and the Administrative State as Unlocked. Whenever you select **Refresh time slot allocation**, the Nways Switch Configuration Tool (NCT) will update the Maximum Bandwidth Available field.

Make sure you select the **Protocol Options** to specify the correct LMI protocol options.

Name	Resource identifier	Protocol	Line attachment
N1S5P1	ITSCN1S5P1	Frame Relay	Rack A – Slot 5 – P
N1S5P2	ITSCN1S5P2	HDLC	Rack A – Slot 5 – P
N1S5P3	ITSCN1S5P3	Frame Relay	Rack A – Slot 5 – P

A logical connection to a device in user premises. Double click to see th

Figure 286. Viewing the Defined Ports on N1

We now define the 3174 port in our N2 Nways Switch. Double-click on the top left corner until you are back to the main menu and double-click on the **N2** icon and the **Ports** icon. Select the **Ports** and the **Create port** options and you will get the following screen where you define the third port for the N2 Nways Switch:
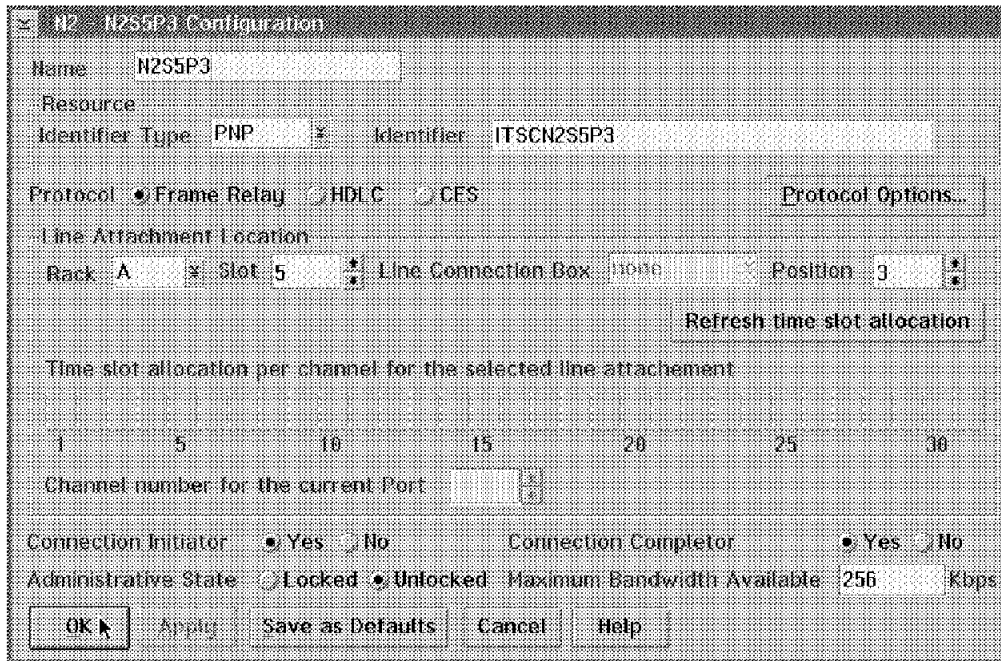
Figure 287. Defining the Port on N2

According to our naming convention, we will name this port N2S5P3 to reflect the fact that it is the third port on adapter Position 5 of our N2 Nways Switch. We will select Frame Relay as the Protocol and the Private Numbering Plan (PNP) naming convention and tie this port definition to the correct physical Line Attachment Location which is Rack A, Slot 5 and Position 3.

We keep the Connection Initiator and Connection Completor as Yes and the Administrative State as Unlocked. Whenever you select Refresh time slot allocation, the Nways Switch Configuration Tool (NCT) will update the Maximum Bandwidth Available field.

Make sure you select the **Protocol Options** to specify the correct LMI protocol options. After selecting **OK**, you will see a screen similar to the one in Figure 288 on page 296 that shows our third port.

We now define the Nways 2210 port in our N3 Nways Switch. Double-click on the top left corner until you are back to the main menu and double-click on the **N3** icon and the **ports** icon. Select the **Ports** and the **Create port** options, and you will get the following screen where you define the third port for the N3 Nways Switch:
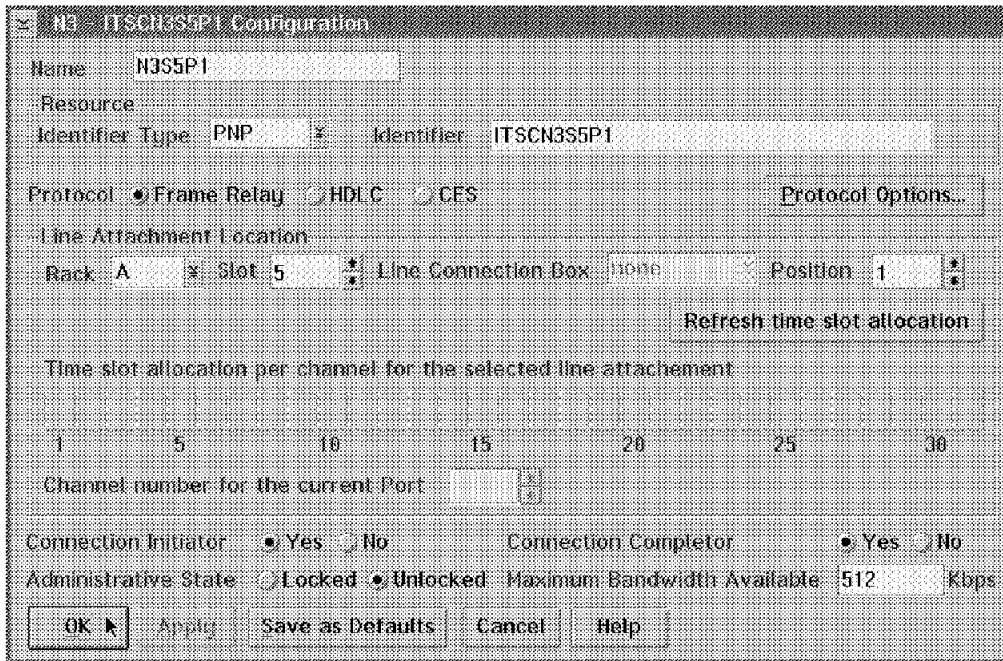
Figure 288. ITSCN3S5P1 Configuration

According to our naming convention, we will name this port N3S5P1 to reflect the fact that it is first port on the adapter position 5 of our N3 Nways Switch. We select Frame Relay as the Protocol and the Private Numbering Plan (PNP) naming convention and tie this port definition to the correct physical Line Attachment Location which is Rack A, Slot 5, and Position 3.

We keep the Connection Initiator and Connection Completor as Yes and the Administrative State as Unlocked. Whenever you select Refresh time slot allocation, the NCT will update the Maximum Bandwidth Available field.

Make sure you select the **Protocol Options** to specify the correct LMI protocol options. After selecting the **OK** button, you will get the following screen showing our third port:
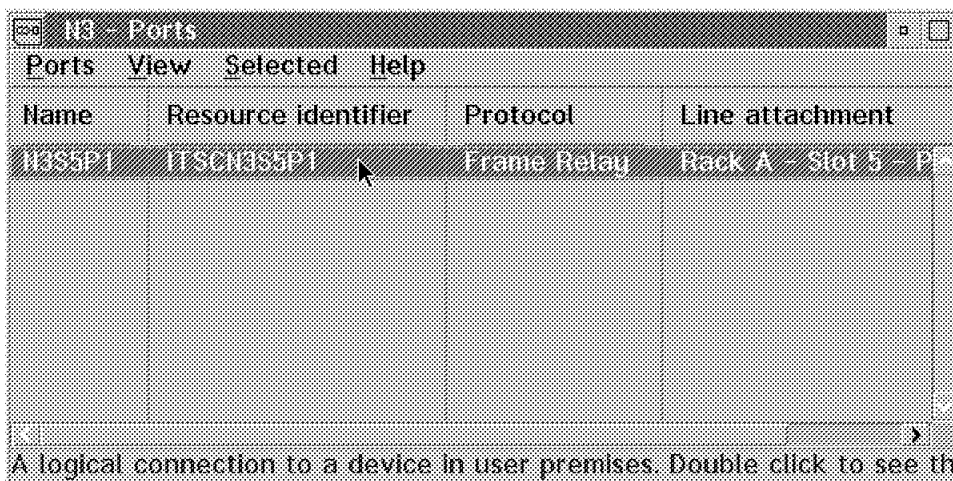
Figure 289. N3 Ports

9.11 Frame Relay Connection Definition

This section focuses on the frame relay connection definition.

9.11.1 Frame Relay 3745 Potential Connection Definition

Now that we have completed all our NBBS port definitions, the only thing left to do is to define all the new frame relay connections. Let us first start by defining a connection from our N1 Nways Switch for our 3745 to the N2 Nways Switch for our 3174 to allow them to talk to each other. We first define the potential connection from the N1 Nways Switch side. In order to do that, double-click on the top left corner until you get to the main menu where you can double-click on the **N1** icon and the **Ports** icon which will list all ports. Double-click on the **N1S5P3** port which will bring you to a screen where you will be able to select the **Port** option followed by the **Create Potential Connection** option as in the following illustration:

Figure 290. Create Potential Connection

We have decided to use the Virtual Circuit Number 30 for this connection. According to our naming convention this will be named PORT3FR30. On the Initiator side, the NCT has already filled in the Nways Switch, Resource Identifier Type and Resource Identifier fields for us. The only thing we have to define is the DLCI. We have chosen a value of 30. This DLCI has local significance only and is used to identify the specific frame relay connection for our 3745.

On the Completor side we have to tell the NCT the specific Nways Switch that we want to talk to, and therefore we have selected N2. In our case, since we want to talk to the port in slot 5 position 1 of that Nways Switch, we used ITSCN2S5P1 as the Resource Identifier.

Now we have to describe the characteristics of our traffic. In our case we have chosen to define this as an NBBS connection. The Peak Bit Rate is already predefined for us using the Clock Speed value we defined earlier when we created this line in our LIC. You can change that peak rate value if you wish. We have defined our Mean Bit Rate as 128 kbps in both directions. This specifies what you want the average rate to be over a relatively long period of time. This parameter is similar to the Committed Information Rate (CIR) which is a frame relay parameter. We have left the Mean Burst Length default at 10 milliseconds, which is the average duration for which a user can submit data to the network at the peak rate. This parameter is similar to the Committed Burst Size (Bc) which is a frame relay parameter.

The redbook *IBM 2220 Nways Switch: Concepts and Products*, SG24-4307 covers in greater detail the frame relay components of the product.

We have then selected the QoS table value QOSFRHDLCNDPS, which is the QoS table value for frame relay and HDLC for nondisruptive path switching (NDPS). For the startup Mode we have selected Permanent. We specified the Administrative State as Unlocked and since we do not wish to gather accounting information yet, we specified Accountable as No.

The parameter called Bandwidth Sensitivity states the minimum percentage size change in the bandwidth required before logging an accounting record that indicates a connection traffic variation. In our case, since we have elected not to gather accounting data for this connection, this parameter does not apply.

Once this is done, you will have to build the corresponding virtual connection and the system will issue a message asking to build it for you. In our case, we will specify No this time because we want to show you how you can manually do it.

Select **OK** and you will get the following screen showing the new potential connection:
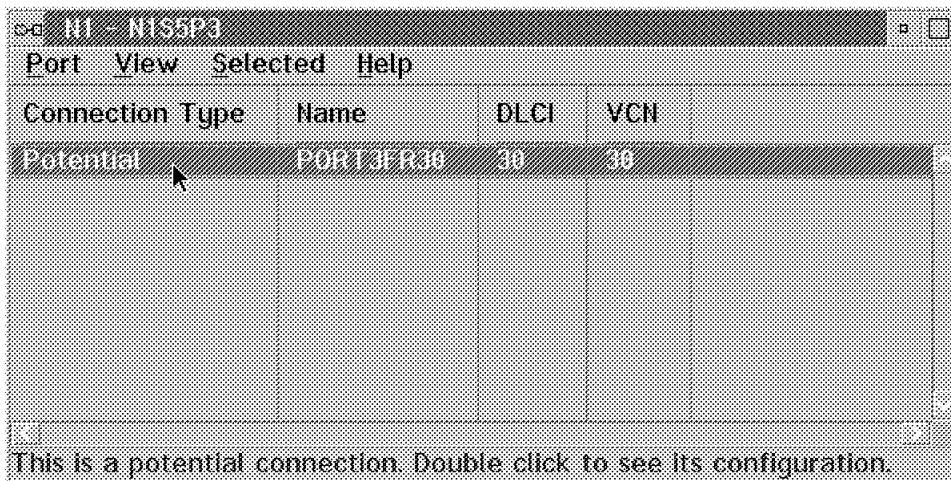
Figure 291. New Potential Connection

9.11.2 Frame Relay 3174 Virtual Connection Definition

Double-click on the top left corner until you get to the basic screen. Then double-click on the **N2** icon and the **Ports** icon. Select the **N2S5P3 NBBS** port and then select **Port** and **Create Virtual Connection**, which will bring you to the following screen:

Figure 292. Create Virtual Connection

It is important to specify the same Virtual Circuit Number of 30 and we use the name PORT3FR31. We specify N1 for the Nways Switch as well as ITSCN1S5P3 in the Resource Identifier fields on the Initiator side section.

We use the DLCI value of 31 for this side of the connection. This will complete the definition of this connection; once you select **OK** you will get the following screen showing your new virtual connection:
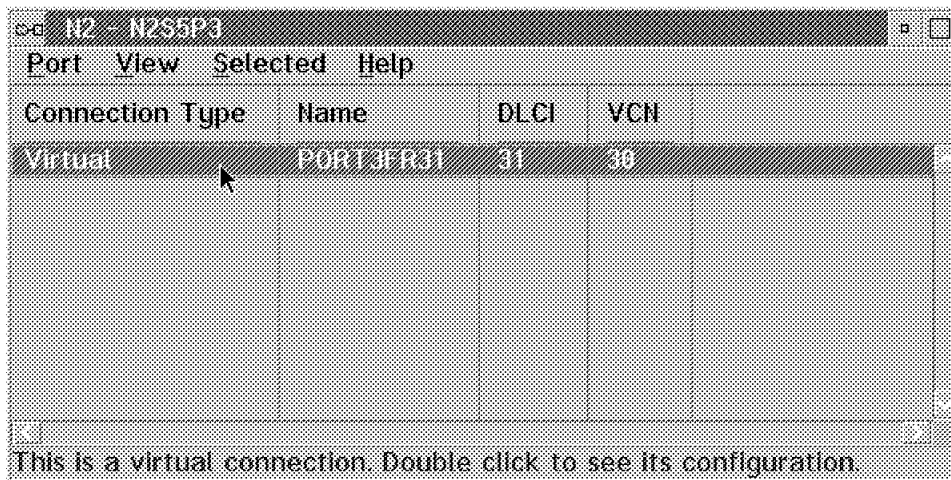
Figure 293. This Displays a Virtual Connection

9.11.3 Frame Relay 2210 Potential Connection Definition in N2

We now define a connection from our 6611 R2 router on the N2 Nways Switch for our Nways 2210 router on the N3 Nways Switch to allow them to communicate with each other. We first define the potential connection from the N2 Nways Switch side. In order to do that, we double-click on the top left corner until we get to the main menu where we double-click on the **N2** icon and the **Ports** icon which will list all our ports. We double-click on the **N2S5P1** port which brings us

to a screen where we are able to select the **Port** option followed by the **Create Potential connection** option as in the following illustration:
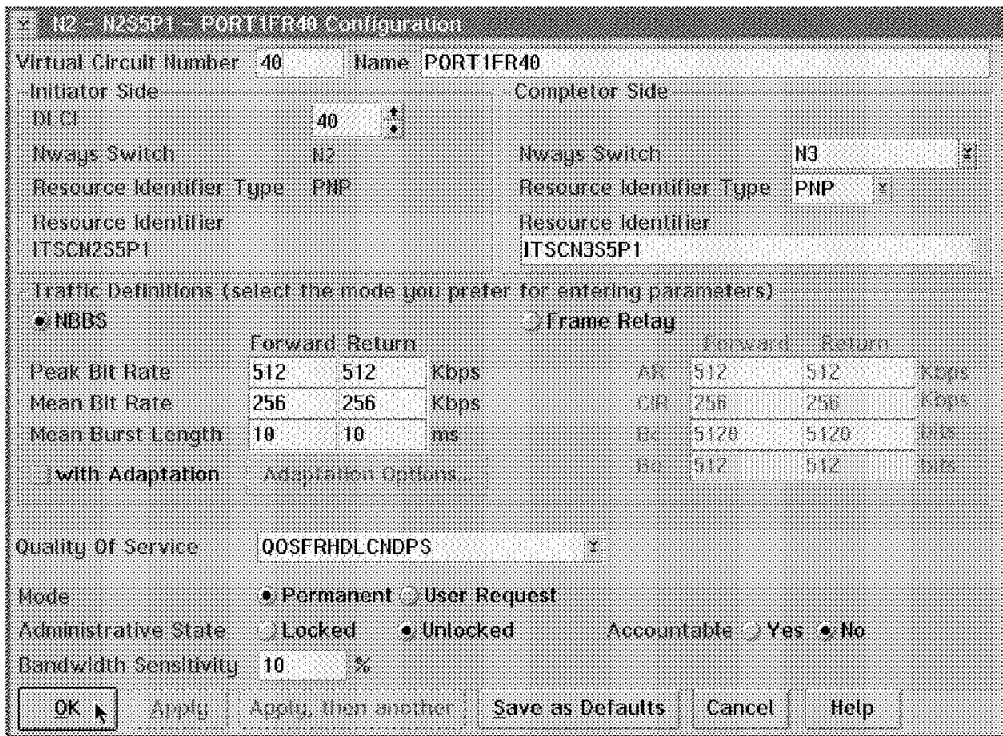
Figure 294. Potential Connection Configuration

We have decided to use the Virtual Circuit Number 40 for this connection, and according to our naming convention this will be named PORT1FR40. On the initiator side the NCT has already filled in the Nways Switch, Resource Identifier Type and Resource Identifier fields for us. The only thing we have to define is the DLCI. We have chosen a value of 40. This DLCI has local significance only and is used to identify the specific frame relay connection in our 6611.

On the Completor side we have to tell the Nways Switch Configuration Tool (NCT) the specific Nways Switch that we want to talk to, and therefore we have selected N3. In our case, since we want to talk to the port in slot 5 position 1 of that Nways Switch, we use ITSCN3S5P1.

Now we have to describe the characteristics of our traffic; in our case, we have chosen to define this as an NBBS connection. The Peak Bit Rate is already predefined for us using the Clock Speed. You can change this peak rate value if you wish. We then defined our Mean Bit Rate as 256 kbps in both directions. This establishes the average rate over a relatively long period of time. This parameter is similar to the Committed Information Rate (CIR) which is a frame relay parameter. We have left the Mean Burst Length default at 10 milliseconds which is the average duration for which a user can submit data to the network at the peak rate. This parameter is similar to the Committed Burst Size (Bc) which is a frame relay parameter.

We then selected a QoS table value QOSFRHDLCNDPS which is the QoS table value for frame relay and HDLC for nondisruptive path switching (NDPS). For the startup Mode we selected Permanent. We specified the Administrative State as

Unlocked and since we do not wish to gather any accounting information yet, we specified Accountable as No.

The parameter called Bandwidth Sensitivity states the minimum percentage size change in the bandwidth required before logging an accounting record that indicates a connection traffic variation. In our case, since we have elected not to gather accounting data for this connection, this parameter does not apply.

Once this is done you will have to build the corresponding virtual connection and the system will issue the following message asking to build it for you. In our case, we said no this time because we want to show you how you can manually do it. Select **OK** and you will get the following screen showing our new potential connection together with the virtual connection we defined in the previous scenario:
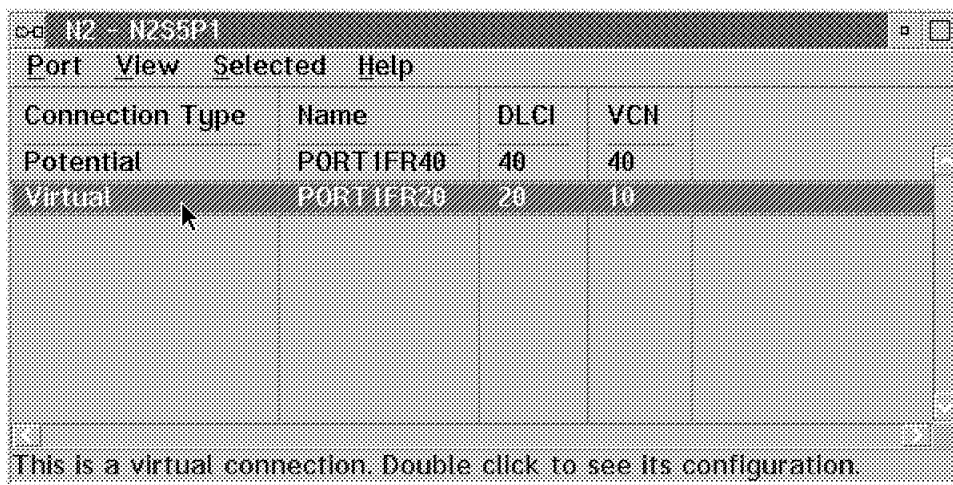
Figure 295. Potential Connection Together with Virtual Connection

9.11.4 Frame Relay 2210 Virtual Connection Definition in N3

Double-click on the top left corner until you get to the basic screen. Then double-click on the **N3** icon and the **Ports** icon. Select the **N3S5P1 NBBS** port and then select **Port** and **Create Virtual Connection** which will bring you to the following screen:
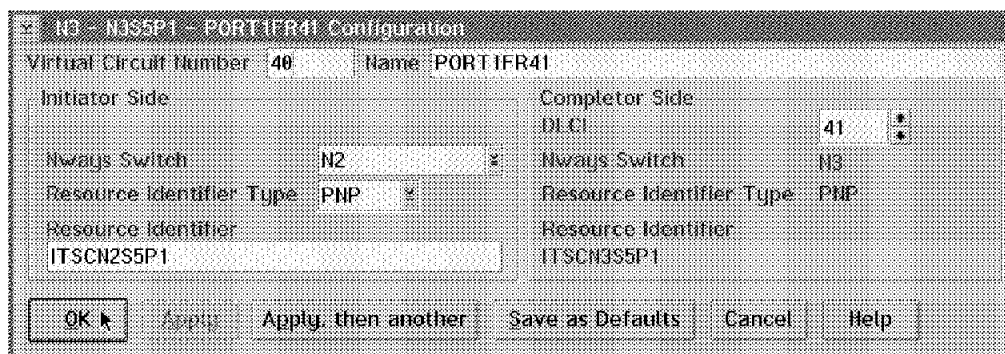
Figure 296. Creating the Virtual Connection for the 2210

It is important to specify the same Virtual Circuit Number of 40, so we use the same name of PORT1FR41. We specify N2 for the Nways Switch as well as ITSCN2S5P1 in the Resource Identifier fields on the Initiator side.

We use the DLCI value of 41 for this side of the connection. This completes the definition of this connection; once you select **OK**, you will get the following screen showing your new virtual connection:
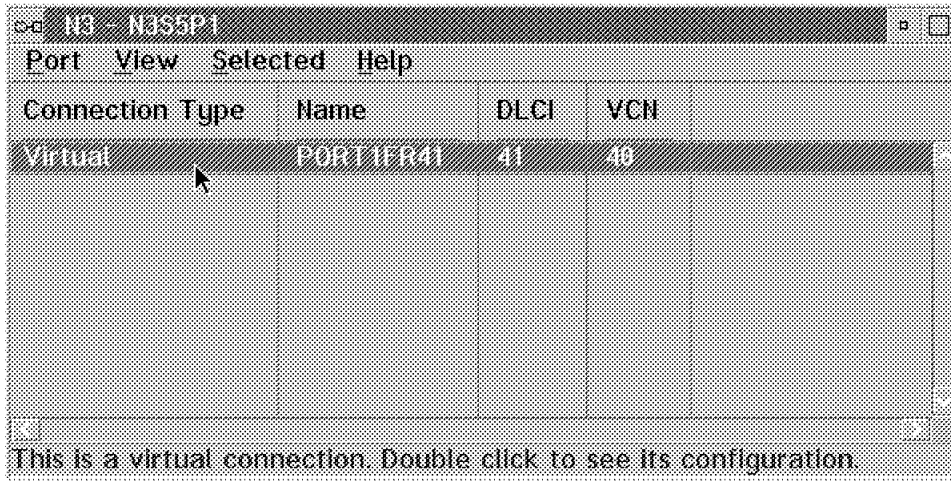
Figure 297. The New Virtual Connection

9.11.5 Frame Relay 2210 Potential Connection Definition in N1

We now define a connection, from our 6611 R1 router on the N1 Nways Switch, for our Nways 2210 router on the N3 Nways Switch to allow them to talk to each other. First, define the potential connection from the N1 Nways Switch side. In order to do that you can double-click on the top left corner until you get to the main menu where you can double-click on the **N1** icon and the **Ports** icon which will list all of your ports. Then, double-click on the **N1S5P1** port which will bring you to a screen where you will select the **Port** option followed by the **Create Potential connection** option as in the following illustration:
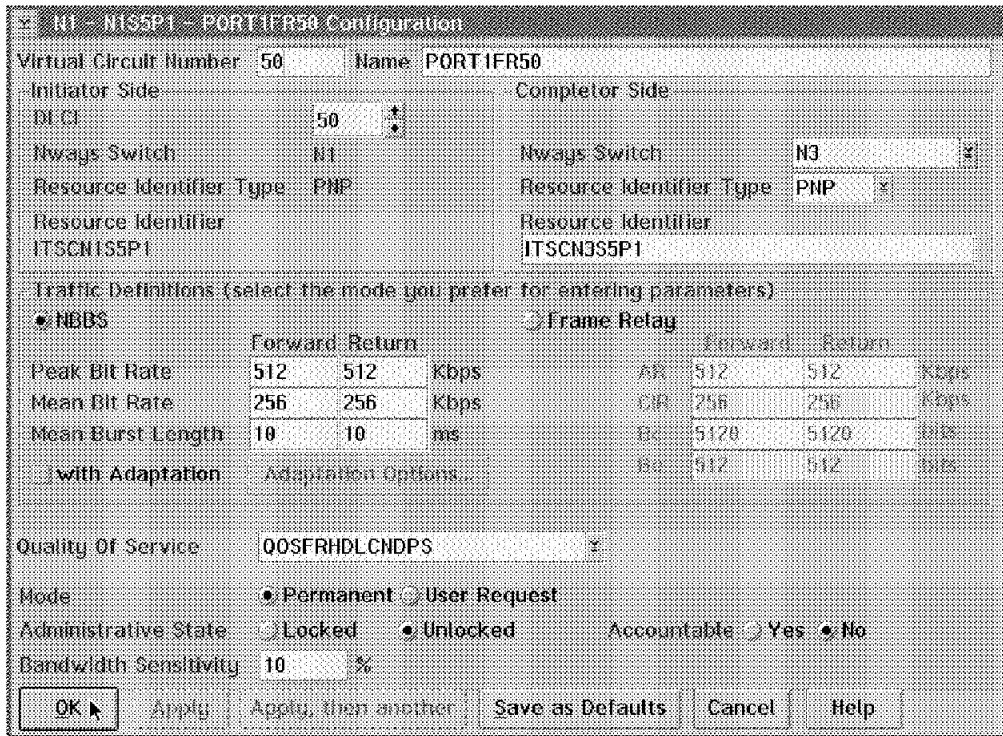
Figure 298. Create a Potential Connection

We decided to use the Virtual Circuit Number 50 for this connection and according to our naming convention this will be named PORT1FR50. On the Initiator side, Nways Switch Configuration Tool (NCT) has already filled in the Nways Switch, Resource Identifier Type and Resource Identifier fields for us. The only thing we have to define is the DLCI. We have chosen a value of 50. This DLCI has local significance only and is used to identify the specific frame relay connection for our 6611.

On the Completor side we have to tell the Nways Switch Configuration Tool (NCT) the specific Nways Switch that we want to talk to, and therefore, we have selected N3. In our case, since we want to talk to the port in slot 5 position 1 of that Nways Switch, we used ITSCN3S5P1.

Now we have to describe the characteristics of our traffic. In our case, we have chosen to define this as an NBBS connection. The Peak Bit Rate is already predefined for us using the Clock Speed value we defined earlier when we created that line in our LIC. You can change that peak rate value if you wish. We then defined our Mean Bit Rate as 256 kbps in both directions. This establishes the average rate over a relatively long period of time. We left the Mean Burst Length default at 10 milliseconds.

We then selected a QoS table value QOSFRHDLCNDPS which is the QoS table value for frame relay and HDLC for nondisruptive path switching (NDPS). For the startup Mode we have selected Permanent. We specified the Administrative State as Unlocked, and since we do not wish to gather accounting information yet, we specified Accountable as No.

The parameter called Bandwidth Sensitivity states the minimum percentage size change in the bandwidth required before logging an accounting record that

indicates a connection traffic variation. In our case, since we have elected not to gather accounting data for this connection, this parameter does not apply.

Once this is done, you will have to build the corresponding virtual connection, and the system will issue a message asking to build it for you. In our case, we will say no this time because we want to show you how you can do it manually.

9.11.6 Frame Relay 2210 Virtual Connection Definition in N3

Double-click on the top left corner until you get to the basic screen. Then double-click on the **N3** icon and the **Ports** icon. Select the **N3S5P1 NBBS** port and then select **Port** and **Create Virtual Connection** which will bring up the following screen:
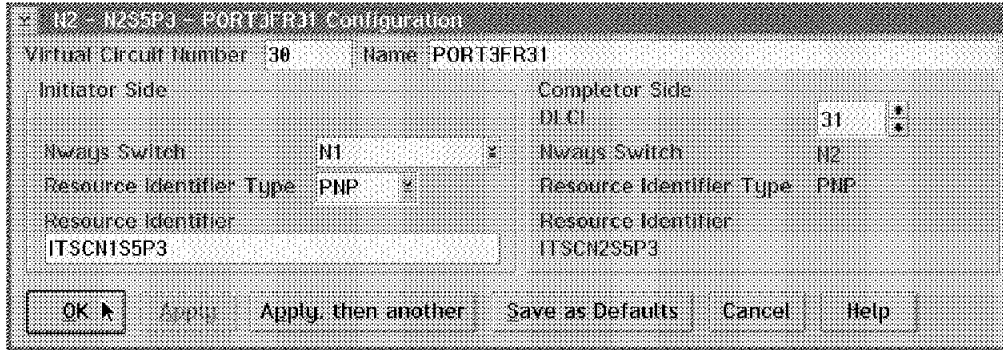
```
┌──────────────────────────────────────────────────────────────────────┐
│ ▣  N3 - N3S5P1 - Create Virtual Connection                             │
│ Virtual Circuit Number  50      Name  PORT1FR51                        │
│ Initiator Side                         Completor Side                  │
│                                         DLCI                  51   ▲▼   │
│  Nways Switch          N1          ▼    Nways Switch         N3         │
│  Resource Identifier Type  PNP     ▼    Resource Identifier Type  PNP   │
│  Resource Identifier                    Resource Identifier            │
│  │ITSCN1S5P1                      │     ITSCN3S5P1                      │
│                                                                        │
│  ┌────────┐                                                            │
│  │ OK ▶   │  Apply   Apply, then another   Save as Defaults  Cancel  Help │
│  └────────┘                                                            │
└──────────────────────────────────────────────────────────────────────┘
```
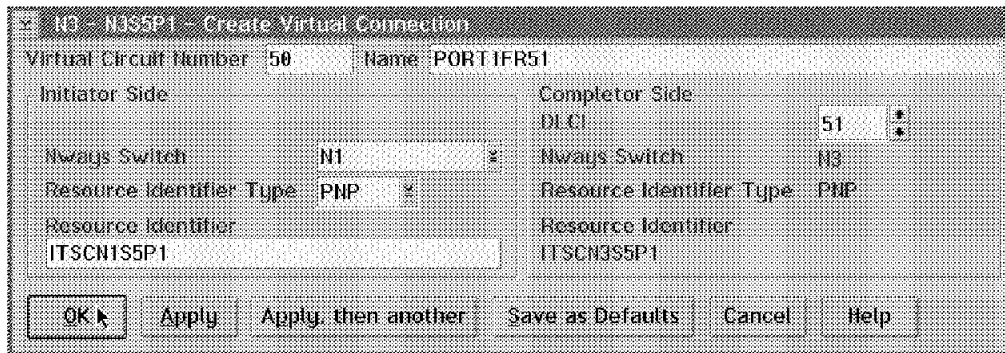
Figure 299. Create a Virtual Connection

It is important to specify the same Virtual Circuit Number of 50, so we use the name PORT1FR51. We specify N1 for the Nways Switch as well as ITSCN1S5P1 in the Resource Identifier fields on the Initiator Side.

We use the DLCI value of 51 for this side of the connection. This completes the definition of this connection; once you have selected the **OK** button, you get the following screen showing your new virtual connection together with the virtual connection defined in the previous scenario.

```
┌──────────────────────────────────────────────────────────────────────┐
│ ▣  N3 - N3S5P1                                              □ ◻        │
│ Port   View   Selected   Help                                         │
│                                                                        │
│ Connection Type      Name          DLCI    VCN                         │
│ ▓Virtual▓▓▓▓▓▓▓▓▓▓▓▓▓▓PORT1FR41▓▓▓▓▓41▓▓▓▓▓40▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓   │
│ Virtual              PORT1FR51     51      50                          │
│                                                                        │
│                                                                        │
│                                                                        │
│                                                                        │
│                                                                        │
│                                                                        │
│                                                                        │
│ This is a virtual connection. Double click to see its configuration    │
└──────────────────────────────────────────────────────────────────────┘
```
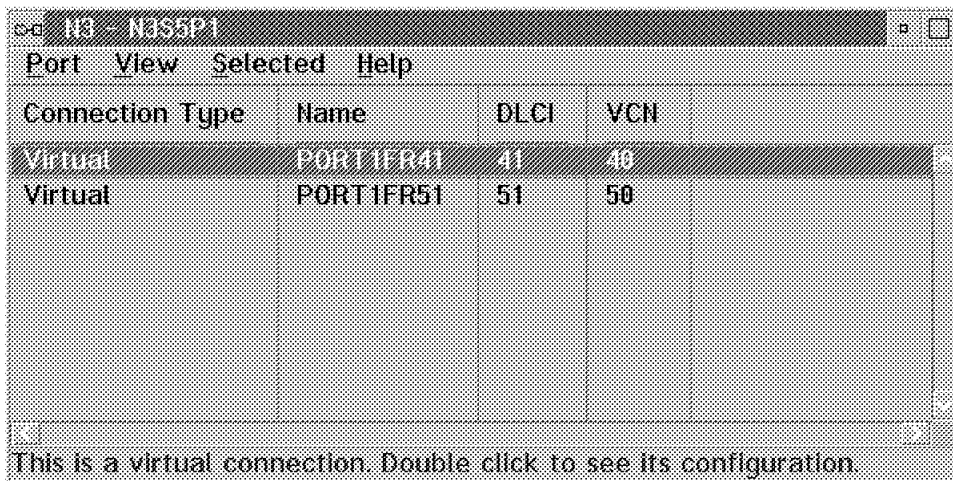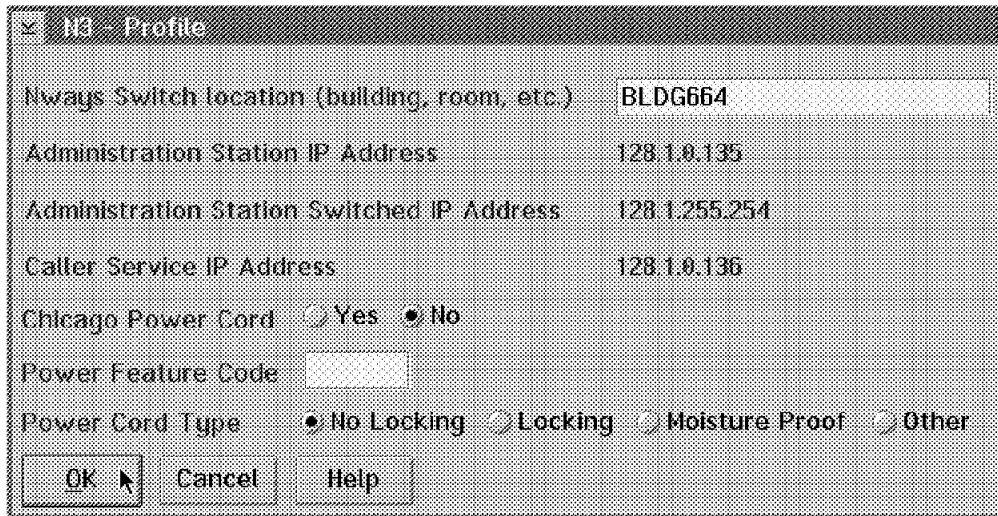
Figure 300. This Is a Virtual Connection

9.12 Administrative Details

Do not forget to update your administrative information for the N3 Nways Switch. The Nways Switch profile is where you may specify the location of your machine and the following details as illustrated in Figure 301. In order to get to this screen, you must go back to the main screen and double-click on the Nways Switch that you want to work on. In our case it was N1 and then we selected **Selected** and **Open Profile**. This will bring up the following screen where NCT has already filled in some information on the IP addresses:

Figure 301. N3 Profile

You will notice that since we generated this specific Nways Switch on the same Nways Switch Configuration Tool (NCT) as the other two (N1 in our case), it has automatically defined this new Nways Switch at the 128.1.0.135 Administration Station IP Address (which was the next available address for this network). Please refer to 1.7.2, "Dealing with A, B or C Classes" on page 35 for more details on these addresses. You may fill in the field Nways Switch Location (building, room, etc.) with a description of your machine's exact location. You may also, on this screen, specify the power cords.

Since there is no Change Control Server (CCS) or Network Management Station (NMS) directly attached to this Nways Switch, we do not need to update the Attached IP Host Definition.

Since this Nways Switch would probably, in real life, be located at a different site, we have updated the profile definition as follows. Double-click on the top left corner until you are at the main screen and then double-click on the **N3** icon. Select the **Network**, **Open** and **Profile** options. This way you will be able to visualize the Nways Switch profile.
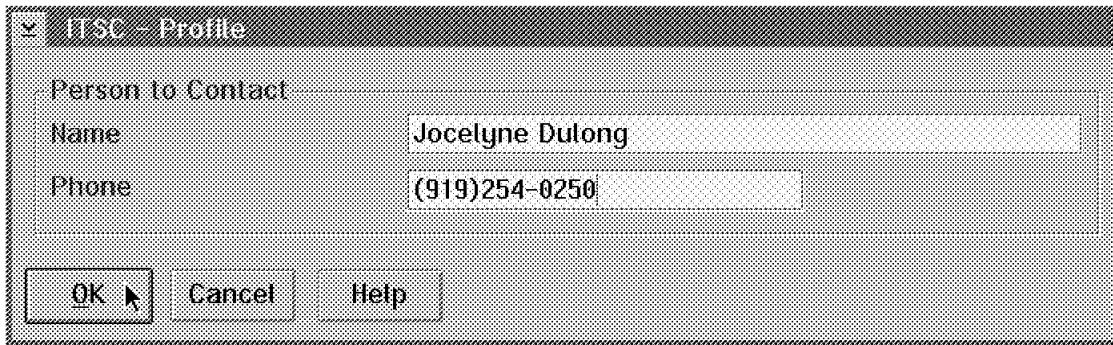
Figure 302. ITSC Profile

In the Nways Switch profile, you may specify the Person to Contact name and telephone number as we did.

This completes our second scenario for 3745 Nways 2210 routers and Nways Switch interoperability.

Chapter 10. Nways Switch IDNX Interoperability - Scenario 3

This chapter describes an IDNX and Nways Switch interoperability configuration in our lab. For this scenario, we used the following equipment:

- Two IDNX multiplexers (Micro 20s)
- Redundancy for all our Nways Switches
- Nondisruptive path switching
- Bandwidth adaptation

The purpose of this scenario is to show how to mix traffic from a multiplexer using Circuit Emulation Service (CES) as well as some of the added value features of the product such as the redundancy, nondisruptive path switching and bandwidth adaptation.

Please refer to Appendix C, "IDNX Configuration Scenario 3" on page 363 for details on the IDNX configurations.

Please note

Our machines are at the Nways Switch Configuration Tool (NCT) Version 1 Release 2. Depending on the version that you are using, the screen format may vary. Whenever your screen is different than the one illustrated in this redbook, please use the Help function of the Nways Switch Configuration Tool (NCT).

10.1 IDNX Circuit Emulation Service (CES) Scenario

In order to illustrate Circuit Emulation Service (CES) interoperability between IDNX and Nways Switches we connected an IDNX Micro 20 to the N1 and N3 Nways Switches. In both cases, the IDNX was added to a new port adapter in slot position 6.

10.2 Scenario Physical Setup

The following illustration shows the physical setup of this scenario:
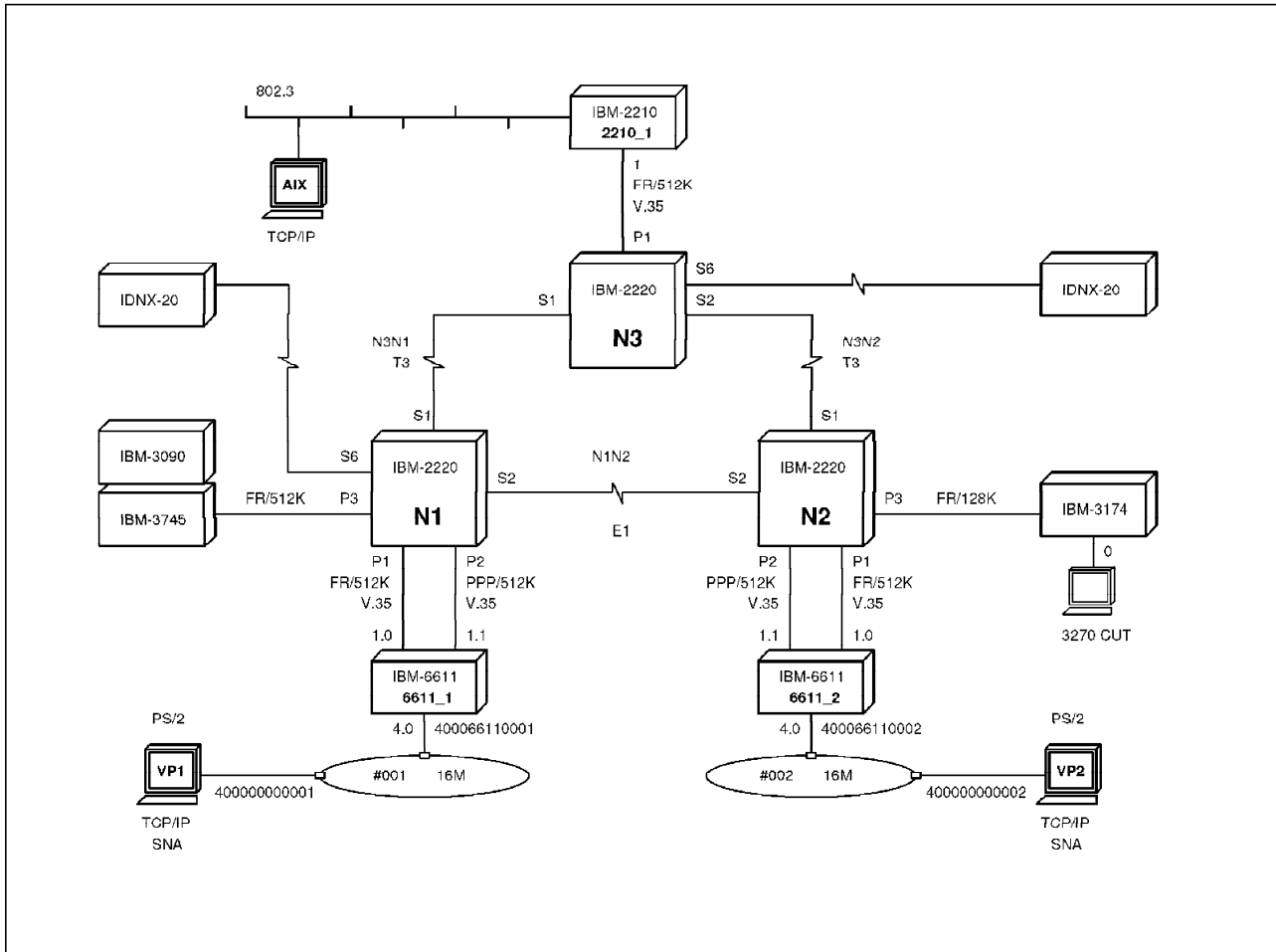
Figure 303. IDNX Scenario Physical Illustration

10.3 Nways Switch Machine Description

As you will see, we added (in both the N1 and N3 Nways Switches) a Low-Speed Adapter Type 1 (LSA1) with a T1 LIC514 to connect our IDNX and the clock adapter to synchronize our network correctly.

10.4 Port Adapter Physical Line Definition

We defined a Low-Speed Adapter Type 1 (LSA1) in slot position 3 for our IP gateway backup and 6 for the IDNX connection. In the back of slot 6 we defined a T1 LIC514. The following illustration shows what our N1 Nways Switch Rack A looks like after these actions:
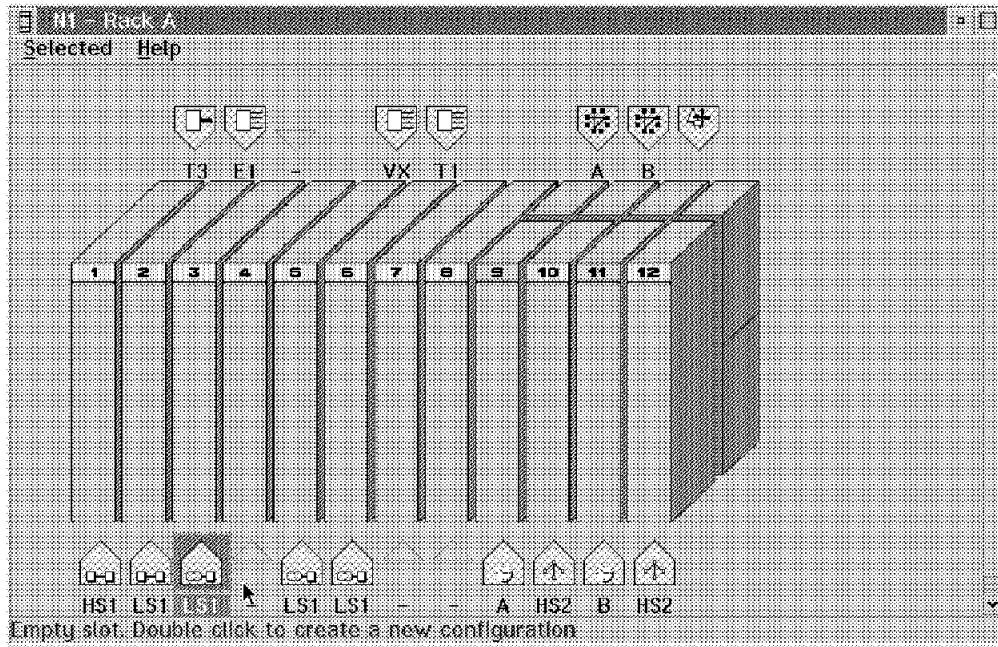
Figure 304. N1 Rack Configuration

In order to physically define the line we will use to connect our IDNX we double-click on the **T1** icon. On the next screen we double-click on the **LINE 1** icon which will bring up the following screen:
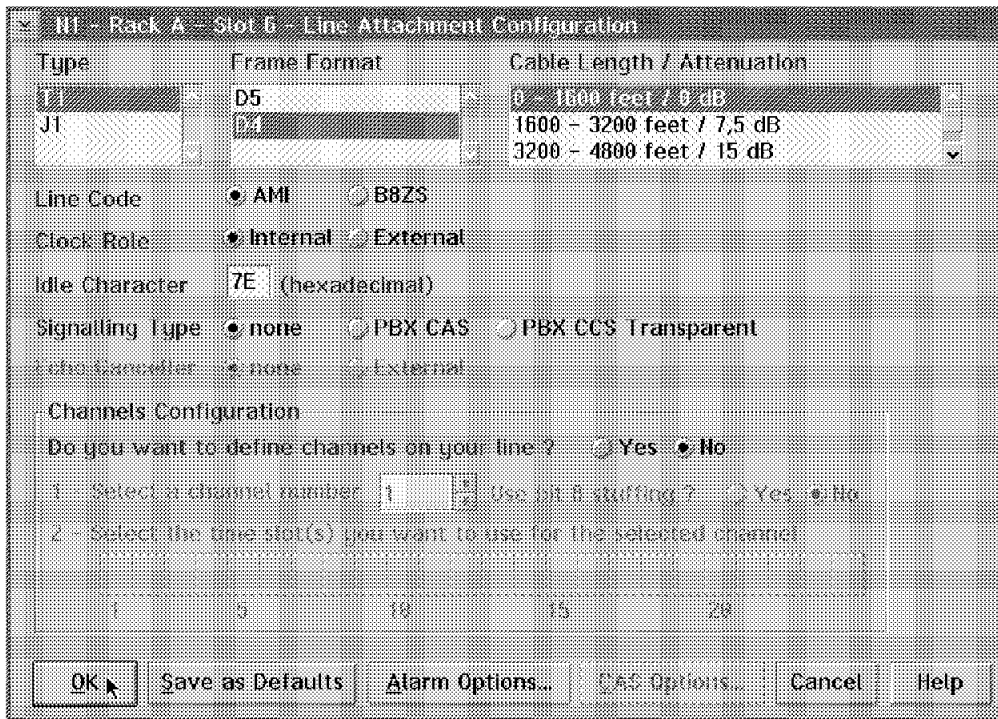
Figure 305. N1 Line Configuration

As you can see we specified T1, the D4 Frame Format and the correct Cable Length/Attenuation for our environment. We also used the AMI Line Code and the 7E Idle Character for our connection.

Since we want the Nways Switch to provide the clocking, we selected the Internal Clock Role. In our case we have defined the Signalling Type as none which means that we will neither use the Channel Associated Signalling (CAS) nor the Change Control Server (CCS) features on the product; we will only transport one full T1 link from the origin to the destination.

10.5 Clock References Configuration

Before we proceed further, we need to explain the clocking strategy we are planning to use for our network. Another redbook entitled *Just in Time for IDNX and IBM 2220 Clock Synchronization Planning*, GG24-4462, covers in greater detail the clock synchronization process.

For constant bit rate traffic, the transmitter must operate at the same frequency as the receiver to prevent loss of information.

The objective is to guarantee a specific clock accuracy to synchronize both the transmitter and the receiver.

When synchronous digital signals are transported in the network, if the transmitter sends at a bit rate higher than the receiver, the switching system will overflow, and cause a frame to be lost. If the transmitter sends at a bit rate lower than the receiver, the switching system will underflow, causing a frame to be repeated. Either occurrence is called a controlled slip. The impact of slips can be a reduction of throughput on digital data, a click on voice, and a drop out of call on voice band data or facsimile.

In order to avoid these problems we need to synchronize our clocks to an accurate clock source. We could get the clocking from the IDNX multiplexer but since our Nways Switches will make the core of our network we have decided to let them provide the clocking for the whole network.

Each one of our Nways Switches will require a clock card. There are essentially three sources of highly accurate clocking signals:

- A high stability clock locally connected to the Nways Switch clock cards
- A carrier providing T1, J1, E1, T3 and E3 links
- A carrier providing clock line

In our case, since we were working in our laboratory without carrier lines or a stratum clock we used the clock on the Nways Switch clock card itself. The clock card of the Nways Switch is of Stratum 3 accuracy which is good enough for our application.

We have decided to use the N1 Nways Switch clock card as the reference for all the other Nways Switch clock card synchronization.

10.5.1 N1 Nways Switch Clock Definition

After defining the physical adapters we will proceed to define the clock references in the N1 Nways Switch. Exit from the previous screen until you are in the basic N1 Nways Switch as follows:
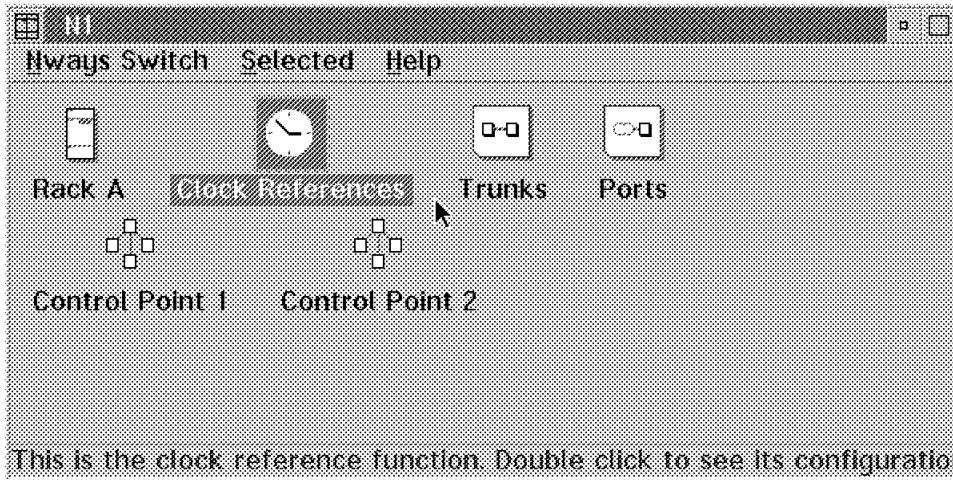
Figure 306. Viewing N1

Double-click on the **Clock References** icon as shown to get to the following Clock References Configuration screen.
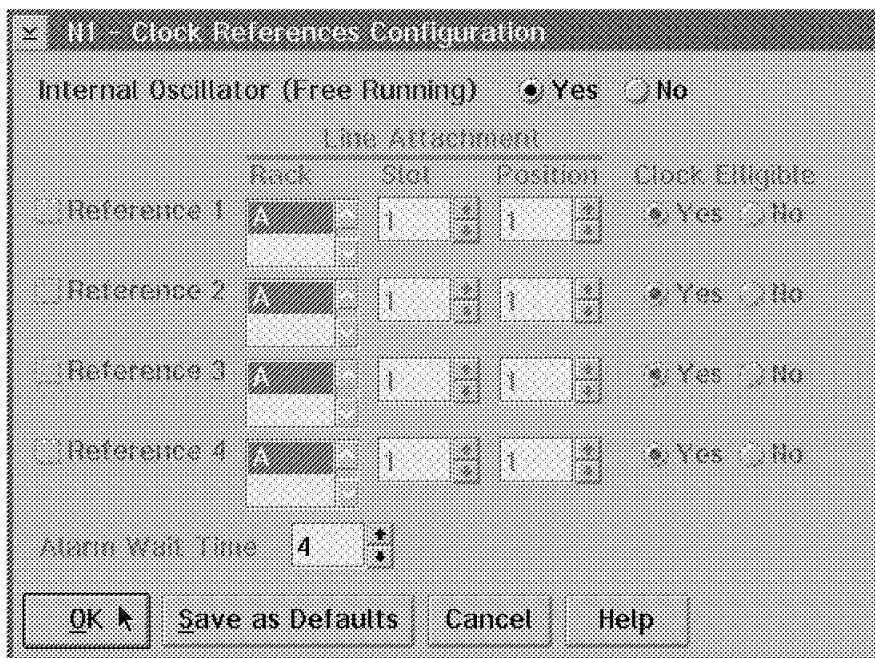
Figure 307. Configuring the Clock References

In our case, since we have decided to use the clock adapter of our N1 Nways Switch to provide the clocking for all our isochronous traffic, we have defined the Internal Oscillator (Free Running) as Yes which means that the Stratum 3 clock on the N1 Nways Switch clock card will provide the reference clock. We will not get the clocking from any line attachment so no other reference clock was selected. The Alarm Wait Time is a value after which an alarm will be sent to the Network Management Station (NMS) in case of a problem with the clock card.

10.5.2 N3 Nways Switch Clock Definition

The Nways Switch can take the clocking from a line adapter if it is appropriately clocked by either a carrier or an external source like the IDNX or another Nways Switch. We have selected to get the clocking from the N1 Nways Switch. The N3 Nways Switch will be getting its clocking from the N1N3TRK1 trunk between the two Nways Switches.

The Nways Switch can get its clocking from up to four different lines because if you have only defined one and that line fails, you lose the clocking. In our example we have defined only one because we wanted to keep the scenario simple. It is a good practice to define more than one but you must be careful to avoid clock loops. A clock loop is a configuration where an Nways Switch synchronizes with a clock reference it issued itself. The redbook entitled *Just in Time for IDNX and IBM 2220 Clock Synchronization Planning*, GG24-4462 covers the details of the clock loop consequences.

Double-click on the **Clock References** icon of the N3 Nways Switch and you will get the following screen:
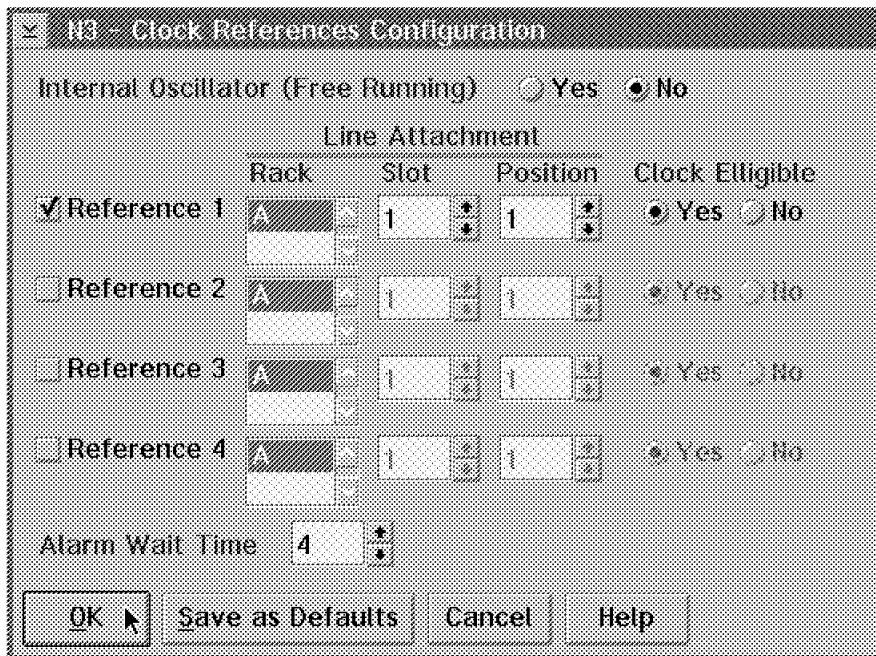
Figure 308. Clock References Configuration

This time we selected Internal Oscillator (Free Running) as No because the source will not come from the clock card in this machine. We defined a Line Attachment reference clock coming from the N1N3TRK1 trunk adapter which is in Rack A, Slot 1 and Position 1.

The clock references are presented in order of precedence. Whenever the primary reference fails, there is an automatic switch to the secondary reference and so on up to the fourth one. Whenever a higher preference reference clock comes back, the system automatically switches back to it. We let the Alarm Wait Time default to 4 seconds. Please define the clock on the N2 Nways Switch exactly like we did for the N3 one.

10.6 Existing Trunks Modifications

Once the clock is received from an external source, it is necessary to consistently configure the trunk or port adapter and the corresponding LIC line(s) that is receiving the clock from the external source. Make sure the physical trunk line definitions at both ends reflect the correct clock source for the trunk. In our case we already specified in the N1 Nways Switch that the N1N3TRK1 had internal clocking and that the other end in the N3 Nways Switch called N3N1TRK1 had external clocking. Do the same for the other trunks between the N1 and N2 Nways Switches and the N2 and N3 Nways Switches.

Once the clocking options are correctly set we will need to modify all the existing trunks to allow Circuit Emulation Service (CES) traffic flow on them. You need to do this on all the trunks where you expect Circuit Emulation Service (CES) traffic flow including the ones where traffic may be re-routed in case of trunk failure or traffic re-allocation.

We will only show how to do this on the trunk between the N1 and N3 Nways Switches. Exit from the previous screen and double-click on the **Trunks** icon. Select the appropriate trunk and then the **Selected** and **Open Configuration** options as in the following illustration:
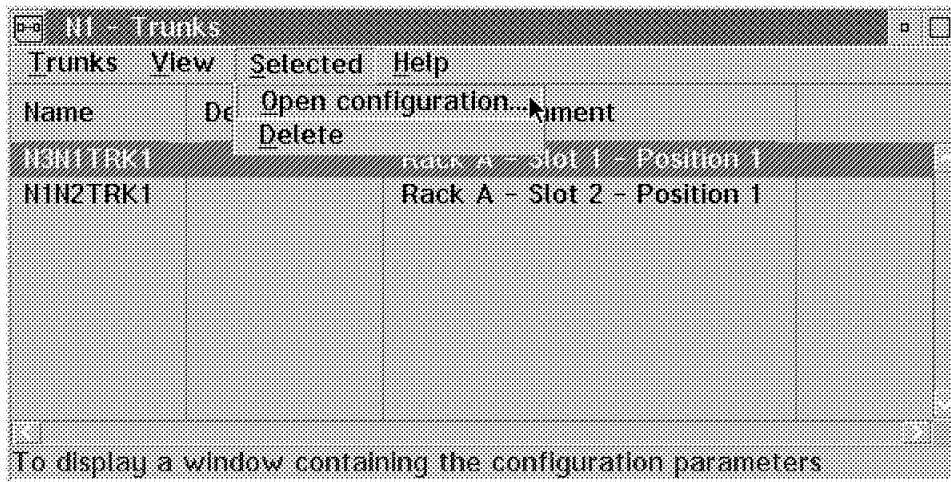
Figure 309. N1 Trunks Configuration

This will bring you to the trunk definition screen where you should select the **Advanced Options...** as follows:
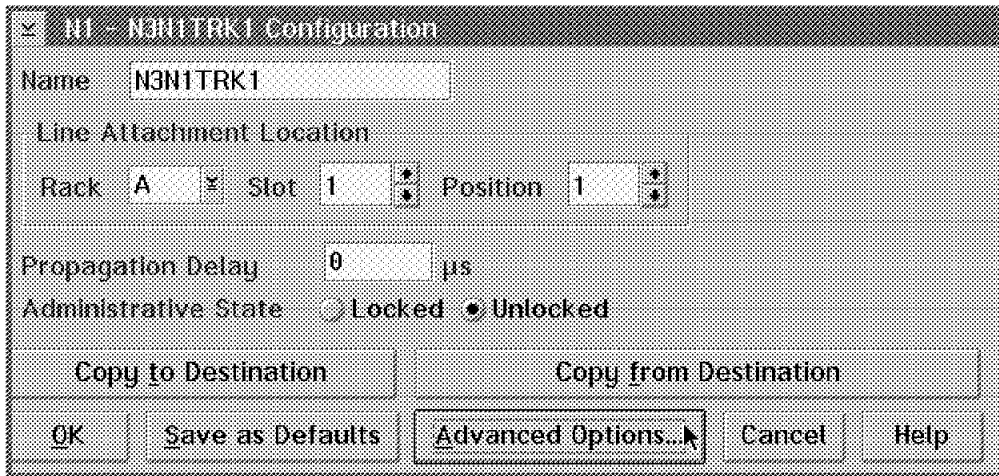
Figure 310. N1 - N3N1TRK1 Configuration

> This will bring up the trunk configuration where you will need to specify the Circuit Emulation Traffic Support as Yes (as in the following illustration):
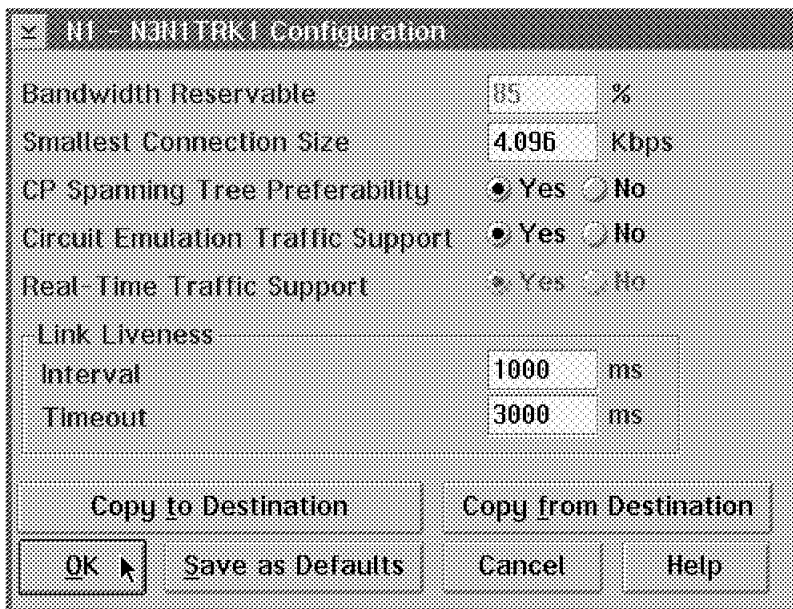
Figure 311. N1 - N3N1TRK1 Configuration

> This will allow Circuit Emulation Service (CES) traffic to flow. Make sure you modify all the trunks where you want the Circuit Emulation Service (CES) traffic to flow, including the trunks where this type of traffic may eventually be re-routed in case of a problem.

10.7 NBBS Port Definition

> We now define the new NBBS port to connect our IDNX device. We only describe the N1 Nways Switch configuration. Double-click on the top left corner until you get back to the basic screen. Double-click on the **N1** icon and the **Ports** icon. Then select the **Ports** and **Create port...** options and you will get the following screen:
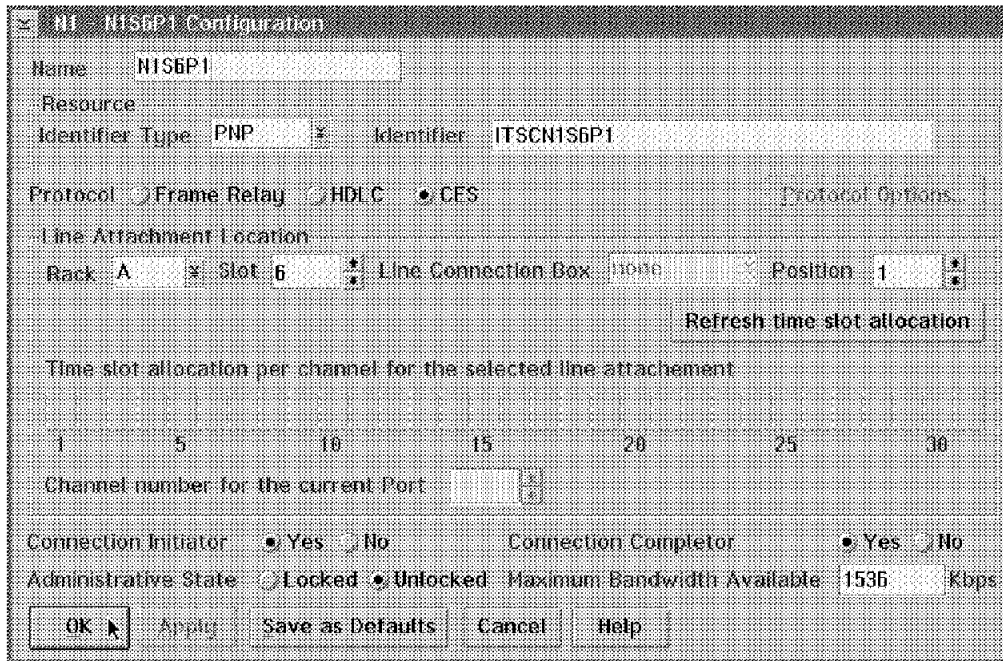
Figure 312. N1 - N1S6P1 Configuration

According to our naming convention we will name this port N1S6P1 to reflect the fact that it is the first port on the adapter in position 6 of our N1 Nways Switch. We will select **CES** as the Protocol and the Private Numbering Plan (PNP) naming convention and tie this port definition to the correct physical Line Attachment Location which is Rack A, Slot 6 and Position 1.

We will keep the Connection Initiator and Connection Completor as Yes and the Administrative State as Unlocked. Whenever you select Refresh time slot allocation, the NCT will update the Maximum Bandwidth Available field. After selecting the **OK** push button you will get the following screen showing our new port:
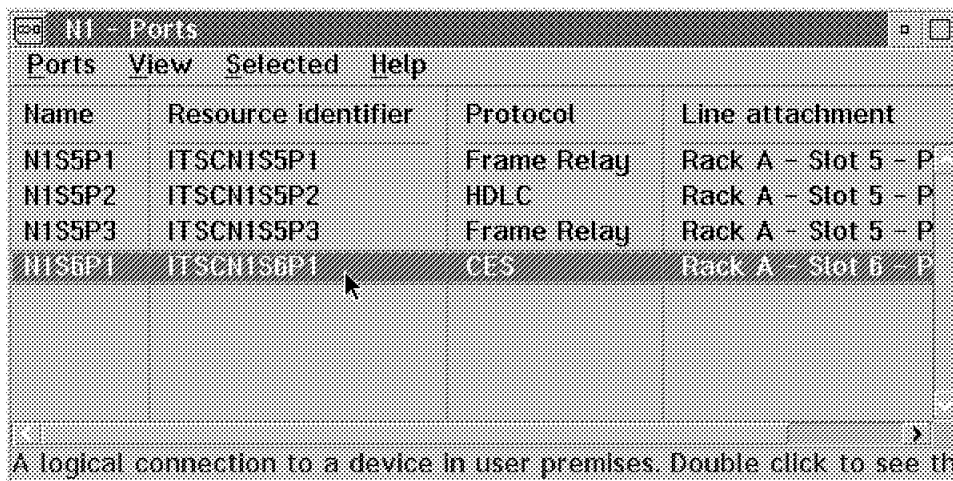
Figure 313. N1 Ports

Proceed with a similar port definition in the N3 Nways Switch.

10.8 IDNX Potential Connection Definition

Now that we have completed all our NBBS port definitions, the only thing left to do is to define the new Circuit Emulation Service (CES) connection. In order to do that double-click on the newly created port and then select the **Port** and the **Create Potential connection...** options, which will bring up the following window:
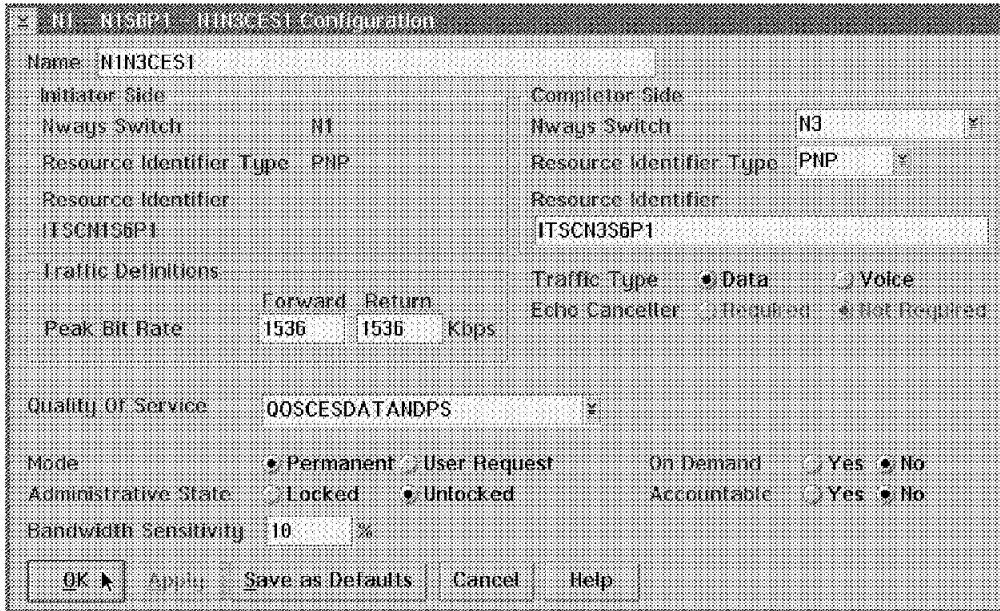
Figure 314. Create Potential Connection

We have selected to name our PCO N1N3CES1. As expected, the NCT filled in the Initiator Side. We specify on the Completor Side the destination as the ITSCN3S6P1 Resource Identifier of the N3 Nways Switch.

We have specified the Traffic Type to be data and the Peak Bit Rate to be 1,536 kbps in both directions. The QoS value we have selected was QOSCESDATANDPS to allow for nondisruptive path switching of our CES data traffic. The other parameters were defined as usual for this PCO.

Once you select **OK** you will get the following screen showing our new PCO.
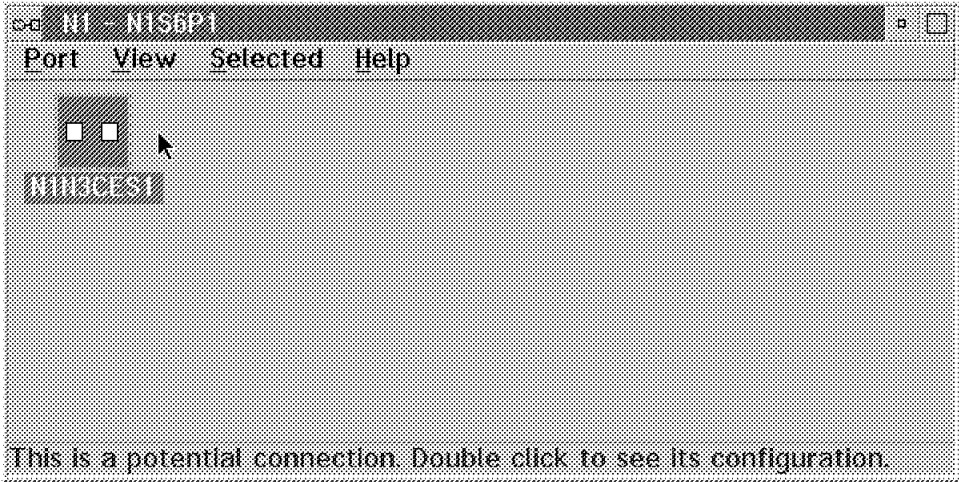
Figure 315. Potential Connection Icon

Appendix A. Nways Switch Scenario 1

This section describes the configuration of the IBM 6611 router in our 2220 network used in Chapter 8, "Nways Switch Router Interoperability - Scenario 1" on page 263.

A.1 IBM 6611 Configuration

The IBM 6611 configuration program Release 1.3 was installed on an RS/6000. It is assumed that the reader is familiar with the router technology as well as with the IBM 6611 configuration program. It is not the intent of this section to explain, in detail, how to configure an IBM 6611. For details, please refer to the appropriate IBM 6611 documentation.

However, we show here how the router was configured and explain why it was configured that way.

For convenience, the drawing of scenario 1 is repeated here:
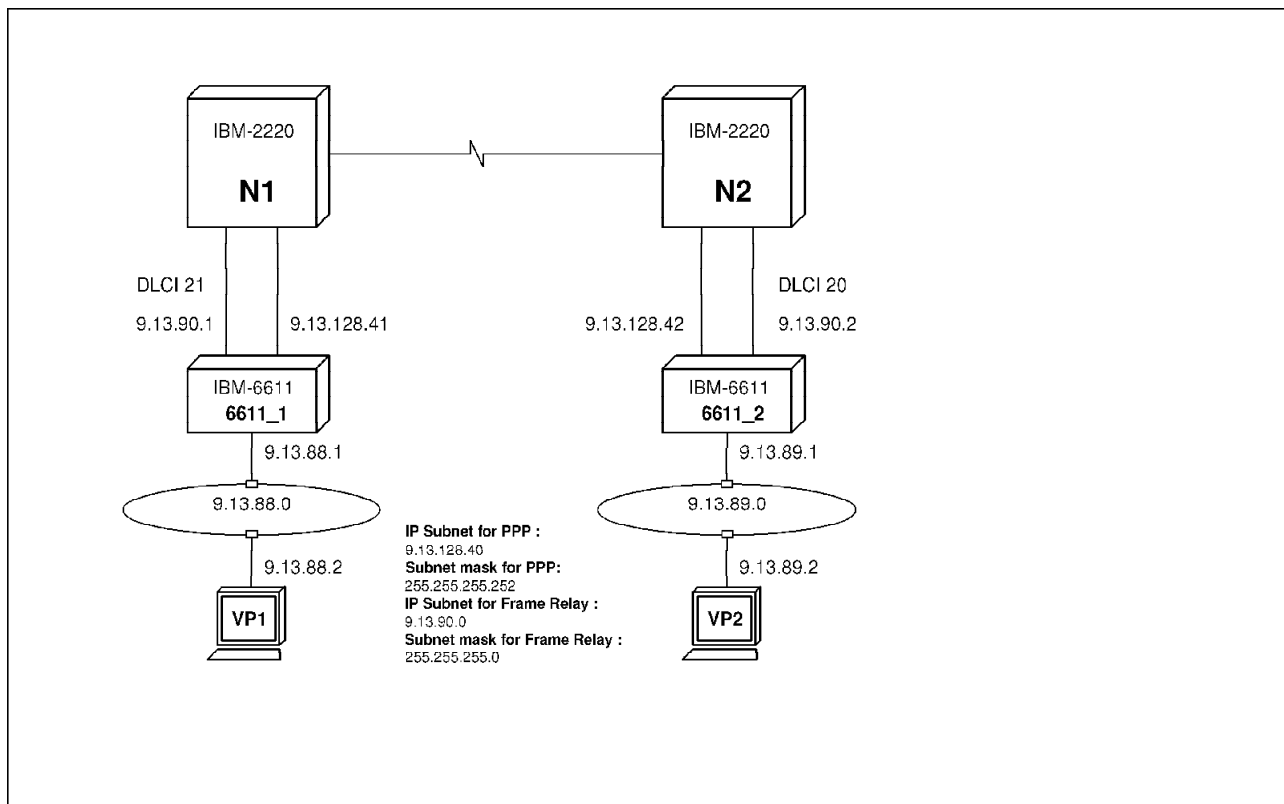
Figure 316. Scenario 1

A.1.1 IBM 6611 Configuration

The router 6611-1 and 6611-2 are both Model 140s. After the IBM 6611 MPNP
Config Program is started, the following is the first screen that is displayed:
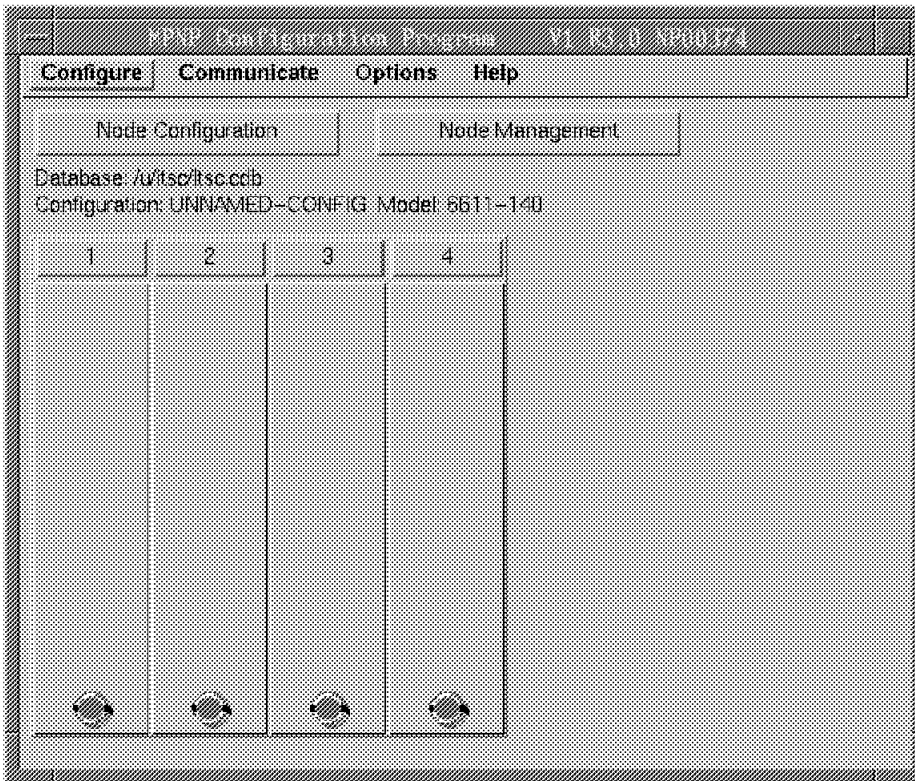
Figure 317. Blank Config Screen for the Model 140

On the next screen, we define the adapter cards in the router. To configure an
adapter, select the slot number shown in the previous screen and select, from
the pull-down window, the type of adapter you want to configure.
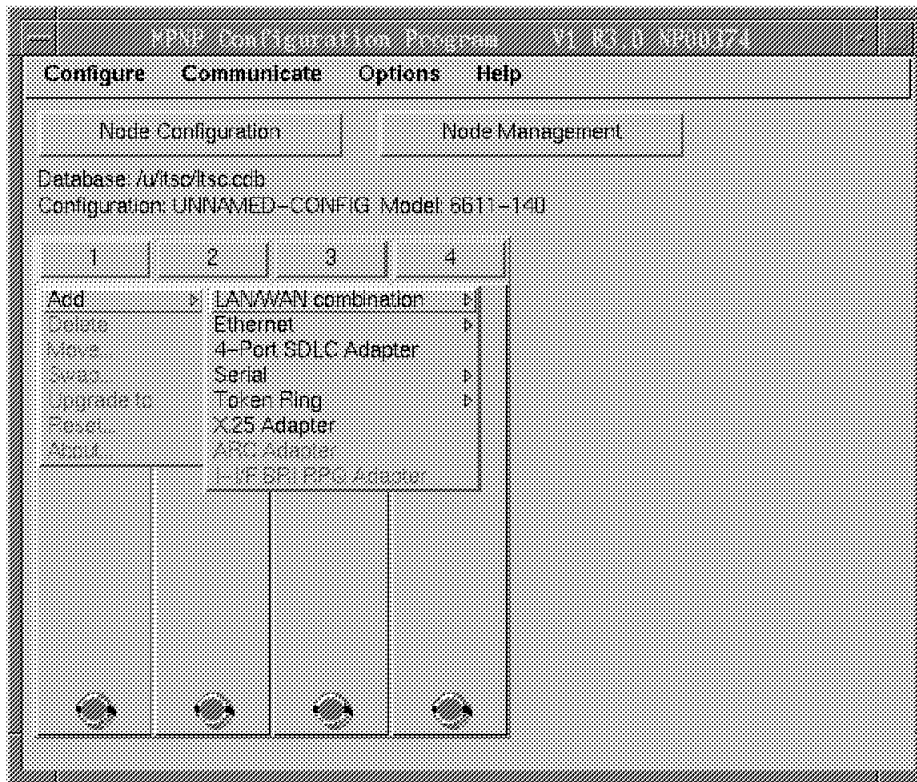
Figure 318. How to Configure an Adapter

We used a Model 140 with the following adapter configuration:

- Slot 1 serial adapter
- Slot 2 Ethernet adapter
- Slot 3 token-ring adapter
- Slot 4 token-ring adapter

The following screen displays the adapters installed in the router:
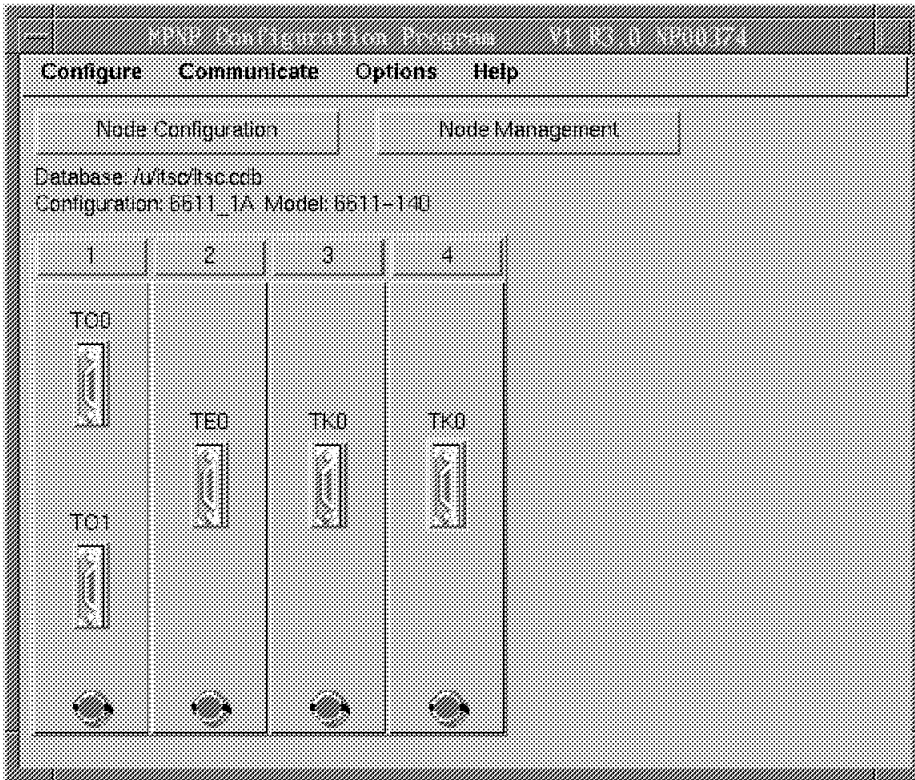
Figure 319. Main Screen with the Hardware Configured

The next thing to do is to configure each hardware adapter. In this scenario, we used only the token-ring adapter in slot 4 and the serial adapter in slot 1. We will configure the serial port 0 for frame relay and the serial port 1 for PPP protocol. So let's start with the token-ring in adapter slot 4. Select the **Interface** icon in slot 4 and the physical interface definition screen will be displayed:
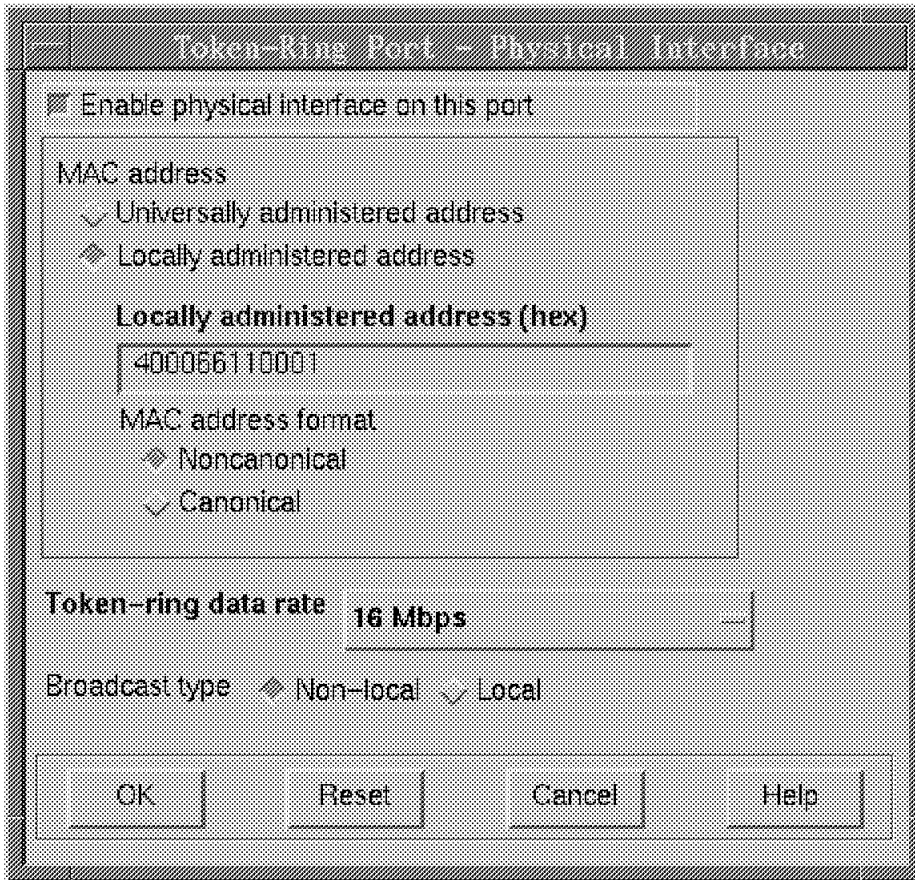
Figure 320. Physical Interface Definition Screen

In the previous screen, make sure that the physical interface is enabled by clicking on the **Enable physical interface on this port**. Then define the MAC address and the token-ring speed. The Broadcast type parameter allows or prevents broadcast frames (explorer frames) to cross bridges on the token-ring side. (Local means no RIF in the frame.) Accept the default of non-local.

On the Figure 321 on page 324, select **IP**. The following screen is the Token-Ring Port IP parameter screen:
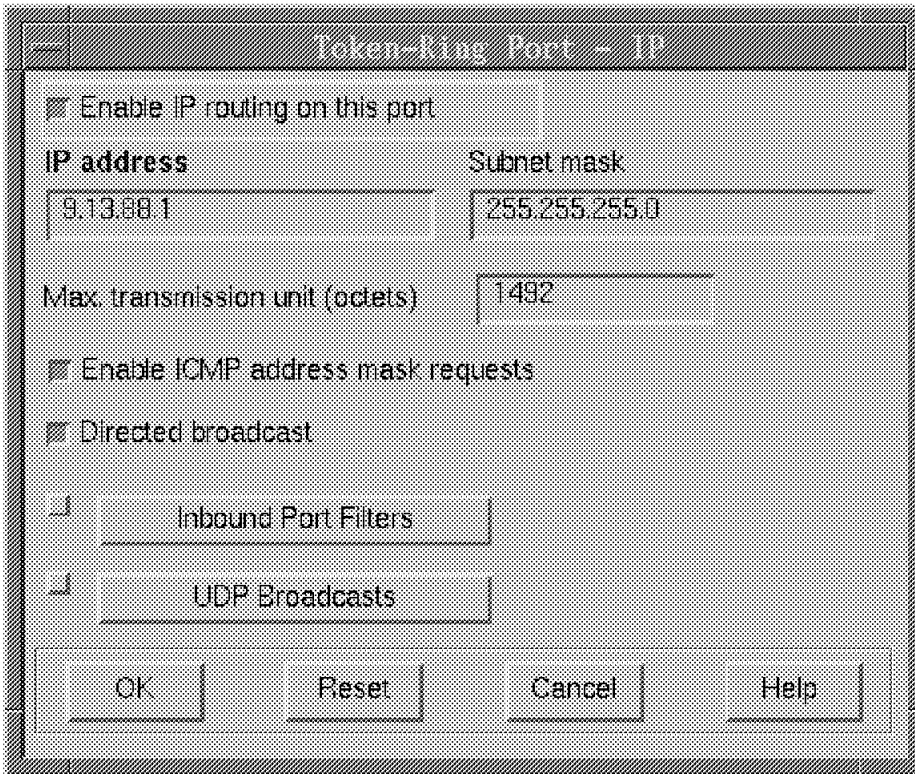
Figure 321. Token-Ring Port IP Parameter Screen

First, enable IP routing on this port and then enter the IP address and the subnet mask. You may let the other parameters stay at the default values. We do not need filters at the token-ring port because we're in a lab environment. Select **OK**.

We are finished with the token-ring port. Next, configure the serial interface ports. On the main screen, select the **Serial Interface Port 0** icon in slot 1. The following screen is the Serial Port parameter screen.
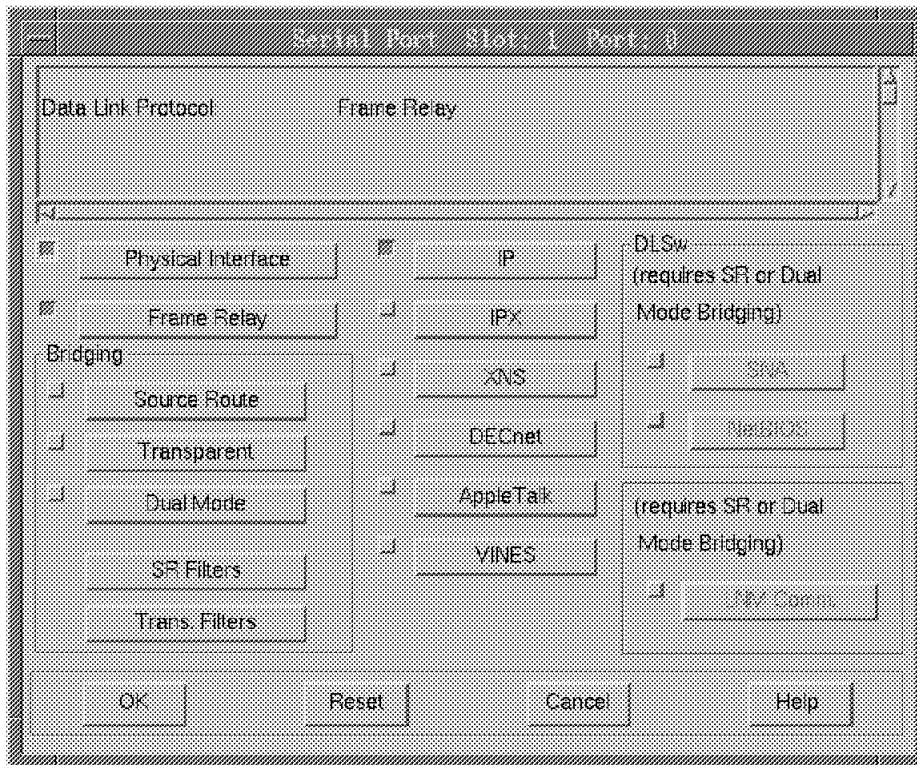
Figure 322. Serial Interface parameter Screen

For this scenario, the only protocol we need is IP; we don't need any other protocol or DLSw or bridging. So all we need to define for this serial port is the following:

- The physical interface
- The IP protocol
- The frame relay protocol

Let's start with the physical interface.

In the previous screen, select **Physical Interface**. The following screen is the Physical Interface parameter screen:
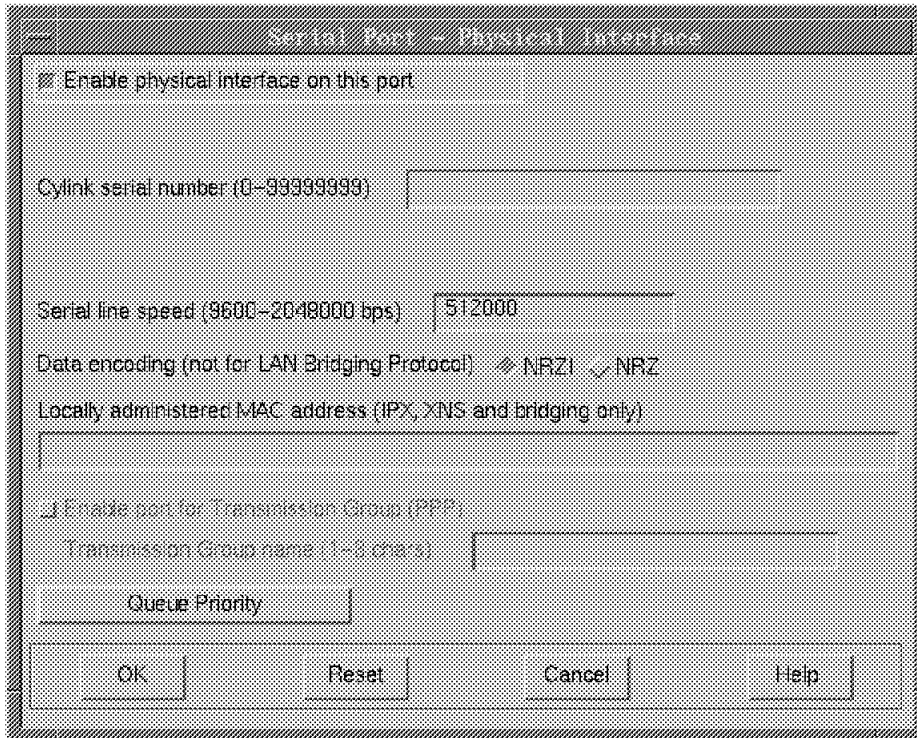
Figure 323. Physical Interface Parameter Screen

In the previous screen, enable the physical interface. A Cylink serial number is not needed, so leave this field blank. Enter the line speed in bits per second and select the data encoding NRZI or NRZ. Make sure that the data encoding matches the definition of the other equipment where this interface is connected. Both ends of this serial link must either be NRZI or NRZ. Note that some equipment may not support NRZI. In this case, define Data encoding as NRZ. Then select **OK**.

The next step is to define the IP parameters. Select **IP** on the Serial Port parameter screen.

The following screen is the Serial Port IP over Frame Relay screen.

Serial Port - IP over Frame Relay

☑ Enable IP routing on this port

IP address   Subnet mask

| 8.13.30.1 | | 255.255.255.0 |

Max transmission unit (octets) | 1500 |

☑ Enable ICMP address mask requests

☑ Directed broadcast

☐ Point-to-point only

Assignment for discovered DLCIs   ◉ Mesh   ○ Point-to-point

| Destinations per DLCI | | IP Point-to-Point Addresses |

☐ | IP Priority | ☐ | Inbound Port Filters |

☐ | UDP Broadcasts |

| OK | | Reset | | Cancel | | Help |

Figure 324. Serial Port IP over Frame Relay Screen

On the above screen, enable IP routing on this port and then enter the IP address and the subnet mask for this serial port. The other parameters can be left at the default values. Now select **OK**.

The next step is to define the frame relay parameters. Select **FR** on the Serial Port parameter screen.

This concludes the serial port 0 definition.

Now let's go to the serial port 1 screens. Go back to the main screen and select the **Serial Interface Port 1** icon. The following screen is the Serial Interface parameter screen for PPP protocol:
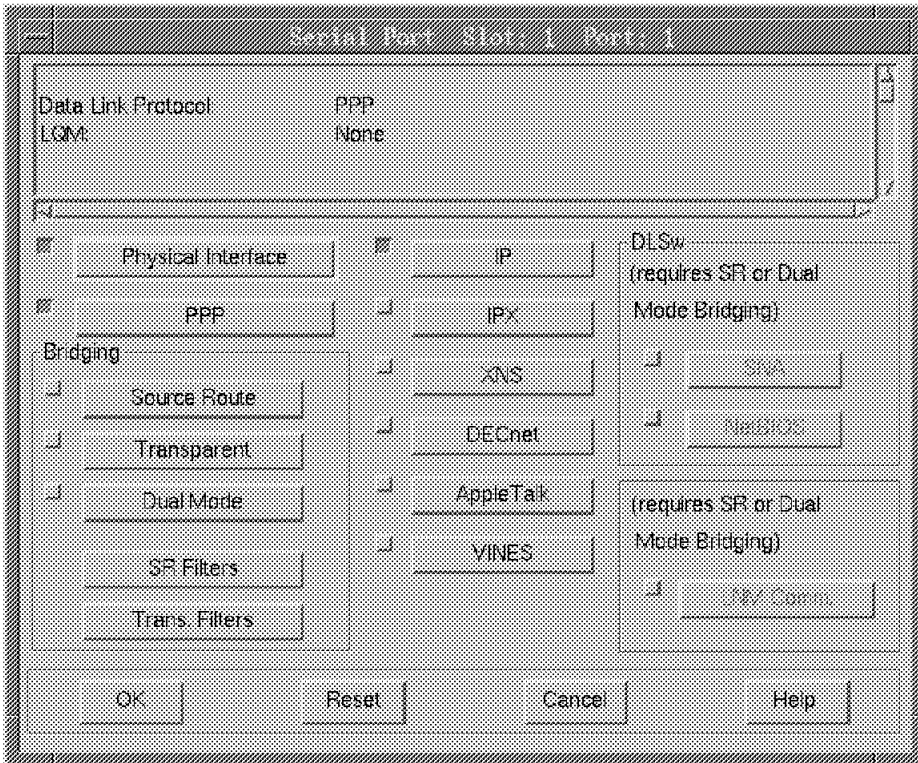
Figure 325. Serial Port Slot 1 Port 1 Screen

Again, for this scenario, the only protocol we need is IP; we don't need any other protocol or DLSw or bridging. Thus, all we need to define for this serial interface is the following:

- The physical interface
- The PPP protocol
- The IP protocol

Let's start with the physical interface.

On the previous screen, select the **Physical Interface** option. The following screen is the Physical Interface parameter screen:
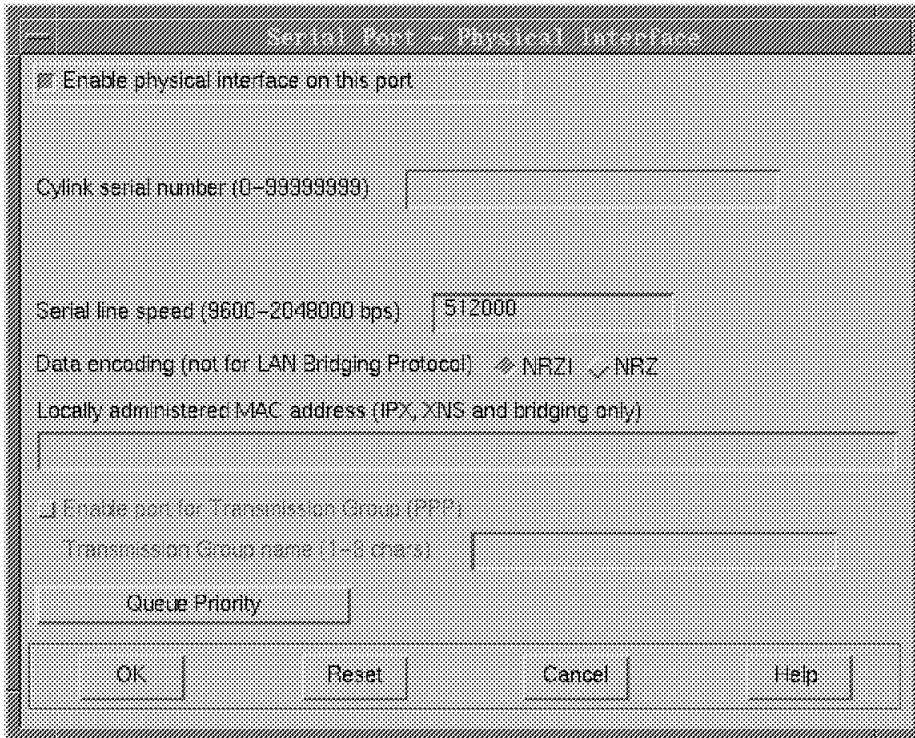
Figure 326. Physical Interface Parameter Screen

In the previous screen, enable the physical interface on this port. A Cylink serial number is not needed, so leave this field blank. Enter the line speed in bits per second and select the data encoding NRZI or NRZ. Although the clock signal is delivered by the 2220 switch (DCE), the line speed parameter is used internally by the router for statistics and protocol timing. Make sure that the data encoding matches the definition of the other equipment where this interface is connected. Both ends of this serial link must be either NRZI or NRZ. Note that some equipment may not support NRZI. In that case, define Data encoding as NRZ.

Select **OK**.

The next step is to define the point-to-point parameters. Select **PPP** on the Serial Interface Slot 1 Port 1 screen.

The following screen is the Serial Port Point-to-Point screen:
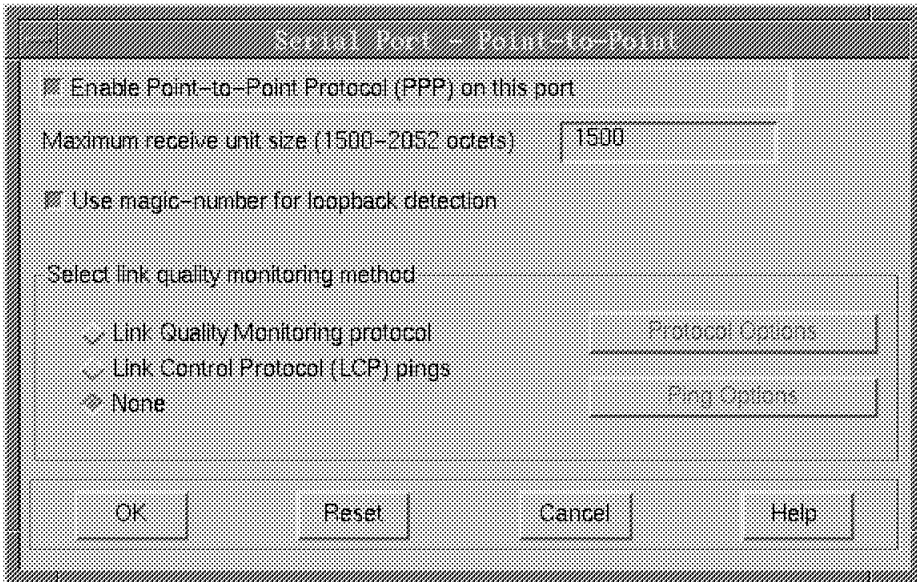
Figure 327. Serial Port Point-to-Point Screen

In the previous screen, enable point-to-point protocol (PPP) on this port. All the other parameters can be left at the default values. Now select **OK**. This will get you back to the Serial Port Slot 1 Port 1 screen. Now we need to define the IP protocol, so select **IP**.

The following screen is the IP over PPP screen:
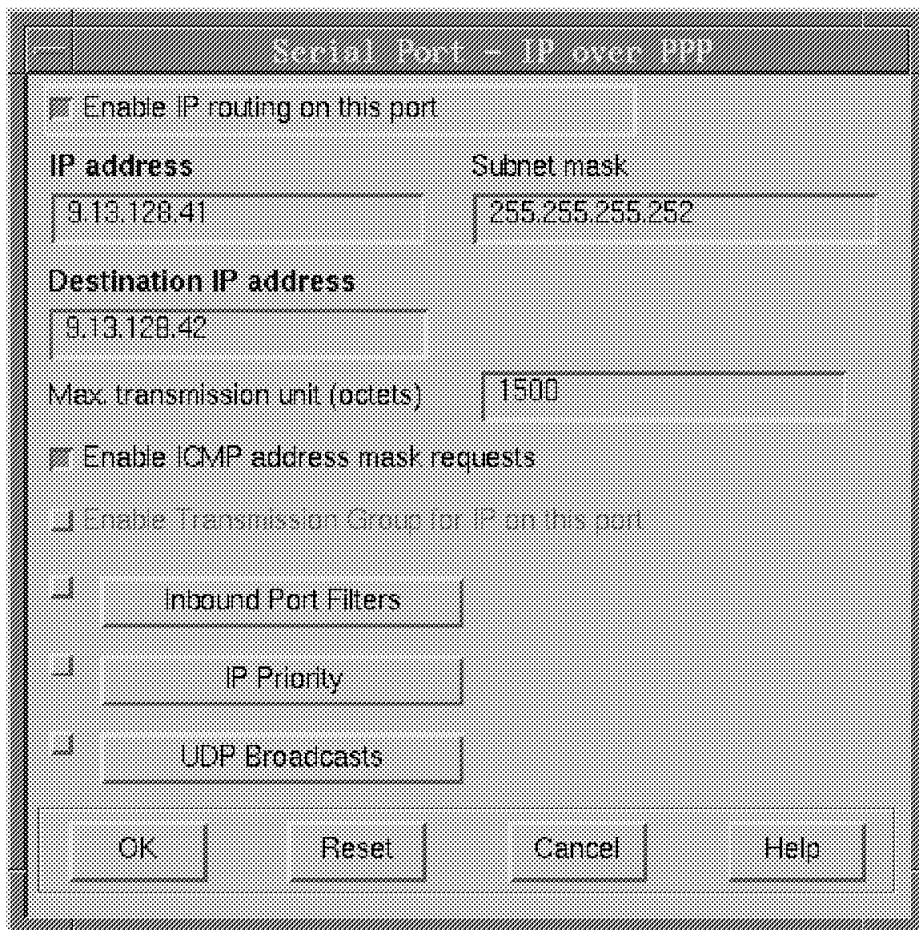
Figure 328. Serial Port, IP over PPP Screen

The first thing to do here is enable IP routing on this port; then enter the IP address and the subnet mask. The subnet mask (255.255.255.252) makes use of the variable subnet masking of the physical network 9.0.0.0 and defines the subnets with only two hosts for point-to-point lines. This prevents the wasting of IP addresses.

Note that for PPP, unlike frame relay, you need to define the destination IP address, which is the other end of the PPP line. All the other parameters can be left at the default values. Now select **OK**.

This concludes the serial interface port 1 definition.

The next step is to configure the parameters which span not just a single port, but the whole router such as routing protocols, filters, etc. This is called node configuration.

Now go back to the main screen and select **Node Configuration**.
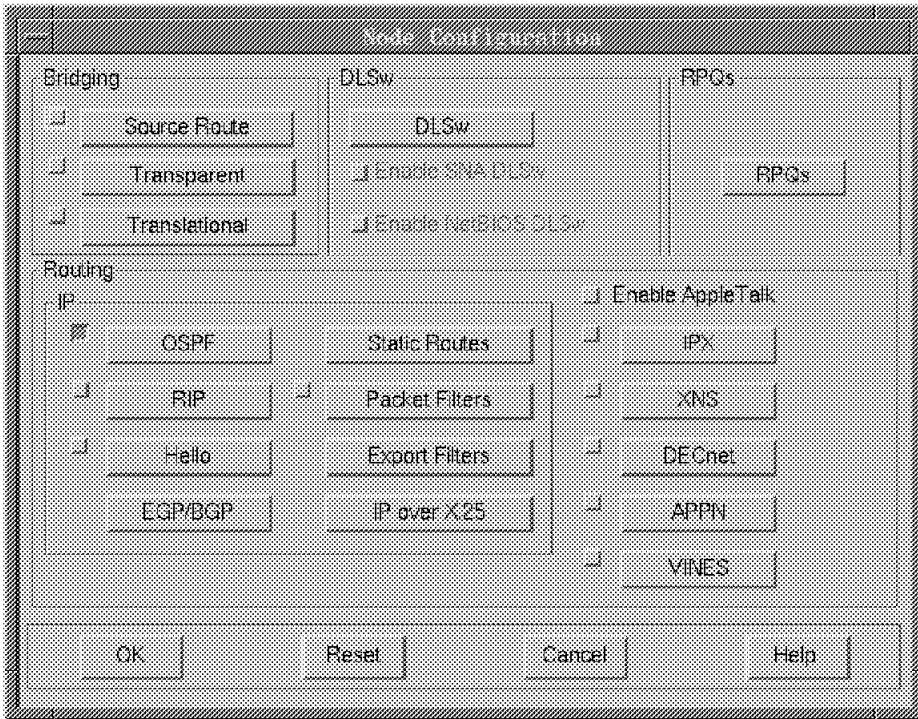
Figure 329. Node Configuration Screen

For this scenario, we do not need bridging, DLSw, filters, etc. However, we need to define a routing protocol. A simple and straightforward routing protocol is RIP, but OSPF is a much more advanced and sophisticated routing protocol that replaces RIP in router networks. In addition, OSPF allows variable subnet masks, whereas RIP does not.

We now define OSPF by first selecting **OSPF**.

The next few screens show you how to configure OSPF.
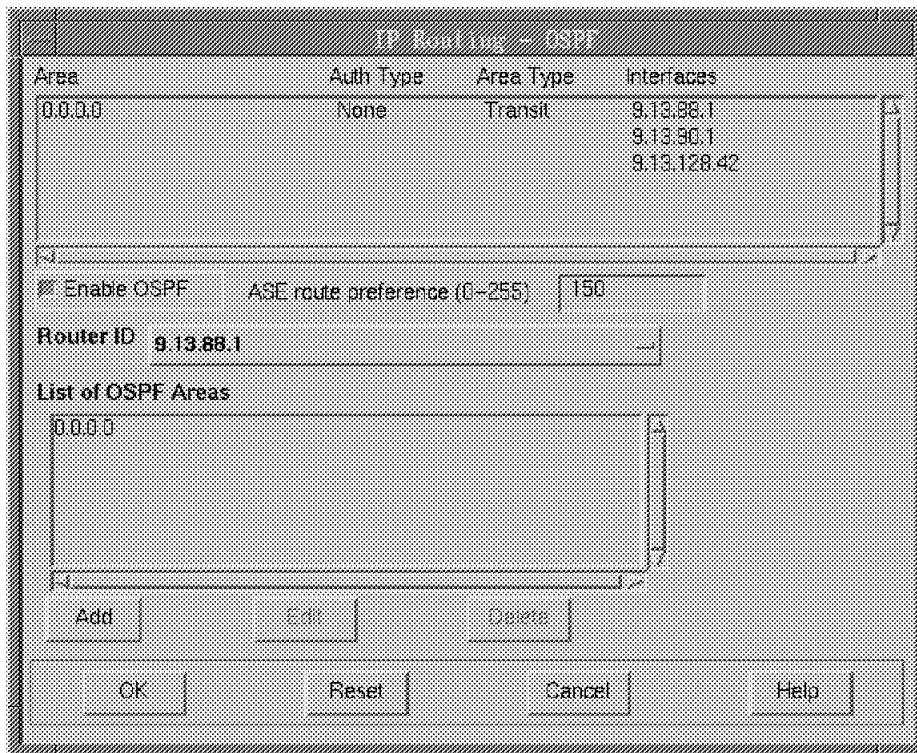
Figure 330. IP Routing OSPF Screen

First, enable OSPF and then define the router ID. The router ID is one of the interface IP addresses and is used by the OSPF protocol as an identifier for this router in the OSPF domain. Select the list and the token-ring IP address 9.13.88.1.

The next step is to define an OSPF area. An OSPF area has an identifier that is represented in the same form as an IP address. The first area in an OSPF network is the backbone area and *must* have the identifier 0.0.0.0. Select **Add**; this will display the OSPF Area-Detail window.

Figure 331. OSPF Area Detail Screen

In the previous screen, the only thing to do is define the interfaces using OSPF. Don't worry about the area type or Authentication type, which allow you to set a password for OSPF advertisements. Select **OSPF Interfaces**, and the OSPF Interfaces window will be displayed.
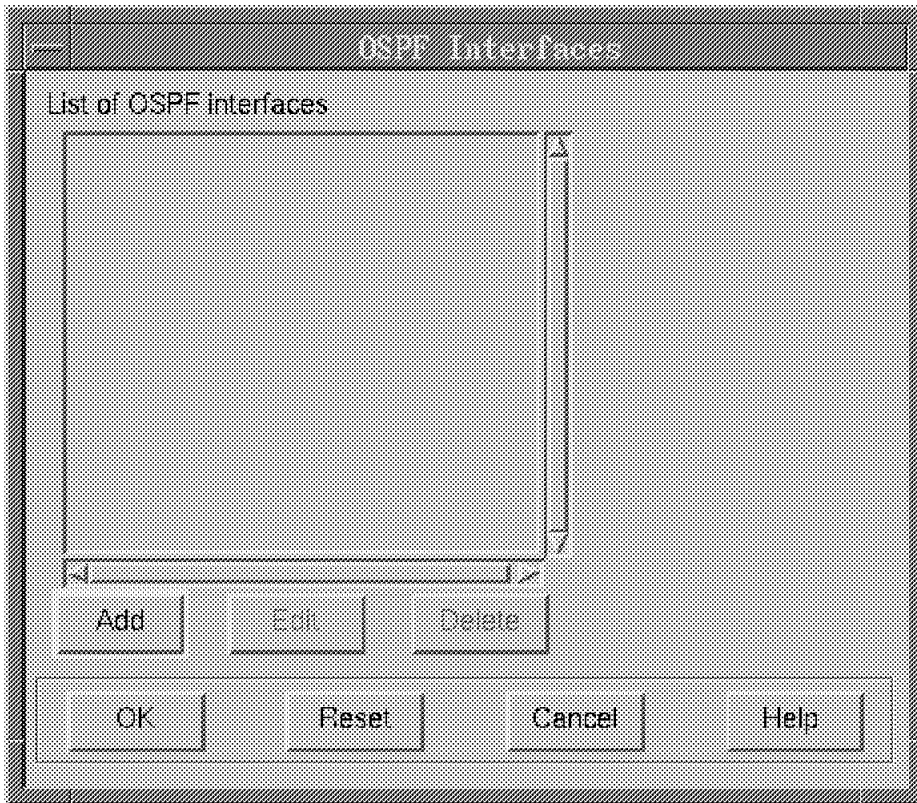
Figure 332. OSPF Interfaces

Here you need to add all the interfaces that the to that OSPF area. The following are all interfaces on that router:

- The token-ring interface 9.13.88.1
- The Serial Port 0 (FR) 9.13.90.1
- The Serial Port 1 (PPP) 9.13.128.42

Note that on the serial interface port 1 (PPP) the IP address is the remote side of the PPP link.

To add interfaces to the list, select **Add** and the OSPF Interface - Detail window will be displayed.
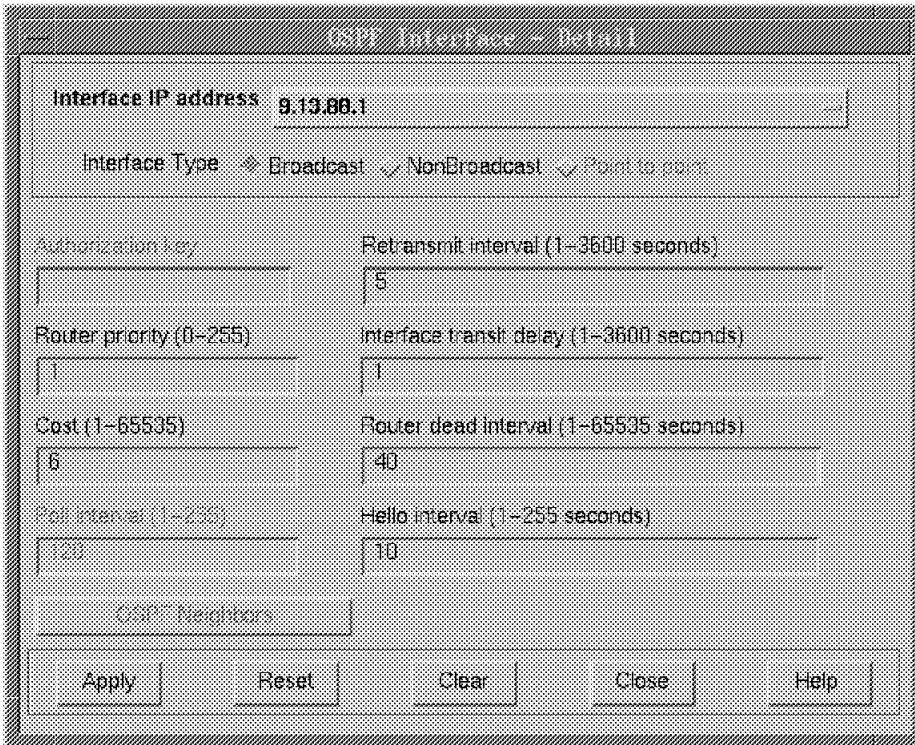
Figure 333. OSPF Interface Detail

Select the **Interface IP address** option. This will display a list of all the interfaces configured for IP. Select the Token-Ring IP address (9.13.88.1) from the list. The config program will insert the appropriate default values for the selected interface. The defaults match our needs, so we leave all parameters at their default values. Select **Apply** to register this interface in the list.

Now select this option again and select the frame relay interface (9.13.90.1).
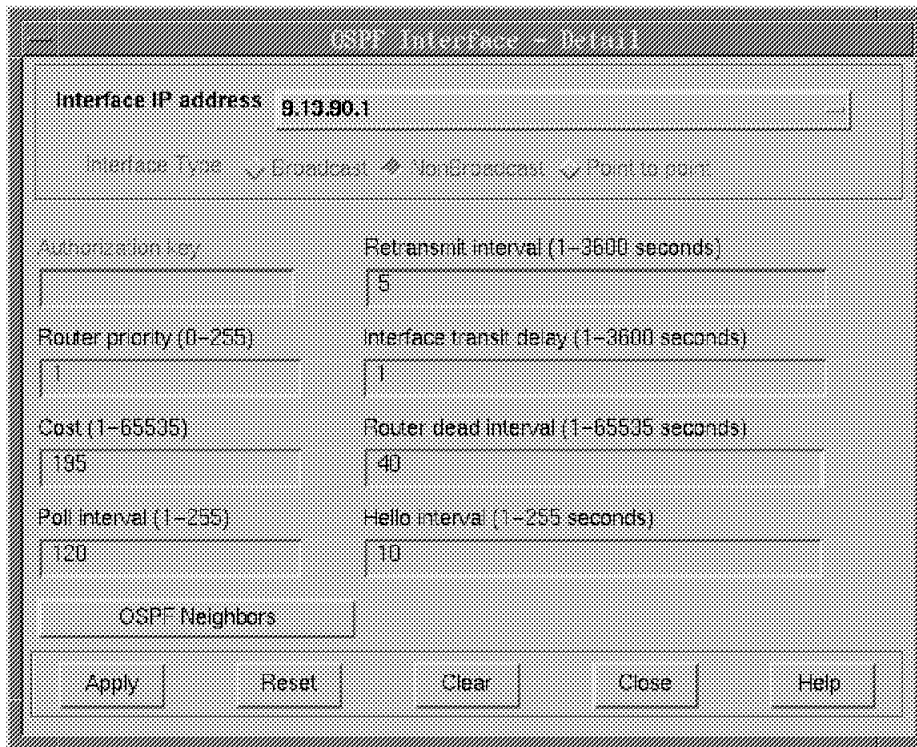
Figure 334. OSPF Interface Detail

Here again, the config program will insert the appropriate default values for the frame relay interface. The defaults match our needs, so we leave all the parameters at their defaults.

Here, unlike at the token-ring interface, we need to define the OSPF Neighbors. (This is because a frame relay network is a non-broadcast multi-access network.) Select **OSPF Neighbors**.
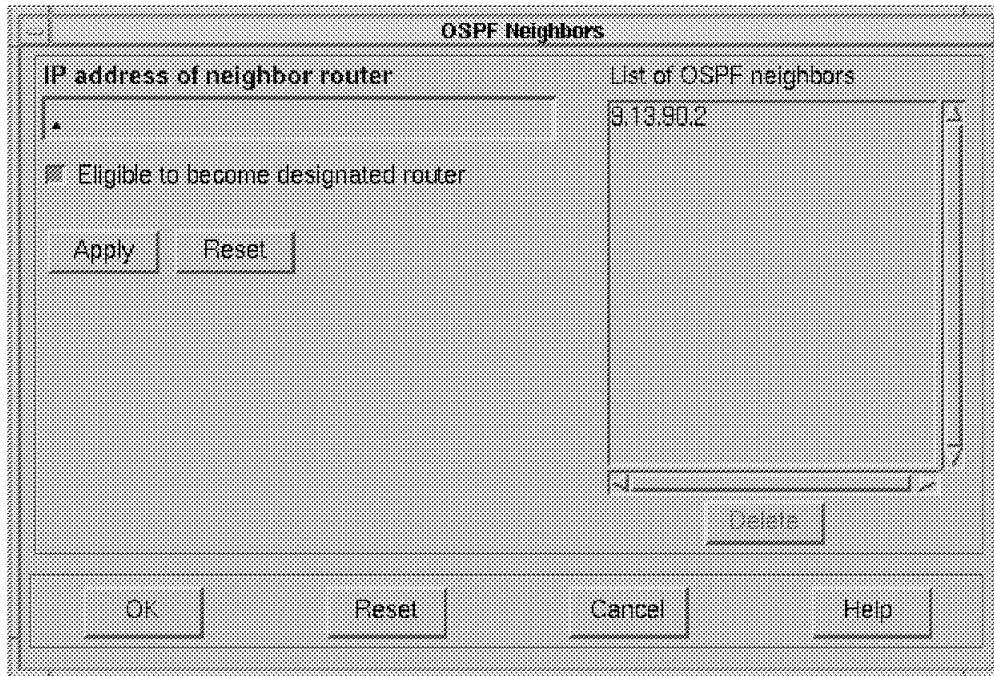
Figure 335. OSPF Neighbors

The OSPF protocol is able to dynamically discover the other OSPF routers on a shared media such as token-ring or Ethernet by sending broadcast Hello packets. Frame relay looks like a LAN because the routers are attached to one physical access with several logical connections. However, frame relay doesn't allow broadcasting. This is the reason we have to manually define the OSPF neighbors. Enter the IP address of the neighbor (9.13.90.2) router in the previous screen and select **Apply**.

That's all for this screen; select **OK** and then **Apply**.
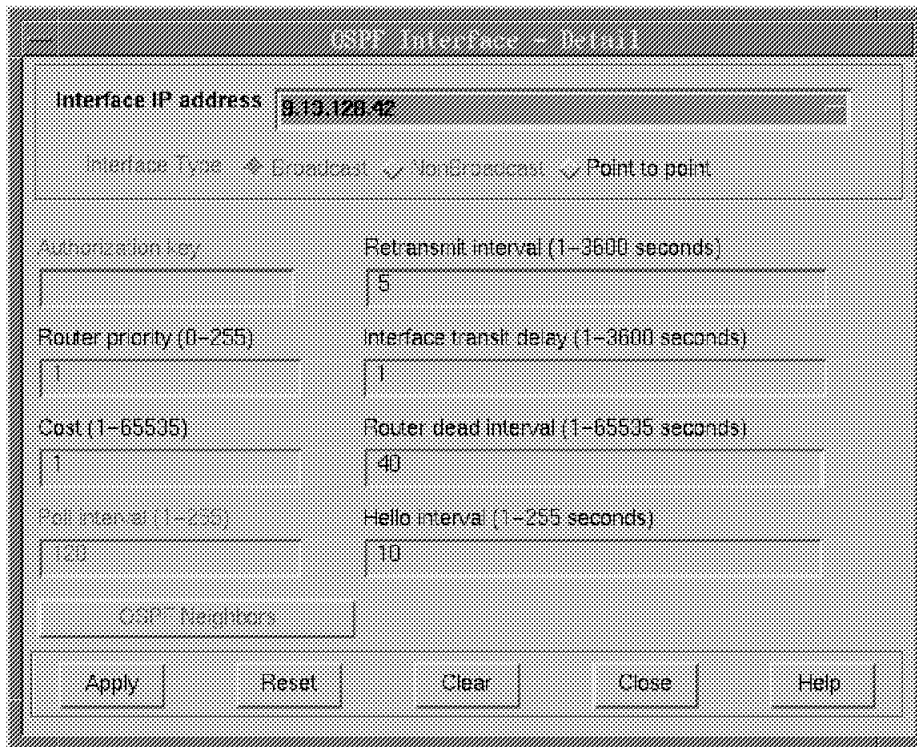
Figure 336. OSPF Interface Detail

Once again, select the Interface IP address option. Select the Serial interface PPP IP address (9.13.128.42) from the list. The config program will insert the appropriate default values for the serial interface. The defaults match our needs, so we leave all parameters at their defaults.

Select **Apply** and then select **Close**.

This concludes the OSPF definition.

The next few screens show how to configure SNMP. On the main screen select **Node Management**.
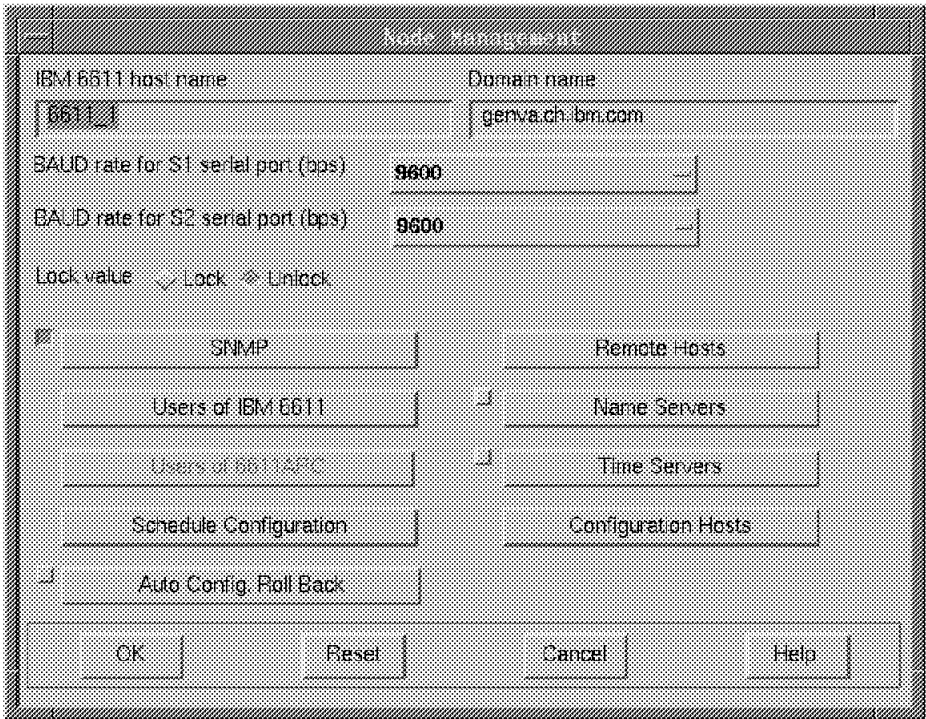
Figure 337. Node Management Screen

This is the Node Management screen. Enter or check the IBM 6611 host name and the domain name as well as the speed for the serial ports.

Now we need to define the SNMP parameters. To do this, select **SNMP**.
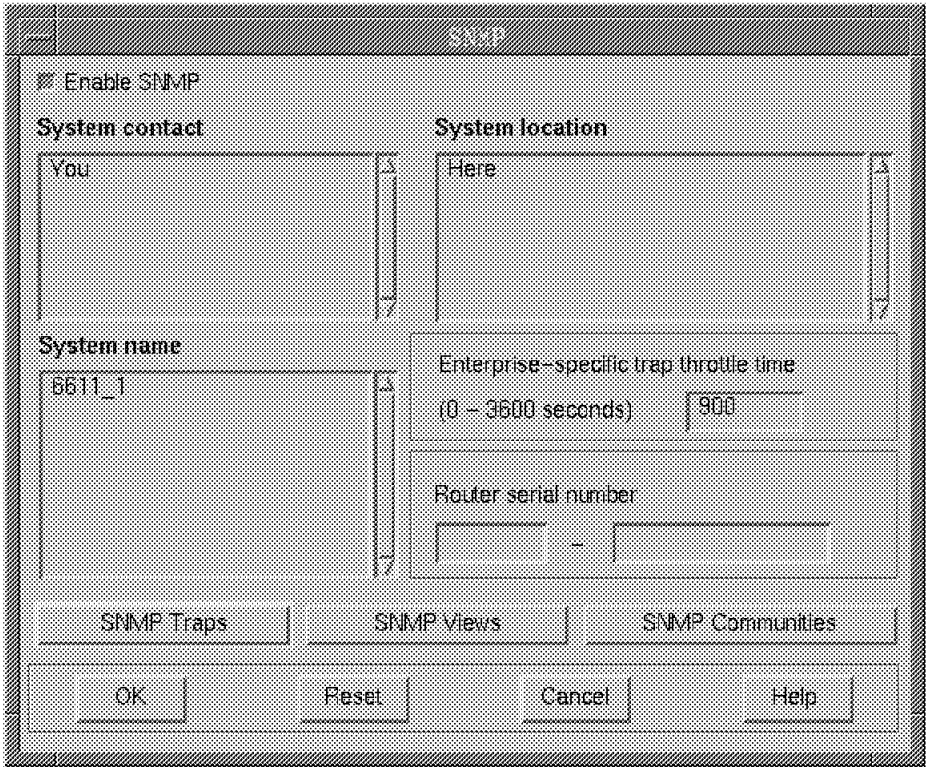
Figure 338. SNMP Screen

This is the SNMP screen. Enable SNMP and enter a contact/location in the fields System contact and System location. These fields are used by the MIB and indicate the person responsible for this router and the location of the router.

Next, select **SNMP Traps**.

Figure 339. SNMP Traps

You can enter the SNMP Management Stations that you want to receive the traps generated by this router.

This concludes the 6611_1 router configuration. The only (but most important) step to do now is to save the configuration. The following screen shows how to save a configuration:
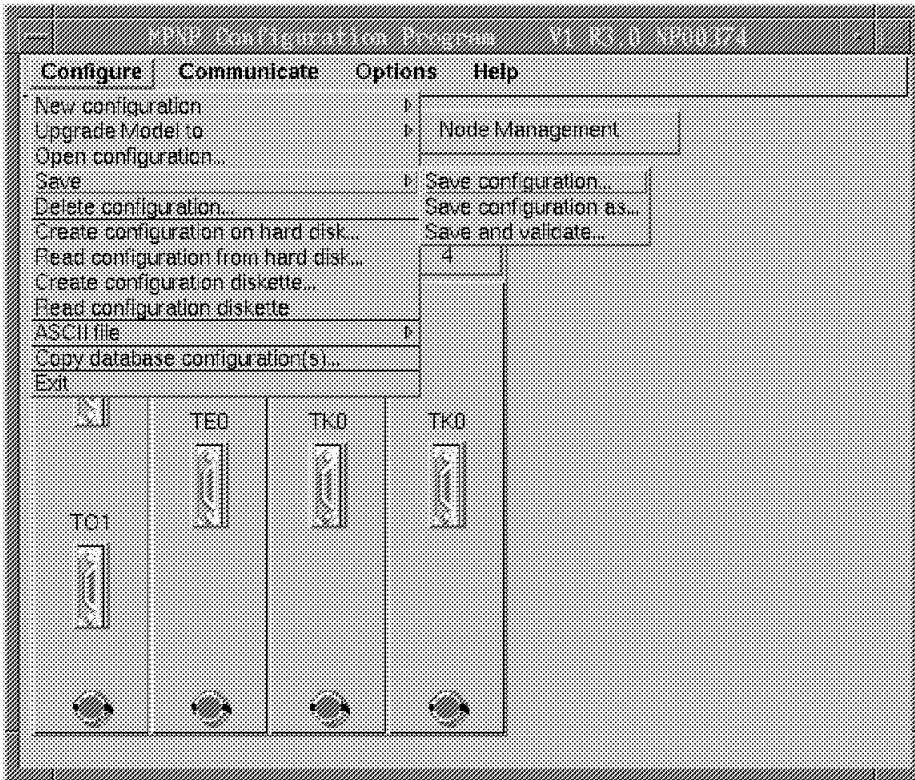
Figure 340. Save the Configuration

A.1.2 The 6611-2 Configuration

Instead of repeating all the configuration windows for router 6611-1, we will only indicate the difference from 6611-1. The router configurtion is symmetric; this means both routers are configured in the same way. The only exceptions are, of course, the IP addresses. So, for the 6611-2 configuration, enter the IP addresses accordingly.

Appendix B. Nways Switch Scenario 2

This section describes the configuration of the IBM 3745 in our 2220 network used in Chapter 9, "Nways Switch IBM 3745 Interoperability - Scenario 2" on page 279.

B.1 IBM 3745 Configuration

This is the NCP gen for our 3745 configuration.

```
*REPORT=NCP,VTAM,CABLE                                                 00012800
*01/13/95 - ADD DIAL LINES ON TO2600L AND TO2601L (9600 BAUD)
          OPTIONS NEWDEFN=(YES,ECHO)
LSSMVS  PCCU  CUADDR=411,        3725 CONTROL UNIT ADDRESS         X00014300
              AUTODMP=NO,        PROMPT BEFORE DUMPING NCP         X00014400
              AUTOIPL=YES,       NO PROMPT BEFORE RELOADING NCP    X00014500
              DUMPDS=VTAMDUMP,   DUMP FILE VTAM DDNAME             X00014600
              CDUMPDS=CSPDUMP,   DUMP FILE VTAM DDNAME             X00014700
              MDUMPDS=MOSSDUMP,   DUMP FILE VTAM DDNAME            X00014800
              MAXDATA=4096,      MAX DATA SIZE                     X00014900
              SUBAREA=1,         LSSMVS VTAM SUBAREA               X00015000
              OWNER=HOSTMVS,     RESOURCE OWNER                    X00015100
              GWCTL=ONLY,        FOR GWNCP                         X
              NETID=USIBMTO,     FOR GWNCP                         X
              INITEST=NO         NO 3725 INITIAL TEST               00015200
        TITLE 'NCP FOR PRODUCTION'                                  00015300
***********************************************************************  00015400
*                                                                  *  00015500
*       BUILD MACRO SPECIFICATIONS                                 *  00015600
*                                                                  *  00015700
***********************************************************************  00015800
NCPBUILD BUILD MAXSUBA=63,       MUST BE SAME AS IN VTAM STR DEF   X00015900
              MEMSIZE=4M,                                          X
              VERSION=V7R2,      NCP VERSION FOR 3725              X00016000
              NETID=USIBMTO,     NETWORK ID REQ.                   X00016000
              HSBPOOL=400,       FOR GWNCP                         X00016000
              LOADLIB=NCPLOAD,   GIVES ERROR BUT REQUIRED FOR VTAM X00016100
              TYPSYS=MVS,        OS  USED FOR STAGE 2              X00016200
              TYPGEN=NCP,        NCP ONLY                          X00016400
              BFRS=240,          NCP BUFFER SIZE (DEFAULT)         X00016500
              UCHAN=NO,                                            X00016800
              MAXSSCP=2,         TWO HOSTS CAN ACTIVATE THIS NCP   X00017500
              NUMHSAS=5,         3 HOSTS CAN COMMUNICATE CONCURRENTLYX00017600
              DIALTO=60,         WAIT 1 MIN FOR ANSWER             X00017800
              DSABLTO=3.0,       USED WHEN DEACTIVATING LINK       X00017900
              ENABLTO=180,       LARGE ENOUGH FOR DIAL OR LEASED   X00018000
              MODEL=3745-170,                                      X00018100
              NEWNAME=NCP26,                             EEW 5     X00018200
              OLT=YES,           ONLINE TEST AVAILABLE(DEFAULT)    X00018300
              SLODOWN=12,        SLOWDOWN AT 12% BUFS AVAIL        X00018400
              SUBAREA=26,        SUBAREA ADDRESS = 28              X00018500
              BRANCH=100,        BRANCH TRACE TABLE                X00018900
              LTRACE=2,          LINE TRACE TABLE                  X00019000
              ADDSESS=100,                                         X00019000
              AUXADDR=50,                                          X00019000
              NAMTAB=50,                                           X00019000
              USGTIER=3,                                           X00019000
```

```
                        MAXSESS=100,                                    X00019000
                        TRACE=NO           ADDRESS-TRACE ENTRIES          00019100
      ***************************************************************** 00019400
      *                                                             *    00019500
      *        SYSCNTRL OPTIONS REQUIRED BY VTAM                    *    00019600
      *                                                             *    00019700
      *                                                             *    00019800
      ***************************************************************** 00019900
      NCPSYSC SYSCNTRL OPTIONS=(MODE,STORDSP,                           X00020000
                        RCNTRL,RCOND,RECMD,RIMM,ENDCALL,                X00020100
                        BHSASSC)                                         00020200
      *  GWNAU NEEDED FOR GWNCP
              GWNAU NUMADDR=200
      ***************************************************************** 00020300
      *        HOST MACRO SPECIFICATIONS OS VTAM                    *    00020400
      *        UNITSIZ TIMES MAXBFRU MINUS BFRPAD EQUALS MAX MESSAGE SIZE * 00020500
      *        FOR INBOUND MESSAGES                                 *    00020600
      ***************************************************************** 00020700
      HOSTMVS  HOST  INBFRS=40,          # OF BUFFERS                   X00020800
                     MAXBFRU=41,         # OF BUFFERS                   X00020900
                     UNITSZ=384,         THREE BUFFERS HOLD BATCH PIU   X00021000
                     BFRPAD=0,                                          X00021100
                     STATMOD=YES,                                       X00021200
                     SUBAREA=1           SUBAREA OF LSSMVS VTAM          00021300
              PATH  DESTSA=(1),                                         X00021400
                     ER0=(1,1),VR0=0                                     00021500
              PATH  DESTSA=(27,28,29),                                  X00021400
                     ER0=(29,1),VR0=0                                    00021500
      * NO CSB MACROS                                                    00021600
              LUDRPOOL NUMTYP1=50,NUMTYP2=100,NUMILU=200                 00021700
      ***************************************************************** 00022500
      *  INN LINKS
      ***************************************************************** 00022500
      I2629P    SDLCST GROUP=I2629GP,MODE=PRI
      I2629S    SDLCST GROUP=I2629GS,MODE=SEC
      I26RTPP   SDLCST GROUP=RTPPGRP,MODE=PRI
      I26RTPS   SDLCST GROUP=RTPSGRP,MODE=SEC
      ***************************************************************** 01590000
      ***************************************************************** 02310000
      *      INN GROUP DEFINITIONS FOR NCP29 AT WESTON                *  02310000
      ***************************************************************** 02310000
      I2629GP  GROUP  LNCTL=SDLC,DIAL=NO,MODE=PRI
      I2629GS  GROUP  LNCTL=SDLC,DIAL=NO,MODE=SEC
      *                                                                  05900000
      ***************************************************************** 19330200
      ***      SNI CONNECTION TO SER NETWORK                       ***   19330400
      ***************************************************************** 19330500
      RTPPGRP    GROUP ACTIVTO=360,DIAL=NO,LNCTL=SDLC,MODE=PRIMARY,REPLYTO=3   19330600
      RTPSGRP    GROUP ACTIVTO=360,DIAL=NO,LNCTL=SDLC,MODE=SECONDARY,REPLYTO=3 19330700
      ***************************************************************** 00015400
      *                                                                  17090000
      GRP26SW1 GROUP DIAL=YES,DUPLEX=FULL,                              +17100000
                     LNCTL=SDLC,                                        +17110000
                     CALL=IN,                                           +17120000
                     PAUSE=.1,                                          +17130000
                     PUTYPE=(1,2),REPLYTO=4,                            +17140000
                     TYPE=NCP,RETRIES=(3,3,2)                            17150000
              *                                                          17090000
```

```
*                                                                    17360000
TO2600L LINE     ADDRESS=000,ANSWER=ON,ISTATUS=ACTIVE,DUPLEX=FULL,    X17320000
                 CLOCKNG=EXT,SPEED=9600,NRZI=YES                       17330000
TO2600P PU                                                             17350000
*                                                                    17310000
TO2601L LINE     ADDRESS=001,ANSWER=ON,ISTATUS=ACTIVE,DUPLEX=FULL,    X17320000
                 CLOCKNG=EXT,SPEED=9600,NRZI=NO                        17330000
TO2601P PU                                                             17350000
*                                                                    17360000
******************************************************************** 06970000
TO26SDLC GROUP LNCTL=SDLC,DIAL=NO,TYPE=NCP,                           X
                 PASSLIM=254,MAXOUT=7
TO2604L  LINE    ADDRESS=(04,FULL),ANS=CONT,DUPLEX=FULL,NRZI=YES,     X
                 SDLCST=(I2629P,I2629S),                              X
                 SPEED=19200,                                         X
                 ISTATUS=INACTIVE
*                                                                    09510000
TO2604P  PU      TGN=1,PUTYPE=4,DATMODE=FULL
*
*
******************************************************************** 11910000
* FRAME RELAY PHYSICAL LINE 1028 - FULL DUPLEX HPTSS           * 11920000
******************************************************************** 11930000
TO2FRGP0 GROUP FRELAY=(PHYSICAL,PER),                                X11940000
                 ISTATUS=ACTIVE,                                     X11950000
                 MAXFRAME=2048,                                      X11960000
                 TYPE=NCP                                             11980000
*                                                                    11990000
TO2F1028 LINE    ADDRESS=(1028,FULL),                                X12000000
                 PORTADD=28,                                         X
                 CLOCKNG=EXT,                                        X12010000
                 NRZI=YES,                                           X12030000
                 LMI=ANSI,                                           X12040007
                 SPEED=1536000                                        12050000
TO2P1028 PU      ANS=CONTINUE                                         12060000
*                                                                    12070000
******************************************************************** 13920000
* FRAME RELAY LOGICAL LINES                                    * 13930000
******************************************************************** 13940000
TO2FRBG1 GROUP FRELAY=(LOGICAL,PER),                                X13950000
                 MODETAB=AMODETAB,                                   X13990000
                 ISTATUS=ACTIVE,                                     X14000000
                 PHYSRSC=TO2P1028,                                   X14020000
                 USSTAB=AUSSTAB                                       14030000
*
TO2FL1   LINE
*
TO2FL1P1 PU      PUTYPE=2
*
******************************************************************** 15338000
***      TOKEN RING CONNECTIONS                                      15340000
******************************************************************** 15341000
*   BUILDING RING DEFINITIONS (PHYSICAL)
TO26T1PG GROUP ECLTYPE=(PHYSICAL,SUBAREA)                             15342000
TO26T1PL LINE  ADDRESS=(1089,FULL),LOCADD=400037451001,PORTADD=1,    X15343000
                 RCVBUFC=4095,MAXTSL=2044
TO26T1PU PU      XMONLNK=YES                                          15343100
TO26T1LU LU      ISTATUS=ACTIVE                                       15343200
```

```
          T026T2PG GROUP ECLTYPE=(PHYSICAL,PERIPHERAL)                            15342000
          T026T2PL  LINE   ADDRESS=(1088,FULL),LOCADD=400037451002,PORTADD=2,    X15343000
                    RCVBUFC=4095,MAXTSL=2044
          T026T2PU  PU                                                            15343100
          T026T2LU LU    ISTATUS=ACTIVE                                           15343200
          *   PERIPHERALS (LOGICAL) - SITE RING DEFINITIONS
          *
          T026T2G1 GROUP ECLTYPE=(LOGICAL,PERIPHERAL),PHYPORT=2                    15342000
          T026T2L1  LINE   CALL=INOUT                                             15343000
          T026T2P1  PU                                                            15343000
          T026T2L2  LINE   CALL=INOUT                                             15343000
          T026T2P2  PU                                                            15343000
          T026T2L3  LINE   CALL=INOUT                                             15343000
          T026T2P3  PU                                                            15343000
          T026T2L4  LINE   CALL=INOUT                                             15343000
          T026T2P4  PU                                                            15343000
          T026T2L5  LINE   CALL=INOUT                                             15343000
          T026T2P5  PU                                                            15343000
          T026T2L6  LINE   CALL=INOUT                                             15343000
          T026T2P6  PU                                                            15343000
          T026T2L7  LINE   CALL=INOUT                                             15343000
          T026T2P7  PU                                                            15343000
          T026T2L8  LINE   CALL=INOUT                                             15343000
          T026T2P8  PU                                                            15343000
          T026T2L9  LINE   CALL=INOUT                                             15343000
          T026T2P9  PU                                                            15343000
          T026T2LA  LINE   CALL=INOUT                                             15343000
          T026T2PA  PU                                                            15343000
          T026T2LB  LINE   CALL=INOUT                                             15343000
          T026T2PB  PU                                                            15343000
          T026T2LC  LINE   CALL=INOUT                                             15343000
          T026T2PC  PU                                                            15343000
          T026T2LD  LINE   CALL=INOUT                                             15343000
          T026T2PD  PU                                                            15343000
          T026T2LE  LINE   CALL=INOUT                                             15343000
          T026T2PE  PU                                                            15343000
          T026T2LF  LINE   CALL=INOUT                                             15343000
          T026T2PF  PU                                                            15343000
          T026T2LH  LINE   CALL=INOUT                                             15343000
          T026T2PH  PU                                                            15343000
          T026T2LI  LINE   CALL=INOUT                                             15343000
          T026T2PI  PU                                                            15343000
          T026T2LJ  LINE   CALL=INOUT                                             15343000
          T026T2PJ  PU                                                            15343000
          T026T2LK  LINE   CALL=INOUT                                             15343000
          T026T2PK  PU                                                            15343000
          T026T2LM  LINE   CALL=INOUT                                             15343000
          T026T2PM  PU                                                            15343000
          T026T2LN  LINE   CALL=INOUT                                             15343000
          T026T2PN  PU                                                            15343000
          T026T2LO  LINE   CALL=INOUT                                             15343000
          T026T2PO  PU                                                            15343000
          T026T2LQ  LINE   CALL=INOUT                                             15343000
          T026T2PQ  PU                                                            15343000
          T026T2LR  LINE   CALL=INOUT                                             15343000
          T026T2PR  PU                                                            15343000
          T026T2LS  LINE   CALL=INOUT                                             15343000
          T026T2PS  PU                                                            15343000
          T026T2LT  LINE   CALL=INOUT                                             15343000
```

```
          TO26T2PT  PU                                                       15343000
          *
          *   SUBAREA DEFINITIONS  (LOGICAL)  - SITE RING
          *
          TO26T1G2 GROUP ECLTYPE=(LOGICAL,SUBAREA),PHYPORT=1                  15342000
          *
          *   INN CONNECTIONS TO NCP29 IN WESTON
          *
          TO26T1I1  LINE SDLCST=(I2629P,I2629S),MONLINK=YES                   15343000
          TO26T1S1  PU TGN=1,ADDR=04400037451006,DATMODE=FULL,PUTYPE=4        15343000
          **                                                                  15400000
          *
          *   SNI CONNECTION TO SER
          TO26T1I2  LINE SDLCST=(I26RTPP,I26RTPS)                             15343000
          TO26T1S2  PU TGN=1,ADDR=04400003016091,DATMODE=FULL,PUTYPE=4,      X15343000
                       NETID=RTPLSS
          **                                                                  15400000
          ********************************************************************* 15343800
          ***     CHANNEL ADAPTERS                                           15344000
          ******************************************************************** 15345000
          GR30CA    GROUP LNCTL=CA                                            15350000
          **                                                                  15360000
          TO29CAOL LINE  CA=TYPE6,ADDRESS=00,                               X15370000
                        NCPCA=ACTIVE                                          15380000
          TO29CA0P PU    PUTYPE=5,NETID=USIBMTO                               15390000
          **                                                                  15400000
          **                                                                  15400000
          **                                                                  21468000
          **   NETWORK DEFINTIONS FOR THE NULL NETWORK BETWEEN LSSMVS AND RIS  21470000
          **                                                                  21480000
          RTPLSS    NETWORK NETID=RTPLSS,                                    X21490000
                        SUBAREA=3,      SUBAREA IN NULL NETWORK (RTPLSS)     X21500000
                        MAXSUBA=7,      MAXSUBA IN RTPLSS NETWORK            X21510000
                        NUMHSAS=10,     NUMBER OF HOST SUBAREAS              X21520000
                        COSTAB=ISTSDCOS, COS TABLE IN RTP                    X21530000
                        ACTPU=NO        RTP CAN NOT ACTIVATE                  21540000
                    GWNAU NETID=USIBMTO,NAME=TOCDRM1,ELEMENT=1,NUMSESS=10     21550000
                    GWNAU NUMADDR=100                                         21560000
                    PATH  DESTSA=2,ER0=(2,1),VR0=0                            21570000
                    GENEND
                    END                                                       00620000
```

B.2 VTAM Switched Major Node

```
          FR3174A  VBUILD TYPE=SWNET,MAXGRP=200,MAXNO=400
          *
          FRAPU1    PU     ADDR=04,PUTYPE=2,MAXPATH=4,                         X
                          DLOGMOD=D4A32792,MAXOUT=3,ANS=CONTINUE,              X
                          IDBLK=017,IDNUM=04009,PACING=0,                      X
                          MODETAB=LMT3270,SSCPFM=FSS,VPACING=0,                X
                          ISTATUS=ACTIVE,USSTAB=AUSSTAB                 06110000
          *   MODETAB WAS AMODETAB AND DLOGMOD WAS D6327802
          *
          FRPATH1  PATH  DIALNO=280400000000001E,GID=1,GRPNM=TO2FRBG1
          *                 28=PORTADD IN NCP
          *                 04=DESTINATION SAP (DSAP)
          *                 1E=DLCI X'1E' (DEC 30)
          *                 GRPNM=LOGICAL LINE GROUP IN NCP
```

```
                    *
                    *
                    FRAU02   LU    LOCADDR=2,ISTATUS=ACTIVE
                    FRAU03   LU    LOCADDR=3,ISTATUS=ACTIVE
                    FRAU04   LU    LOCADDR=4,ISTATUS=ACTIVE
                    FRAU05   LU    LOCADDR=5,ISTATUS=ACTIVE
                    FRAU06   LU    LOCADDR=6,ISTATUS=ACTIVE
                    FRAU07   LU    LOCADDR=7,ISTATUS=ACTIVE
                    FRAU08   LU    LOCADDR=8,ISTATUS=ACTIVE
```

B.3 IBM 2210 Configuration

This section describes the IBM 2210 Router configuration. It is not the intent of
this section to explain, in detail, how to configure an IBM 2210. For details please
refer to the appropriate IBM 2210 documentation.

However, we show here how the IBM 2210 was configured and explain why we
did it this way.

For convenience, the drawing of scenario 3 is repeated here:
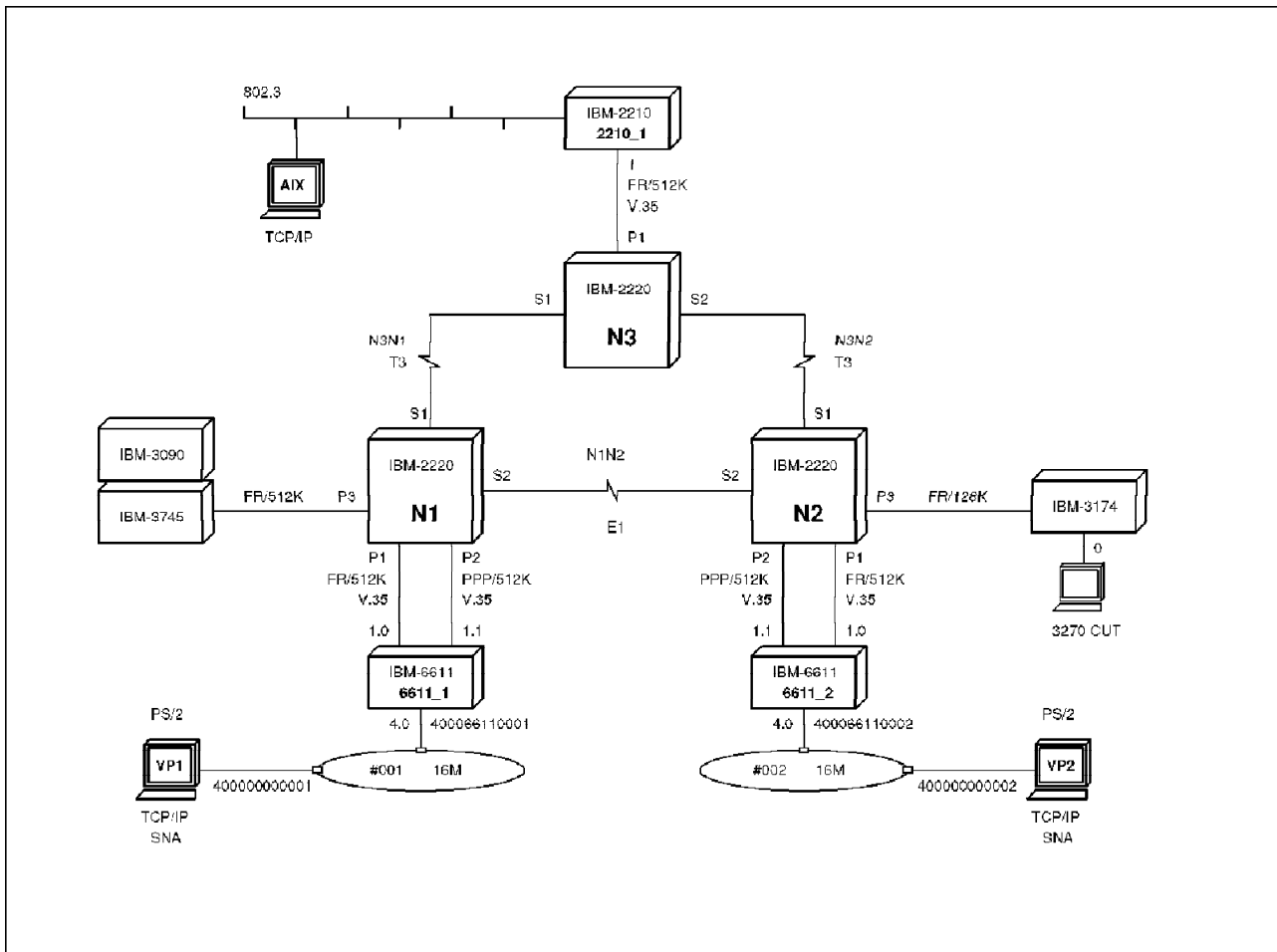
Figure 341. Scenario 2

We used the IBM 2210 Configuration Tool V1R2. The items to configure are:

- Interface

- IP General
- IP Interface
- OSPF General
- OSPF Areas
- OSPF Interfaces

B.3.1 IBM 2210 Interface Configuration
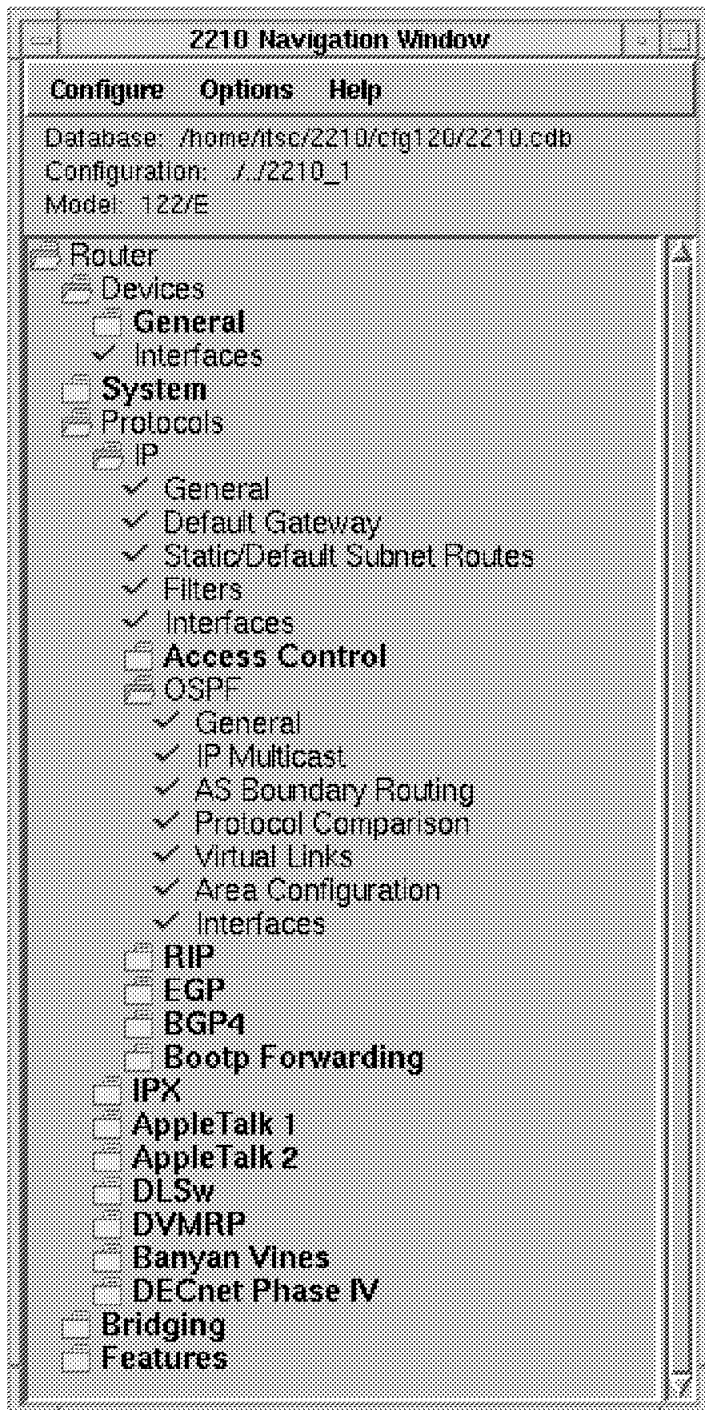
Figure 342. Navigation Window

The config tool allows you to expand only selected folders in the navigation window. Here, we open only the folders needed for our configuration example. When you select an item on the navigation window, the corresponding configuration screen is displayed on the right side. Enter the parameters and select the next item in the navigation window.

Note: Sometimes you need to press Enter after entering a value in a configuration field. If you do not, the entered value can be lost.

Figure 343. Device Interfaces

Select the correct 2210 model by clicking on the list at the top of the screen. Also, you need to select the protocol used on serial port 1; the only one used in our configuration. Select **Frame Relay** from the list. Now you can configure the ports individually.
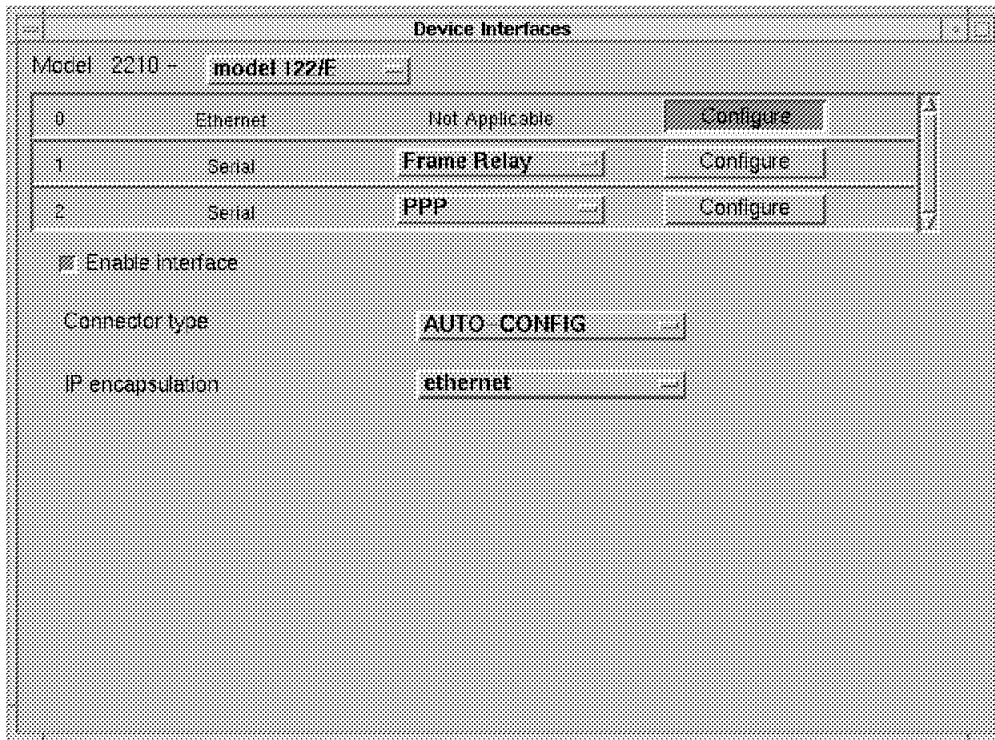
Figure 344. Device Interfaces Ethernet Configuration

By clicking on **IP encapsulation**, you can enable the interface, select the Ethernet connector type (AUTO-CONFIG allows you to detect the connector type automatically) and select the IP encapsulation method used on the LAN (Ethernet DIX or IEEE 802.3).
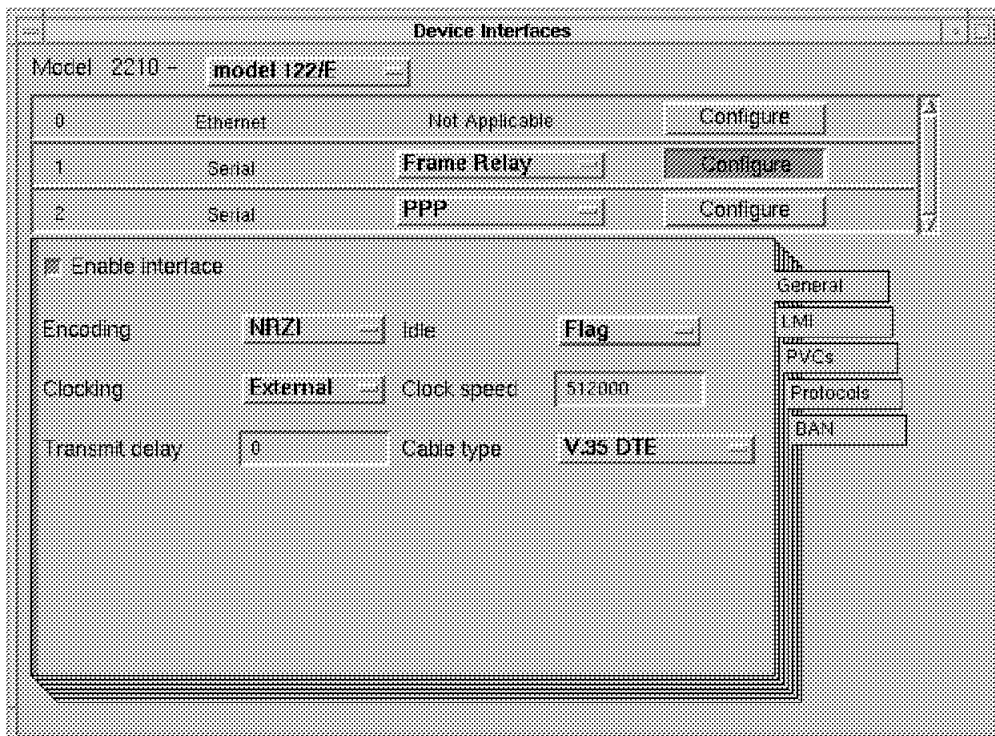
Figure 345. Device Interfaces Frame Relay General

By clicking on the port 1 **Configure** button, you can now configure the frame relay parameters. The different parameters are presented to you in a notebook. By selecting a page label (General, LMI, etc.) you can enter all the parameters related to this interface. On the General page, enter the line speed. (Actually, this is not used to clock the data because the DCE will deliver the clock signal.) In our case it is the 2220. Enter the cable type and the encoding method (NRZ or NRZI).
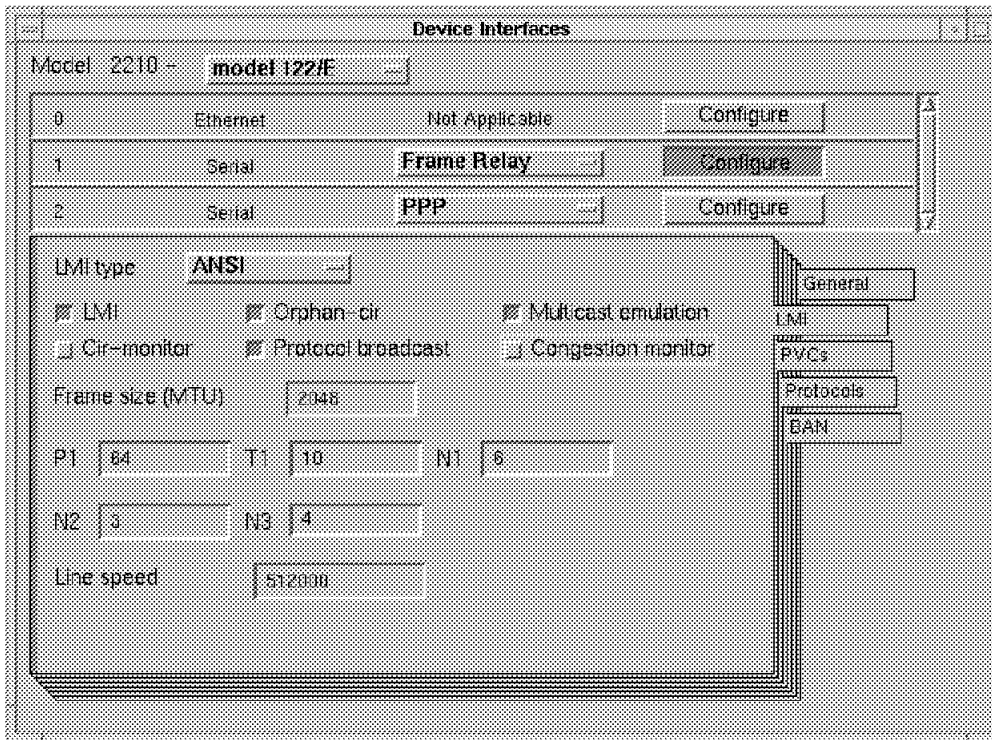
Figure 346. Device Interfaces Frame Relay LMI

Enable LMI on the LMI page. The 2220 supports LMI ANSI T1.617 Annex D and ITU-T Q.933 Annex A standards. By enabling LMI, the 2210 can be informed from the 2220 of changes in the DLCI status. By enabling Orphan-Circuits, this allows discovery of the DLCIs from the 2220. We let this value default (Enabled), although we will manually define the two DLCIs starting from the router (no InARP in the current release). Also, CIR monitoring and Congestion monitoring won't be used in this scenario. The reason for this is that we wanted to test the bandwidth adaptation capability of the 2220. If the 2210 could monitor the CIR and react to BECN bits, it would reduce the bit rate on the frame relay interface and the 2220 would not find any reason to adapt the bandwidth.
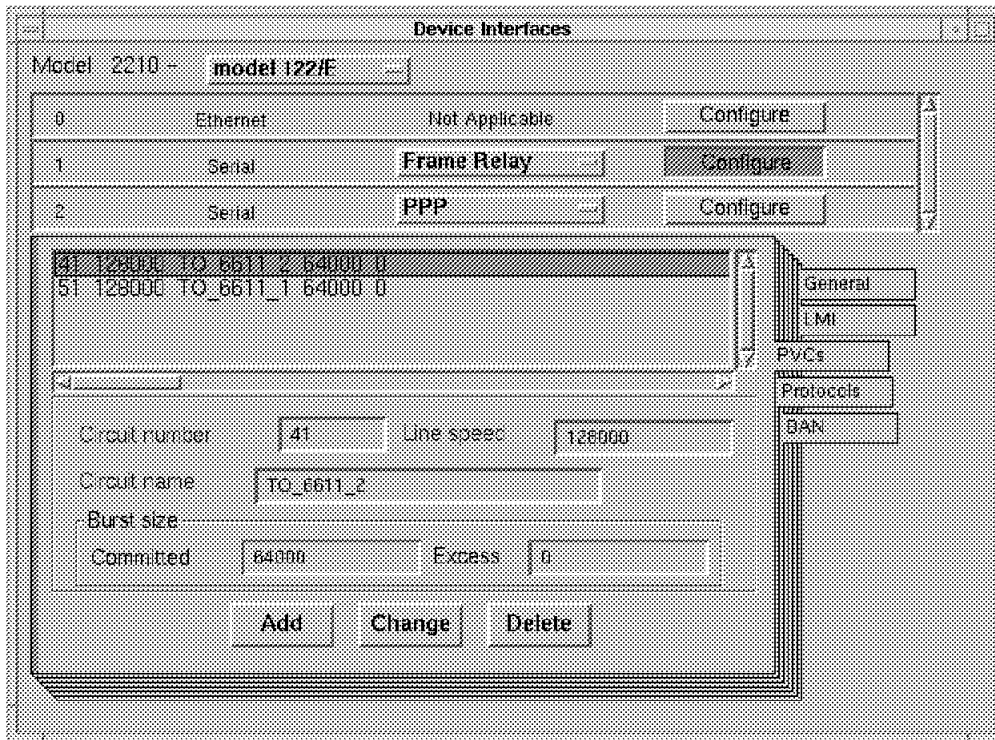
Figure 347. Device Interfaces Frame Relay PVC

On the PVC page, add the two DLCIs (41 and 51) starting from the 2210. The Line Speed parameter is actually the CIR as defined in the 2220 frame relay port. We entered the real CIR used (128 kbps) but this value is not used by the 2210 as the CIR monitor is not enabled. The same is true for Burst size parameters.
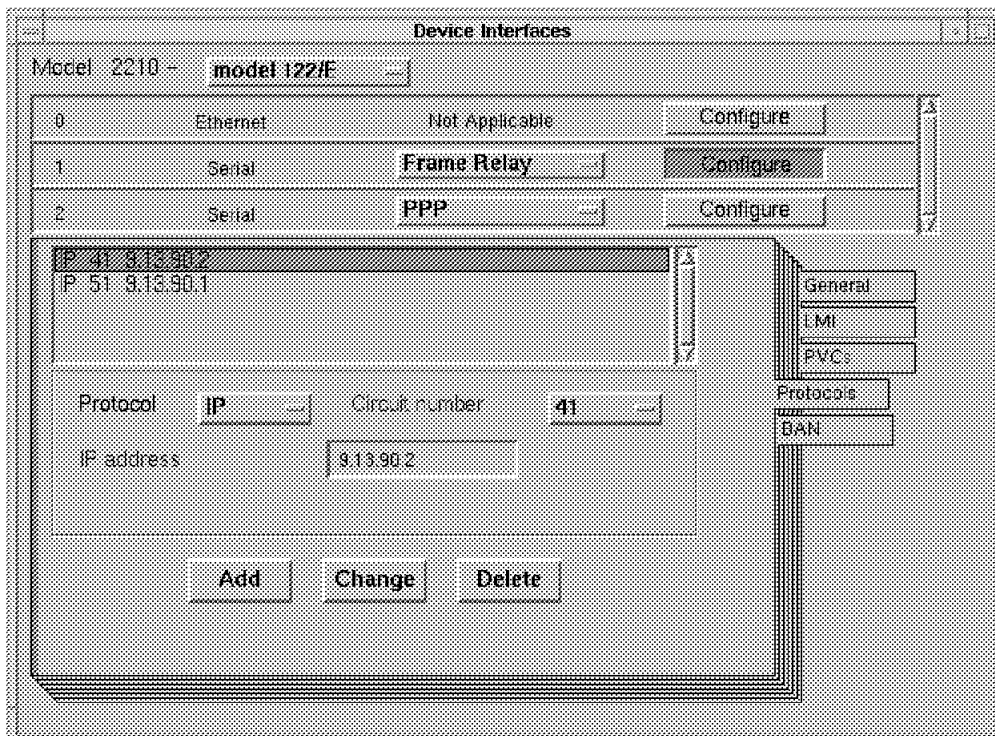
Figure 348. Device Interfaces Frame Relay Protocols

With the current MNRS release, the 2210 cannot use InARP to resolve remote IP addresses (the one on the other side of the DLCIs, the neighbors). So we have to define the DLCI-to-IP address mapping for each defined DLCI. Add this definition for DLCI 41 and 51.

The BAN page is not applicable in our scenario.

B.3.2 IBM 2210 IP General Configuration

On the IP General screen, enter the router internal address and the router ID (used by OSPF to identify the Link State Updates).

Next, you need to define the Ethernet and frame relay interface IP address on the following screens:


```
                              IP General
  ☒ Enabled
  ☐ Enable access control
  ☒ Enable directed-broadcast
  ☐ Enable per-packet-multipath
  Internal address         9.13.67.100
  Routing table size       766
  Cache size               64
  Router ID                9.13.67.100
```
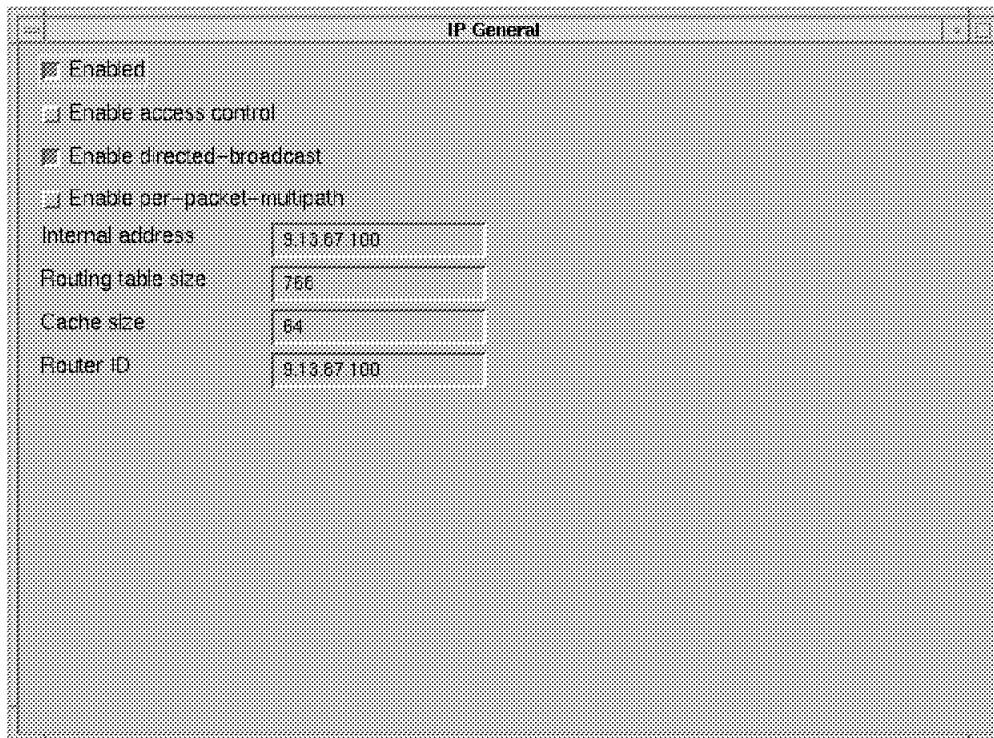
Figure 349. IP Interfaces
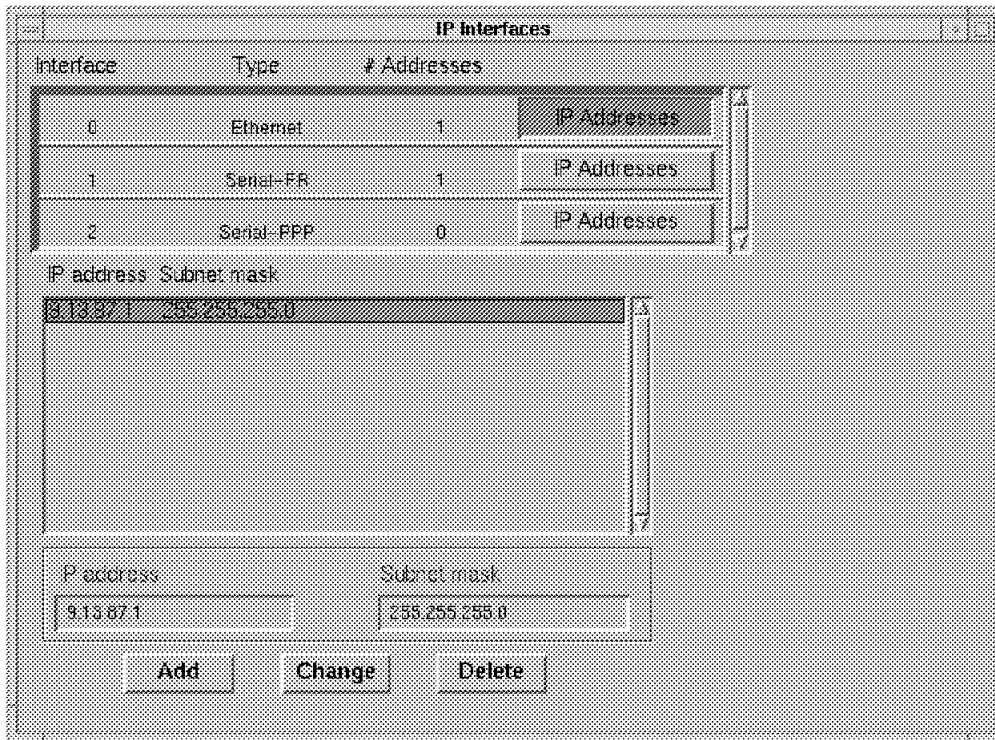
Figure 350. IP Interfaces Ethernet
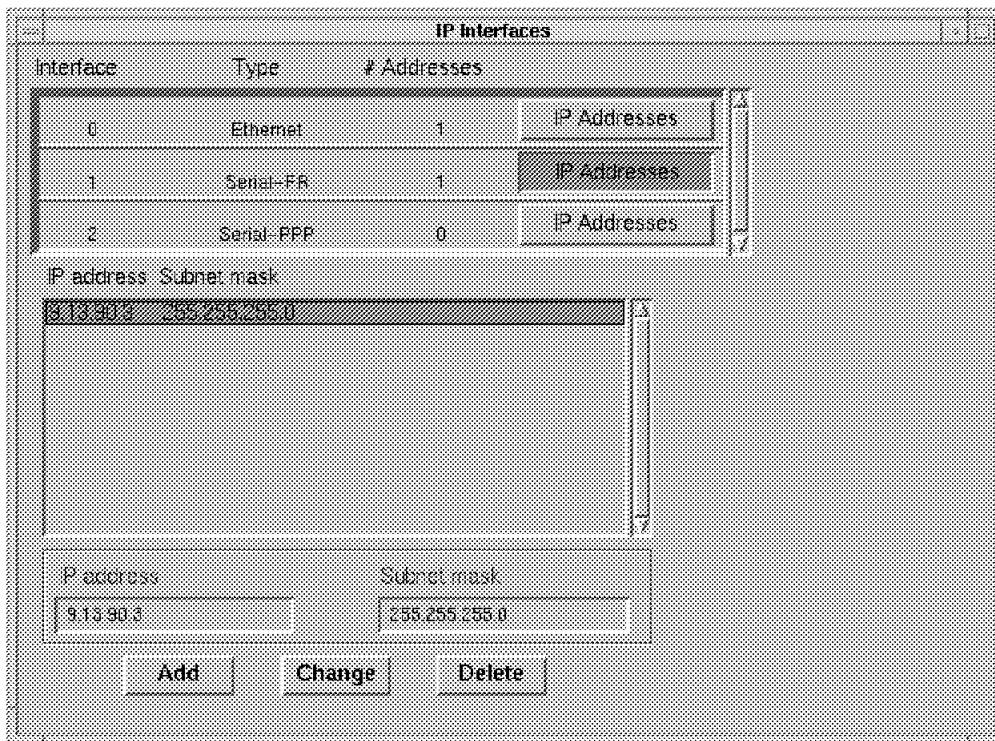
Figure 351. IP Interfaces Serial Frame Relay

B.3.3 IBM 2210 OSPF Configuration

On the following screen, simply enable OSPF:
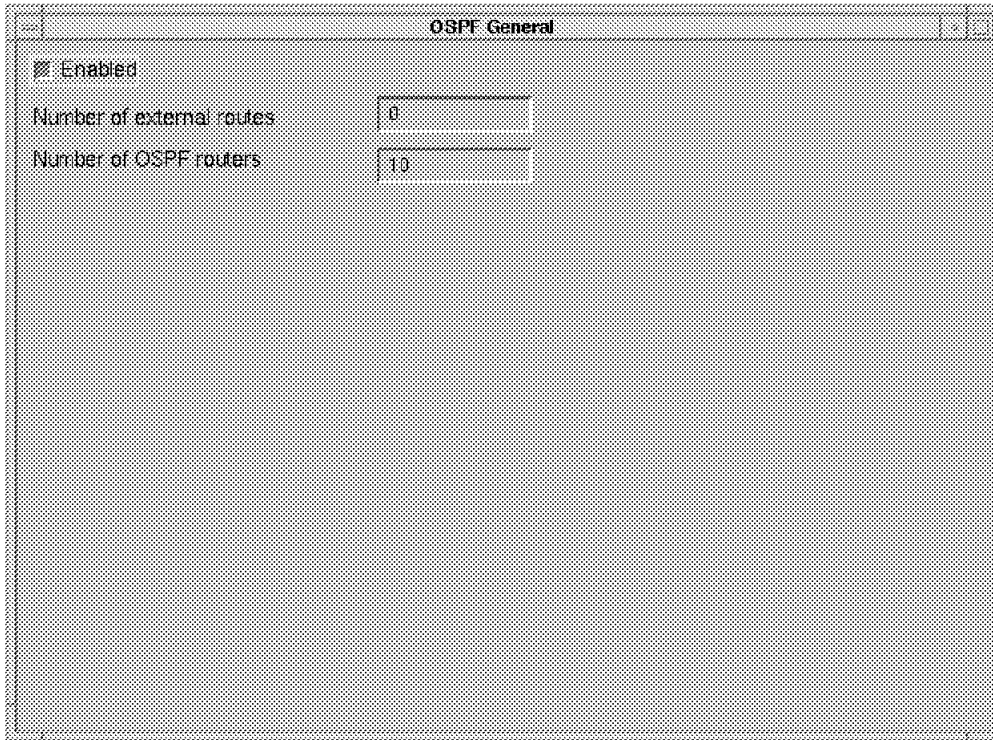
Figure 352. OSPF General Screen
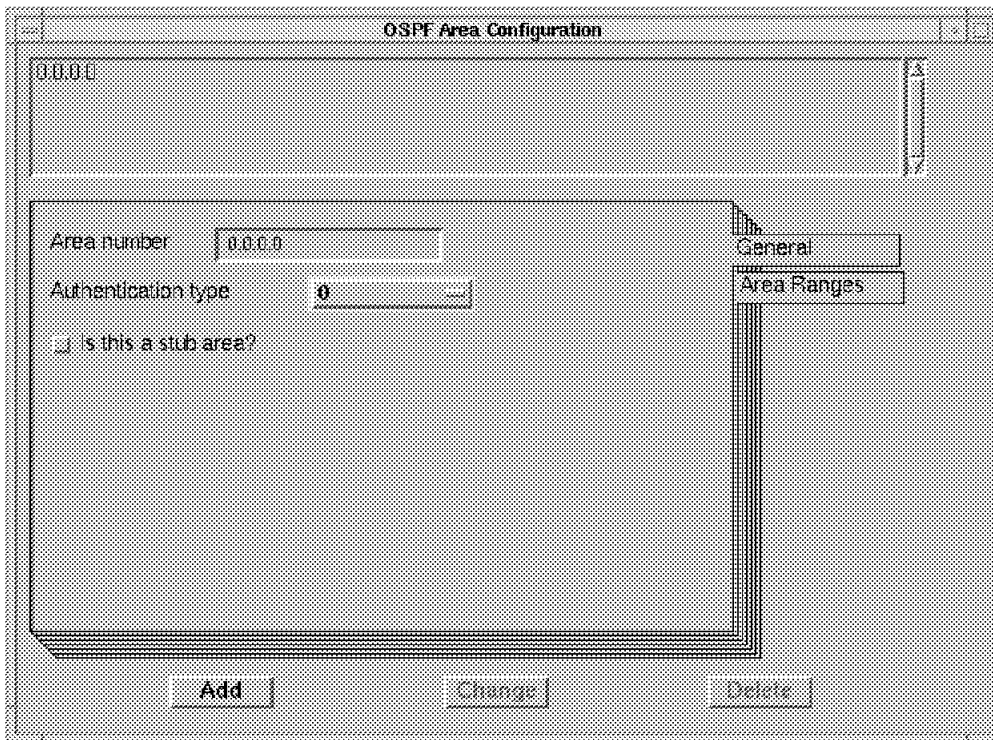
Figure 353. OSPF Area Config General

On this screen, define the router to belong to the backbone area 0.0.0.0. Authentication type 0 says that no authentication will be used in the Hello packets. The Area Ranges page is not applicable in our scenario.

On the OSPF Interfaces screens, you have to configure each interface for OSPF:
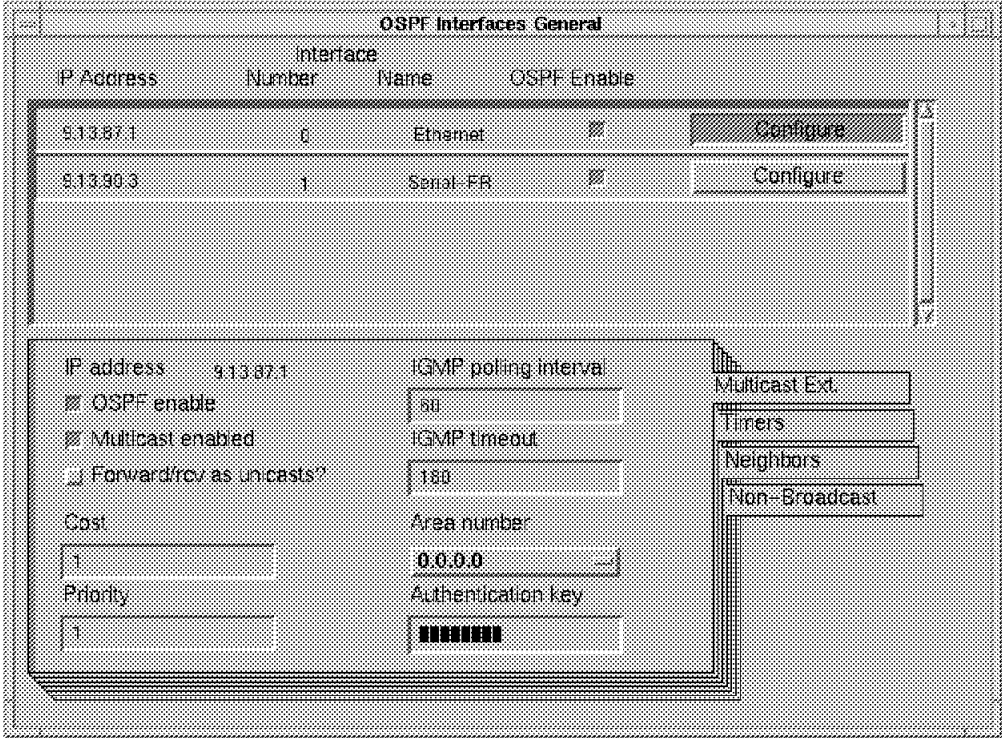
Figure 354. Ethernet Interface OSPF Configuration

Enable OSPF on this interface and set the Area number (0.0.0.0).
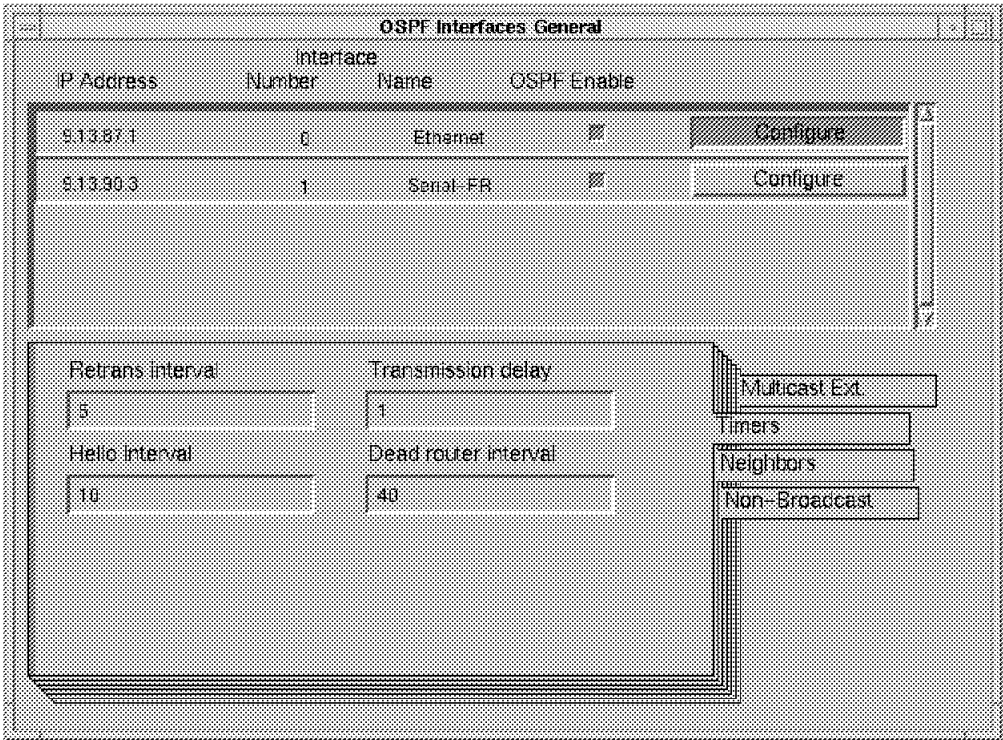
Figure 355. Ethernet Interface OSPF Timers

Let the values default.

Next, configure the OSPF parameters for the frame relay interface:
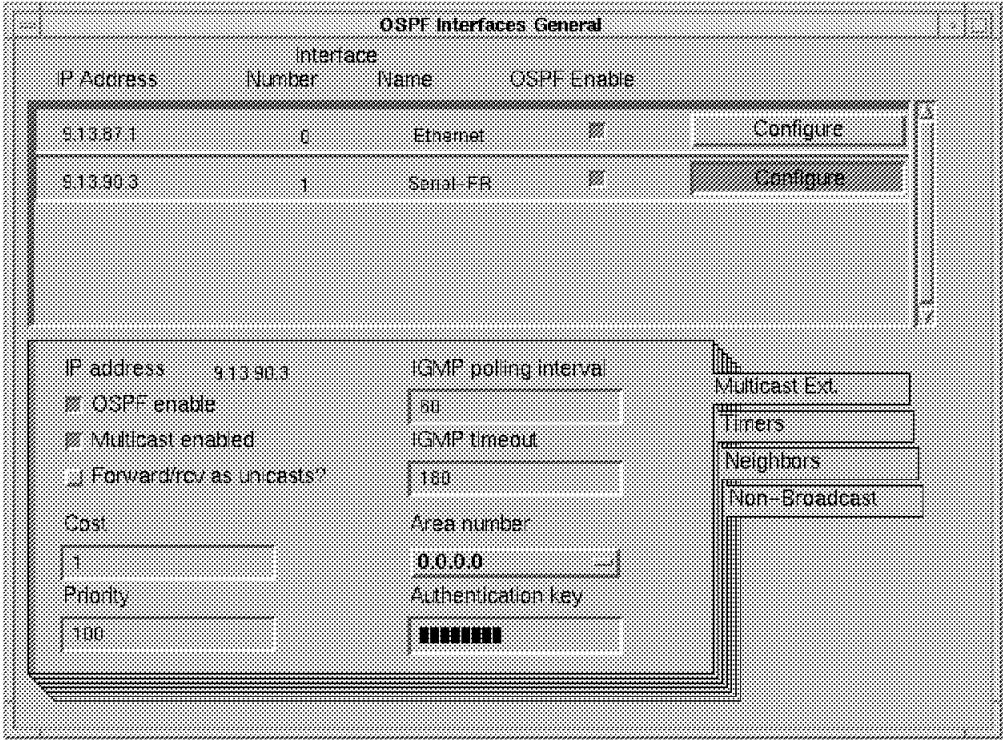
Figure 356. Frame Relay Interface OSPF Configuration

Enable OSPF and set the priority to 100. (We wanted the 2210 to become the designated router.) Also, set the Area number to 0.0.0.0.
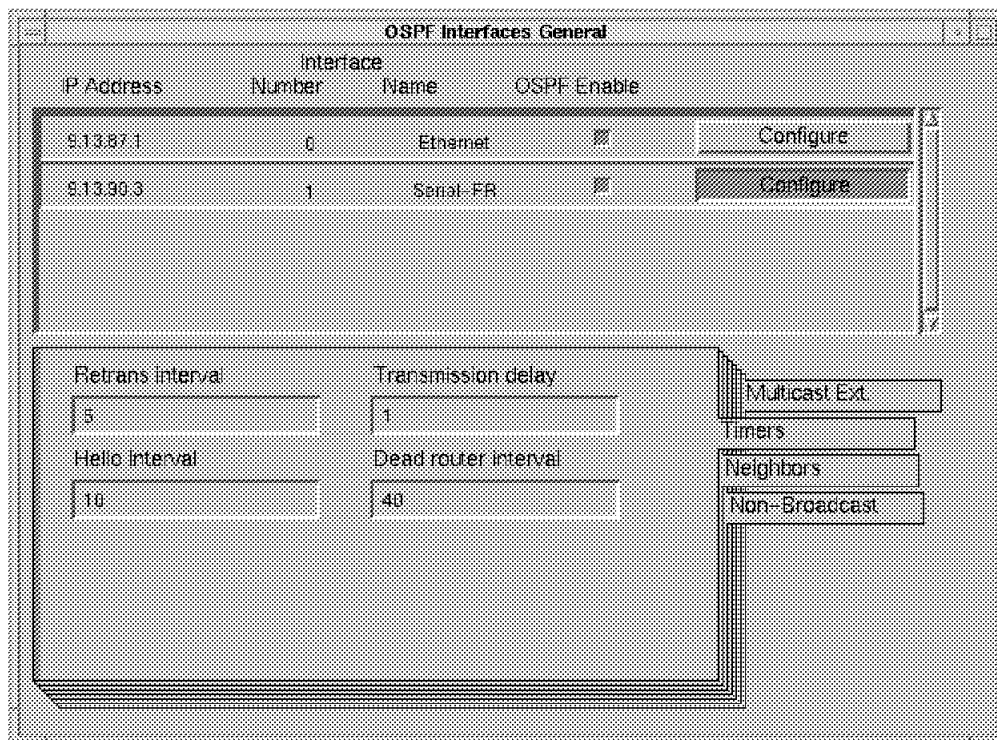
Figure 357. Frame Relay Interface OSPF Timers

Let the times default.
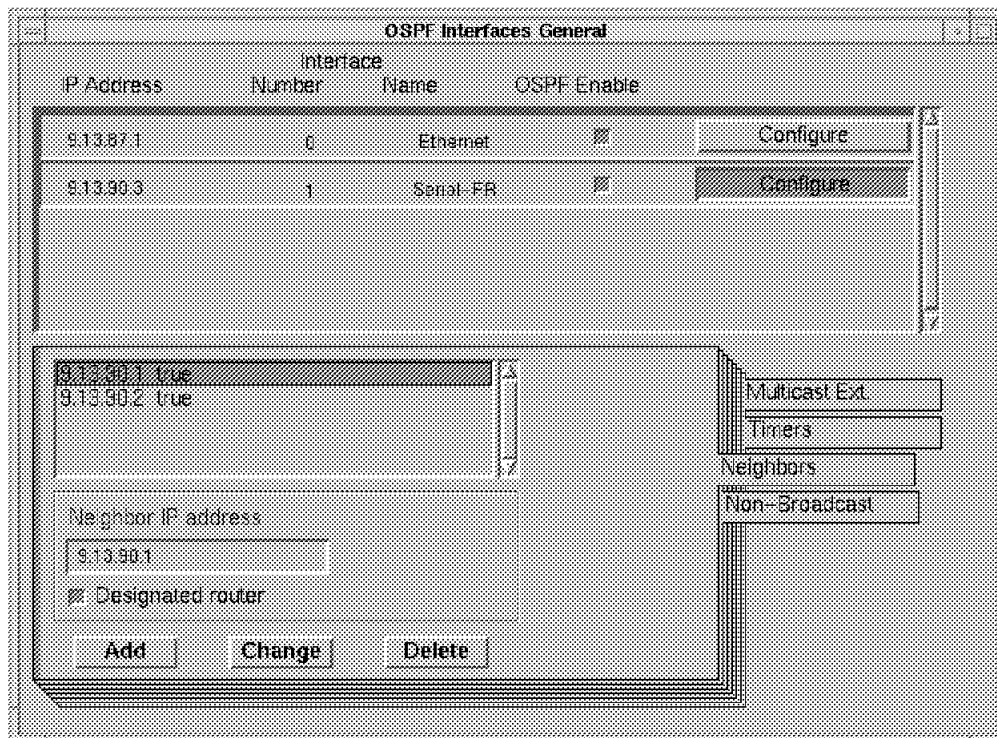
Figure 358. Frame Relay Interface OSPF Neighbors

Because frame relay is a multi-access non-broadcast network, there is no way to broadcast Hello packets on all DLCIs to discover the OSPF neighbors as is the case in a LAN. Therefore, we have to manually configure the list of neighbors. Specify the IP address of the remote 6611 on the other side of the DLCIs.
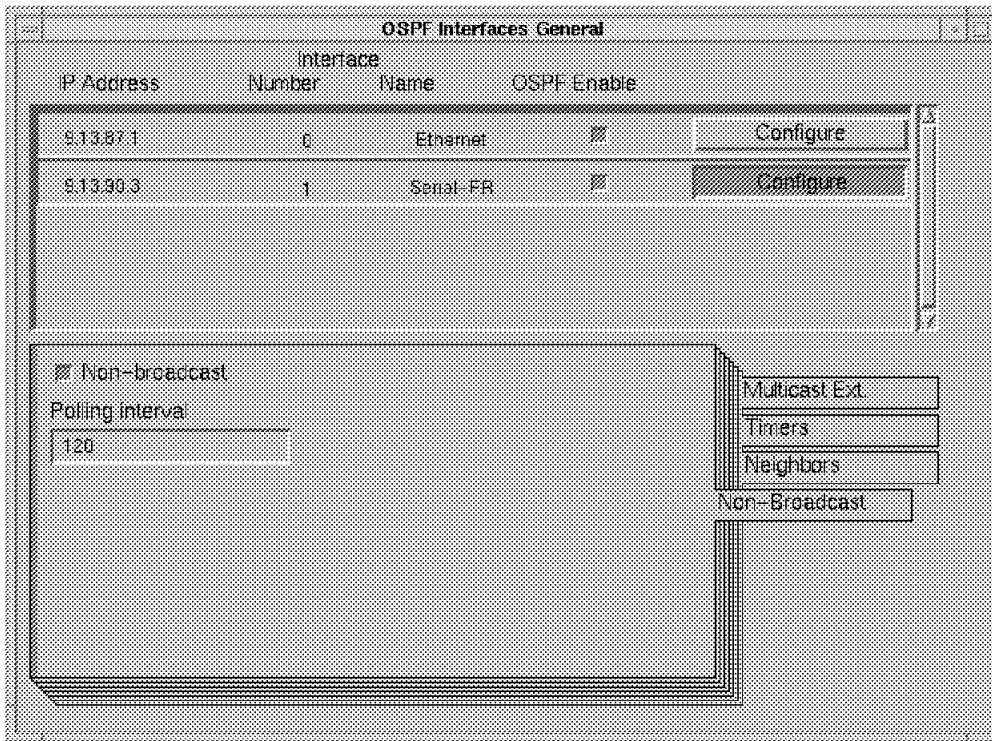
Figure 359. OSPF Interfaces General Serial-FR Non-Broadcast

On the non-broadcast page, enable the Non-broadcast button and let the polling interval default.

This concludes the 2210 configuration.

B.4 IBM 6611-1 Configuration Update

The IBM 6611 config is very similar to the one in scenario 1. In fact, there is only one difference in the configuration. We need to define the additional neighbor IP address for the IBM 2210.
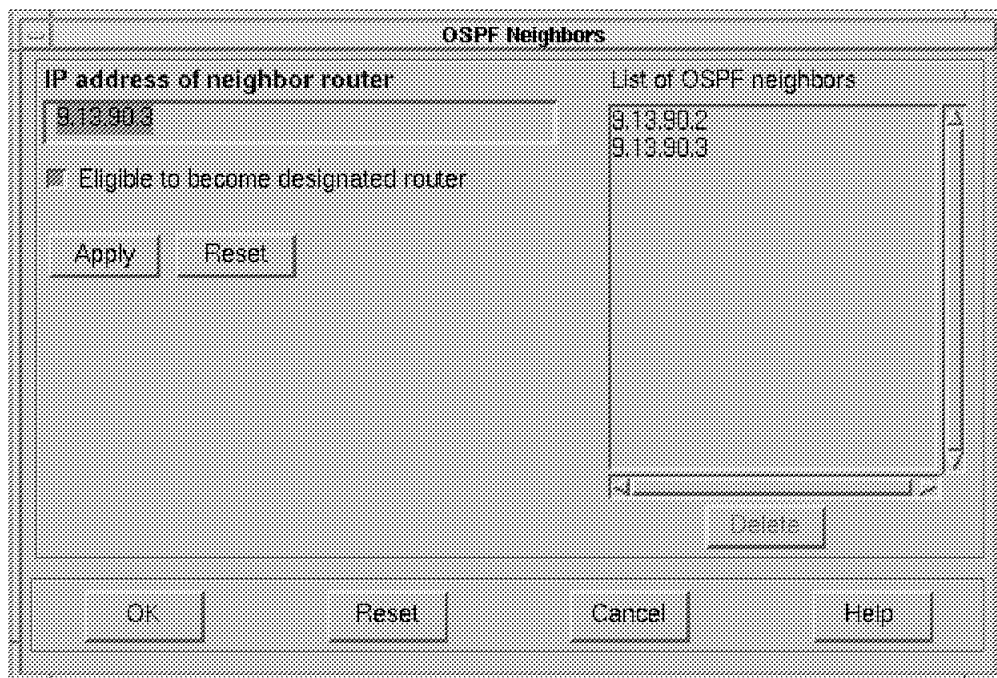
Figure 360. OSPF Neighbor Window

For details on how to get to the above screen, see Appendix A, "Nways Switch Scenario 1" on page 319.

Here is a quick reminder of how to get to this screen:

1. At the initial screen, click on **Node Config**.

2. Click on **OSPF**.

3. Select **Area 0.0.0.0**, then click on **Edit**.

4. Click on **OSPF Interfaces**.

5. Select **FR Interface 9.13.90.1**, then click on **Edit**.

   For 6611-2, select **FR Interface 9.13.90.2**, then click on **Edit**.

6. Click on **OSPF Neighbors**.

7. Enter the new Neighbor IP address 9.13.90.3 for the 2210.

B.5 IBM 6611-2 Configuration Update

The configuration for the 6611-2 is the same as for the 6611-1 so update the 6611-2 accordingly.

Appendix C. IDNX Configuration Scenario 3

This section describes the IDNX trunk and clock configuration.

C.1 IDNX Configuration

It is not the intent of this section to explain in detail how to configure an IDNX. For details please refer to the appropriate IDNX documentation:

- *IBM IDNX Digest*, GA34-0816

- *IBM IDNX Documentation Set*, SR70-3050

However, below is a network scenario that includes IDNXs. We show how an IDNX can be incorporated in an Nways 2220 environment.

For convenience, the drawing of scenario 3 is repeated here:
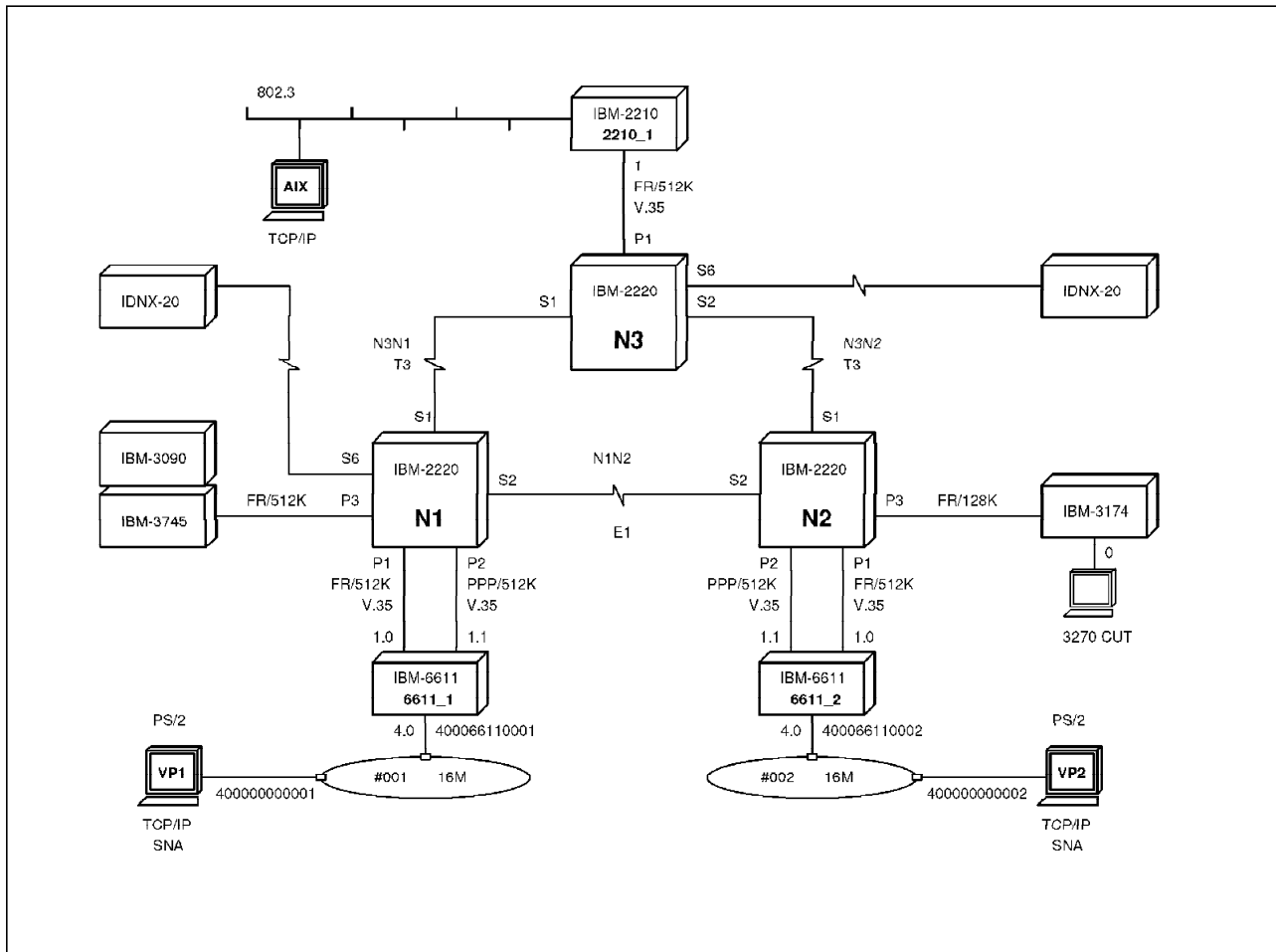
Figure 361. Scenario 3

C.2 Clock Synchronization

When interconnecting IDNXs with Nways Switches, you should understand clock synchronization planning. For more information on clock synchronization please refer to *Just in Time for IDNX and IBM 2220 Clock Synchronization Planning*, GG24-4462. In our example, N1 is the clock master. N3 will derive the clock from the trunk attached to N1. The IDNXs derive their clock from the trunks attached to the Nways Switches.
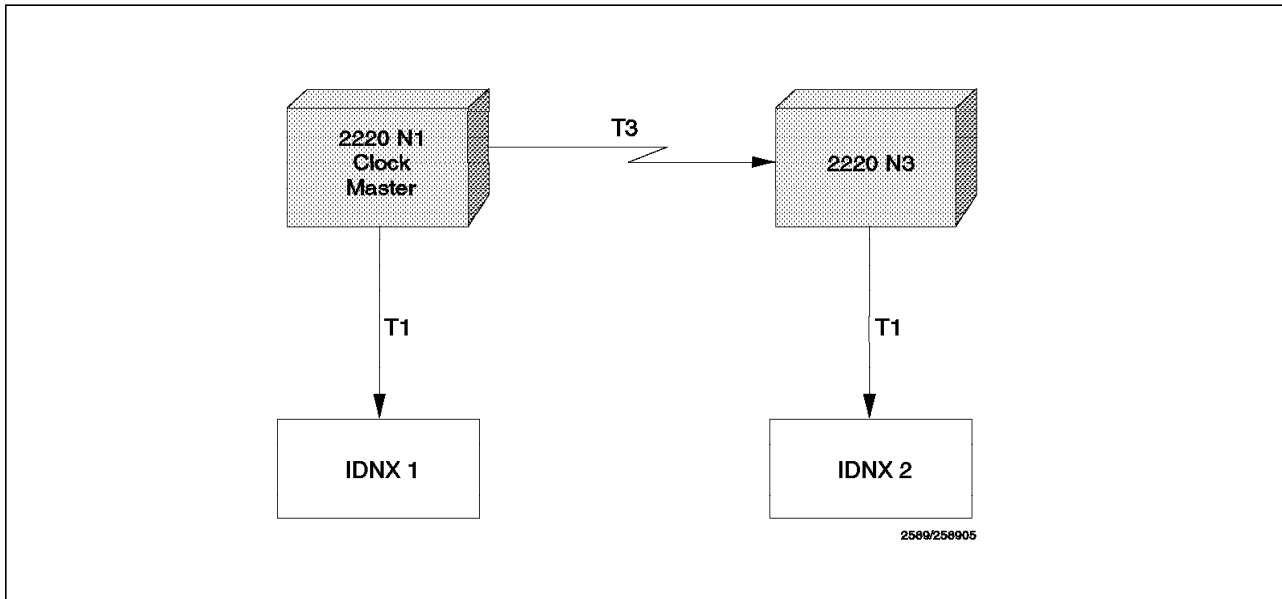
Figure 362. Clock Synchronization Plan

C.2.1 IDNX1 Trunk Definition

```
    *** CONFIGURATION PARAMETERS FOR TRK-2 CARD N1C2 ***
    [ 0]  NEIGHBOR NODE =   2(IDNX2)
    [ 1]  SAT/TERR = TERRESTRIAL
    [ 2]  ENCRYPTION = NOT ENCRYPTED
    [ 3]  REDUNDANT CARD = **NONE**
    [ 5]  ZERO SUPPRESSION = BW EFF ZERO SUPP
    [ 6]  ALARM WAIT TIME = 4 SECONDS
    [ 7]  ALARM PERCENTAGE = 100 PERCENT
    [ 8]  FIBER OPTION = NO
    [10]  BER REPORT INTERVAL = 30 MINUTES
    [11]  HIBER REPORT THRESHOLD = 10E-4
    [14]  AUX ALARM POLARITY = LOW
    [15]  CLK REF SELECT: 0
    [16]  LOOP TIMEOUT = 0 SECONDS
```

C.2.2 IDNX1 Node Definition

```
    *** NODE 1 CONFIGURATION PARAMETERS ***
    [ 0]  NODE NAME: IDNX1
    [ 1]  TIME ZONE: GMT
    [ 2]  DAYLIGHT SAVINGS TIME DOES NOT APPLY TO TIME ZONE.
    [ 4]  NETWORK EVENT LOG NODES:  0(NONE),  0(NONE)
    [ 5]  REFERENCE CLOCK SOURCES:   0    1
                         PRIORITY:   1
                           TIMING:  NET
```

```
                                   CARD:    2
          [ 6]   MAXIMUM CALLS = 512
          [ 7]   MAXIMUM HOPS PER CALL = 12
          [ 8]   MAXIMUM CALL SETUP RETRIES = 8
          [ 9]   MAXIMUM SATELLITE HOPS = 1
          [10]   STATISTICS REPORTING INTERVAL = 60 MINUTES
          [11]   CALL DETAIL RECORDING = ENABLED FOR VOICE AND DATA
          [12]   RECONNECT TIMEOUT = 10 SECONDS
          [13]   PREEMPT CONTROL = 0 HOPS
          [14]   PREFERRED SOFTWARE VERSION: NONE
          [15]   SYNC RETRY TIME = 30 SECONDS
          [16]   COUNTRY: U.S.A.
```

C.2.3 IDNX2 Trunk Definition

```
          *** CONFIGURATION PARAMETERS FOR TRK-2 CARD N2C2 ***
          [ 0]   NEIGHBOR NODE =    1(IDNX1)
          [ 1]   SAT/TERR = TERRESTRIAL
          [ 2]   ENCRYPTION = NOT ENCRYPTED
          [ 3]   REDUNDANT CARD = **NONE**
          [ 5]   ZERO SUPPRESSION = BW EFF ZERO SUPP
          [ 6]   ALARM WAIT TIME = 4 SECONDS
          [ 7]   ALARM PERCENTAGE = 100 PERCENT
          [ 8]   FIBER OPTION = NO
          [10]   BER REPORT INTERVAL = 30 MINUTES
          [11]   HIBER REPORT THRESHOLD = 10E-4
          [14]   AUX ALARM POLARITY = LOW
          [15]   CLK REF SELECT: 0
          [16]   LOOP TIMEOUT = 0 SECONDS
```

C.2.4 IDNX2 Node Definition

```
          *** NODE 2 CONFIGURATION PARAMETERS ***
          [ 0]   NODE NAME: IDNX2
          [ 1]   TIME ZONE: GMT
          [ 2]   DAYLIGHT SAVINGS TIME DOES NOT APPLY TO TIME ZONE.
          [ 4]   NETWORK EVENT LOG NODES:   0(NONE),   0(NONE)
          [ 5]   REFERENCE CLOCK SOURCES:    0    1
                                  PRIORITY:    1
                                    TIMING:  NET
                                      CARD:    2
          [ 6]   MAXIMUM CALLS = 512
          [ 7]   MAXIMUM HOPS PER CALL = 12
          [ 8]   MAXIMUM CALL SETUP RETRIES = 8
          [ 9]   MAXIMUM SATELLITE HOPS = 1
          [10]   STATISTICS REPORTING INTERVAL = 60 MINUTES
          [11]   CALL DETAIL RECORDING = ENABLED FOR VOICE AND DATA
          [12]   RECONNECT TIMEOUT = 10 SECONDS
          [13]   PREEMPT CONTROL = 0 HOPS
          [14]   PREFERRED SOFTWARE VERSION: NONE
          [15]   SYNC RETRY TIME = 30 SECONDS
          [16]   COUNTRY: U.S.A.
```

C.2.5 IDNX Trunk Backcard Switches

Note that the T1 interface card has DIP switches. For the details of the switches, please consult the IDNX trunk manual. The switch setting must reflect what is defined in the software for that trunk; otherwise the function has no effect. The parameters to pay attention to are:

- ZERO SUPPRESSION = BW EFF ZERO SUPP (BEZS)
- CLK REF SELECT: 0

Note that zero suppression must be set to BEZS in order to be compatible with the Nways Switch.

Switch setting for switch block 1 for CLK REF 0 if you have a TRK-2 front card:

- SW1=on
- SW2=on
- SW3=on
- SW4=off

For a TRK front card:

- SW1=on
- SW2=off
- SW3=on
- SW4=off

Switch block 2 refers to BEZS/MBZS. For BEZS, all switches must be in the off position.

Appendix D. Special Notices

This publication is intended to help customers and IBM systems engineers or networking specialists who evaluate, install and implement the IBM Nways 2220 network. The information in this publication is not intended as the specification of any programming interfaces that are provided by the IBM Nways BroadBand Switch Release 4.4, Nways BroadBand Switch Control Program Version 2, Release 3, and the IBM Nways Switch Manager for AIX Version 2. See the PUBLICATIONS section of the IBM Programming Announcement for IBM Nways BroadBand Switch Release 4.4 and the IBM Nways Switch Manager for AIX Version 2 for more information about what publications are considered to be product documentation.

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Appendix E. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

E.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see "How to Get ITSO Redbooks" on page 371.

- *IBM 2220 Nways Switch: Concepts and Products,* SG24-4307
- *IBM Frame Relay Guide*, GG24-4463
- *Using the Nways 2220 Performance Tools*, SG24-5304
- *NBBS Architecture Tutorial*, GG24-4486
- *Asychronous Transfer Mode (ATM) Technical Overview*, SG24-4625
- *Just in Time for IDNX and IBM 2220 Clock Synchronization Planning*, GG24-4462
- *2220 in the Voice World*, SG24-2123

E.2 Redbooks on CD-ROMs

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E.3 Other Publications

These publications are also relevant as further information sources:

- *2220 Nways BroadBand Switch At a Glance, an Overview*, GA33-0292
- *2220 Nways BroadBand Switch Planning Guide*, GA33-0293
- *2220 Nways BroadBand Switch Managing the Accounting and Performances Monitoring*, GA33-0366
- *2220 Nways BroadBand Switch Physical Lines Interfaces Specifications*, GA33-0379
- *2220 Nways BroadBand Switch ATM Interface Specifications*, GA33-0378
- *2220 Nways BroadBand Switch HDLC Interface Specifications*, GA33-0375

- *2220 Nways BroadBand Switch CES Interface Specifications*, GA33-0376

- *2220 Nways BroadBand Switch Frame-Relay Interface Specifications*, GA33-0374

- *2220 Nways BroadBand Switch X.25 Interface Specifications*, GA33-0413

- *2220 Nways BroadBand Switch Setup Guide*, SY33-2105

- *2220 Nways BroadBand Switch Service Guide*, SY33-2106

- *2220 Nways BroadBand Switch Safety*, GA33-0401

- *IBM Nways Enterprise Manager Installation Guide*, SH11-3086

- *ATM Switch-on-a-Chip*, G325-3512

- *IBM IDNX Digest*, GA34-0816

- *IBM IDNX Documentation Set*, SR70-3050

- *NetView for AIX V4R1 Installation and Configuration*, SC31-8163

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List of Abbreviations

APC	Alarm and Power Control	NBBS	Networking BroadBand Services
ATM	Asynchronous Transport Mode	NCT	Network Configuration Tool
CAS	Channel Associated Signaling	NDPS	Non Disruptive Path Switching
BECN	Backward Explicit Congestion Notification	NMS	Network Management Station
		NRZI	Non Return to Zero Inversion
CCS	Common Channel Signaling	NAS	Nways Administration Station
CES	Circuit Emulation Service	NMS	Network Management Station
CCS	Change Control Server	OSPF	Open Shortest Path First
DCD	DC Distribution	PCM	Pulse Code Modulation
DLCI	Data Link Connection Identifier	PPP	Point to Point Protocol
DTE	Data Terminal Interface	PCO	Potential Connection
FECN	Forward Explicit Congestion Notification	PNIC	Private Numbering Identifier Code
FEP	Front End Processor	PNP	Private Numbering Plan
HDLC	High Level Data Link Control	QOS	Quality of Service
HSA	High Speed Adapter	SNMP	Simple Network Management Protocol
HSSI	High Speed Serial Interface	TDU	Topology Database Update
IBM	International Business Machines Corporation	TDM	Time Division Multiplexing
IDNX	Integrated Digital Network eXchange	TPA	Trunk/Port Adapter
		VC	Virtual Circuit
ITSO	International Technical Support Organization	VCN	Virtual Circuit Number
		VCO	Virtual Connection
LIC	Line Interface Coupler	VPD	Vital Product Data
LMI	Local Management Interface	VSA	Voice Server Adapter
LSA	Low Speed Adapter		

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