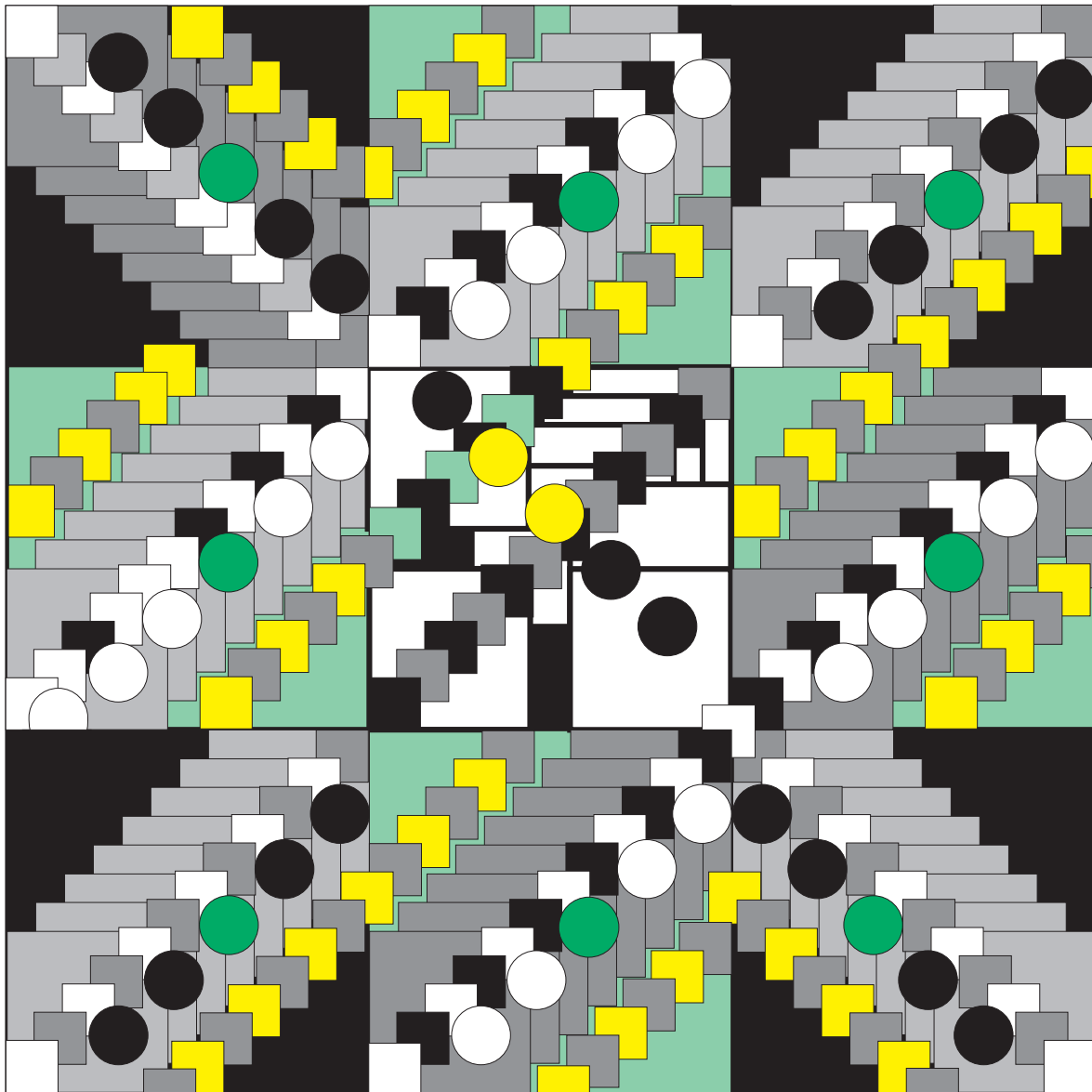2220 Nways BroadBand Switch
Models 300, 500, and 501

Planning Guide

2220 Nways BroadBand Switch
Models 300, 500, and 501

Planning Guide

IBM

> **Note!**
>
> Before using the information in this book and the product it describes, be sure to read Notices in *2220 Nways BroadBand Switch Physical Lines Interface Specifications, External Cable References, GA33-0379*.

Contents

Figures

Tables

About This Guide

The *2220 Nways BroadBand Switch Planning Guide* contains information that refers
to IBM 2220 Nways BroadBand Switches Model 300, Model 500, and Model 501
used to build broadband networks that implement the IBM Networking BroadBand
Services (NBBS). Use this book to gather the necessary planning information to
install, configure, and build an NBBS network using Nways Switches.

The Planning Guide also describes the information that you need to provide to your
IBM service representative and network specialists who install Nways Switches,
including:

* An overview of planning tasks
* Description of Nways Switch hardware
* Network layout
* Network management and administration
* Maintenance
* Ordering
* Configuration
* Installation preparation
* Model migration.

This guide does not include:

* Details of network design. Only general guidelines are provided. Your IBM branch
  office can help you with problems that may arise from specific network needs.
* Basic planning and installation information for mandatory non-Nways Switch
  products, such as:
  – IBM AIX
  – IBM Netview for AIX
  – IBM NetView Distribution Manager for AIX
  – IBM NetView Distribution Management Agent/6000.

Who Should Use This Guide

This guide is intended for teleprocessing specialists, system programmers, network
administrators, and network specialists responsible for preparing the information
required for installing and integrating an Nways Switch in the network.

The prerequisite knowledge and training depends on the task to be performed. For
example, network operators that work on the network management station (NMS) or
the change control server (CCS) must be familiar with how to use the following IBM
hardware and software products:

* IBM RISC System/6000, POWERstation, or POWERserver
* IBM AIX/6000 operating system

- IBM NetView for AIX
- IBM NetView Distribution Manager for AIX
- IBM NetView Distribution Management Agent/6000 (NetView DMA/6000).

Ntwork operators using an Nways Switch configuration station should be familiar with how to use the IBM OS/2 program running on an IBM PS/2 workstation (or equivalent) or the AIX/6000 operating system running on a RISC System/6000.

How This Guide Is Organized

This guide is divided into the following parts, chapters, and appendixes:
- Part 1. Before You Start provides overview information that you should read before planning your 2220 network.

    Chapter 1. Planning and Installation Tasks gives an overview of the steps to follow to plan network connections and summarizes the planning and installation tasks.

    Chapter 2. Nways Switch Hardware provides information about how to configure different Nways Switch models and lists the features available for each model.
- Part 2. Planning Your Network provides planning information needed at the network level.

    Chapter 3. Network Topology and Bandwidth Requirements describes how to design your network topology and evaluate bandwidth requirements.

    Chapter 4. Internet Protocol Addressing and Control Point Spanning Tree describes how IP addresses are used in a 2220 network and how to plan your IP addressing.

    Chapter 5. Network Synchronization defines the requirements for network synchronization and describes how to prepare a network synchronization plan.
- Part 3. Planning Network Management and Administration describes how to plan and perform network management, administration, and maintenance tasks.

    Chapter 6. Network Management Station describes 2220 network management facilities and how to plan the setup of network management stations.

    Chapter 7. Code Distribution and Updates describes how to plan a code distribution strategy for your network using NetView Distribution Manager for AIX.

    Chapter 8. Remote User Console describes how to set up and use remote consoles in a 2220 network.

    Chapter 9. Network Security describes the passwords and authorizations used to access network management facilities.

    Chapter 10. Nways Switch Maintenance describes the information you must prepare before contacting a Remote Support Center to maintain Nways Switches.
- Part 4. Ordering Nways Switch Hardware and Software describes how to order Nways Switches for your 2220 network from IBM and the lines used to connect to the 2220 network from carriers.

    Chapter 11. Ordering from IBM describes the hardware and software information that you must provide to order an Nways Switch.

Chapter 12. Ordering Communication Facilities from Common Carriers describes the information that you must provide to order lines from a carrier.

- Part 5. Planning for Installation describes how to physically install an Nways Switch and connect it to external lines.

    Chapter 13. Site Preparation provides physical machine specifications and cable routing information to prepare your site.

    Chapter 14. Planning for Model Migration and Feature Installation provides information, such as configuration modification and possible machine down-time, for planning a model migration.

- The following information is included at the back of this guide:
    - Glossary, on page 133.

    - Bibliography on page 143. Refer to the listed documentation to find more information about the 2220 Nways Switch.

    - Index, on page 151.

What's New in This Book

Note: The section, Planning for Configuration, has been moved to the *IBM 2220 Nways Broadband Switch Configuration Guide* (GA33–0474). This section describes how to use the Nways Switch Configuration Tool Version 2 (NCT2) to configure your 2220 network.

The following functions are new or have changed in Nways Switch products since the last edition of this book.

Nways 2220 Switch Manager for AIX

The IBM Nways 2220 Switch Manager (2220 Switch Manager) Version 1 is available and replaces IBM Nways Enterprise Manager (NEM). Router and Bridge Manager (RABM) that was a part of NEM is now a part of Nways Manager LAN.

This release of 2220 Switch Manager provides new functions that allow you to:
- Use Nways Switch Control Program V2R2, V2R1, and V1R5
- Import and export of Nways Switch configuration files from 2220 Switch Manager using NetView and the AIX command line
- Manage how the status of 2220 nodes and failing resources in a node are graphically displayed
- View progress messages during network discovery
- Use 2220 Switch Manager to manage two levels of Nways Switch Control Program code from a network management station.
- Translate alarms into SNMP traps
- Reset adapters using AIX command scripts
- Activate trunk lines using AIX command scripts
- List all trunks for a given 2220 node using AIX command scripts.

2220 Nways Switch Control Program

The Nways Switch Control Program Version 2 Release 2 (V2R2) provides the following new functions:

- Frame Relay over ISDN allows Frame Relay Data Terminating Equipment (DTE) to access 2220 Frame Relay ports through an ISDN dial-up connection.
- ISDN Trunk Backup allows you to define backup trunk lines over a Euro-ISDN network and set up temporary trunk lines that can be activated when more bandwidth is required in your 2220 network.
- ATM Bearer Service provides a cost-effective way to interconnect Nways Switches by splitting a physical ATM line interface into several NBBS trunks and mapping the trunks over ATM Virtual Paths (VPs) of an ATM service provider.
- The treatment of non-reserved Frame Relay and ATM traffic has been enhanced so that destination devices are notified of congestion conditions in the network. A warning is usually sent to the source device so that it can reduce its data transmission.

  For non-reserved ATM traffic, ATM Available Bit Rate (ABR) Explicit Forward Congestion Indication (EFCI) is supported. Early Packet Discard (EPD) is supported on Virtual Circuit (VC) connections. EPD-like support is provided on Virtual Path (VP) connections.
- Non-disruptive path switching (NDPS) is enhanced with parallel NBBS trunks that ensure continued network availability in case of trunk failure.

2220 Hardware Features

- In order to use the Euro-ISDN trunk backup function, the line interface coupler type 563 (LIC563) is required.

Part 1. Before You Start

Chapter 1. Planning and Installation Tasks

This chapter provides the following information:

- The procedure to follow to plan your 2220 network
- The tasks that you and IBM perform when installing 2220 Nways Switches.

Planning Your 2220 Network

To plan your 2220 network, proceed as follows:

1. Make an inventory of all the devices that you want to attach to your 2220 network and their traffic needs. Refer to "Chapter 3. Network Topology and Bandwidth Requirements" on page 37 for more information.

2. Create a numbering plan to uniquely identify all resources in the network. Refer to "Naming Conventions" on page 37 for more information.

3. Create a connection matrix that lists all possible connections that you want to establish.

4. Define the characteristics of each (potential) connection.

5. Place your order and request the ordering system report from your IBM representative. There is one report per Nways Switch. You use this report with the line characteristics obtained from your carrier to prepare the configuration of the following resources:

   a. Adapters, attached LICs, and line attachments

   b. Control point

   c. Clock used in your network synchronization plan

   d. Quality of Service (QoS) parameters

   e. Logical ports and trunks.

6. Finish your connection plan by allocating physical and logical resources to each potential connections.

Items 4 and 5 are documented in the *2220 Configuration Guide.* Although you are responsible for planning the network design, IBM offers assistance if needed. See "Evaluating Network Topology" on page 37 for more information.

Network Installation Tasks

The 2220 network installation tasks performed by you are documented in *2220 Network Installation and Migration* available from your IBM representative.

The 2220 Nways Switch installation tasks performed by IBM are documented in the *2220 Nways BroadBand Switch Setup Guide*, SY33-2105 (P/N 59G0544) that is delivered with the Nways Switches.

Table 1 on page 4 lists the different tasks performed before and during the installation of your network and shows:

- What tasks you must perform before and during installation.
- What tasks IBM performs during the installation.

Table 1. 2220 Network Installation Tasks

Task	Before Installation	During Installation	
	You	You	IBM
Installing the Nways Switch configuration station under OS/2			
Installing the workstation	✔		
Installing OS/2	✔		
Installing DB2	✔		
Installing TCP/IP and configuring	✔		
Installing the Nways Switch Configuration Tool (NCT2)	✔		
Installing the Nways Switch configuration station under AIX			
Installing the RISC System/6000 workstation	✔		
Installing AIX	✔		
Installing DB/6000	✔		
Installing TCP/IP	✔		
Installing NCT2 for AIX 4.2			
Task 1: Preparing Nways Switch configurations			
Entering configuration parameters, exporting configuration files, and distributing to each Nways Switch	✔		
Task 2: Installing the change control server			
Installing the RISC System/6000 workstation	✔		
Installing AIX	✔		
Installing NetView Distribution Manager for AIX or TME10 Software Distribution Manager	✔		
Preparing the software data base	✔		
Installing other change control servers, if necessary	✔	✔	
Task 3: Installing the network management station (on the same or different RISC System/6000 as the change control server)			
Installing the RISC System/6000 workstation, if necessary	✔		
Installing AIX, if necessary	✔		
Installing NetView for AIX or TMN/6000, if necessary	✔		
Installing Nways 2220 Switch Manager	✔		
Installing other network management stations, if necessary	✔	✔	
Task 4: Preparing Nways Switch sites and cables			
Providing the power sources	✔		
Preparing the raised floors, if necessary (raised floor is not mandatory)	✔		
Installing or modifying the air conditioning system	✔		
Building external cables, if necessary	✔		
Labelling and installing the external cables	✔		

Table 1. 2220 Network Installation Tasks (continued)

Task	Before Installation	During Installation	
	You	**You**	**IBM**
Task 5: Installing Nways Switches			
Installing the racks, Nways Switch administration station (NAS), and modem			✔
Connecting to the power supplies			✔
Testing the Nways Switch locally			✔
Connecting to the external cables			✔
Running the Nways Switch Installation Program to configure the machine and import the configuration file.			✔
Connecting to the Network Support Center and testing the connection.			✔
Updating the Control Program, if required		✔	
Task 6: Activating Nways Switches			
Restarting the Nways Switch		✔	
Connecting to the network management station and testing the connection		✔	
Connecting to the change control server and testing the connection		✔	
Testing the end-user to end-user connections		✔	
Installing user remote consoles, if any		✔	

Chapter 2. Nways Switch Hardware

This chapter describes the hardware features of the 2220 Nways Switch and provides instructions on how to configure the hardware.

2220 Nways Switch Models

The following models of the IBM 2220 Nways Switch are available:

- 300
- 500
- 501 (Model 500 expansion).

Each Nways Switch model is installed in a 19-inch rack (see Figure 1). Some components of the Nways Switch are accessed from the front, such as adapters; others are accessed from the rear, such as line interface couplers (LICs).
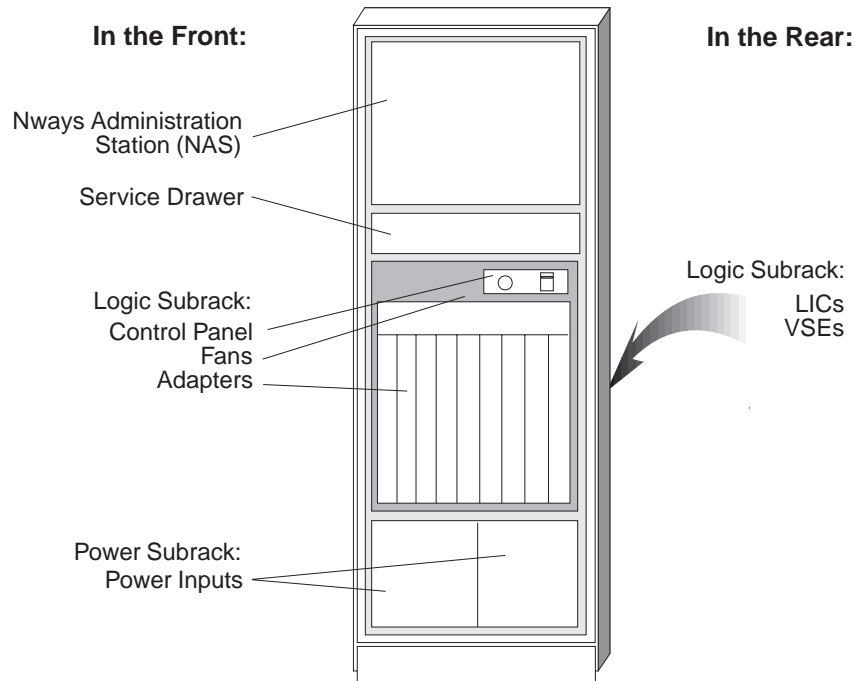
Figure 1. 2220 Nways Switch Model 300 or 500

Rack, Slot, and Position

When configuring an Nways Switch physical resource, the **rack** parameter indicates the 2220 Model. *Rack A* is the 2220 base frame (Model 300 or 500), *rack B* is the expansion frame (Model 501).

Front View (Adapter Side)

2220-500 (Rack A)   2220-501 (Rack B)

NAS ——→

Display

Control
Panel ——→

Service Drawer

Logic
Subrack ——→

Fan 2 | Fan 1

Fan 2 | Fan 1

Slots
1 to 12 ——→

Power
Subrack ——→

| Power Input 2 | Power Input 1 | Power Input 2 | Power Input 1 |
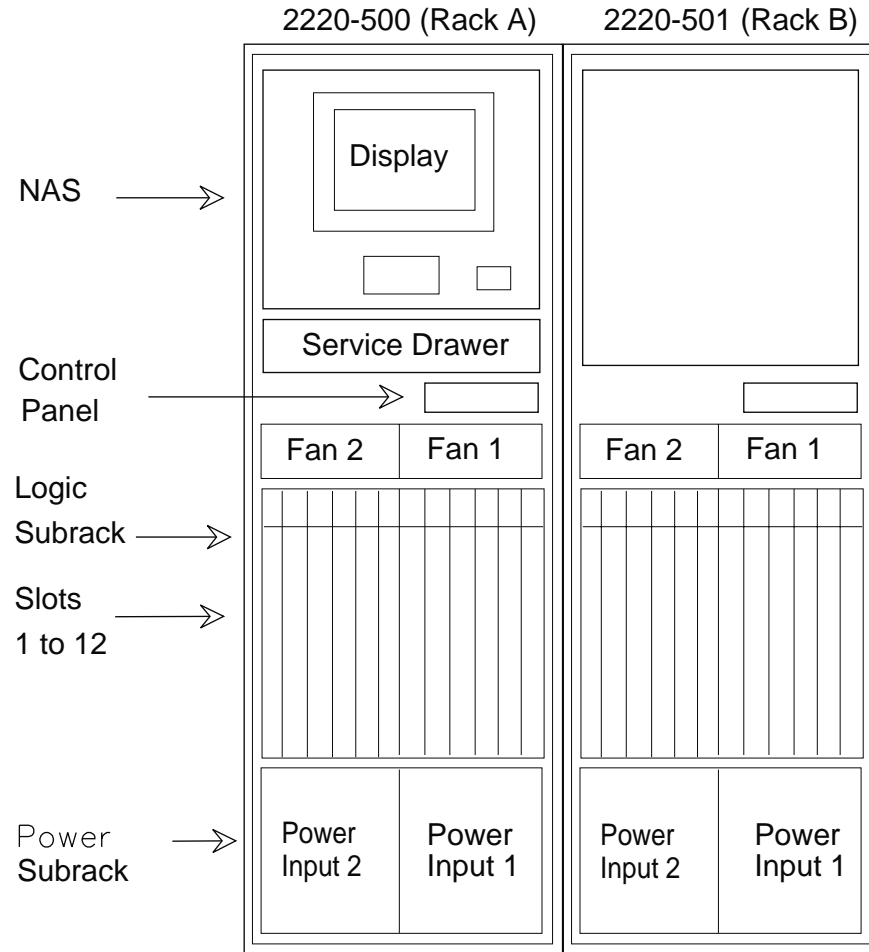
Figure 2. 2220 Models 500 and 501 (Racks A and B)

The **slot** parameter indicates the module location (1 to 12) in the logic subrack.

The **position** parameter indicates the line attachment number on the LIC module (1 to 8, depending on the LIC type).
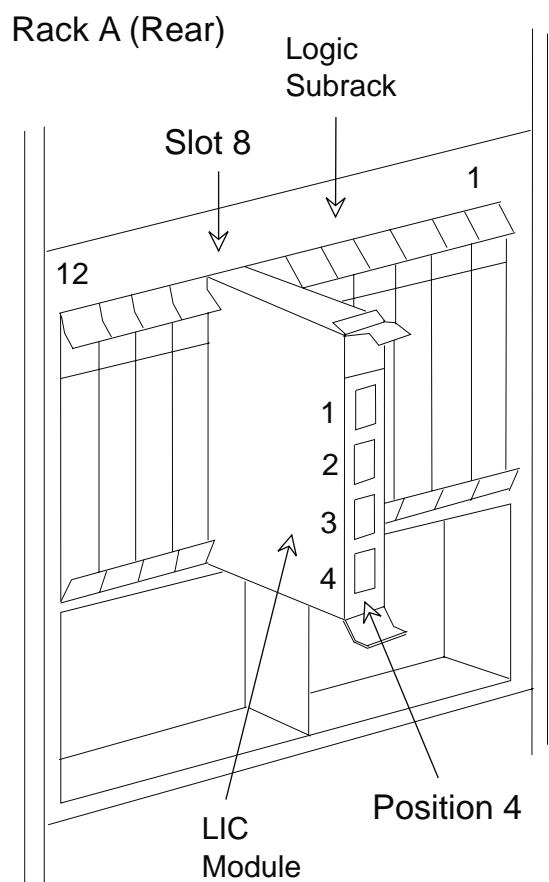
Figure 3. Rack, Slot, and Position

The sequence ″Rack, Slot, and Position″ identifies the location of the Nways Switch physical resources and also associates physical and logical resources. For example, the line attachment shown on Figure 3 is identified by Rack=A, Slot=8, and Position=4.

Line Cables

You can order external line cables for the Nways Switch in the following ways:

- As standard complete external cables. Short (2m or 6.56 ft) stub cables are also available to adapt OEM cables to the LIC connectors.
- In a cable connector kit. These kits allow you to build your own cables and contain connectors that match the LIC514 (RJ-48 for T1) and LIC530 (HSSI) connectors. There is also a kit for the LIC516 with flying leads for the E1 interface.

For details about physical line interfaces and line cables, see *2220 Nways BroadBand Switch Physical Lines Interface Specifications, External Cable References, GA33-0379*.

Hot Pluggable Features

Nways Switch features are *hot pluggable* and can be installed or removed without disturbing the resources that are not connected to or dependent on them. For

example, a port or trunk adapter can be exchanged without stopping the other adapters. Also, a line cable can be unplugged without disturbing the other line attachments on the same LIC.

Resource Usage and Machine Capacity

Each component of the Nways Switch uses machine resources (electrical power, processing power, a physical location, and cooling). The IBM ordering system assigns a resource usage level to each component. The usage levels are used to ensure that the configuration of a given machine resource is compatible with the total machine capacity.

Adapter Functions and Configuration

When ordering Nways Switch adapters, specify the following features:
- Asynchronous transfer mode (ATM) adapter type 2 (ATMA2)
- High-speed adapter type 3 (HSA3)
- Low-speed adapter types 2 and 3 (LSA2 and LSA3)
- Voice server adapter (VSA). For details, refer to "Voice Server Features" on page 24 .

Adapter Functions

An adapter performs one of the following functions according to its hardware type and the code it uses:
- A port adapter provides access services to port lines.
- A trunk adapter provides transport services to trunk lines.
- A control point adapter provides the network control functions to the Nways Switch.
- A trunk and control point adapter provides both transport services and network control.

Table 2 summarizes the functions that each adapter can perform.

Table 2. Adapter Functions

Adapter Function	LSA2	LSA3	HSA3	ATMA2
Port adapter	Yes	Yes	Yes	Yes
Trunk adapter	Yes	Yes	Yes	Yes
Control point adapter	Yes	Yes	Yes	No
Trunk and control point adapter	Yes	Yes	Yes	No

Control Point Configuration

The following configuration rules apply to control points:
1. There must be at least one control point in each Nways Switch.
2. A control point can be duplicated for availability reasons.

3. The control point function can be housed in a low-speed adapter type 2 (LSA2) or type 3 (LSA3), or a high-speed adapter type 3 (HSA3).

   The ATM adapter type 2 (ATMA2) cannot be used as a control point.

4. Defining the control point in slots 10 or 12 of the logic subrack dedicates the adapter to the sole control point function. It is then a *control point adapter* (CPA).

   In the other slots of the subrack (1 to 6 for Model 300, or 1 to 8 for Model 500), the control point is housed by a trunk adapter and is then a *trunk and control point adapter* (TCPA).

5. The control point function cannot be defined on a port adapter, whatever the slot in which the adapter is plugged.

6. The maximum number of Nways Switches and trunk lines supported by a control point depends on the adapter type.

7. The control point function cannot be located in an adapter plugged in a Model 501.

Duplicated Control Point

Duplicating the control point increases the availability of the machine by providing a backup if the active control point fails. Control point duplication is provided by the *redundancy mode* and applies to the control point and switch module and to the clock module (if installed).

IP Gateway Adapter

The network control messages between Nways Switch administration stations (NASs) and network management stations use IP addresses and are routed through a port adapter in each Nways Switch. This adapter is called *IP gateway adapter*. It must have the lowest traffic among all the port adapters, and can be duplicated.

Maximum Number of Adapters per 2220 Model

Table 3 summarizes the number of adapters allowed in each Nways Switch model:

Table 3. Maximum Number of Adapter Features Per Nways Switch Model

2220 Model	Low-Speed Adapters and LICs	High-Speed Adapters and LICs	ATM adapters and LICs	VSAs (and VSEs)	Control Points (CPAs and TCPAs)	Total (See Note)
300	4	4	4	2	2	8
500	8	8	8	4	2	10
501	6	6	6	6	0	6
500 and 501	14	14	14	10	2	16
Note: The totals can include a mixture of LSA, HSA, VSA, and ATMA for the front of the subracks, and a corresponding mixture of LIC and VSE for the back of the subracks. For the Model 300 and Model 500, the figures include the control point adapters in slots 10 and 12.						

Asynchronous Transfer Mode (ATM) Features

ATM Adapter Type 2 (ATMA2)

The ATMA2 adapter attaches port or trunk lines with speeds up to 155.520 Mbps. It is used as a port or trunk adapter; it cannot be used as a control point.

The types of links and protocols supported are given in the following ATM LIC descriptions.

DS3 Line Interface Coupler (LIC551)

The LIC551 attaches two DS3 port or trunk lines. Each attachment provides one channel at 44.736 Mbps. The LIC551 requires an ATMA2 configured as port or trunk adapter. The access services are ATM.

E3 Line Interface Coupler (LIC552)

The LIC552 attaches two E3 port or trunk lines. Each attachment provides one channel at 34.368 Mbps. The LIC552 requires an ATMA2 configured as port or trunk adapter. The access services are ATM.

SDH/SONET Electrical Line Interface Coupler (LIC553)

The LIC553 attaches one electrical 155.520 Mbps port or trunk line. The connection uses BNC connector. The range is limited to 450 m (1476 ft). The LIC553 requires an ATMA2 configured as a port or trunk adapter. The access services are ATM.

SDH/SONET Optical Line Interface Coupler (LICs 554, 555, and 556)

The LIC554, 555, or 556 attaches one optical 155.520 Mbps port or trunk line. The connection is through an SC transceiver. The allowed distances are:

- Up to 40 km (24.86 mi) for LIC554
- Up to 20 km (12.43 mi) for LIC555
- Up to 2 km (1.24 mi) for LIC556.

The LIC554, 555, or 556 requires an ATMA2 configured as a port or trunk adapter. The access services are ATM.

ATM LIC and Adapter Compatibility

Table 4 shows the ATM adapters that can be used with each ATM LIC.

Table 4. ATM LIC and Adapter Compatibility

LIC Type	ATMA1 (Note)	ATMA2
551 (Two DS3)	Port or trunk	Port or trunk
552 (Two E3)	Port or trunk	Port or trunk
553 (One SDH/SONET electrical)	Port or trunk	Port or trunk
554 (One SDH/SONET optical long range)	Port or trunk	Port or trunk
555 (One SDH/SONET optical short range)	Port or trunk	Port or trunk
556 (One SDH/SONET optical multi-mode)	Port or trunk	Port or trunk
Note: ATMA1 is no longer available.		

High-Speed Features

High-Speed Adapter Type 3 (HSA3)

The HSA3 attaches port or trunk lines with speeds up to 51.84 Mbps and can be used as one of the following:

- Port adapter
- Trunk adapter
- Control point adapter
- Trunk and control point adapter.

The types of links and protocols supported are given in the following high-speed LIC descriptions.

T3 Line Interface Coupler (LIC513)

The LIC513 attaches one clear channel T3 port or trunk line at 44.736 Mbps. The LIC513 requires an HSA3 configured as a port or trunk adapter. The access services are high data link control (HDLC) and frame relay.

For a trunk attachment, a second LIC513 can be used as a backup. A ″Y″ cable can connect both LICs to the same line. One HSA3 is required per LIC513.
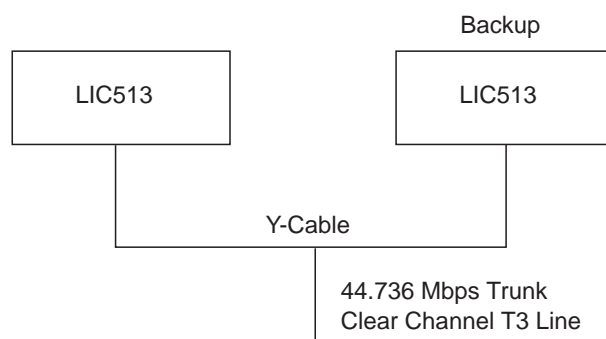
Figure 4. LIC513 Connectivity with Backup and Y-Cable

E3, E2, and J2 Line Interface Coupler (LIC523)

The LIC523 attaches one E3, E2, or J2 port or trunk line at speeds up to 34.368 Mbps. The LIC523 requires an HSA3 configured as a port or trunk adapter. The access services are HDLC and frame relay.

HSSI Line Interface Coupler (LIC530)

The LIC530 attaches one HSSI port or trunk line at speeds up to 51.84 Mbps for DTE and DCE interfaces. The LIC530 requires an HSA3 configured as a port or trunk adapter. The access services are HDLC and frame relay.

High-Speed LIC and Adapter Compatibility

Table 5 shows the high-speed adapters that can be used with each high-speed LIC.

Table 5. LIC Compatibility with High-Speed Adapters

LIC Type	HSA1 (Note)	HSA2 (Note)	HSA3
513 (One T3)	Port or trunk	Port or trunk	Port or trunk
523 (Four E2/J2/E3)	Port or trunk	Port or trunk	Port or trunk
530 (One HSSI)	Port or trunk	Port or trunk	Port or trunk
Note: HSA1 and HSA2 are no longer available.			

Low-Speed Features

Low-Speed Adapter Type 2 (LSA2)

The LSA2 attaches port or trunk lines with speeds from 2400 bps to 2.048 Mbps and can be used as one of the following:

- Port adapter
- Trunk adapter
- Control point adapter
- Trunk and control point adapter.

Low-Speed Adapter Type 3 (LSA3)

The LSA3 attaches port or trunk lines with speeds up to 2048 kbps and can be used as one of the following:

- Port adapter
- Trunk adapter
- Control point adapter
- Trunk and control point adapter.

LSA3 is required for:

- X.25 on LIC511 or LIC522
- Merged line protocols on low-speed LICs except LIC517 (for details, see "Merged Line Protocols" on page 21)
- ISDN on LIC types 515, 516, 545, 546, and 567
- Trunk J2 MA/SR on LIC type 562
- Multiple logical trunk (MLT) support.

The types of links and protocols supported are given in the following low-speed LIC descriptions.

X.21, V.24, and V.35 Line Interface Coupler (LIC511)

The LIC511 attaches up to 60 port lines at speeds up to 256 kbps. Each LIC511 connector attaches one or two line connection boxes (LCBs) with their active

remote connectors (ARCs). Also see Figure 5. The ARCs provide links for DCE direct attachments and DTE attachments.

The LIC511 supports the following ITU-T interfaces:

- X.21 for leased lines at speeds up to 256 kbps
- V.24 (RS-232) for leased lines at speeds up to 19.2 kbps
- V.35 for leased lines at speeds up to 256 kbps.

The LIC511 requires an LSA2 or LSA3 configured in port adapter. The access services are HDLC, frame relay, CES, X.25, and merged line protocols, which allows frame relay, HDLC, and CES traffic to run on the same adapter. One protocol per line is supported. Merged line protocols and X.25 require an LSA3.

Table 6 gives the maximum number of low-speed communication lines supported by each Nways Switch model using LIC511.

Table 6. Maximum Number of Low-Speed Lines and LIC511 per Nways Switch Model

2220 Model	Maximum Number of Low Speed Lines	Maximum Number of LIC511
300	120	2
500	240	4
501	360	6
500 and 501	600	10
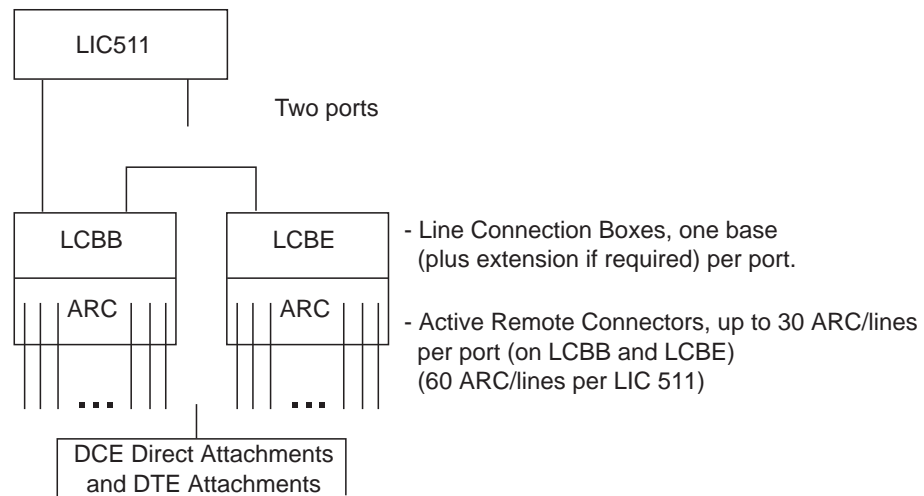
Figure 5. LIC511 Connectivity

For more information, refer to "Line Connection Box Features" and "Active Remote Connector Features" on page 16 .

Line Connection Box Features

The *line connection boxes* (LCBs) provide multiplexing of up to 30 communication lines to each LIC511 connector using only one cable. This reduces the cable requirements between the Nways Switch and the modem room.

Each of the two LIC511 connections can connect four LCBs and each LCB connects up to 15 lines. This allows up to 60 low-speed lines to be multiplexed into the two LIC511 ports. The actual number of lines depends on their speed. For example, only 16 lines can be supported at 256 kbps.

The LCBs can be located in a standard 19-inch (**metallic**) rack up to 103.5 m (341 ft) from the Nways Switch or housed in the rear of the Nways Switch rack.

There are two types of LCBs and they are functionally equivalent:
- Line connection box base (LCBB), which connects directly to the LIC511.
- Line connection box expansion (LCBE), which connects to the LCBB.

Figure 6 shows how LCBs are connected.
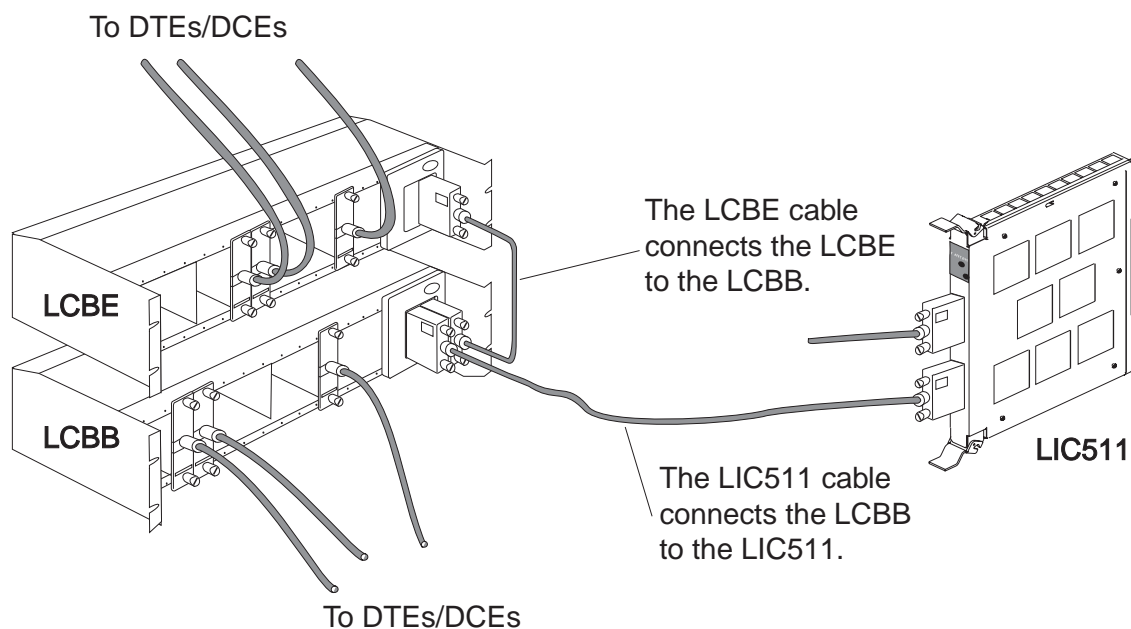
Figure 6. LCB Connections. The ARCs are housed in the LCBs and connect to the DTEs and DCEs.

Active Remote Connector Features

The *active remote connectors* (ARCs) are housed in the LCBs and provide the electrical and physical interfaces between the DCE (modem) or DTE (terminal) and the LIC511. The cable type depends on the interface type and whether the attachment is DTE or DCE.

Three types of ARCs are available. An ARC attaches to a DTE or DCE through a standard ITU-T interface:

ARC/X.21
    Uses the X.21 interface connector at speeds up to 256 kbps.

ARC/V.24
    Uses the V.24 interface connector at speeds up to 19.2 kbps.

ARC/V.35
    Uses the V.35 interface connector at speeds up to 256 kbps.

There are several different ARC features depending on the interface, attachment (DCE or DTE), and cable length.

T1 and J1 Line Interface Coupler (LIC514)

The LIC514 attaches four T1 or J1 port or trunk lines. Each attachment provides from one channel at 1.536 Mbps to 24 channels at 64 kbps. Multiple aggregate 64 kbps channels and fractional T1 and J1 services are supported. The multiple logical trunk is also supported on T1 and J1 lines.

The LIC514 requires an LSA2 or an LSA3 configured as a port or trunk adapter. The access services are HDLC, frame relay, CES, PCM voice (T1 only), ISDN/QSIG, or merged line protocols (HDLC, frame relay, CES, and ISDN/QSIG).
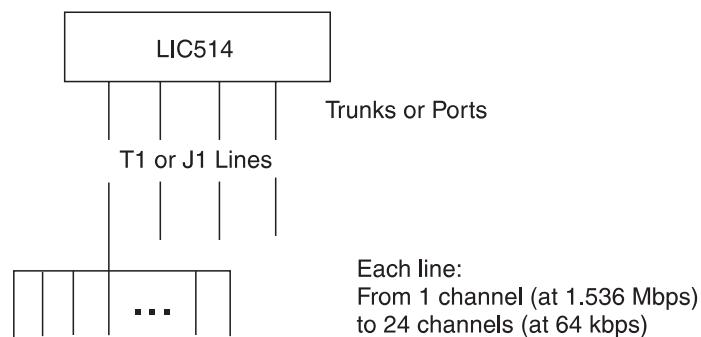
Figure 7. LIC514 Connectivity

Each attachment provides:
- In T1/J1 mode, from one channel at 1.536 Mbps to 24 channels at 64 kbps.
- In ISDN mode, 23 channels at 64 kbps plus the D-channel (primary rate access 23B+D).

E1 Line Interface Coupler (LIC515)

The LIC515 attaches four E1 port or trunk lines and uses coaxial connectors with a terminating impedance of 75 ohms. Multiple aggregate 64 kbps channels, or fractional E1 services are supported. The multiple logical trunk function is also supported on E1 lines.

The LIC515 requires an LSA2 or an LSA3 configured as a port or trunk adapter. The access services are:
- HDLC
- Frame relay
- CES
- PCM voice
- ISDN
- Merged line protocols (HDLC, frame relay, CES, and ISDN).

Each attachment provides:
- In E1 mode, from one channel at 1.984 Mbps to 31 channels at 64 kbps.

- In ISDN mode, 30 channels at 64 kbps plus the D-channel (primary rate access 30B+D).

E1 Line Interface Coupler (LIC516)

The LIC516 attaches four E1 port or trunk lines and uses RJ 48 (telephone-type) connectors with a terminating impedance of 120 ohms. Multiple aggregate 64 kbps channels and fractional E1 services are supported. The multiple logical trunk function is also supported in E1 lines.

The LIC516 requires an LSA2 or an LSA3 configured as a port or trunk adapter. The access services are HDLC, frame relay, CES, PCM voice, ISDN, or merged line protocols (HDLC, frame relay, CES, and ISDN).

Each attachment provides:
- In E1 mode, from one channel at 1.984 Mbps to 31 channels at 64 kbps.
- In ISDN mode, 30 channels at 64 kbps plus the D-channel (primary rate access 30B+D).

JJ-20 TTC Line Interface Coupler (LIC517)

The LIC517 attaches four JJ-20 TTC port lines to Japanese PBX interfaces. Each interface handles from one channel at 2048 kbps to 30 channels at 64 kbps.

The LIC517 requires an LSA2 configured as a port adapter. The access services are PCM voice and CES.

X.21, V.35, and V.36 Line Interface Coupler (LIC522)

The LIC522 attaches four X.21, V.35, or V.36 port or trunk lines. DTE and DCE interfaces with clock extraction are supported.

The LIC522 requires an LSA2 or LSA3 configured as a port or trunk adapter. The access services are HDLC, frame relay, CES, X.25, and merged line protocols (HDLC, frame relay, and CES).

```
                    ┌──────────────────────┐
                    │  LIC522              │
                    └──┬──────┬───────┬────┘
                       │      │       │  Trunks or Ports
                       │      │       │
                 X.21, V.35,  or  V36
                       │      │       │
                       │      │       │
                 DCE          or      DTE
                 from 56 kbps         512 kbps, 1 Mbps,
                 to 2.048 Mbps        1.5 Mbps, or 2 Mbps
```
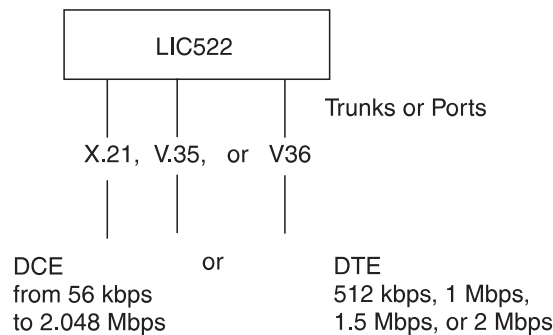
Figure 8. LIC522 Connectivity

Note: When connecting a 2220 to a 2210 router through a V.35 interface (LIC522), the 2210 must be configured as **DTE** and the corresponding 2220 port as **DCE**.

T1 and J1 Line Interface Coupler (LIC544)

The LIC544 attaches eight T1 or J1 port or trunk lines. Each attachment provides from one channel at 1.536 Mbps to 24 channels at 64 kbps. Multiple aggregate 64 kbps channels and fractional T1 and J1 services are supported. The multiple logical trunk function is also supported in T1 and J1 trunk lines.

The LIC544 requires an LSA3 configured as a port or trunk adapter. The access services are HDLC, frame relay, CES, PCM voice (T1 only), ISDN/QSIG, or merged line protocols (HDLC, frame relay, CES, and ISDN/QSIG).

Each attachment provides:
* In T1/J1 mode, from one channel at 1.536 Mbps to 24 channels at 64 kbps.
* In ISDN mode, 23 channels at 64 kbps plus the D-channel (primary rate access 23B+D).
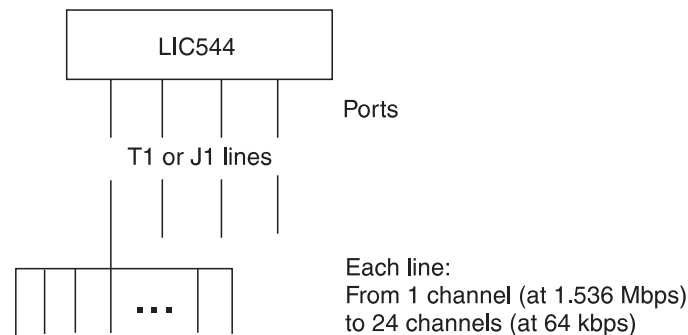
Figure 9. LIC544 Connectivity

E1 Line Interface Coupler (LIC545)

The LIC545 attaches eight E1 port lines and uses a terminating impedance of 75 ohms. Multiple aggregate 64 kbps channels and fractional E1 services are supported. The multiple logical trunk function is also supported in E1 lines.

The LIC545 requires an LSA3 configured as a port or trunk adapter. The access services are HDLC, frame relay, CES, PCM voice, ISDN, or merged line protocols (HDLC, frame relay, CES, and ISDN).

Each attachment provides:
* In E1 mode, from one channel at 1.984 Mbps to 31 channels at 64 kbps.
* In ISDN mode, 30 channels at 64 kbps plus the D-channel (primary rate access 30B+D).

E1 Line Interface Coupler (LIC546)

The LIC546 attaches eight E1 port or trunk lines and uses a terminating impedance of 120 ohms. Multiple aggregate 64 kbps channels and fractional E1 services are supported. The multiple logical trunk function is also supported in E1 lines.

The LIC546 requires an LSA3 configured as a port or trunk adapter. The access services are HDLC, frame relay, CES, PCM voice, ISDN, or merged line protocols (HDLC, frame relay, CES, or ISDN).

Each attachment provides:
- In E1 mode, from one channel at 1.984 Mbps to 31 channels at 64 kbps.
- In ISDN mode, 30 channels at 64 kbps plus the D-channel (primary rate access 30B+D).

J2 Multi-Access/Sub-Rate Interface (LIC562)

The LIC562 attaches one J2 multi-access/sub-rate (MA/SR) trunk line at a speed limited to 1.536 Mbps. However, because it supports the multiple logical trunk (MLT) function, speeds of 3 Mbps, 5 Mbps, and 6 Mbps can be reached by using respectively two, three, or four logical NBBS trunks.

The LIC562 requires an LSA3 configured as trunk adapter.

Euro-ISDN Trunk Backup (LIC563)

LIC563 is required with an LSA3 adapter for setting up trunks over a Euro-ISDN switched network. The bandwidth of each ISDN trunk ranges from 64 Kbps to 1920 Kbps.

LIC563 attaches four E1 trunk lines that support:
- E1 G-703, G-704, and G-706 interfaces with or without CRC-4
- ETSI recommendations

Each E1 line is defined as a trunk and provides one channel at 1.920 Mbps dedicated to ISDN traffic (slots 0 and 16 are reserved) or to an E1 channelized interface to a leased line.

In LIC563, lines 1 and 2 contain the inverse multiplexing unit used for backup trunks over ISDN. Inverse multiplexing supports the grouping (bonding) of 2 to 30 B-channels in each trunk across the ISDN network.

Lines 3 and 4 function without inverse multiplexing and are used as standard E1 leased lines with a terminating impedance of 120 ohms.

E1 ISDN Line Interface Coupler (LIC567)

The LIC567 attaches four E1 ISDN/QSIG port lines and uses a terminating impedance of 120 ohms. This LIC is designed for public telephone networks where Telecommunications approval is required.

The LIC567 requires an LSA3 configured as a port adapter. The access services are HDLC, frame relay, CES, PCM voice (without CAS), ISDN, or merged line protocols (HDLC, frame relay, CES, and ISDN).

Each attachment provides:
- In E1 mode, from one channel at 1.984 Mbps to 31 channels at 64 kbps.
- In ISDN mode, 30 channels at 64 kbps plus the D-channel (primary rate access 30B+D).

Low-Speed LIC and Adapter Compatibility

Table 7 shows which low-speed LICs can be used with the low-speed adapters.

Table 7. Compatibility with Low-Speed Adapters

LIC Type	LSA1 (Note)	LSA2	LSA3
511 (60 V.24, V.35, or X.21)	No	Port	Port
514 (Four T1 or J1)	Port or trunk	Port or trunk	Port or trunk
515 or 516 (Four E1)	Port or trunk	Port or trunk	Port or trunk
517 (Four JJ-20)	No	Port	No
522 (Four V.35, V.36, or X.21)	No	Port or trunk	Port or trunk
544 (Eight T1 or J1)	No	No	Port or trunk
545 (Eight E1, 75 ohms)	No	No	Port or trunk
546 (Eight E1, 120 ohms)	No	No	Port or trunk
562 (One J2, 75 ohms)	No	No	Trunk
563 (Two Euro-ISDN, two E1 120 ohms)	No	No	Trunk
567 (Four E1, 120 ohms)	No	No	Port
Note: LSA1 is no longer available			

Merged Line Protocols

The low-speed adapter type 3 (LSA3) allows merging multiple protocols (frame relay, HDLC, CES, and ISDN) on its attached LIC. With CES, channel associated signaling (CAS) and channel common signaling (CCS) are available. With ISDN, Q signaling (QSIG) can be used. Except for LIC type 517 (four JJ-20 line attachments), all the low-speed LICs support merged line protocols.

The following configuration rules apply to merged line protocols:

1. Merging line protocols requires an LSA3.
2. On LIC types 511 and 522, protocols are selected at line level. Each line attachment of a LIC can be configured with a different protocol (frame relay, HDLC, or CES).
3. On the other LIC types (T1, J1, or E1), each line attachment can be configured without channels (clear-channel mode) or with channels (channel mode).
   - In *clear-channel mode*, protocols are selected at line level, as for LIC511 or LIC522. Each line attachment can be configured with a different protocol (frame relay, HDLC, or CES). ISDN is not available in clear-channel mode.
   - In *channel mode:*
     a. Frame relay, HDLC, and CES protocols are selected at channel level. Each channel can be configured with a different protocol.
     b. CAS and CCS signaling modes are selected at line level. Each line attachment can be configured with a different signaling mode.
     c. ISDN and QSIG are available on E1 lines.
     d. In ISDN, each B-channel can be dynamically assigned to data or voice in HDLC, frame relay, or CES. Data traffic is transparently transported end-to-end over the 2220 network. Voice traffic can use voice server functions as required.

Table 8 shows how protocols and signaling modes can be merged on low-speed LICs.

Table 8. Low-Speed LICs and Merged Line Protocols

LIC Type	HDLC or FR	CES	CAS	CCS	ISDN QSIG
511	Yes	Yes	No	No	No
522	Yes	Yes	No	No	No
514 or 544 in clear channel mode	Yes	Yes	No	No	No
514 or 544 in channel mode	Yes	Yes	Yes	Yes	No
515, 516, 545, or 546 in clear channel mode	Yes	Yes	No	No	No
515, 516, 545, or 546 in channel mode	Yes	Yes	Yes	Yes	Yes
567 in clear channel mode	Yes	Yes	No	No	No
567 in channel mode	Yes	Yes	No	Yes	Yes

LICs and Protocols

Table 9 shows the physical interfaces and protocols that are available for each LIC. (For LIC and adapter compatiblity, refer to Table 10 on page 23.)

Table 9. LIC Physical Interfaces and Protocols

LIC Type	CES	PCM Voice	HDLC and FR	ISDN/QSIG (1)	ATM	X.25 (1)	Protocol Merge (1)
511 (Sixty V.24, V.35, or X.21)	Yes	No	Yes	No	No	Yes	Yes (2)
513 (One T3)	No	No	Yes	No	No	No	No
514 (Four T1 or J1)	Yes	T1 only	Yes	Yes(6)	No	No	Yes (3)
515 (Four E1 75 ohms)	Yes	Yes	Yes	Yes (5)	No	No	Yes (3) (4)
516 (Four E1 120 ohms)	Yes	Yes	Yes	Yes (5)	No	No	Yes (3) (4)
517 (Four JJ-20 TTC)	Yes	Yes	No	No	No	No	No
522 (Four V.35, V.36, or X.21)	Yes	No	Yes	No	No	Yes	Yes (2)
523 (Four E2, J2, or E3)	No	No	Yes	No	No	No	No
530 (One HSSI)	No	No	Yes	No	No	No	No

Table 9. LIC Physical Interfaces and Protocols (continued)

LIC Type	CES	PCM Voice	HDLC and FR	ISDN/QSIG (1)	ATM	X.25 (1)	Protocol Merge (1)
544 (Eight T1 or J1)	Yes	T1 only	Yes	Yes (6)	No	No	Yes (3)
545 (Eight E1 75 ohms)	Yes	Yes	Yes	Yes (5)	No	No	Yes (3) (4)
546 (Eight E1 120 ohms)	Yes	Yes	Yes	Yes (5)	No	No	Yes (3) (4)
551 (Two DS3)	No	No	No	No	Yes	No	No
552 (Two E3)	No	No	No	No	Yes	No	No
553 (One SDH Sonet electrical)	No	No	No	No	Yes	No	No
554 (One SDH Sonet optical LR)	No	No	No	No	Yes	No	No
555 (One SDH Sonet optical SR)	No	No	No	No	Yes	No	No
556 (One SDH Sonet optical multi mode)	No	No	No	No	Yes	No	No
567 (Four E1 ISDN 120 ohms)	Yes	Yes (no CAS)	Yes	Yes (5)	No	No	Yes (3) (4)

Notes:

1. Requires an LSA3.
2. Each line can have a different protocol (HDLC, frame relay, or CES).
3. Each clear-channel line or channel can have a different protocol (HDLC, frame relay, or CES).
4. In ISDN, each B-channel can be dynamically assigned to data or voice in HDLC, frame relay, or CES.
5. LIC567 may be required depending on country certification.
6. INS-Net Support (ISDN in Japan) on J1-type line only. QSIG in USA on T1-type line only.

LIC and Adapter Compatibility

Table 10 shows the adapters that are available for each LIC type.

Table 10. LIC and Adapter Compatibility

LIC Type	LSA2	LSA3 (Note)	HSA3	ATMA2
511 (Sixty V.24, V.35, or X.21)	Yes (port)	Yes (port)	No	No
513 (One T3)	Yes (port or trunk)	Yes (port)	No	No
514 (Four T1 or J1)	Yes (port or trunk)	Yes (port or trunk)	No	No
515 (Four E1 75 ohm)	Yes (port or trunk)	Yes (port or trunk)	No	No
516 (Four E1 120 ohm)	Yes (port or trunk)	Yes (port or trunk)	No	No
517 (Four JJ-20 TTC)	Yes (port)	No	No	No

Table 10. LIC and Adapter Compatibility (continued)

LIC Type	LSA2	LSA3 (Note)	HSA3	ATMA2
522 (Four V.35, V.36, or X.21)	Yes (port or trunk)	Yes (port or trunk)	No	No
523 (Four E2, J2, or E3)	No	No	Yes (port or trunk)	No
530 (One HSSI)	No	No	Yes (port or trunk)	No
544 (Eight T1 or J1)	No	Yes (port or trunk)	No	No
545 (Eight E1 75 ohm)	No	Yes (port or trunk)	No	No
546 (Eight E1 120 ohm)	No	Yes (port or trunk)	No	No
551 (Two DS3)	No	No	No	Yes (port or trunk)
552 (Two E3)	No	No	No	Yes (port or trunk)
553 (One SDH Sonet electrical)	No	No	No	Yes (port or trunk)
554 (One SDH Sonet optical LR)	No	No	No	Yes (port or trunk)
555 (One SDH Sonet optical SR)	No	No	No	Yes (port or trunk)
556 (One SDH Sonet optical multiple mode)	No	No	No	Yes (port or trunk)
562 (One J2)	No	Yes (trunk)	No	No
563 (Two Euro-ISDN, two E1 120 ohms)	No	Yes (trunk)	No	No
567 (Four E1 ISDN 120 ohm)	No	Yes (port)	No	No
Note: LSA3 is required for X.25, ISDN, J2 and merged line protocols.				

Voice Server Features

Voice Server Adapter (VSA)

The VSA handles voice processing on twenty 64 kbps channels. It offers the following functions:

- Voice compression using the GSM or the adaptive differential pulse code modulation (ADPCM) algorithm (with a five-to-one compression ratio)

   Note: The two algorithms cannot be used in the same voice server adapter.
- Silence removal (with a two-to-one compression ratio)
- Echo cancellation
- Idle signal removal
- Silence removal
- Fax demodulation (using the GSM algorithm)
- Compression law conversion.

The voice server adapter can detect voice-band data signals (fax or modem) and automatically switch from one of the first three modes to the pass-through mode for the duration of these signals.

There is a digital echo canceler built into the VSA. It can compensate for up to 32 ms of local delay. Voice digital echo cancellation is subject to the approval of appropriate country regulatory authorities.

Dual-tone multifrequency (touch-tone) dialing is transparently forwarded. If voice compression, silence removal, and echo canceling are used together, then fewer channels are supported for voice processing (for details, see Table 11).

Voice Server Extension 1 (VSE1) and 2 (VSE2)

The voice modules (VSA, VSE1, and VSE2) are built with digital signal processors (DSP) that have:

- Five voice slots each (when configured as GSM)
- Four voice slots each (when configured as ADPCM).

Table 11 gives the maximum number of voice slots available for a VSA alone, a VSA with a VSE1, or a VSE2.

Table 11. Voice Server Adapter Channel Capacities

Voice Modules	DSP	GSM Slots	ADPCM Slots
VSA only	4	20 (4x5)	16 (4x4)
VSA and VSE1	16	80 (16x5)	64 (16x4)
VSA and VSE2	28	140 (28x5)	112 (28x4)

Note:

If echo cancellation is required, the figures in Table 11 must be divided by 2.

2220 Model 500 Configuration

As shown in Figure 1 on page 7, the 2220 Model 500 consists of three main sections (from top to bottom):

- Nways Switch administration station (NAS)
- Logic subrack
- Power subrack.

Nways Switch Administration Station

The Nways Switch administration station (NAS) is a processor mounted in the rack of the 2220 Model 300 or 500 and is used to locally control and service the Nways Switch. The NAS consists of the following components:

- Display, keyboard, and mouse
- Hard-disk drives (primary and backup)
- Diskette drive
- Modem for connection to a remote user console and an IBM Network Support Center through the public switched network
- Integrated battery backup
- An attachment to the network management station (running Nways 2220 Switch Manager) via an Ethernet LAN, if the Nways Switch is used as a network management access switch
- An attachment to the change control server (running NetView Distribution Manager for AIX) via an Ethernet LAN, if the Nways Switch is used as a change management access switch

Hardware Evolution

In order to support the dual code-level management function and benefit from the improved performance, the Nways Switch must be equipped with a more powerful NAS. Two migration paths are possible. You can either:

- Replace the hard disks by larger disks in order to use the new functions
- Replace the NAS in order to benefit from both the new functions and performance.

You can visually check the level of a NAS. If the rear of the NAS is equipped with six adapter slots, and if there is no connector on the left side of the mouse and keyboard connectors, the NAS must be upgraded.

Performance

The IBM Nways BroadBand Switch Control Program Version 2 and the more powerful NAS result in improved performance of the Nways Switch:

- Increased number of connections per node: from 2000 up to 6000.
- Shorter IML time. It has been reduced by 30%.
- Shorter delay to control all the resources. It has been reduced by 30%.
- Shorter response time. It has been reduced by 30%.

2220–500 Logic Subrack (Front)

The front of the logic subrack, shown in Figure 10 on page 27 contains the following parts:

Control panel
    Contains the manual power ON/STANDBY switch, the alarm and power control (APC) reset switch, and six status LEDs.

Fan units
    Two fan units with two fans in each.

Slots 1 to 8
    Can be used to plug:

- Up to eight trunk or port adapters (TPAs)
- Up to four voice server adapters (VSAs).

Control point adapter (CPA)
    Can be used alone as a dedicated control point adapter module in slot 10. Can have a backup CPA module in slot 12.

Trunk and control point adapter (TCPA)
    A trunk adapter module where control point and trunk adapter functions coexist. It can be plugged in slots 1 to 8 and can have a backup module (also in slots 1 to 8).

Clock module (CLK)
    Optional module (in slot 9). It can have a backup module (in slot 11).
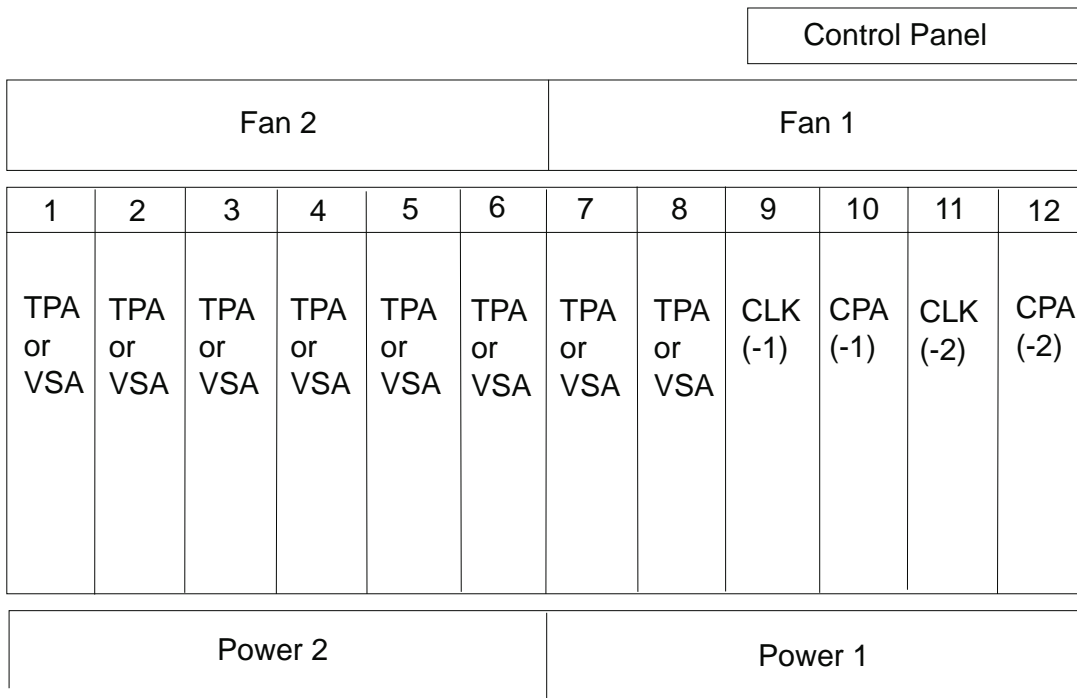
	Control Panel	

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	TPA or VSA	TPA or VSA	CLK (-1)	CPA (-1)	CLK (-2)	CPA (-2)

Power 2	Power 1

Legend

CLK   clock

CPA   control point adapter

TPA   trunk or port adapter

VSA   voice server adapter

Figure 10. 2220-500 Logic Subrack (Front)

2220–500 Logic Subrack (Rear)

The rear of the logic subrack, shown in Figure 11 on page 28, contains the following parts:

Slots 1 to 8
Can be used to plug:

- Line interface couplers (LICs), each attached to its appropriate adapter.
- Voice server extensions (VSEs), each attached to its VSA.

Switch module (SW)
An ATM cell switch (in slot 9). It can have a backup module (in slot 10).

Alarm and power control (APC) module
Connects the NAS, reports alarms, and controls the power supplies.

DC power distribution (DCD)
Two half-modules, one for each power module.

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)	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE	LIC or VSE
Power 1						Power 2					

Legend

APC   alarm and power control

DCD   dc distribution

LIC   line interface coupler

SW   switch module

VSE   voice server extension

Figure 11. 2220-500 Logic Subrack (Rear)

2220-500 Power Subrack

The power subrack contains the ac or dc power module feature. In a machine that has a backup power module, both modules can be the same or different types.

The ac power supply can be from 208 to 240 V ac (single phase, 50 or 60 Hz). It has an internal backup battery (providing up to five minutes of power supply). The dc power supply can be from -36 to -60 V dc.

2220-500 Redundant Mode

The Model 500 is normally configured to operate in redundant mode. The following key components are duplicated:

- Switch module
- Control point adapter
- Clock module, if present.

2220 Model 501 Configuration

This is an expansion unit used with the 2220 Nways Switch Model 500 to increase the number of attachments. It is attached to either side of the Model 500. It does not have a NAS nor a modem, but does contain logic and power subracks.

Line connection boxes (refer to page 15) can be housed in the rear of the machine for use with the active remote connectors.

2220-501 Logic Subrack (Front)

Control panel
As for the Model 500. Refer to "2220 Model 500 Configuration" on page 25.

Fan units
Two fan units with two fans in each.

Slots 1 to 6
Can be used to plug:

- Up to six trunk or port adapters (TPAs)
- Up to six voice server adapters (VSAs).

A mixture of the two types is allowed up to a total of six adapters.

Clock redrive (CLKRD)
For a clock module in the Model 500, there is a clock redrive module in the Model 501 (in slot 9). The clock redrive module is linked to the Model 500 clock module and has a similar function.

Dummy modules
Used to fill in the empty slots of the logic subrack in order to ensure correct air cooling.

						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	D u m m y	D u m m y	CLKRD (-1)	D u m m y	CLKRD (-2)	D u m m y

Power 2	Power 1
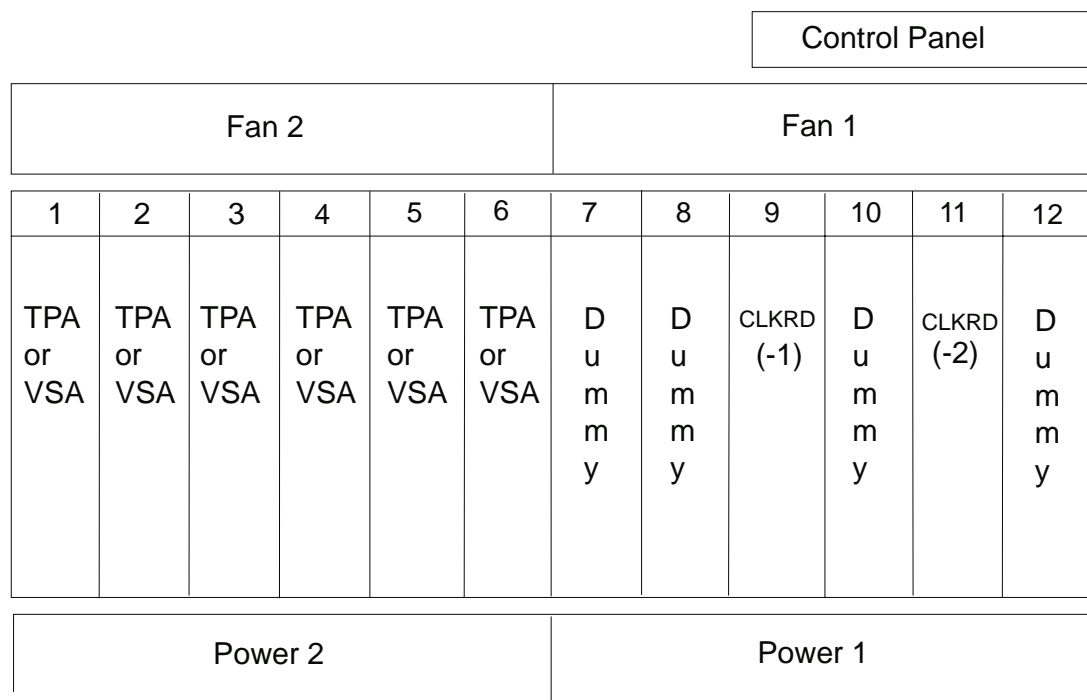
Legend

CLKRD
> clock redrive

TPA   trunk or port adapter

VSA   voice server adapter

Figure 12. 2220-501 Logic Subrack (Front)

2220-501 Logic Subrack (Rear)

The rear of the logic subrack, shown in Figure 13 on page 31, contains the following parts:

Slots 1 to 6
> Can be used to plug:
>
> - Line interface couplers (LICs), each attached to its appropriate adapter.
> - Voice server extensions (VSEs), each attached to its VSA.

Switch module redrive (SWRD)
> For a switch module in the Model 500, there is a switch redrive module in the Model 501. The switch redrive module is linked to the Model 500 switch module and has a similar function.

Alarm and power control (APC) module
> Connects the NAS, reports alarms, and controls the power supplies.

DC power distribution (DCD)
> Two half-modules, one for each power module.

Dummy modules
> Same as for the front of the Model 501 logic subrack.

Fan 1						Fan 2					
DCD	APC	10	9	8	7	6	5	4	3	2	1
DCD (-1) DCD (-2)	APC	SWRD (-2)	SWRD (-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					

Legend

APC alarm and power control

DCD dc distribution

LIC line interface coupler

SW switch module

VSE voice server extension

Figure 13. 2220-501 Logic Subrack (Rear)

2220-501 Power Subrack

The power subrack contains the ac or dc power module feature, which can be duplicated to provide backup. The Model 501 power modules must match the Model 500 power modules. Refer to "2220-500 Power Subrack" on page 28 for more information.

2220-501 Redundant Mode

If the clock is duplicated in the Model 500, the clock redrive module is duplicated in the Model 501 (front side, slot 11).

If the switch module is duplicated in the Model 500, the switch redrive is duplicated in the Model 501 (rear side, slot 10). There is no control point in the Model 501 and no duplication of the control point.

2220 Model 300 Configuration

The Model 300 has less capacity than the Model 500. Physically, the Model 300 is the same size as the Model 500 and can be field-upgraded to a Model 500.

The Model 300 consists of three main sections (from top to bottom):
- Nways Switch administration station (NAS)
- Logic subrack
- Power subrack.

2220-300 Nways Switch Administration Station

The Nways Switch administration station for Model 300 is the same as the one in the Model 500 (refer to page 25).

2220-300 Logic Subrack (Front)

The front of the logic subrack, Figure 14 on page 33, contains the following elements:

Control panel
Same as for the Model 500. Refer to "2220 Model 500 Configuration" on page 25

Fan units
Two fan units with two fans in each.

Slots 1 to 6
Can be used to plug:

- Up to four trunk or port adapters (TPAs)
- Up to two voice server adapters (VSAs).

A mixture of the two types is allowed, up to a total of six adapters.

Control point adapter (CPA)
Can be used alone as a dedicated adapter module in slot 10. Can have a backup module in slot 12.

Trunk and control point adapter (TCPA)
Is a trunk adapter module where control point and trunk adapter functions coexist (can be plugged in slots 1 to 6). Can have a backup module (also in slots 1 to 6).

Clock module (CLK)
Optional in slot 9 and can have a backup module in slot 11.

Dummy modules
Used to fill in the empty slots of the logic subrack in order to ensure correct air cooling.

									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)	CPA (-1)	CLK (-2)	CPA (-2)

Power 2						Power 1					
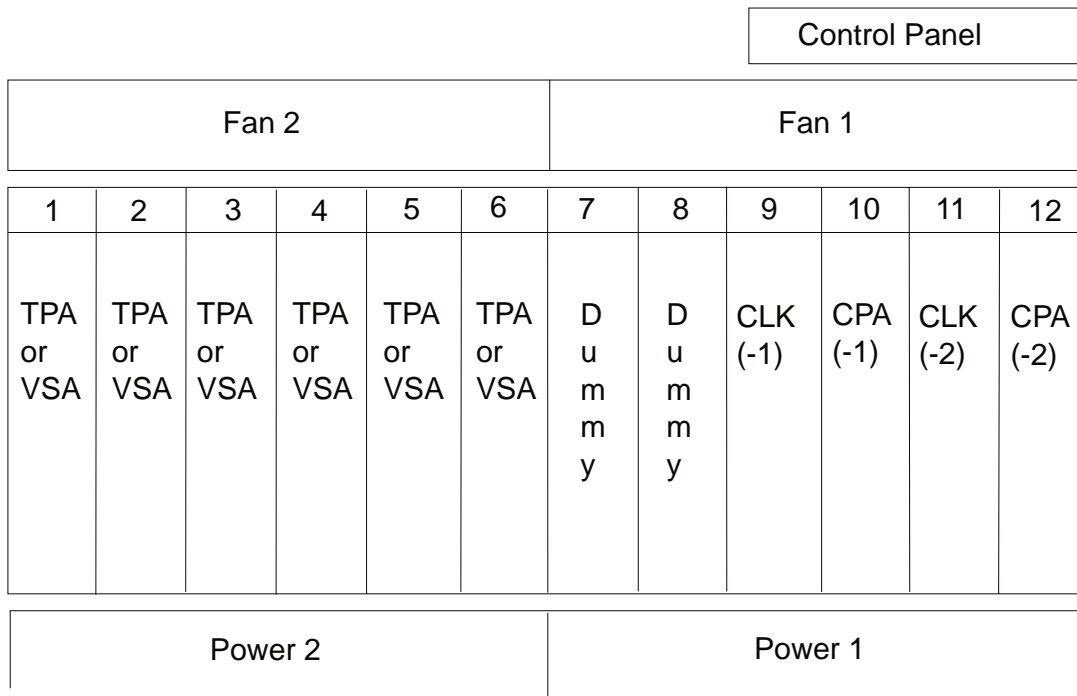
Legend

CLK   clock

CPA   control point adapter

TPA   trunk or port adapter

VSA   voice server adapter

Figure 14. 2220-300 Logic Subrack (Front)

2220-300 Logic Subrack (Rear)

The rear of the logic subrack Figure 15 on page 34, contains the following parts:

Slots 1 to 6
Can be used to plug:

- Line interface couplers (LICs), each attached to its appropriate adapter.
- Voice server extensions (VSEs), each attached to its VSA.

Switch module (SW)
An ATM cell switch (in slot 9), which can have a backup module (in slot 10). It has a smaller capacity that the Model 500 switch module.

Alarm and power control (APC) module
Connects the NAS, reports alarms, and controls the power supplies.

DC power distribution (DCD)
Two half-modules, one for each power module.

Dummy modules
Same as for the front of the Model 300 logic subrack.

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					

Legend

APC   alarm and power control

DCD   dc distribution

LIC   line interface coupler

SW   switch module

VSE   voice server extension

Figure 15. 2220-300 Logic Subrack (Rear)

2220-300 Power Subrack

The Model 300 power subrack is the same as the Model 500 power subrack. Refer to "2220-500 Power Subrack" on page 28 for more information.

2220-300 Redundant Mode

The Model 300 can be configured to operate in redundant mode. The following key components are duplicated:

• Switch module

• Control point module

• Clock module, if present.

Part 2. Planning Your Network

Chapter 3. Network Topology and Bandwidth Requirements

When planning your 2220 network, you must take into account the following items:

- Naming conventions
- Network topology and bandwidth requirements (see "Chapter 3. Network Topology and Bandwidth Requirements")
- IP addressing (see "Chapter 4. Internet Protocol Addressing and Control Point Spanning Tree" on page 45)
- Synchronization plan (see "Chapter 5. Network Synchronization" on page 55).

Naming Conventions

You must define a naming convention at the network level for the following resources:

- 2220 network name (obtained from your IBM sales representative through the IBM Network Identification Registration)
- Nways Switch (Nways Switch administration station) names must be unique within the network.
- Physical resources (adapters, lines, and so on)
- Logical resources (connections, ports, and so on). Assign a resource number to each physical device connected to the network. The resource number connects each physical device to a potential connection through the NBBS port definition. You can use one the following identification plans to ensure that each device has a number that is unique throughout the network:
  - X.121
  - E.164
  - Your private numbering plan (PNP).

Evaluating Network Topology

The first step in determining the topology of your 2220 network is to evaluate your network needs. To do this, you should gather as much relevant information as possible. To assist you in evaluating network topology, IBM has developed a network design tool.

Input

You must provide an IBM customer engineer or the IBM network design tool with the following information:

- List of network nodes
- List of connections including the characteristics of the desired NBBS services and data traffic

  For data traffic, you must also include the following parameters:
  - Peak rate (for NBBS), peak cell rate (for ATM), or access rate (for frame relay and high data link control)
  - Mean rate (for NBBS), sustainable cell rate (for ATM), or peak cell rate (for frame relay)

- Burstiness (for NBBS), cell delay variation tolerance (for ATM), or burst committed or in excess (for frame relay).

Output

As output, the IBM network design tool proposes a minimum topology that assumes that 85% of the bandwidth is reserved for data traffic. The tool uses a path algorithm similar to the algorithm used in the Nways Switch Control program that plans connection routing over trunks to estimate trunk load and required bandwidth.

When evaluating your network topology, only data traffic is taken into account. Control traffic is taken into account only in the next step when you validate the proposed topology.

Validating Network Topology

When you validate network topology, the feasibility of the proposed topology is checked by taking into account the following items:
- Amount of bandwidth required for *control traffic*
- Network operation in case of one or more failing trunks or an increase in data traffic
- Connection adaptability.

Control Traffic

Control traffic mainly consists of steady state NBBS messages that are divided into three groups:
- *NBBS messages* (including call setup, release, and connection refresh messages) are sent during connection setup and release or when a connection is in a steady state. Because NBBS messages are forwarded using the connection path, any trunk in the network can be used.
- *Trunk liveness messages* check whether a trunk is alive or not.
- *Topology exchange and directory search messages* are sent to the control point (CP) spanning tree to update the topology database or locate a resource.

Evaluating and Computing the Bandwidth

By default, 85% of the bandwidth is reserved for data traffic. This means that 15% of the bandwidth is reserved for control traffic transmission in reasonable delays and excess data traffic.

Using the formulas in this section, you can more accurately compute the bandwidth required for control traffic according to your network requirements. IBM recommends that you evaluate your bandwidth needs as precisely as possible, particularly if you plan to use low-speed trunks. Depending on the number of connections, control traffic can be significantly increased and require a higher percentage of bandwidth than the amount originally planned.

Critical Bandwidth-Sizing Parameters

The bandwidth required to transmit control traffic on a trunk depends on the following parameters:
- Number of trunks across the network (T)

- Directory cache miss ratio (*M*)
- Link utilization update frequency (*Lf*)
- The number of connections carried by the trunk (*Cs*)
- Average connection duration (*Cd*)
- Average number of hops of a connection (*h*)
- Average aggregate rate for the establishment of a connection on a per trunk-basis (*Cg*)
- Refresh frequency (*R*)
- Trunk refresh frequency (*Rt=2/s*)

Bandwidth Required for Network, Trunk, and Connection Control Traffic

Trunk–specific control traffic is transmitted over each trunk in the network and consists of local messages that are not propagated from one trunk to another. The bandwidth required to transmit trunk control traffic is computed by the formula shown in Table 12.

Table 12. How to Compute the Bandwidth Required for Trunk Control Traffic

Parameter	Identifier	Formula
Bandwidth for trunk liveness messages	Bt	Bt=800*Rt or 800*2=1.6 kbps

Network control traffic is transmitted at network establishment time using links that allow all network nodes to be joined. Network control traffic consists of link utilization update messages and directory search messages. The bandwidth required to carry network control traffic is computed by the formula shown in Table 13.

Table 13. How to Compute the Bandwidth Required for Network Control Traffic

Parameter	Identifier	Formula
Bandwidth for directory search messages	Bd	Bd=1800*M*Cg*T
Bandwidth for topology update messages	Bu	Bu=2400*Lf*T

Connection control traffic is transmitted along the path of each connection and includes data for call control (establishments/disconnections) and refresh or bandwidth adjustment. The bandwidth required to carry connection control traffic is computed by the formula shown in Table 14.

Table 14. How to Compute the Bandwidth Required for Connection Control Traffic

Parameter	Identifier	Formula
Bandwidth for call control messages	Bc	Bc=15000*Cs/Cd
Bandwidth for connection refresh messages	Br	Br=2900*Cs*R

Example

The following example helps you understand the role of the *T* and *Cs* parameters. Table 15 on page 40 shows the sample values specified for some of the critical parameters. For detailed information on each parameter, see "Critical Bandwidth-Sizing Parameters" on page 38.

Table 15. An Example of Parameter Values

Parameter	Examples of Values
Lf	1/60 Hz
R	1/160 Hz
Cd	180 sec
h	4
M	0.01

Computing Cg

Cg is the average aggregate rate for establishing connections on a per trunk basis and is computed as follows:

$$Cg=1/T \quad \left(\text{SUM}_{i=1}^{T} \ Cs(i)/Cd(i)*h \right)$$

where T is the number of trunks. This means that for X trunks with 50 and 150 connections per trunk, *Cg* would be computed as follows:

Cg=50/180*4*T/T=1.1   (50 connections per trunk)

Cg=150/180*4*T/T=3.3 (150 connections per trunk)

Computing Bu, Bd, Bt, Bc, and Br

The values shown in Table 16 are generated by using the formulas in Table 12 on page 39 , Table 13 on page 39, and Table 14 on page 39.

Table 16. Values for the Bu, Bd, Bt, Bc, and Br Parameters

Messages for	Id	Bandwidth Required in bps
Topology update	Bu	40*T
Directory search	Bd	20*T (50 connections per trunk)
Trunk liveness	Bt	1600
Connection call control	Bc	83*Cs
Connection refresh	Br	18*Cs

Computing the Total Bandwidth for NBBS Messages

Total bandwidth=Bt+Bc+Br=83*Cs+18*Cs + 1600 =101*Cs +1600

For high- and low-speed trunks, Table 17 and Table 18 on page 41 show the maximum number of connections (Cs) that can be transmitted by the trunks if the limit is the amount of bandwidth used by control messages and within the range of 0.5% to 5%.

Table 17. Maximum Number of Connections and Bandwidth for High-Speed Trunks

High-speed Trunks	Number of Connections (Cs)	Percentage of Total Bandwidth (Bt+Bc+Br)
T1/E1	256	1.5

Table 17. Maximum Number of Connections and Bandwidth for High-Speed Trunks (continued)

T3/E3	4096	1
OC3	8192	0.5
OC12	32192	0.5

Table 18. Maximum Number of Connections and Bandwidth for Low-Speed Trunks

Low-speed Trunks	Number of Connections (Cs)	Percentage of Total Bandwidth (Bt+Bc+Br)
64 kbps	32	7.5
128 kbps	64	6.3
192 kbps	96	5.9
256 kbps	126	5.7
320 kbps	160	5.5
384 kbps	192	4.4
448 kbps	224	5.3
512 to 2048 kbps	256	5

Note: In addition to the connection-oriented traffic that requires dedicated call control traffic, trunks can carry an unlimited number of connections in connection-less mode. These connections are then routed by the automatic network routing (ANR).

Computing the Total Bandwidth for Network Control Traffic

Network control traffic that is transmitted over trunks (50 and 256 connections per trunk) belonging to the control point (CP) spanning tree is computed as follows:

Example: 50 connections per trunk

$Bu+Bd=40*T+20*T = 60*T$

Bd results from:
$Bd=1800*0.01*Cg*T$
where $Cg=50/180*4=1.1$
Therefore $Bd=1800*0.01*1.1*T$

Example: 256 connections per trunk

$Bu+Bd=40*T+100*T=140*T$

Bd results from:
$Bd=1800*0.01*Cg*T$
where $Cg=256/180*4=5.68$
Therefore $Bd=1800*0.01**T$

Examples:

- For a 64-kbps trunk (32 connections per trunk) belonging to the spanning tree of a network with 50 trunks, the bandwidth required for network control traffic is 2.5 kbps.
- For a 512-kbps trunk (256 connections per trunk) belonging to the spanning tree of a network with 50 trunks, the bandwidth required for network control traffic is 7 kbps.

In the preceding examples, the total amount of control traffic is as follows:
- For a 64-kbps trunk belonging to a spanning tree (assuming an average number of 32 connections per trunk and 50 trunks in the network), 13% of the bandwidth (7.4 kbps) is required for NBBS control traffic.
- For a 512-kbps trunk belonging to a spanning tree (assuming 256 connections per trunk and 50 connections in the network), 5% of the bandwidth is required for NBBS control traffic.

Important

If a large amount of bandwidth is not required for NBBS control traffic on T1/E1, high-speed, and ATM trunks, you can increase the amount of bandwidth for low-speed trunks. For this reason, the total amount of bandwidth required for NBBS control traffic must be calculated as accurately as possible.

For example, if 200 connections are defined on each 64-kbps trunk and if there are 50 trunks in the network, then the total amount NBBS control traffic is equal to 21.6 kbps + 6 kbps or 42% of the bandwidth. This means that the percentage of bandwidth originally planned (15%) for NBBS control traffic is not sufficient.

Other Factors that Impact Bandwidth Requirements

To accurately evaluate the bandwidth requirements in your 2220 network, you must calculate for additional control traffic if you use either of the following options:
- Non-disruptive path switching
- Bandwidth adaptation mode.

Non-Disruptive Path Switching Requests

An NDPS request results in traffic (full-duplex control data flow) between the origin and the destination CAs of each connection on which NDPS is required. The data flow consists of (750 bytes+240 bytes)*Nbhops (number of hops) on the new path. Control messages are also sent on the old path but require less bandwidth.

NDPS requests are sent at the following intervals:
- 2.5 requests per second for very low-speed links
- 10 requests per second for all other links

Assuming three hops, 1500 bytes are sent per connection. This corresponds to 30-kbps bandwidth on very low-speed trunks at a rate of 2.5 calls per second. This means that when NDPS is performed, up to 50% of the bandwidth is required for the NDPS traffic exchange. On high-speed trunks, 120-kbps bandwidth is required.

Bandwidth Adaptation Traffic

Depending on the number of connections that simultaneously require bandwidth adaptation and on the type of lines (high, medium or low-speed lines), the amount of bandwidth required can vary from an acceptable level to an unacceptable level, such as when there is a large number of connections requiring bandwidth adaptation on low-speed lines.

Example: A given connection that requires bandwidth adaptation has the following characteristics:

- Each connection continuously tries to reach the necessary bandwidth by cyclically performing three bandwidth increases followed by one bandwidth decrease.
- The connection path includes three hops.
- The length of a control message is 1000 bytes.

Normal Mode

In normal mode, the bandwidth used by control messages sent during a bandwidth adaptation cycle varies from 1 kbps to 280 bps, depending on the decrease coefficient value. The duration of the bandwidth adaptation cycle per connection varies from 32 seconds to 112 seconds.

Slow Adaptation Mode

In slow adaptation mode, attempts to increase the amount of bandwidth are performed every 10 sampling periods. In a worst case scenario in which 2 increase attempts are followed by 1 decrease and then immediately followed by 1 increase, four bandwidth adaptation attempts are made in 64 seconds. This corresponds to the previously computed values divided by two: 500 bps, 400 bps, 320 bps, and 140 bps.

Maximum Bandwidth Reached Mode

No bandwidth increase can be attempted. The worst case scenario is when bandwidth increases are followed by immediate bandwidth increases that reach the maximum bandwidth. The same values as the ones given for the slow adaptation mode can be assumed.

- For medium-speed lines in normal mode, the low-speed values must be multiplied by two, resulting in 560 bps to 2 kbps of required bandwidth.
- For high-speed lines in normal mode, the low-speed values must be multiplied by four, resulting in 1.1 kbps to 4 kbps of required bandwidth.

These calculations show that 50 to 100 connections can require simultaneous bandwidth adaptation on high- and medium-speed lines, requiring:

- 50 kbps to 200 kbps of bandwidth on T1/E1 lines, which can be taken from the 15% of bandwidth originally reserved.
- Up to 400 kbps on a high-speed trunk, corresponding to less than 1.3% of the bandwidth on E3 lines.

These calculations also show that low-speed lines cannot support simultaneous bandwidth adaptation for 100 connections. Therefore, considering a worst case scenario of 1 kbps to adjust a connection during a 32 second interval and assuming a maximum trunk load of 5% due to bandwidth adaptation, only three or four connections can simultaneously require bandwidth adaptation on low-speed lines.

Control Processor Constraints

Another bandwidth requirement to take into account is the process necessary in the control processor in source connection adapters to compute the required increase and decrease in bandwidth and issue a request. When too many connections simultaneously request bandwidth increase or decrease, spacing mechanisms are used in the control processor to prevent the bandwidth adaptation process from monopolizing all the resources. Bandwidth adaptation requests are, therefore, delayed. This does not impact decrease requests, but can result in data discarding in the leaky bucket when an increase request is delayed for a long time.

> **Important**
>
> IBM recommends that you carefully study the traffic characteristics and select the appropriate connections for bandwidth adaptation, particularly when there are a large number of connections on very low-speed lines. Also, the limitation factor in bandwidth adaptation is not the actual number of connections configured in bandwidth adaptation mode, but the potential number of connections that can simultaneously request bandwidth increases and decreases.

Chapter 4. Internet Protocol Addressing and Control Point Spanning Tree

This chapter explains:

- The need for an Internet Protocol (IP) network.
- What you should know to plan for the IP addresses.
- The requirements for IP addressing within a 2220 network.
- How to plan for the Control Point (CP) spanning tree.

Why an IP Network Is Required

2220 network operation is based on message exchange using IP addresses between network management stations (NMSs) and Nways Switches. All Nways Switches, along with their Nways Switch Administration Station (NAS) and adapters, are organized as an IP network or IP subnetworks. The change control server (CCS), NMSs, and remote consoles can be directly attached to the service bus of an Nways Switch or indirectly attached through a router:

- When directly attached, their IP addresses belong to the same network (same addressing space) as the Nways Switches and are automatically allocated by the Nways Switch Configuration Tool Version 2 (NCT2).
- When indirectly attached through a router, they belong to another IP network (different addressing space). Their IP addresses are defined by the network planner and must be entered in NCT2.

The Nways Switch uses a service bus, which works as an Ethernet LAN, to exchange the operation management information between the NAS and the various adapters of the machine. Other exchanges of information can take place between any Nways Switch and NMSs, CCSs, or remote consoles. To allow such exchanges, an IP network is built from information entered via NCT2 at configuration time, using the lines that interconnect the machines. The IP network is strictly dedicated to the 2220 network management and administration, and Nways Switch services. Its hosts must *not* be used to handle any other IP traffic.

Except for the NASs, switched remote consoles, directly or indirectly-attached NMSs, CCSs, and remote consoles, which are called externally addressable hosts, none of these hosts can be directly addressable by the user.

Knowing the total number of existing (or planned) externally addressable hosts mandatory in order to choose the network IP address class, as explained in "Choosing a Class A, B, or C Network IP Address".

Choosing a Class A, B, or C Network IP Address

Because 16 to 24 bits out of the 32 available IP address bits are used by the network IP address, according to its class, the choice of class depends on the total expected number of externally addressable hosts in your network. The higher the class, the shorter the network address field and the more externally addressable hosts in your 2220 network. Actual figures related to the various possible options are given in Table 19 on page 46.

Dealing with Class A, B, or C Addresses

The choice of IP address class depends on the size of your organization and 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 very often directly related to the size of the organization.

If you already have a class A or B network IP address and want your 2220 network to be seen as a network of its own, while being accessed through your existing network IP address, you should give your 2220 network a subnetwork address. This is available only in class B, or in class A which is then used like class B for subnetworking.

The maximum number of IP addresses available for Nways Switches, NMSs, and CCSs, depends both on the network IP address class and the network mask. Table 19 gives the corresponding possibilities according to the address class and network mask.

Table 19. Externally Addressable Host Capabilities

Network Address IP Class	Subnetworking Available	Subnetwork 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	No	255.255.	32702
C	No	255.255.255	63
Note: Class A is supported as class B.			

Logical 2220 Networks and Subnetworking

If necessary, you can organize your Nways Switches into logical networks, or into subnetworks. Choose this option if:

- The 2220 network must be accessed using your existing network IP address and is given a subnetwork address.
- You want to group the Nways Switches according to organizational constraints (for example by geographical area). The various groups can be either logical 2220 networks, each with their own class C network IP address, or subnetworks, each with its own subnetwork IP address. All the subnetworks would share the same class B network IP address and network mask.
- You are running short of available addresses for a network expansion (additional Nways Switches).

There can be up to 16 logical IP networks in a 2220 network. All the network mask bits must be consecutive. The subnetwork addresses:

- Do not need to be consecutive

- Cannot use an all 0's or 1's patterns, which are reserved.

Obtaining a Network IP Address

To interconnect your network to other IP networks, the IP address of your network must be unique. Ask for it to the Network Information Center (NIC) by specifying:

- The address class you want to use
- The number of addressable hosts in your network, or the number of subnetworks.

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

Attaching User Stations

Remote user consoles, NMSs, and CCSs, are attached to their 2220 network through the service bus of an Nways Switch. This section deals with this attachment from the IP addressing standpoint. For considerations related to the physical connection, refer to "Linking the Change Control Server to the Network" on page 83 and "Attaching a Network Management Station to the NBBS Network" on page 77 .

The following two types of attachments are possible:

- Direct attachment, with two options:
  – The units are physically attached to each other (several hosts on a 10 Base2 connector, or only one host on a 10 BaseT connector)
  – The units are connected using a bridge.

  In both cases, the units belong to the Nways Switches IP network and their addresses are automatically allocated by the Nways Switch configuration station.
- Indirect attahement through a router. In this case, the attached items belong to a different IP network. Their addresses must be given to the Nways Switch configuration station.

The network management station, remote console, and router IP addresses must be only specified in the configuration of the Nways Switch which they are attached to. The change control server IP address must be defined via the NAS installation program in every client Nways Switch.

Note: It is recommended to use the indirect attachment in order to filter any propagation of broadcast IP traffic to or from the 2220 network.

Which IP Addresses are Important

The following IP addresses are important:
- 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 console, and CCS addresses, when indirectly attached.
- Local IP address for the switched remote Network Support Center (NSC) console.

In addition, for every Nways Switch, NCT2 generates IP addresses for all the adapters in the machine. The first 127 addresses (for class A or B networks) or 63 addresses (for class C networks) are reserved for adapters and broadcast purposes. Do not worry about these addresses, but being aware of them helps you understand the overall 2220 network IP addressing.

All the IP addresses previously mentioned (except those of the indirectly-attached NMSs and CCSs) are generated by NCT2. They use the bits left available by the network IP address, and the subnetwork address when applicable (class A or B only), as defined by the network mask and illustrated by Figure 16

Figure 16. IP Addressing Network Mask

The Nways Switch configuration station allocates the addresses as follows:

NAS The first available odd-numbered addresses taken in increasing sequence starting after the addresses reserved for the Nways Switch adapters (129 or 65, depending on the network address class B or C).

Switched remote consoles
For each Nways Switch, the even-numbered address immediately following the NAS address of the same Nways Switch.

NSC remote console local IP address
The upper available address (254 for class C, xx.254 for classes A or B).

> **Note:** xx (set to all 1's) is the part corresponding to the bits left free by the subnetwork address in the 3rd byte.

Directly attached NMS, CCS, or router
Addresses taken 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 NCT2. However knowing these rules help you define your needs in terms of network IP address class and network mask. You must know the network address to start with NCT2 (which generates the network mask) but if you want to make sure of the maximum number of Nways Switches the 2220 network is able to accommodate, give the network mask value to the network interconnection center (NIC) when applying for a network address.

Figure 17 on page 49 gives an example of IP addressing in a 2220 network with a class C IP address.

Class C address 192.12.97-Mask 255.255.255

Figure 17. Example of IP Addressing in a 2220 network

Note that in a 2220 network:

- Every IP address for NAS, remote consoles, directly attached NMSs or CCSs, and routers for indirectly attached NMSs and CCSs is unique.

- Adapter addresses (for TPAs and CPAs) are not unique. 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.

Using a Single Configuration Database

The mechanism for automatic IP address allocation requires all the addresses to be on a single NCT2 station. This ensures consistency of addressing and the uniqueness of the IP addresses when needed.

It is therefore necessary to use NCT2 on an Nways Switch configuration station to :
- Enter the IP network address and mask.
- Create all the Nways Switches of the network.
- Create the directly-attached NMSs and CCSs, and routers for indirectly-attached hosts.

You can also perform further configuration on the same station. However, the previously mentioned steps are mandatory to ensure correct IP address generation. The configuration files for the different Nways Switches can then be exported via file transfer protocol (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.

A 2220 network can be made of up to 16 logical IP networks. In this case:
- All the IP addresses of every IP logical network configuration must be defined in a single configuration database.
- The same Nways Switch configuration station can be used to prepare configurations for several logical IP networks, but each configuration must be distinct from the others.
- Any Nways Switch can belong to only one logical IP network at a time.

Setting the Routers and Externally Addressable Hosts

You must comply with the following requirements:
- All the directly-attached externally addressable hosts (NMSs, CCSs, and remote consoles), and routers, must run route information protocol (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 this request.
- The routers must be configured by entering the IP addresses generated by the Nways Switch configuration station, and the routing tables corresponding to the other attached networks.
- The routers must be configured so that all broadcast traffic is filtered, whether coming from other networks or from the 2220 network.

Preparing Nways Switch Configurations

Prepare the following information:

Network-Wide Definitions

- The network address and the maximum number of externally addressable hosts. It is recommended that you make provision for future network extensions. The mask are automatically generated from this information.

  These values, which are unique throughout the network, are requested by NCT2 for every Nways Switch.

- The switched remote console access IP address is computed by NCT2.

Nways Switch Definitions

In addition to the network-wide definitions, you must specify, for every Nways Switch, the physical location of:

- The control point (CP). Depending on whether the redundancy feature is present, give the address of the primary and optional backup modules (rack and slot).

- The IP gateway (rack, slot). NCT2 uses this information to build the internal IP network as explained in "Why an IP Network Is Required" on page 45.

Preparing for NAS IP Configuration

The data prepared in this section are used by NCT2 when creating the configuration of the Nways Switches. The configuration for every Nways Switch is then exported from the database of the Nways Switch configuration station and imported to the corresponding Nways Switch. When activating the configuration, the IP configuration of all the adapters is automatically set.

Therefore, the NAS IP configuration file is not updated by activating an Nways Switch configuration. This is done by service personnel at installation time, by running the NAS installation program. The installation program uses the IP information from the imported configuration and prompts the user for additional input.

Planning for the Control Point (CP) Spanning Tree

Once you have located the CP function by defining the CPAs or TCPAs (the adapters that will run the function), you must then plan for the exchange of 2220 network management IP messages through the network. This traffic uses 2220 network trunks that comprise the CP spanning tree.

Note: There is no direct relation between the CP adapters and the adapters of the trunk lines used by the CP spanning tree.

Why a CP Spanning Tree Is Used

The CP spanning tree is a model of the inter-Nways Switch links used for 2220 network management exchanges through the 2220 network. The CP spanning tree is automatically built and maintained using the best-performance trunks. The purpose of the spanning tree is to interconnect every node and to distribute the topology and directory services control messages over the selected trunks of the spanning tree. In other words, the 2220 network management exchanges IP messages through the selected trunks of the 2220 network that belong to the CP spanning tree. These IP messages are considered as non-reserved traffic.

Planning for the CP spanning tree involves selecting eligible trunks and defining the percentage of bandwidth that can be used.

If you decide to use the default trunk configuration, the spanning tree uses the highest-speed trunks.

Choosing the Trunk Lines for the CP Spanning Tree

On every Nways Switch, you must select at least one trunk line to be used in the CP spanning tree. Make the choice based on the following criteria:

Preferability
For more flexibility, you can define several trunk lines for the spanning tree and give them preferability levels from 0 to 15 (0 means not eligible for the spanning tree, 15 is the highest preferability). It is advised to assign a higher prefarability to the trunks that are really interesting. This includes:

- *Higher-speed trunks* for fastest connection setup and NDPS in order to get responsive network management
- *Reliable trunks* for minimized controll traffic delays and receoverires
- *Low-delay trunks* instead of satellites trunks which have increasing feedback delays
- *Cost effective trunks*.

Furthermore, when selecting the trunks and specifying the preferability levels, the location of the gateway to the network manager is to be considered. The outgoing trunks of the gateway node can be assigned a high preferability, so that the paths to every node's agent are as short as possible. Choosing such a configuration, the spanning tree looks like a star with the gateway located in the middle. However, for performance reasons, it is not recommended that the spanning tree has more then ten branches, even if up to 16 branches are possible.

Volume of management traffic
When assigning a trunk to the CP spanning tree, you define the percentage of the bandwidth that may be used for this type of traffic (non-reserved traffic) over the normal traffic. Refer to "Evaluating and Computing the Bandwidth" on page 38 for further information about bandwidth evaluation.

Congestion or blocking considerations
You must take into account the estimated traffic volume (reserved and non-reserved) over the selected trunks to avoid possible congestion. This congestion can consist either of non-reserved management traffic delayed due to the priority of reserved traffic, or normal non-reserved traffic delayed by too high a volume of non-reserved 2220 network management traffic.

Reliability and redundancy
One or more trunks (minimum of one) are allowed to the CP spanning tree depending on the level of reliability expected.

How NBBS Uses the CP Spanning Tree

The 2220 network management builds, maintains, and updates the CP spanning tree by using an algorithm that takes into account the way the previous items are defined in the various Nways Switch configurations. This is a dynamic process that does not require any action by you. The only way you can interact with this process is through the choice of eligible trunks, their preferability level, and the bandwidth that may be used.

Choosing the Management Access Nways Switch

The management access Nways Switch is the Nways Switch to which the network management station is attached. Therefore, all the 2220 network management traffic exchanged between the network management station and the Nways Switches of the 2220 network concentrates at this level. This must be considered when deciding which Nways Switch to use, and when defining the trunks to be used for the CP spanning tree for this Nways Switch.

Depending on the expected traffic, it may be advisable to dedicate the full capacity of a trunk to the CP spanning tree.

Chapter 5. Network Synchronization

This chapter:

- Helps you define the requirements of your network in terms of network synchronization.
- Explains the levels of clock accuracy and helps you select the reference clock that you need.
- Provides information to prepare the network synchronization plan.
- Helps you prepare the corresponding configuration parameters.

When and Where Network Synchronization Is Required

Network synchronization is required when the Nways Switches must provide the synchronization for attached constant-bit-rate devices such as:

- Private branch exchanges (PBXs)
- Time division multiplexing (TDM) switches
- Other equipments that use clocking from the physical layer (such as isochronous hubs).

Nways Switches providing network synchronization need at least one clock module (two if the redundancy feature is installed). The clock module accuracy level is stratum 3. This level does not provide enough accuracy for an acceptable synchronization, and an external reference synchronization signal must therefore be used. This signal, coming from a *reference source* (RS) is derived from a *primary reference source* (PRS); it is then provided to one Nways Switch, and propagated to the other Nways Switches.

The Nways Switches used for the RS propagation must be equipped with a clock module, even if they do not provide clocking to circuit emulation service devices, as shown in Figure 18 on page 56 and Figure 19 on page 57.

Figure 18 on page 56 shows a case where two synchronized devices (DTEs 1 and 2) rely on the Nways Switch they are attached to for their clocking. One Nways Switch receives a single RS and propagates it to the other one through a trunk line that interconnects them directly.

Note: The external and internal configuration mechanism specifies how the reference signal is propagated. The trunk side configured as *internal* determines the direction in which the reference signal is propagated.

RS

DTE
1

Line Clocking
from Nways Switch A

Nways
Switch
A

Synchronization reference
signal must be propagated

NBBS Network

Nways
Switch
B

Line Clocking
from Nways Switch B

DTE
2

Connection (CBR Traffic) between DTEs 1 and 2
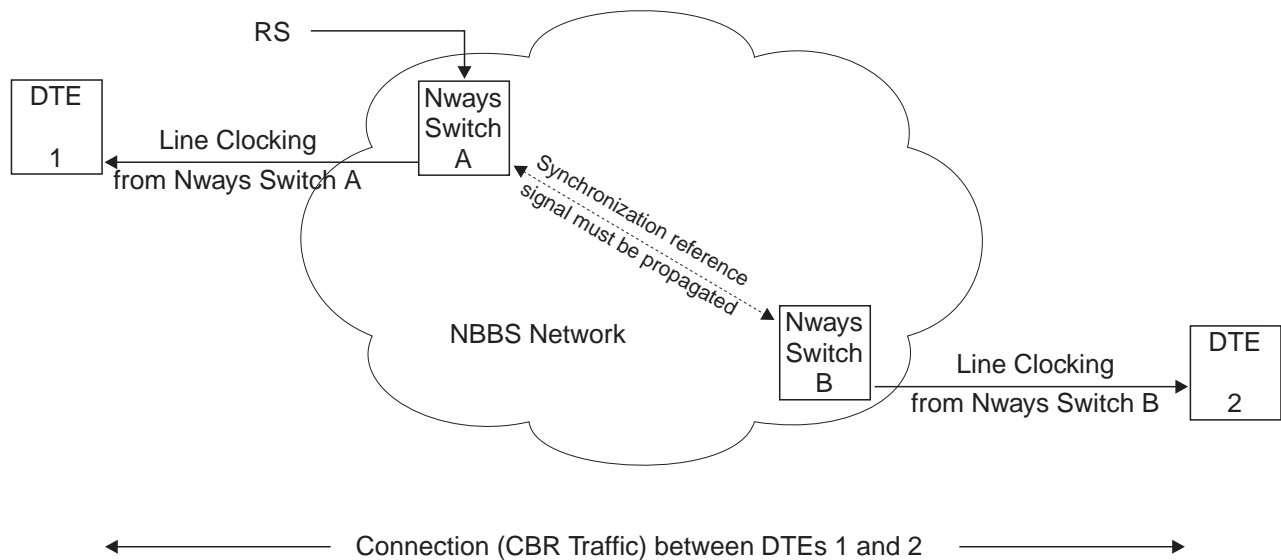
Figure 18. Single RS with Direct Propagation

Figure 19 on page 57 shows a more general case where the synchronization reference signal is propagated through an intermediate Nways Switch. The intermediate Nways Switch is usually not attached to any CES device, but because it is used to propagate the reference signal, it must be equipped with a clock module.

Line Config Window

Port or Trunk Line
defined with
External Clocking

Clock Reference Window

The Line carrying the
RS is defined as
REFERENCE 1

TK Line Config Window

TK Line defined with
Internal Clocking

TK Line Config Window

TK Line defined with
Internal Clocking

Nways
Switch
A

RS

Trunk Line

Synchronization reference
signal propagation

Nways
Switch
T

Trunk Line

Synchronization reference
signal propagation

Nways
Switch
B

NBBS Network

TK Line Config Window

TK Line defined with
External Clocking

Clock Reference Window

This trunk is defined as
REFERENCE 1, 2, 3, or 4

TK Line Config Window

TK Line defined with
External Clocking

Clock Reference Window

This trunk is defined as
REFERENCE 1, 2, 3, or 4

Figure 19. Single RS with Propagation via a Transit Nways Switch

Note: When the source of the reference clock is of a high quality and is local, it is
configured as *reference 1*.

For higher reliability, there can be several synchronization reference signals
entering several Nways Switches and propagated across the network to prevent
that an outage of a reference, Nways Switch, or trunk line used for propagation
impairs the network's synchronization. An example (without propagation) is shown
in Figure 20 on page 58.

RS ─────

DTE
1

Line Clocking
from Nways Switch A

Nways
Switch
A

No need for synchronization
reference signal propagation

NBBS Network

Nways
Switch
B

RS

DTE
2

Line Clocking
from Nways Switch B

◄──────── Connection (CBR Traffic) between DTEs 1 and 2 ────────►

Figure 20. Several RSs on Different Nways Switches

Network Synchronization Plan

The network synchronization plan tells how the various reference sources (RSs) are organized and how the synchronization reference signal is propagated to the Nways Switches that required it. The synchronization plan specifies for every network node the source of the primary reference clock. Depending on the network topology and the line reliability level, up to four reference clocks may be required.

When Clock Modules Are Required

In a 2220 network, the Nways Switches that need synchronization (and therefore must have a clock module installed) are:

- The Nways Switches with port lines attached to devices synchronized by the Nways Switch
- The Nways Switches used to extract the clock reference from an external source
- The Nways Switches used to propagate a clock reference, even if there is no port line attached to a constant-bit-rate (CBR) traffic source.

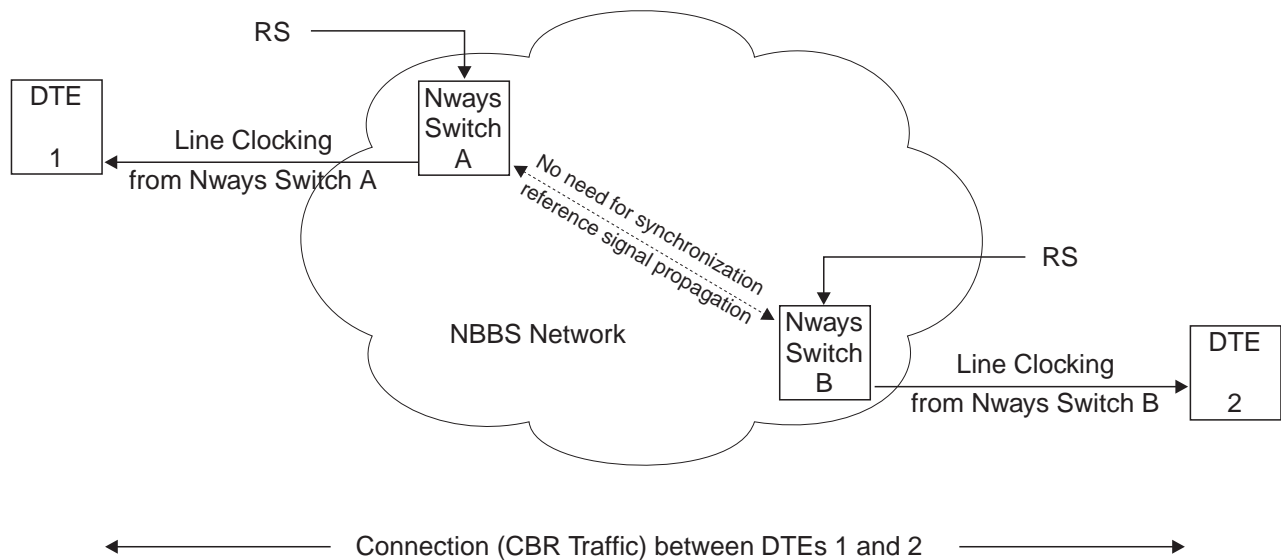Figures 18, 19, and 20 show examples of Nways Switches that must be equipped with clock modules. According to these examples, you can already list the Nways Switches that need hardware clock modules and clocking definitions. This information is useful when ordering machines, as explained in "Chapter 11. Ordering from IBM" on page 99.

When Clock Modules Are Not Required

When all the synchronized devices attached to the 2220 network receive reliable synchronization from outside the 2220 network (as shown in Figure 21 on page 59), the clock modules are not mandatory on the Nways Switches. However, for higher reliability, it is recommended to use clock modules and to establish a network synchronization plan.
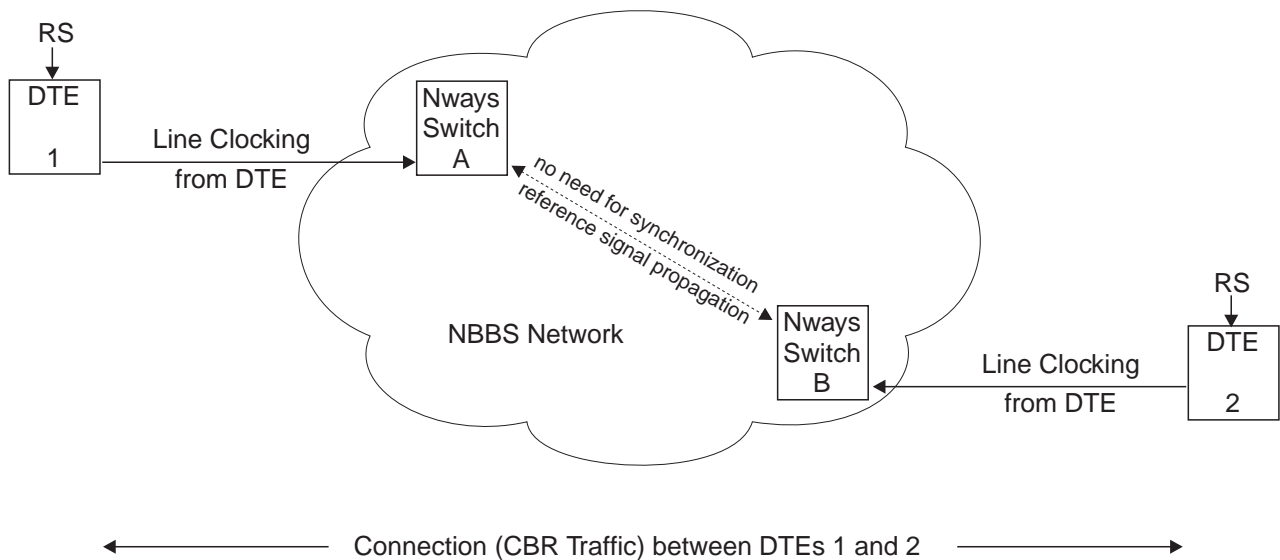
Figure 21. RS Supplied to the External Devices

Which Reference Sources Can Be Used

Reference sources (RSs) deliver synchronization reference signals derived from highly accurate and reliable equipment called primary reference sources (PRSs) whose typical accuracy is 1×10^{-11} or higher. The RS can be:

- Extracted from a line synchronized by the carrier, attached to an appropriate LIC connector
- Obtained from an external clock attached to the connectors located on a dedicated part of the tailgate. Only one external clock can be defined on an Nways Switch and can be defined as one of the four possible reference clocks.

The following lines can be used to deliver an RS:

- T1 (LIC 514) and E1 (LICs 515, 516, and 567)
- E2 and J2 (LIC523 and LIC562)
- T3 (LIC 513) and E3 (LIC 523)
- HSSI (only 49.152 Mhz)
- SONET STS-3c or SDH STM-1 (LIC 554)
- V.35, V.36, or X.21 (LIC 522).

  The clock speeds that can be used as reference clock from lines attached to a LIC 522 are one of the following:

  – 56 kbps, 64 kbps, 72 kbps, or 1.544 Mbps, or
  – Any multiple of 64 kbps within the 128 kbps to 2.048 Mbps range.

Check with country carrier for the line availability and suitability as an RS in your country.

Note: It is not recommended to define an unstructured G.703 line as a reference clock, since some clock failures are not detected and can result in clock synchronization problems. When structured lines are available, they should be defined as the first priorities of the reference table.

Propagating the Synchronization Reference Signal

To propagate the synchronization reference signal, an Nways Switch must have:

- A clock module installed. This is a hardware feature.
- The lines providing the synchronization reference signal configured as *Clock Reference* and *Clock Eligible*.
- A proper definition of the clocking for the lines used to propagate the synchronization reference signal.

The synchronization reference signal can be provided by the carriers. Depending on the country and the operator, a line can be timed by the carrier (synchronous service) or not (asynchronous service).

- Synchronous service allows use of the line as reference source, but does not allow it to be used as the line to propagate the synchronization reference signal to another Nways Switch.
- Asynchronous service is needed to propagate the synchronization reference signal to another Nways Switch.

Asynchronous Service (Supplied by Carrier)

As illustrated in Figure 22, an external source provides the synchronization reference signal to the Nways Switch A. This signal is propagated to the Nways Switch B using a trunk line that interconnects the two Nways Switches. This propagation requires the configuration of appropriate parameters as indicated in the boxes shown in Figure 22 and Figure 23 on page 61.
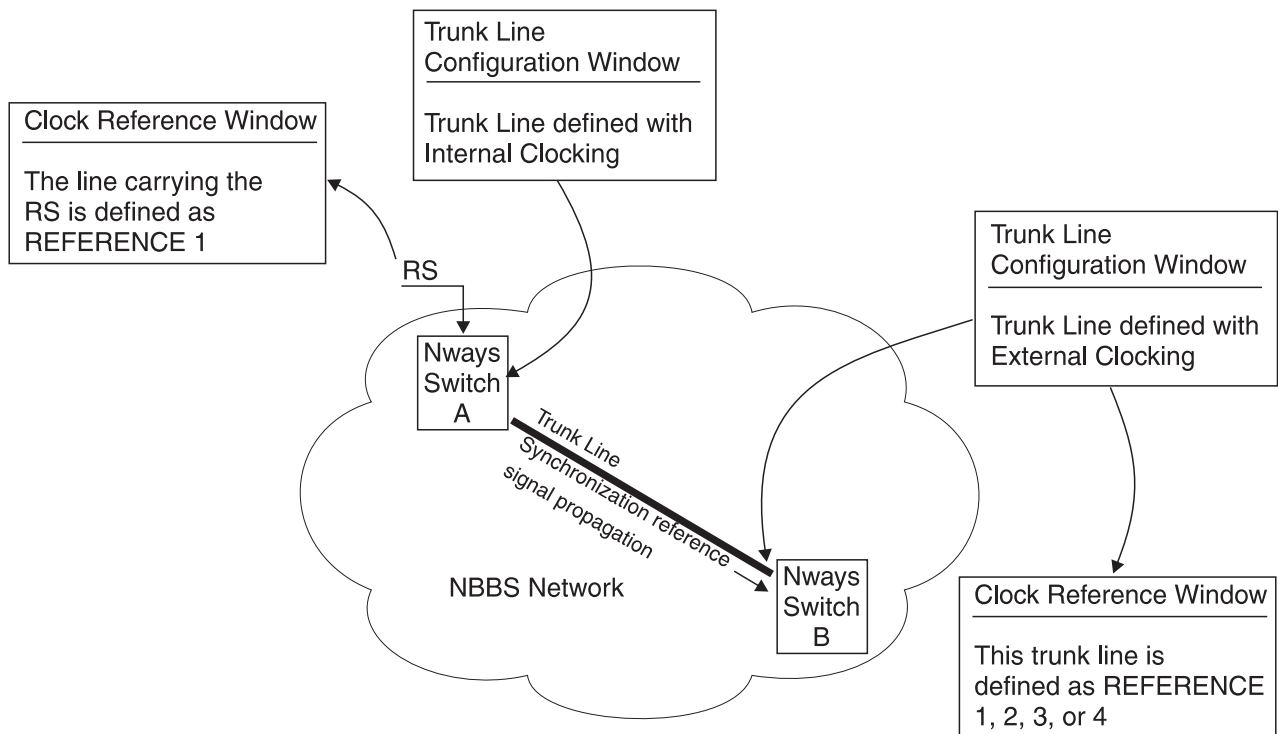

Figure 22. Synchronization Reference Signal Propagation through Asynchronous Service

Synchronous Service (Supplied by Carrier)

As illustrated in Figure 23, the carrier supplies the clock to a trunk line that interconnects two Nways Switches, A and B. The clock can be used as synchronization reference signal by one or both Nways Switches. This propagation requires the configuration of appropriate parameters as indicated in the boxes shown in Figure 23.

This type of trunk does not propagate the synchronization reference signal, which means that both sides must be considered at the same stratum level (when they both have the trunk defined as reference in their configuration).
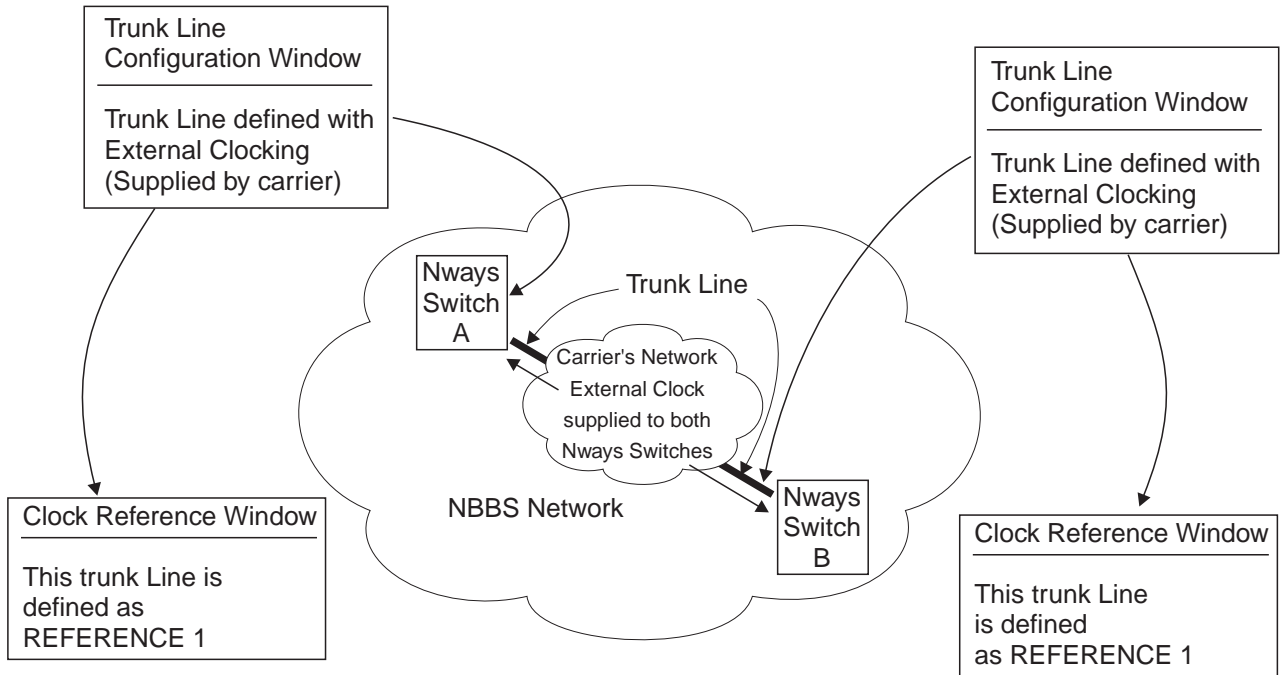
Figure 23. Synchronization Reference Signal from Synchronous Service

Contact your local carrier for conditions of clock availability and for the line type over which the synchronization reference signal can be obtained.

An Nways Switch can handle up to four synchronization reference signals to be defined as reference clocks (Reference 1, 2, 3, or 4). We recommend to use at least two reference clocks for higher reliability. However, be aware that using four reference signals can result in clock loops, depending on your network and line configuration, and result in synchronization problems.

When using synchronization reference signals from several carriers, it is recommended to monitor these references from a central site in order to detect any discrepancy between them.

Defining your Network Synchronization Plan

The network synchronization plan can be established either manually or by using network definition tools. The manual solution can be used for networks with a limited number of synchronized Nways Switches, but becomes difficult to handle when that number approaches 40.

To define your network synchronization plan, process as follows:

1. Draw the network topology (refer to "Chapter 3. Network Topology and Bandwidth Requirements" on page 37 for more information).

2. Identify the Nways Switches that must be synchronized

3. Identify the lines which are:

   - Synchronized by the carriers.

   - Transparent to synchronization reference signals.

4. Check their suitability for propagation of the synchronization reference signal.

5. Assign the levels of synchronization reference signal to each Nways Switch.

6. Draw the synchronization reference distribution links, one level at a time.

7. Check for possible timing loops and eliminate them.

Note: The higher-level node must be synchronized from a line coming either from a carrier or from a high-quality clock source to be connected to the external clock input.

Drawing the Network Topology

The network topology must show every Nways Switch and line with its identification as required for the configuration. Refer to "Chapter 3. Network Topology and Bandwidth Requirements" on page 37 for more information.

Identifying the Nways Switches that Must Be Synchronized

On the network topology map, identify:

- The Nways Switches that have port lines attached to CBR traffic sources.

- The transit nodes participating to the synchronization plan.

Identifying the Lines

Identify the lines which are:

- Synchronized by the carriers and which can be used to extract the RS (see "Synchronous Service (Supplied by Carrier)" on page 61).

- Not synchronized by the carriers and which can be used to propagate the synchronization reference signal throughout the network (refer to "Asynchronous Service (Supplied by Carrier)" on page 60).These lines are called transparent lines.

- Synchronized by two different reference sources which are provided by the carriers.

All these lines must be considered during the configuration of the Nways Switches to:

- Identify the lines used as clock reference

- Set the right clocking for the lines that propagate the clock.

Lines Synchronized by the Carriers

On the network layout chart, identify all the lines for which the carrier provides the clock. The clock source can be different depending on the lines. Several carriers or a same carrier can provide different services with different clock origins. In addition, certain lines can be a better choice as RS than others, owing to their clocking quality or the type of line. For these reasons, proceed as follows:

1. Sort out the lines according to the clock source.

   Identify all the lines that receive their clock directly from the same origin. Use the same color for these lines.

2. Check the quality of clocking and eliminate the unsuitable lines.

International lines are always synchronous. Therefore, take into account the geographical location of the Nways Switches to take advantage of the international links, which can reduce the need to propagate network synchronization.

Transparent Lines

Ensure that these lines are suitable for synchronization reference signal propagation. Check with the carriers the physical characteristics of the lines, and their using equipment that could not be transparent to the clock signals.

Assigning Levels of Synchronization Reference Signals

1. At the top of a chart, draw the lines clocked by carriers with respect to their clock origin, using color coding and draw the Nways Switches connected to them. Use the same color for the Nways Switch as for the line attached to it.

2. Below the Nways Switches, draw the other Nways Switches and the transparent links between them.

3. For every line attached to an Nways Switch, specify the smallest number of Nways Switches to cross before reaching the carrier (including the one to which the line is connected). For example, assign the value 1 to a line clocked directly by the carrier or via the external clock.

Now start handling the Nways Switches with the same color. If there are several clock sources (for example several plesiochronous islands in the network), repeat the process for every clock source.

Select the reference clock lines (reference clocks 1 to 4) with the lowest numbers defined in step 3. If there are several lines with the same number, select them according to the quality of the line, in decreasing order by type:

1. Optical fiber
2. Copper wire
3. Microwave lines.

Drawing the Synchronization Reference Distribution Links

Make a drawing like Figure 24 on page 64 to visualize the synchronization reference distribution paths among the various Nways Switches. This allows you to identify the name of each line, its physical location, and whether it is used as a primary or

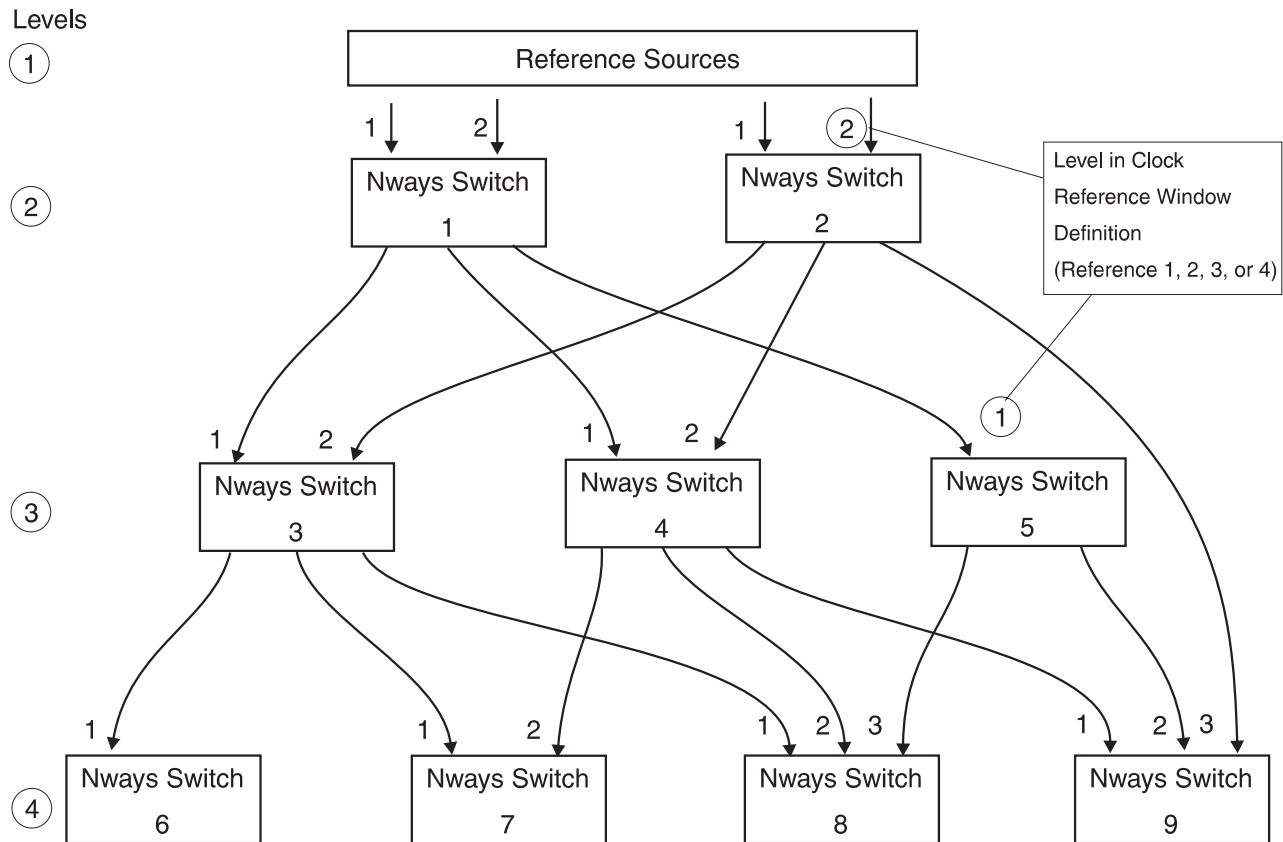secondary reference in every Nways Switch. This information is required to prepare the configuration inputs.

Figure 24. Example of Clock Distribution

Checking for Possible Timing Loops

A way to avoid timing loops is to keep a top-down hierarchical distribution. This means that the synchronization reference distribution must be done to a lower level in the hierarchy and that horizontal distribution (level n to level n) is not allowed.

Note: Acceptable timing loops can be drawn in. For example, a timing loop is acceptable when several different reference sources are defective at the same time.

Example of a Network Synchronization Plan

Figure 25 on page 66 shows a 2220 network where two groups of Nways Switches are synchronized from two different RSs. The two sources can be supplied through international links by carriers located in two different countries. In this way, the two Nways Switch groups become plesiochronous islands. There is no propagation of the synchronization reference signal between the two islands because the accuracy of their respective RSs allows smooth operation for CES traffic.

Monitoring Reference Sources

Synchronization problems can result in traffic disturbances that do not appear to be related to network synchronization. Any Nways Switch receiving network synchronization signals monitors its various inputs to detect problems that could impair the reliability of the synchronization. A failure on the input defined as **primary** reference for this Nways Switch can cause the **secondary** reference to become **primary** until the original primary reference recovers.

There is no such process at the network level. Therefore, it is recommended that you plan for centralized monitoring of the various RSs used in the network. Such monitoring will detect problems such as a drift between independent RSs supplied by different carriers and used to synchronize several plesiochronous islands. It is your responsibility to select and install the appropriate monitoring equipment obtained from specialized suppliers.
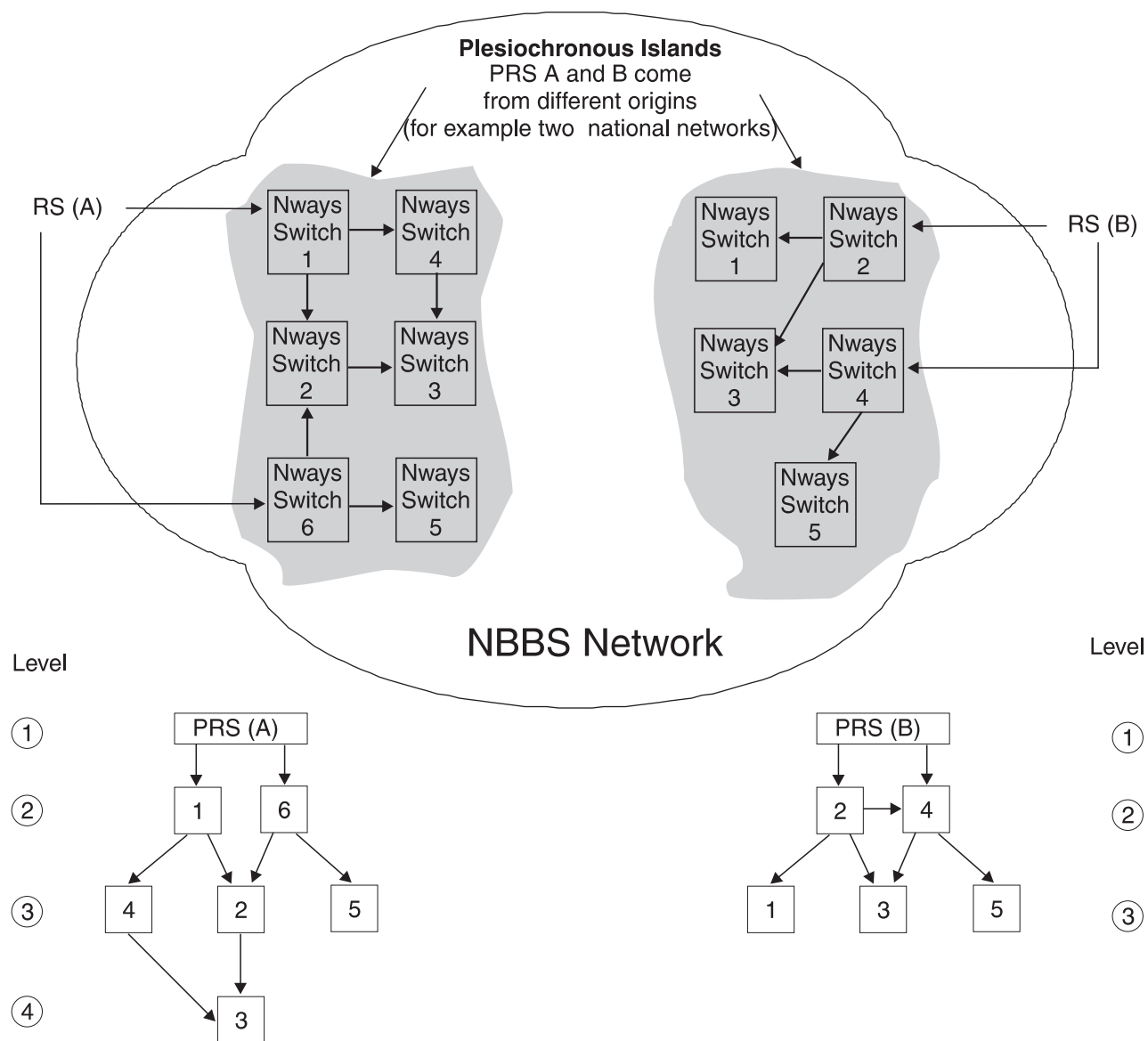
Figure 25. NBBS Network with Plesiochronous Islands

Preparing your Clocking Configuration Definitions

For every Nways Switch, answer the following questions :

- Is it to be free running (clock module installed without clock reference specified)? In this case, the timing accuracy is 4.6 x 10^{-6} (the clock module accuracy). This mode is not suitable for CBR traffic.

- Which physical interfaces receive the reference source clocks? If it is extracted from a line, you must specify:

  - The line identification

  - The slot number of the LIC supporting the line

  - The line number.

- For every clock reference, the rank defining it (1 to 4, assigned in step 3 on page 63) must be used as:

– Primary for rank 1
– Secondary for rank 2
– Monitored clock for ranks 3 and 4.

Note: The line defined with rank number 1 is used as reference clock when it is available. If the clock signal becomes unavailable or is degraded on this line, then the line with rank number 2 is used, and so on.

Figure 26 shows an example of an Nways Switch receiving an RS. It illustrates the relationship between the clocking signal and mode of the line whose clock is extracted to provide the synchronization reference and the driving of the clock module.
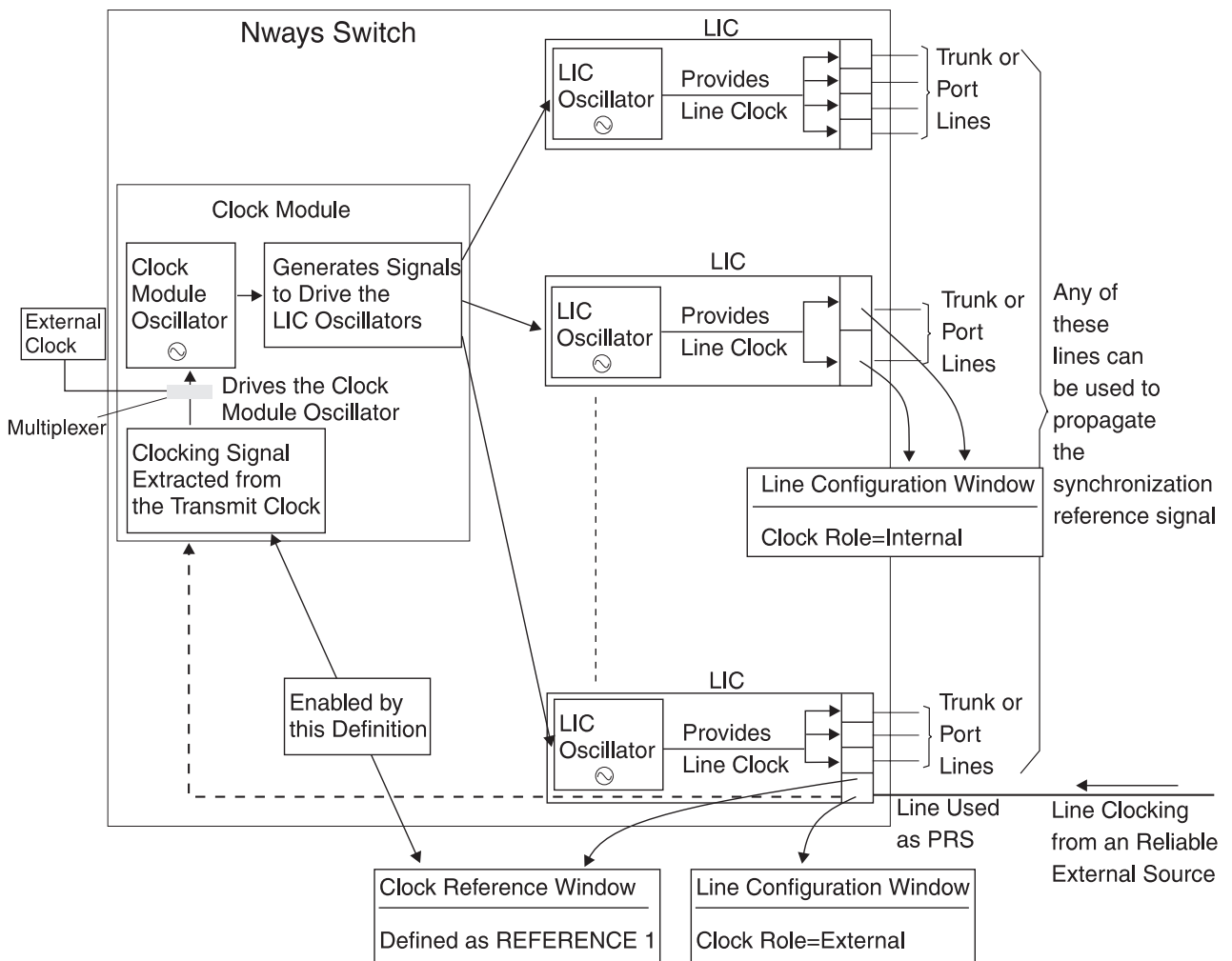

Figure 26. Example of an Nways Switch Receiving an RS

Note: Only one reference clock can be defined per LIC.

Reference Clock Frequencies

If a line of a low-speed LIC is defined as a clock reference, the frequency of the line is sent to the clock module. The LIC does not divide or multiply the received frequency.

The following frequencies (Table 20) are recognized from the LIC:

Table 20. Frequencies Recognized from the LICs

8.448 MHz	1.088 MHz
6.448 MHz	1.024 MHz
6.312 MHz	960 KHz
6.250 MHz	896 KHz
5.592 MHz	832 KHz
4.860 MHZ	768 KHz
4.296 MHz	704 KHz
2.048 MHz	640 KHz
1.984 MHz	576 KHz
1.920 MHz	512 KHz
1.856 MHz	448 KHz
1.792 MHz	384 KHz
1.728 MHz	320 KHz
1.664 MHz	256 KHz
1.600 MHz	192 KHz
1.544 MHz	144 KHz
1.536 MHz	128 KHz
1.472 MHz	72 KHz
1.408 MHz	64 KHz
1.344 MHz	56 KHz
1.280 MHz	8 KHz
1.216 MHz	4 KHz
1.152 MHz	1 KHz

The following frequencies (Table 21) are recognized from the external clock input:

Table 21. Frequencies Recognized from the External Clock Input

10.000 MHz
5.000 MHz
2.048 MHz
1.544 MHz

The clock signals provided on the external clock input must have the following format:

1. Sinus 1volt peak-to-peak
2. Square TTL level 50% duty cycle.

Part 3. Planning Network Management and Administration

Chapter 6. Network Management Station

This chapter:

- Describes the 2220 network management facilities.
- Helps you decide if you need one or more network management stations.
- Defines the prerequisites for the installation of the Nways 2220 Switch Manager
- Explains how to link the network management stations to the 2220 network and how to prepare the connection.

The resources in a 2220 network are managed by the programs shown in Figure 27 on page 72:

- The 2220 network is managed using the IBM Nways 2220 Switch Manager for AIX (2220 Switch Manager) running on a RISC System/6000 workstation.
- 2220 nodes are managed locally by the Nways Switch Control Program that is updated from a RISC System/6000 workstation using IBM NetView Distribution Manager for AIX (NetView DM/6000).
- The 2220 nodes in your network are remotely configured using the Nways Switch Configuration Tool Version 2 (NCT2) running on an OS/2 or AIX workstation.

Note: If you run all three management programs on AIX, you can use the same RISC System/6000 workstation, providing it has sufficient storage space and processing power.

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Figure 27. The IBM Nways 2220 Switch Manager for AIX Network Management Facilities

Nways 2220 Switch Manager: Main Functions

The IBM Nways 2220 Switch Manager for AIX program (2220 Switch Manager) runs on TME 10 NetView for AIX Version 5 or TMN 2.2. The 2220 Switch Manager allows you to manage Nways Switches using a set of management functions based on the Common Management Interface Protocol (CMIP). The network management functions:

- Run in a client/server environment.
- Provide distributed management through NetView for AIX workstations for improved network availability.
- Provide fault management, accounting management, performance management, operational control, and automation capabilities.

- Treat alarms: filtering, thresholds, discrimination, and logging of alarms.
- Provide topology maps that show Nways Switches and links presented as color-coded icons.
- Show path and recompute path for ATM connections
- Provide frame-relay performance management through specific frame-relay counters.
- Query, start, stop, and reroute NBBS connections.
- Allow you to collect, retrieve, and log connection statistical information that can be used by your accounting and network planning applications.
- Allow large backbones to be partitioned into separately managed subnetworks.
- Provide security files to define accesses per category of operators.
- Manage up to 200 Nways Switches of medium size.

New network management functions have been added to 2220 Switch Manager Version 1 to allow you to:
- Import and export 2220 configuration files.

  By importing a 2220 configuration, you can install new configuration settings in a 2220 node. The new configuration is used the next time the node is restarted.

  By exporting a 2220 configuration, you copy the configuration database of a 2220 node to the hard disk of the Nways Switch administration station (NAS). You must then send the configuration file to the workstation running the Nways Switch Configuration Tool Version 2 (NCT2) so that it can be used as the new configuration of a 2220 node.
- Customize the relative importance given to the status of individual resources in a node and the way they are combined to produce the compound status displayed by the color of the node icon.
- Change the color of a resource icon to acknowledge that a network operator has begun troubleshooting a problem on the resource. You can also undo the acknowledgment so that the resource redisplays the color of its actual status in the network topology map.
- Remove a failing resource (*unmanaging*) from network management so that its status is not taken into account in the calculation of the compound node status. The color of the resource icon changes to show that it is no longer managed from the network management station. Network management commands are sent to the resource only after the network operator has restored normal network discovery functions for the resource.
- Display progress messages during rediscovery of the network topology
- Manage two levels of Nways Switch Control Program code from the network management station; that is, updating and activating the version of inactive code or reloading the current version (if necessary).
- Forward alarms received on the network management station to an SNMP platform, such as HP/OpenView or NetView for AIX, so that the events can be viewed as SNMP messages.
- Reset network adapters using an AIX command script from a telnet session or when NetView for AIX is not running.
- Activate and deactivate network trunks using an AIX command script from a telnet session or when NetView for AIX is not running.
- List all the trunks for a given 2220 node using an AIX command script from a telnet session or when NetView for AIX is not running.

The 2220 Switch Manager uses the OSI Common Management Interface Protocol and Common Management Interface Services (CMIP/CMIS).

Planning the Number of Network Management Stations

There must be at least one network management station in your network. However, according to the size and characteristics of your network and your administrative organization, you may need to use more than one network management station as in the following cases:

- You have a large network. The actual number of Nways Switches that can be used depends on the size of the Nways Switches (number of ports, trunks, adapters, and lines).
- Your network covers more than one geographical region.
- Your network covers more than one administrative region.

You can use the network management station in the following ways:

- As a unique NMS that controls all Nways Switches in the network
- As one of several NMSs that share control of a group of Nways Switches to:
  - Provide different control points for your network
  - Run customized 2220 Switch Manager applications, such as accounting, performance monitoring, and alert and error messages.
  - Serve as a backup station.

  Note: The cases listed above are examples of how to use the network management station to distribute administration tasks. All network management functions, however, are available on each network management station.

To customize 2220 Switch Manager on a network management station, a list of the managed Nways Switches is necessary. See "Customizing the Nways 2220 Switch Manager" on page 78 for more information.

Network Management Station: Software Requirements

The software required for the network management station is as follows:

- IBM AIX V4.1.5 (5765-393) and NetScape V3.1 or IBM AIX V4.2 (5765-655) that includes NetScape V3.1
- One of the following platforms:
  - TME 10 NetView for AIX V4.1 or V5 (5697-NVW)
  - TMN 2.2 Support Facility V2.2 (Support Facility 5799-QLN).

An Internet connection server V4.1 (5697–B94) is optional.

Note: For the latest updates and user information about the RISC System/6000 operating system, see **http://www.rs6000.ibm.com/software**.

For the latest user information about TME 10 NetView for AIX and TME 10 Distributed Monitoring, see **http://www.tivoli.com**.

Planning for the Client/Server Environment

When you use the network management station in a client/server environment, the software requirements described in the previous section apply only for the *server* network management station. For each additional *client* network management station running on a separate RISC System/6000 workstation, refer to *NetView for AIX Installation and Configuration* (SC31-8163) or *TMN 2.2 General Information* (GT01-0458), according to the platform used in the management station.

Planning for the Web Browser Interface

To use the web browser interface provided by 2220 Switch Manager, you must have:

- IBM Internet Connection Server Version 4 Release 1 as a prerequisite in the server station.
- Netscape Version 3 Release 1 running on AIX 4.1. When running on AIX 4.2, Netscape is already included.

Note: The Internet Connection Server must be installed before you install 2220 Switch Manager. However, if you plan to install the Internet Connection Server in a network management station where 2220 Switch Manager is already installed and running, refer to the 2220 Switch Manager README file for instructions on how to configure the Internet Connection Server.

For the most up-to-date information on the Internet Connection Server, see **http://www.ics.raleigh.ibm.com**.

Hardware Requirements: Determining the Network Management Station Model

This section helps you identify the hardware configuration you need for the network management station you use to manage your 2220 network.

The management of a 2220 network is based on the common management information protocol (CMIP) which is an agent-manager architecture using object technologies.

Different elements of your 2220 network such as adapters, ports, and trunks are represented by objects. The performance of the network management station directly depends on the total number of objects in your 2220 network.

Using the following tables and according to your 2220 network configuration, you can determine for the network management station:

- The RISC System/6000 workstation model.
- The amount of random access memory (RAM) and disk storage.
- The SPECint95 rating parameter which reflects the processor performance on integer calculation. The higher the rating, the better the performance.

You can access the latest SPECint rating tables for the RISC System/6000 workstations and servers on the following World Wide Web server: http://www.rs6000.ibm.com

"Ordering the RISC System/6000" on page 77 will help you to summarize the characteristics of the RISC System/6000 workstation to be ordered.

Determining the Number of Objects

Table 22 allows you to determine the number of objects in your 2220 network managed by the network management station. If the network management station manages several 2220 networks, you must take into account the elements of all of them. To do so, you must also take into account the routers managed by RABM. Perform the following steps:

- In the second column, write the number of elements you have in your 2220 networks.
- Multiply each number by the factor indicated in the third column to obtain the number of objects and write the result in the last column.
- Once you have calculated the number of objects for all elements, add all figures of the last column to obtain the total number of objects. Write the result in the last line of the table.

Table 22. Number of Objects

Elements	Number of Elements	Multiplying Factor	Number of objects
NBBS Network(s) managed by the network management station		x 5	
Nways Switches		x 5	
Racks (Model 300, 500, or 501)		x 8	
Switch Modules		x 1	
Adapters		x 1	
LICs		x 1	
Physical Lines		x 1	
Logical NBBS Trunks		x 8	
Routers		x 20	
Total Number of Objects in Your NBBS Network			

Determining the RISC System/6000 Model and the RAM You Need

Table 23 on page 77 allows you to determine the RISC System/6000 Model and the RAM you need. To do so, perform the following steps:

- Look at the first column to select the line corresponding to the total number of objects you calculated in Table 22.
- The basic RAM figure (fourth column) is given for a single Nways 2220 Switch Manager operator.
- If you plan to have additional Nways 2220 Switch Manager operators, use their number N to calculate the RAM needed per additional operator (fifth column).
- Add the basic RAM and RAM per additional operator to obtain the total RAM needed and write the result in the sxth column.

Table 23. RISC System/6000 Model

Total Number of Objects in Your NBBS Network	Clock Rate (Minimum Recommended)	SPECint95 Rating (Minimum Recommended)	Basic RAM Including One Operator	RAM per Additional Operator	Total RAM Needed	Example of RISC System/6000 Model
0 to 10000	80	2.20	128MB	N x 64MB		250/410
10000 to 20000	80	2.20	256MB	N x 96MB		250/410
20000 to 35000	77	3.84	512MB	N x 160MB		SP2/59H

Notes:

1. Total calculated in the previous table.
2. You must add 64MB to the basis RAM if you plan to have more than 500 connections in one or more nodes of your network.

Ordering the RISC System/6000

Once you have filled out the previous tables, order your network management station with the following characteristics:

- A RISC System/6000 model as defined by using the Table 23, with at least the indicated clock rate and SPECint95 rating.

- Total amount of RAM calculated in Table 23.

  The minimum memory required manage a small network (less than three nodes) is 64 MB. More RAM must be added according to the number of nodes to manage. The additional memory is about 64MB for each additional operator, minimum or above depending on the number of maps manipulated.

- A minimum disk space of 2GB.
- An additional disk space of 1GB for the accounting file.
- In the case of a large network, a 10MB Ethernet adapter with an appropriate disk drive.
- A Level 2 cache
- A CD-ROM drive.
- One of the following:
  - A 8 mm tape drive
  - A 4 mm tape drive.

Attaching a Network Management Station to the NBBS Network

Figure 27 on page 72 shows that the network management station is attached to your 2220 network via an Ethernet LAN connected to the tailgate of one of the Nways Switches. This Nways Switch is called the *management access Nways Switch*. This tailgate has both a 10Base2 and a 10Base-T connector, supporting the two types of physical media that can be used for the LAN. This LAN connection can be either direct or through a router (required if you use a 10Base-T connector).

The communication between the network management station and its Nways Switches uses TCP/IP. Refer to "Chapter 4. Internet Protocol Addressing and Control Point Spanning Tree" on page 45 for more information about the different ways this LAN can be configured.

Attaching the network management station to your 2220 network involves planning for:

1. The physical connection of the station
2. The customization of the Nways 2220 Switch Manager.

Planning for Physical Connection

The NMS is connected via a LAN to one of the Nways Switches (management access Nways Switch).

- An Ethernet LAN is used with TCP/IP. At installation time, you must be prepared to link the NMS to the network management access station over an Ethernet LAN.
- Connection can be direct or via a router. There is a limit of 25 stations directly attcachable to the Ethernet LAN used for your 2220 network. Due to the amount of NBBS traffic on the LAN, it can only a limited number of stations in order to operate efficiently. Because of the 25-station limit, you have to use one or more routers to interconnect the change control server, network management station, remote console(s), the entry point Nways Switch, and other stations.

Installing the Nways 2220 Switch Manager

For detailed information on how to install the Nways 2220 Switch Manager, refer to the *IBM Nways 2220 Switch Manager for AIX Installation Guide*, SH11-3086, delivered with the Nways 2220 Switch Manager.

Customizing the Nways 2220 Switch Manager

You must plan for:

- Configuring the IP addresses and routing tables
- Defining the Nways Switches managed by the NMS
- Customizing registration files and timers.

Note: Remember that the directly-attached NMS must run RIP in passive (listening) mode, and the routers, when used, must filter any propagation of broadcast traffic (refer to "Chapter 4. Internet Protocol Addressing and Control Point Spanning Tree" on page 45).

Using the Nways 2220 Switch Manager

Refer to the *Nways Switch Manager User's Guide* online manual delivered with the Nways 2220 Switch Manager.

Attaching a Network Management Station to Local Area Networks

As shown in Figure 27 on page 72, the network management station can be attached to one or more local area networks (LANs) via routers. You need the appropriate communication adapters in the RISC System/6000 in addition to the adapter needed to connect the network management station to the 2220 network.

Attaching Other Network Management Stations to the Network

If you want to attach another network management station to your 2220 network, you must define another Nways Switch as management access Nways Switch. This network management station must be connected to the management access Nways Switch through a router or direct LAN attachment. Only one network management station can be attached to a management access Nways Switch. Each network management station will manage the Nways Switches that you have defined to it. We recommend that you to define all your Nways Switches to each network management station so that each can manage your 2220 network.

Chapter 7. Code Distribution and Updates

This chapter describes the change control server (CCS) that runs on a RISC System/6000 workstation and provides the following information:

- Startegies for planning code distribution based on the following questions:
  - Is more than one change control server needed? Two or more CCSs can be used to optimize your code distribution depending on the structure and size of your 2220 network.
  - Will the CCS be installed on the same RISC System/6000 workstation as the Nways 2220 Switch Manager, or is to be on a workstation dedicated to the CCS?
  - How many levels of code should you keep in the CCS?
- CCS disk storage requirement
- How the CCS can be connected to the 2220 network and how to prepare the connection
- Procedure for configuring a CCS and its client stations.

For setting up the RISC System/6000 workstation and its pre-requisite programs, refer to the documentation supplied with the RISC System/6000 workstation.

Change Control Server

The change control server (CCS) handles Nways Switch Control Program updates in a 2220 network. The Nways Switch Control Program is loaded on the NAS disk when you receive the Nways Switch. After installation, the CCS handles all the upgrades and program change files for the Nways Switch Control Program.

To perform these tasks, the CCS uses the NetView Distribution Manager for AIX (NetView DM/6000) or TME 10 Software Distribution. Both programs run on a RISC System/6000 workstation.

Ready to Go at Installation

The RISC System/6000 workstation that you are going to use as the change control server must be operational and set up with the necessary programs before the installation of the network management station and the Nways Switches can start.

Dual Code-Level Management

Dual-code level management is a function of the Nways Switch Control Program available starting from level V2R1. You can use it from the change control server through NetView DM/6000 scripts to update the Control Program on the NAS and activate the new code level.

Hardware Requirements

The change control server is a RISC System/6000 POWERstation or POWERserver system.

The memory and hard disk requirements given here are in addition to the software prerequisites listed in "Software Requirements". When the CCS and the NMS are installed in the same workstation, their respective memory and hard disk requirements must be added. Refer to "Chapter 6. Network Management Station" on page 71 for details on NMS requirements.

Hard Disk Storage

You need 3 GB of disk storage for a CCS with up to 400 client stations (NASs) to distribute the Nways Switch Control Program.

Random Access Memory (RAM)

The CCS function requires a minimum of 16 MB of memory.

Ethernet High Performance Network Adapter and Cable

This attachment must be the NetView DM/6000 default port.

Tape Drive

One of the following is required:
* A 8 mm tape drive
* A 4 mm tape drive
* A CD-ROM drive.

Software Requirements

In order to use a RISC System/6000 workstation as a CCS, the following programs must be installed:
* IBM AIX V3.2.5 or higher (5765–030)
* IBM AIXwindows Environment/6000 V1.2.5 (5601–257)
* TME 10 IBM Software Distribution for AIX V3.1.3 or higher (5697–SWD)

CCS and NMS Installed on the Same or Different Workstations?

The CCS and NMS can be installed on separate workstations or (for smaller networks) on the same workstation. If you install CCS and NMS on the same RISC System/6000, you must set up the station as a network management station (see Chapter 6. Network Management Station) with the following software requirements:
* At least one gigabyte of disk storage
* NetView Distribution Manager for AIX.

> **CCS and NMS Installed on the Same Workstation**
>
> If you install CCS and NMS on the same workstation, you can also perform non-Nways Switch management tasks provided that the station has sufficient storage, memory, and programs to support the NBBS tasks.

Installing the Change Control Server

For the information about installing NetView DM/6000, refer to the documentation listed in "Bibliography" on page 143.

Linking the Change Control Server to the Network

Connecting the CCS to your new 2220 network involves planning for the following tasks:

1. Connecting a CCS via a LAN to a network management station and an Nways Switch (access point). Note that:

   - An Ethernet LAN is used with TCP/IP. At installation time, you must be prepared to link the CCS, NMS, direct-attached remote consoles, and the network management access station together over an Ethernet LAN.

   - Connection can be direct or via a router. There is a limit of 25 stations directly attachable to the Ethernet LAN used for your 2220 network. Due to the amount of NBBS traffic on the LAN, it can only have a limited number of stations in order to operate efficiently. Because of the 25-station limit, you have to use one or more routers to interconnect the CCS, NMS, remote console, the entry point Nways Switch, and other stations.

2. Configuring the IP addresses (as defined by the NCT2) and routing tables for the TCP/IP default port, CCS name (as change control server), and LAN authorization levels.

   The CCS IP address (either defined by the NCT2 for a directly attached CCS or defined by the user for an indirectly attached CCS) must be set in the IP configuration tables, for example by using the System Management Interface Tool (SMIT).

3. Configuring NetView Distribution Manager for AIX by defining:

   - User IDs for administrators (FNDADMN),
   - Optionally, user IDs for NASs (FNDUSER). NASs are normally unattended.
   - Target definition (NASs).

Refer to the Nways Switch Control Program README file for detailed information and procedures on Nways Switch Control Program updates.

Chapter 8. Remote User Console

This chapter describes how to use a remote user console and provides the following information:

- Hardware and software requirements of a remote console
- How to install the Resource Control program on a remote user console

What a Remote User Console Is

A *remote user console* is a workstation running OS/2, TCP/IP, and the Nways Switch Resource Control program (a subset of the Nways Switch Control Program). The remote console can be linked to any Nways Switch administration station (NAS) to remotely operate and service an Nways Switch. The link can be through:

- A switched line using a modem. To establish the connection you need:
  1. The public switched network telephone number of the destination modem. The modem is connected to the NAS of the Nways Switch you want to access.
  2. The IPR1 address for the network. It is an IP address defined during the configuration. This address is unique for a given 2220 network.
- A connection to the service bus (a dedicated Ethernet LAN) of an Nways Switch. The remote user console can then address any NAS of the 2220 network through its access Nways Switch.

To remotely manage an Nways Switch, you must know the IP address of the switched remote console. This address is the address of the Nways Switch NAS + 1. The NAS address is an odd value and the associated switched remote console address is an even value. All the addresses are expressed in the dotted decimal format. Any NAS can be used as a remote user console for other Nways Switches in the same network or subnetwork.

Nways Switch Resource Control

The Nways Switch Resource Control program is a component of the Nways Switch Control Program that can be downloaded to a remote console from the change control server. This program provides the graphical user interface and functions used from a NAS to manage the resources in an Nways Switch.

When used from a remote user console, the Nways Switch Resource Control program allows you to remotely operate an Nways Switch.

Remote User Console and Configuration Station

The configuration station used to create a centralized configuration database of your network under OS/2 can be installed on a remote user console.

The configuration station running under AIX cannot be installed on a remote user console.

Remote User Console and NAS Password Management

A remote user console can be used to remotely manage the NAS access passwords. This task is assigned to a *password administrator* who sets and

changes the passwords on each NAS or remote user console in the network. (For details, refer to "Passwords for NAS Remote Logon" on page 91.)

Hardware and Software Requirements

Hardware Requirements

- IBM Personal Computer PS/2, or compatible, workstation with:
  - 486 SX33 or DX33 processor, or faster
  - 16 MB of random access memory (RAM)
  - 3 MB of free disk space.
- Communication equipment. One of the following:
  - An IBM 7857 modem, or Hayes-compatible asynchronous modem (9.6 kbps, 8 bits, no parity, 1 stop)
  - A LAN attachment.

Software Requirements

- IBM OS/2 2.11 or higher
- TCP/IP V2 with the corrective service diskette (CSD) UN64092 or higher
- The remote Nways Switch Resource Control application transferred from the change control server.
- When the remote user console is used as configuration station:
  - Nways Switch Configuration Tool Version 2 (NCT2)
  - IBM DATABASE 2 OS/2 (DB2/2) Version 2.1

Using a Remote User Console

Figure 28 on page 87 shows an example of how remote user consoles are used in a 2220 network.
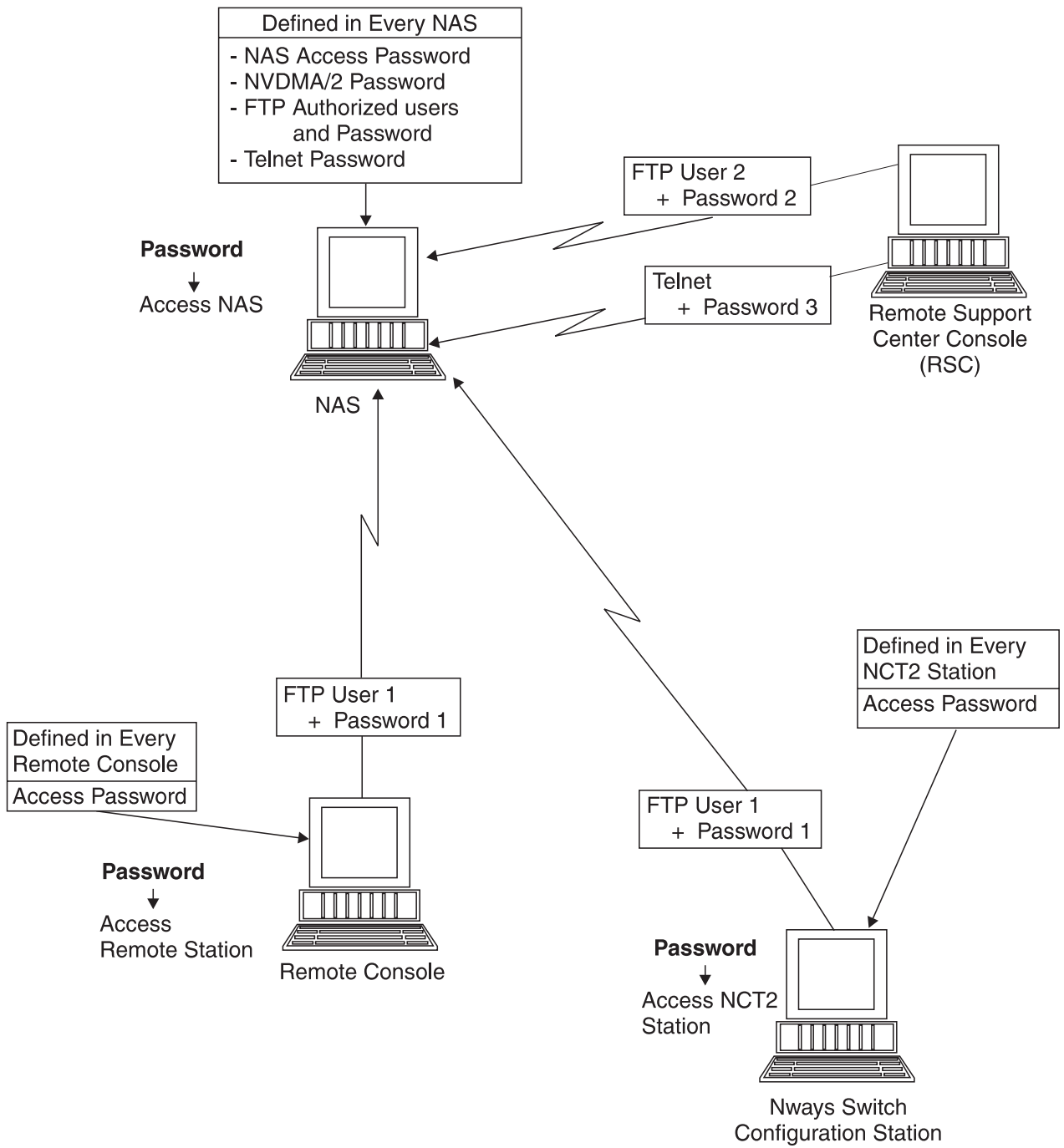
Figure 28. Example of remote user Consoles

Chapter 9. Network Security

This chapter describes the passwords and authorizations that you need to set to provide different security levels in your network.

Passwords are required to access:

- Network management functions
- Nways Switch administration stations (NASs) from user remote consoles or IBM Network Support Center (NSC).

Access authorizations are required for:

- Code distribution and update (CCS and its clients)
- File transfers from the NSC (transmission of Control Program changes).

Security at the Nways Switch Level

Passwords and authorizations control the access to certain network functions. Plan your passwords and authorizations to ensure the security of the Nways Switches in your 2220 network.

Table 24 and Table 26 on page 90 describe the passwords and other information required to perform different network management tasks.

Table 24. NAS Passwords

Password	User	Other Information Needed
Access password	Local NAS user, password administrator, IBM NSC	None
NCT2 password	Local NAS user	None
FTP userID and FTP password of every authorized IP host	Any user authorized to FTP, such as: • Network operator • Network planner • IBM Network Support Center	None

Table 25. NCT2 Passwords

Password	User	Other Information Needed
Access password	Network planner	None
NCT2 password	Network planner	• Switched PSN number to send configuration (if not connected through a LAN) • FTP userID and FTP password

Table 26. Remote Console Passwords

Password	User	Other Information Needed
Access password	Possible remote console users such as: • Network operator • Service personnel • IBM Network Support Center	• Switched PSN number to send configuration (if not connected through a LAN) • FTP userID and FTP password • IPRx address (refer to "Chapter 4. Internet Protocol Addressing and Control Point Spanning Tree" on page 45) • Remote console IP address for the Nways Switch to reach (refer to "Chapter 4. Internet Protocol Addressing and Control Point Spanning Tree" on page 45)
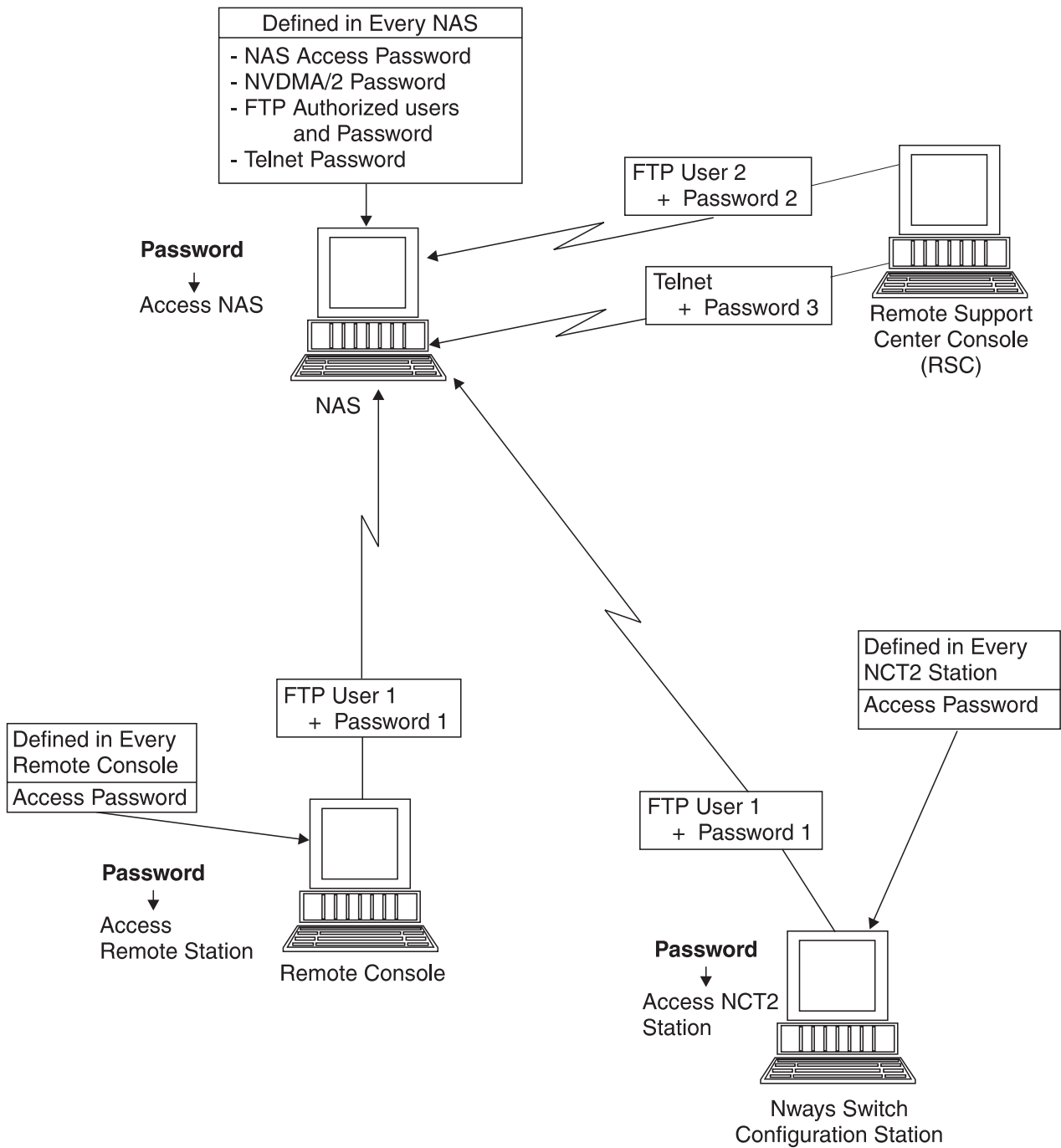
Figure 29. Summary of the Passwords and Authorizations at Nways Switch Level

Passwords for NAS Remote Logon

Passwords can be used in order to restrict access to the NASs.

Resource Control Program

Two versions of Nways Switch Resource Control (local and remote) are available in the Nways Switch Services folder on the NAS desktop.

Local Resource Control

No password is required to access the local version of the Resource Control that is permanently running on the NAS. This means that any user can perform certain functions, such as displaying the status of an adapter or a line attachment.

Remote Resource Control

The remote version of the Resource Control is used when accessing a NAS from a remote user console or from another NAS.

NAS Remote Logon

There are three access levels for the NAS:

1. The **operator** level authorizes the user(s) to locally or remotely run the NAS functions. An operator can change her or his password.
2. The **password administrator** level authorizes the user(s) to manage the NAS passwords throughout the NBBS network. An administrator can remotely logon on and change the operator password and her or his own passwords.
3. The third level concerns the IBM Network Support Center (NSC). With your authorization, IBM logs on with a password that gives access to advanced service facilities. IBM cannot change passwords.

Up to four instances of the Nways Switch Resource Control program can be started at the same time (one local instance and three remote instances). This allows more than one operator to manage Nways Switch resources at the same time.

Important: No message is displayed on the NAS screen to indicate that a remote logon is active.

User Names and Default Passwords

When the NAS is delivered, the default user name and password are as follows:

NAS User	User Name	Password
Any	clipper	soleil

When using the **Change NAS Password** function for the first time:

- The default passwords are set on the NAS hard disk.
- All the password functions become available.

This is done by IBM during the Nways Switch installation. The user names and default passwords are:

NAS User	User Name	Password
Operator	operator	soleil
Password administrator	administrator	suprpwd

The user names (operator and administrator) ***cannot*** be changed.

Rules for NAS Password Changes

When you change NAS passwords, the following rules apply:

- A NAS password consists of four to nine alphanumeric characters in the range 0 to 9 and a to z (lower case).
- An operator can locally or remotely change a NAS using the **Change NAS Password** function.
- The administrator can remotely change the operator and administrator passwords using the **(Administrator) Manage Passwords** function.

Remotely Logging On to a NAS

To remotely log on to a NAS, start the Remote Resource Control program and fill in a dialog box with the following input.

Host name
> This is the Nways Switch name set when configuring the Nways Switch with the NCT2. The Nways Switch IP address is also accepted.

User name
> This name is operator for an operator and for administratorthe password administrator.

Password
> The password is different for each user type (operator and administrator).

Here is an example using the default operator password.

```
Host name: N1
User name: operator
Password:  soleil
```

An Operator Changes the NAS Password

To change the password of a remote NAS, an operator:

1. Logs on to the remote NAS by starting the **Resource Control (Remote)** with, for example:

   ```
   Host name: N1
   User name: operator
   Password:  soleil (default password)
   ```

2. Runs the **Change NAS Password** function from the Selected menu of the Resource Control program (local or remote version) with, for example:

   ```
   Host name: N1
   User name: operator
   Password:  soleil
   New password: etoile
   Verify password: etoile
   ```

To locally change a NAS password, an operator uses the **Change NAS Password** function as described in step 2.

An Administrator Changes the Administrator Password

To change the administrator password of a remote NAS, the administrator:

1. Logs on to the remote NAS by starting **Resource Control (Remote)** with, for example:

   ```
   Host name: N1
   User name: administrator
   Password:  suprpwd (default password)
   ```

2. Runs the **(Administrator) Manage Passwords** function from the Selected menu of the Resource Control program (remote version) with (for example):

```
Host name: N1
User name: administrator
Password:  suprpwd
New password: suprpwd1
Verify password: suprpwd1
```

An Administrator Changes the NAS Password

To change an operator password on a remote NAS, the administrator:

1. Logs on to the remote NAS by starting **Resource Control (Remote)** with, for example:

```
Host name: N1
User name: administrator
Password:  suprpwd1
```

2. Runs the **(Administrator) Manage Passwords** function from the Selected menu of the Resource Control program (remote version) with (for example):

```
Host name: N1
User name: operator
Password:  suprpwd1
New password: lune
Verify password: lune
```

An Administrator Resets the NAS Password

When a user forgets a password, the administrator can reset the password as follows:

1. Log on to the NAS by starting **Resource Control (Remote)** with, for example:

```
Host name: N1
User name: suprusr
Password:  suprpwd1
```

2. Run **(Administrator) Manage Passwords** with, for example:

```
Host name: N1
User name: operator
Password:  suprpwd1
New password: lune
Verify password: lune
```

IBM Network Support Center Logs On to a NAS

If you benefit from the IBM Remote Support Facility, you can authorize an IBM service representative to remotely log on to a NAS from a Network Support Center (NSC) to investigate a problem or change a Control Program module.

Chapter 10. Nways Switch Maintenance

This chapter describes how Nways Switches are serviced and describes the information required to maintain your 2220 network.

Maintenance Overview

Although the replacement of machine parts is performed on site by service personnel, most of the other maintenance activities are performed from a remote site. Service personnel use their own remote consoles in the same way as the user's switched remote consoles. They do this by means of the modem attached to the NAS of each Nways Switch. From the remote maintenance site, a service representative dials the public switched network (PSN) of the Nways Switch to be accessed, then establishes IP communication between the remote console and the Nways Switch NAS.

Requirements for Maintenance

For each Nways Switch, the modem delivered with the Nways Switch is installed and configured by your service representative. This modem must be connected to the switched telephone network using a direct line. It must **not** go through a switchboard.

Remote support will access the desired Nways Switch by dialing the PSN number of the line connected to the modem. Then, it will use TCP/IP procedures to access the Nways Switch. This access is possible by knowing:

- The IPR1 address (an 2220 network-unique IP address generated by the NCT2 at configuration time)
- The Nways Switch switched remote console address (generated by the NCT2 at configuration time).

Note: Refer to "Chapter 4. Internet Protocol Addressing and Control Point Spanning Tree" on page 45 for details on the IP addresses and the way they are defined and generated.

Maintenance Requirements

You must provide the following information to the Remote Support Center:

Network level
- IPR1 IP address of each network to be supported
- Lists of the Nways Switches in each network and the network to which each Nways Switch belongs.

Nways Switch level
- Identification of the Nways Switch (name, location, network)
- PSN number of each Nways Switch
- Switched remote console IP address of each Nways Switch.

Part 4. Ordering Nways Switch Hardware and Software

Chapter 11. Ordering from IBM

This chapter describes:

- The information that your IBM marketing representative will need to place your order through the IBM ordering system. It is your responsibility to define and supply this information.
- The IBM ordering system output, and how to use it.

For every component of an Nways Switch that you can order, there is information needed by the IBM ordering system.

This section is not intended to help you configure an Nways Switch on paper, but to prepare you for efficient use of the ordering system. For a general description of the Nways Switch features, refer to the *2220 Nways BroadBand Switch At a Glance, an Overview*, GA33-0292.

Inputs to the Ordering System

The following information is needed for each product or feature.

Hardware Products

The ordering system records, checks, and computes the hardware that needs to be ordered.

The Nways Switch can be operated in two modes: redundant and non-redundant. When it is used in redundant mode, the following modules are duplicated as backups:

- Switch
- Control point (whichever adapter it uses)
- Clock (if used)

   Note:

- Power input.

Notes:

1. Redundant mode is a global choice. All the previously mentioned installed items are then duplicated.
2. On a machine in redundant mode without clock, further clock module installation must include two clock modules.
3. Power input can be duplicated when the Nways Switch is used in the non-redundant mode.

Table 27 on page 100 gives the information that is needed for each Nways Switch and related components.

Table 27. Hardware Ordering System Input

Item	Information Required
Nways Switch	For each Nways Switch: • Its Nways Switch name (which should be used as IP host name in the TCP/IP NAS configuration file, domain name server, and Nways 2220 Switch Manager customization). • Whether it is to be ordered for redundant mode • Whether it is to be attached to an NMS or CCS. At this stage, you must have decided on the number and location of the NMSs and CCSs in your network.
Power inputs	For each Nways Switch: • If in non-redundant mode, whether its power input is to be duplicated • The type of power it uses: ac, dc, or mixed
Control Point	Whether it is used in a trunk module or alone in a dedicated module
Clock Module	Whether there is a clock module
Port and trunk adapters	For each adapter: • Its symbolic name for the logical link • Its attachment type (for example, T1, T3, V.35, DTE, or DCE) • Its cable information (length and kit needed, if any). • For a trunk adapter used with a T3 line, whether a Y cable is needed for a redundant (backup) adapter
Voice servers	The number of voice server adapters and extensions needed For information to help you plan the number of voice servers and extensions that you need, refer to the Voice Server Adapter Channel Capacities table in *2220 Nways BroadBand Switch At a Glance, an Overview*, GA33-0292
Low-speed lines (up to 256 kbps)	For each line: • Its ARC type: V.24, V.35, or X.21. • Whether it is attached to a DTE or a DCE • Cable length.
LCB Groups	A group consists of one or more LCBs at the same physical location. For each group: • The symbolic name of the location of the group • The number and type of ARC at the location.
Note: All the names used here should conform to the naming convention you have defined as explained in "Naming Conventions" on page 37.	

Software Products

Table 28 on page 101 gives the programs and software features needed for your 2220 network.

Table 28. Software Ordering System Input

Where Used	Program	Information and Features Required
Nways Switch	Nways Switch Control Program (5622-388) or Nways Switch Control Program V2R1 (5765-C71)	One for each Nways Switch. Also, if you use: • Expansion Model 501 with a Model 500, you need a Model 501 feature for each Expansion. • Frame relay or one of the CAS/voice modes, you need these features in each Nways Switch that uses them.
Network Management Station	Nways 2220 Switch Manager (5777-AAK)	One for each Nways Switch administration station in your network and the number of Nways Switches each will each manage.
Change Control Server		If not already installed, you need for each change control server in your network: • IBM NetView for AIX (5696-362) • IBM NetView Distribution Manager for AIX (5765-196).

Outputs from the Ordering System

After your order has been processed by IBM, your IBM marketing representative gives you the list of ordered features, which includes:

• Hardware:

  Machine types and models, adapters, couplers, line connection boxes, active remote connectors (ARCs), power supplies, and cables.

  Placement reports that give a snapshot of the adapter plugging in the machines will be included.

• 2220 Nways Switch Control Program with the related features.

• Nways 2220 Switch Manager you need and, if necessary, one of the platforms required for the change control servers (for more information, refer to "Software Requirements" on page 82).

Chapter 12. Ordering Communication Facilities from Common Carriers

This chapter provides the information necessary for ordering external lines from common carriers. This information includes:

- Line types
- User protocols
- Line characteristics (speed, clocking, and so on).

Because obtaining communication facilities from the common carriers may take some time, you should place your order early in the planning process.

T1 Line Recommendations

For a T1 line (LIC514), the recommended choices are as follows:

1. Use D5 ESF with B8ZS as preferred choice, if these options are provided by your T1 line.
2. If D5 ESF is not provided, use D4 SF with B8ZS.
3. If B8ZS is not available, use AMI.
4. If the T1 is configured with channels:
   - For voice traffic, do not select bit 8 stuffing.
   - For data traffic, select bit 8 stuffing.

   With T1, FT1, J1, and FJ1 port lines, the choices also depend on the connected equipment and their one-bit density. (For example, over an FT1 port line with time slots alternately stuffed with one-bits, bit 8 stuffing is not required.)
5. If the T1 line uses *AMI and clear channel*, consider the need for bit 8 stuffing.

D4 Superframe

D4 Superframe (D4 SF) consists of a pattern of 12 repeating frames sampled at 8 kHz. Each frame is made up of 24 eight-bit time slots. Appended to the start of each frame is a bit which maintains the frame and multiframe synchronization.

D4 SF supports the transport of bits A and B of the channel associated signaling (CAS) protocol. They are transported by robbing the eight bit of each time slot in frames 6 and 12 of the multiframe. D4 SF also supports PBX common channel signaling (CCS), which is placed in time slot 24 of the frame.

For a T1 line, the Nways Switch provides the D4 SF and D5 ESF frame formats. However, select D4 SF only when D5 ESF is not available. For FT1, J1, and FJ1 interfaces, D5 ESF is provided by default.

D5 Extended Superframe

D5 Extended Superframe (D5 ESF) consists of a pattern of 24 repeating frames sampled at 8 kHz. Each frame is made up of 24 eight-bit time slots. Appended to the start of each frame is a bit which maintains frame and multiframe alignment.

D5 ESF supports the transport of bits A, B, C, and D of the CAS protocol. They are transported by robbing the 8th bit of each time slot in frames 6, 12, 18, and 24 of the multiframe. D5 ESF also supports CCS signaling, which is placed in time slot 24 of the frame.

The Nways Switch supports D5 ESF on T1, FT1, J1, and FJ1 lines. On a T1, D5 ESF is the **preferred choice** to D4 SF.

Bipolar with Eight Zeros Substitution (B8ZS)

Bipolar with eight zeros substitution (B8ZS) is a coding method used mainly for 1.544 Mbps Primary Rate ISDN access. In B8ZS, a string of zeros is replaced by an 8-bit pulse string that can be anywhere in the transmitted data block. This means that the maximum length of a string of zeros after substitution is seven.

The Nways Switch offers B8ZS as an option on T1 lines and sets B8ZS by default on FT1, J1, and FJ1 lines. On a T1, B8ZS is the **preferred choice,** when available.

Alternate Mark Inversion (AMI)

Alternate mark inversion (AMI) is a coding method where:
- A 1-bit is represented by either a positive or negative pulse
- A 0-bit is represented by no voltage present on the line.

Successive 1-bits, regardless of how many 0-bits are in between, are of opposite states. Hence the coding is dc balanced.

The drawbacks of using this code are that it requires more transmitter power than NRZI (for example), that it also requires the receiver to recognize three states rather than just a transition, and thta it does not provide for clear channel data.

The Nways Switch supports AMI on T1 lines (not on FT1, J1, and FJ1). On T1 lines, however, select AMI only when B8ZS is not available.

Bit 8 Stuffing

Bit 8 stuffing is a method for improving the 1-bit density by inserting in the transmit mode an eigth bit after seven bits. In the receive mode, the eight bit of each time slot is removed. The data is then coded only on seven bits and the maximum bandwidth is 56 kbps per time slot instead of 64 kbps (the access rate still being 64 kbps). The total bandwidth is 1.344 Mbps (24x56 kbps) instead of 1.536 Mbps.

The first use of bit 8 stuffing is to improve clock synchronization between connected stations. It is recommended for data traffic and optional for voice traffic. Another use of bit 8 stuffing is to reduce the bandwidth of each time slot from 64 kbps to 56 kbps.

The NCT allows selecting bit 8 stuffing only when channels are configured. With AMI and clear channel (AMI and no channel configured on the line):
- On a T1 or FT1 trunk line, bit 8 stuffing is selected by default. The bandwidth is reduced as explained above.
- On a T1 or FT1 port line, bit 8 stuffing **must be selected** to improve transmission characteristics. Here again the bandwidth is reduced to 1.344 Mbps.

Information Related to Certification Statements

Refer to Notices in *2220 Nways BroadBand Switch Physical Lines Interface Specifications, External Cable References, GA33-0379*.

Part 5. Planning for Installation

Chapter 13. Site Preparation

This chapter contains information necessary for planning the physical environment of the Nways Switch Model 300, Model 500, and Model 501.

It provides the information that is required to:

- Prepare the machine area:
    - Physical and environmental specifications
    - Floor loading information and service clearance templates
    - Cable exit areas for connection to external equipment
- Prepare for the connection to the external power sources:
    - Power input requirements
    - Examples of power input configurations.

This section does *not* cover the connection to the external lines. Information on external line attachments is given in *2220 Nways BroadBand Switch Physical Lines Interface Specifications, External Cable References*, GA33-0379.

Preparing the Machine Area

To prepare the area where the machine will be installed, you need to consider:

- The physical dimensions of the machine
- The area that must be left free around the machine for easy access to the cables, connectors, and parts to be replaced
- The floor load
- The environmental constraints detailed in "Specifications" on page 116.

Dimensions

The dimensions of the different models are given in Table 29. Figure 30 on page 110 shows a Model 300 or Model 500, and a Model 500 with Model 501 extension, with the clearance needed for door opening. This can be used to make templates for placement of machines. When a Model 501 is attached to a Model 500, the overall dimensions are slightly smaller than two single machines because the frames are bolted together without the corresponding side covers.

A Model 501 can be attached on either side of its Model 500.

Table 29. Dimensions of Nways Switch Model 300, Model 500, and Model 501

Model	Front	Side	Height
Model 300 and Model 500	660 mm (25.98 in.)	905 mm (35.63 in.)	1803 mm (71 in.)
Model 500 with Model 501	1270 mm (50 in.)	905 mm (35.63 in.)	1803 mm (71 in.)
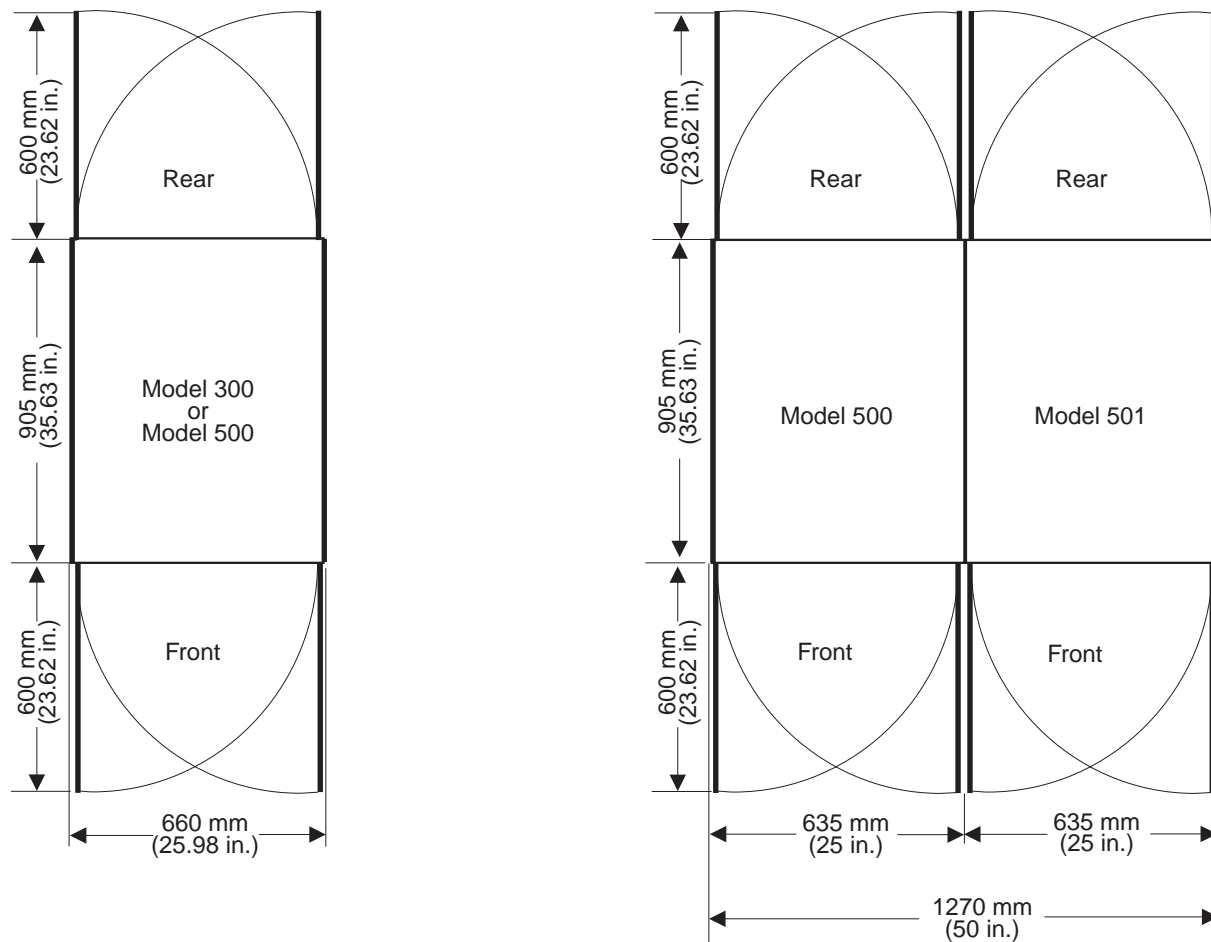
Figure 30. Overall Dimensions for Nways Switch Model 300 or Model 500, or Model 500 with Model 501 Extension

Service Clearances

The doors on the front and rear of the Nways Switch open either from the left or from the right to give access to the components inside the machine.

For easier access to the machine, the doors can be quickly removed without tools.

You must leave free space for service around the machine as shown in Figure 31 on page 111 and Figure 32 on page 112. The front and rear service area are minimum values needed to replace components of the machine. The area left free around the machine accounts for the machine load on the ground. Depending on the acceptable load, the size of this area may vary. Because the front and rear service area cannot be reduced, you may only modify the area on the side of the machine, as specified in Table 30 on page 112.

The examples illustrated on Figure 31 on page 111 and Figure 32 on page 112 are intended to show the area needed to install Nways Switches. The side clearance can be left on either side or split on both sides of the machine, and the Model 501 can be attached to either side of the Model 500.
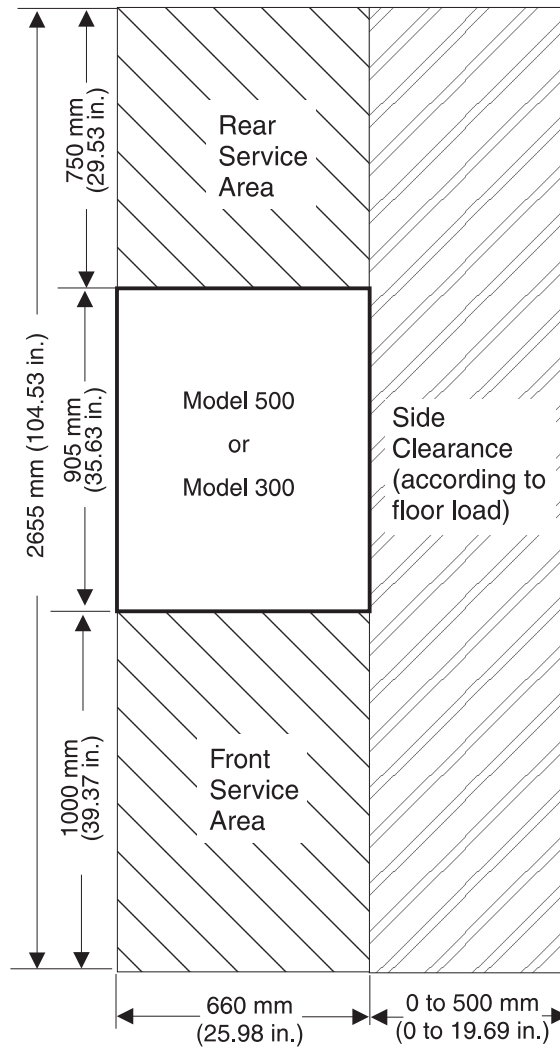
Figure 31. Service Clearance around the Nways Switch
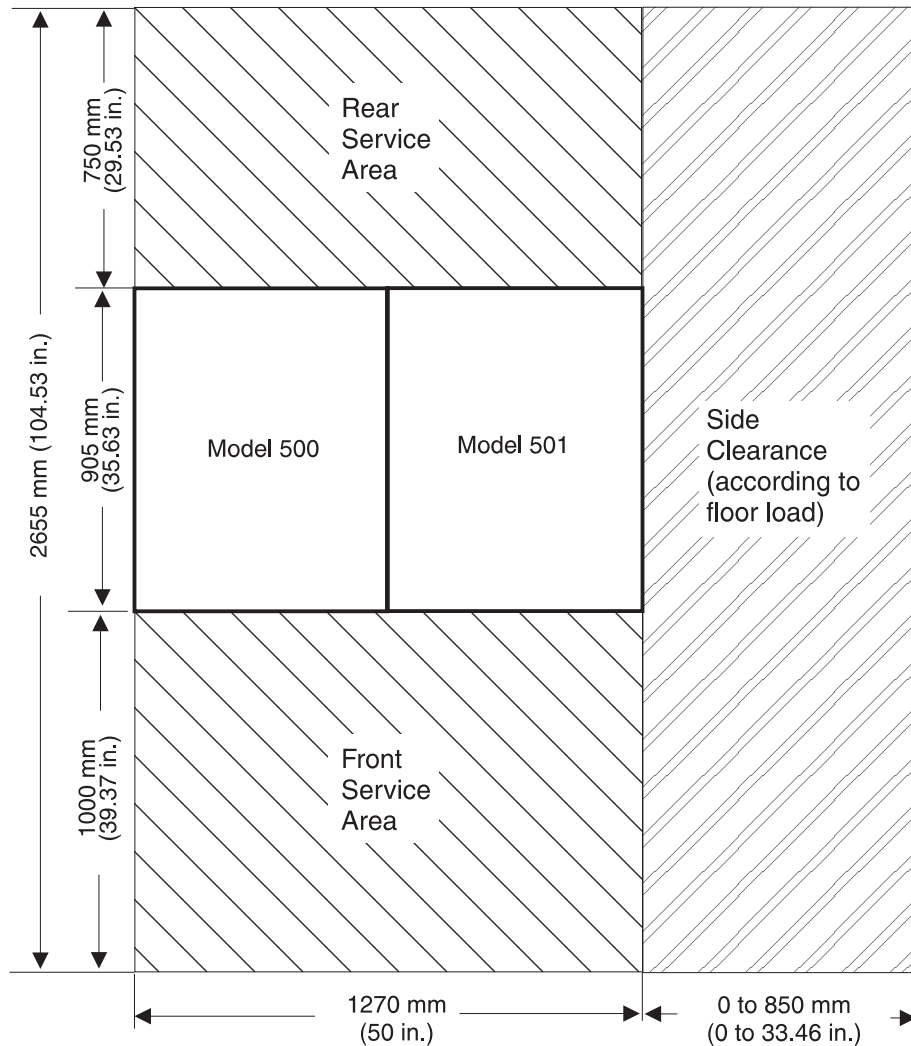
Figure 32. Service Clearance around the Nways Switch

Floor Load Ratings

The floor load ratings are given with respect to the figures given in "Service Clearances" on page 110 and "Weight" on page 116.

Table 30. Service Clearances According to Acceptable Floor Load Rating

	Nways Switch Model 300 or Model 500		Nways Switch Model 500 with Model 501		
	Floor Load (kg/m2-lb/sq.ft)		Floor Load (kg/m2-lb/sq.ft)		
	345-70.5	470-96	345-70.5	385-79	470-96
Front	1000 mm (39.37 in.)	1000 mm (39.37 in.)	1000 mm (39.37 in.)	1000 mm (39.37 in.)	1000 mm (39.37 in.)
Rear	750 mm (29.53 in.)	750 mm (29.53 in.)	750 mm (29.53 in.)	750 mm (29.53 in.)	750 mm (29.53 in.)
Side	500 mm (19.69 in.)	0	500 mm (19.69 in.)	500 mm (19.69 in.)	0

Two Nways Switches can be placed side-by-side 850 mm (33.5 in.) apart. Their side service areas can overlap.

Allowing an extra 595 mm (23.4 in.) free space on one side of a Model 500 or Model 300 provides space for future expansion using the Model 501.

Cable Exit Areas

Figure 33 shows the locations (shaded areas) in the Nways Switch rack that are provided for the cables. This information can be used to cut holes in the raised floor if you elect to route the cables this way. Figure 34 on page 114 illustrates the two possible routings.
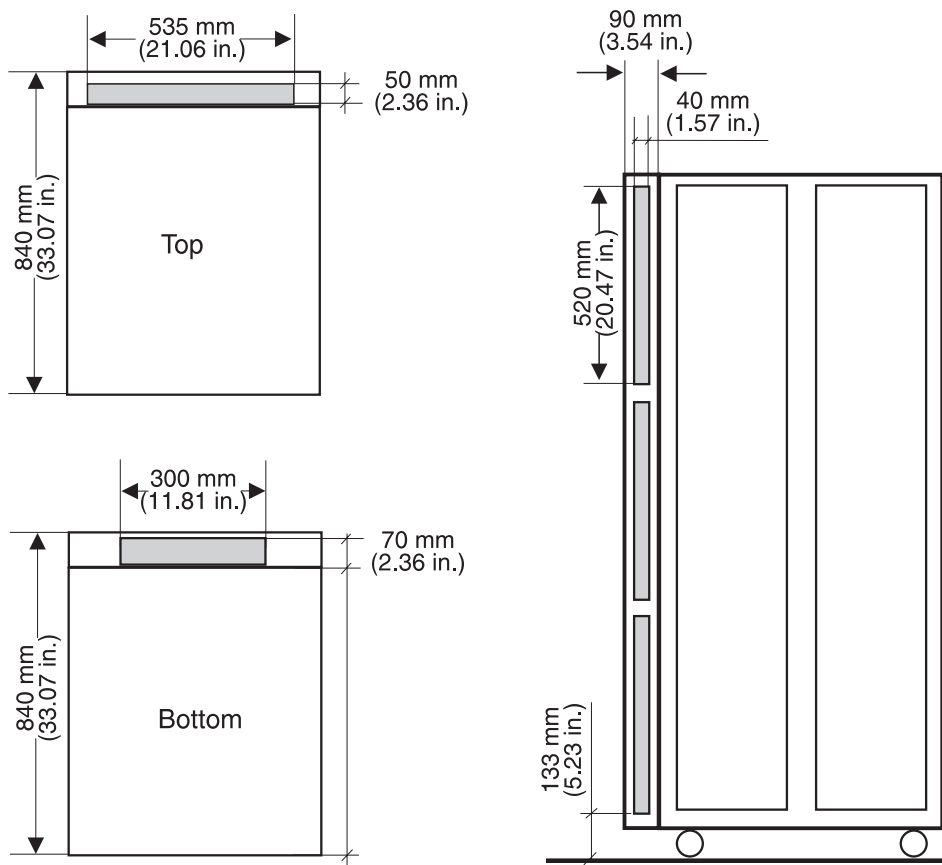
Figure 33. Cable Exit Areas in the Nways Switch
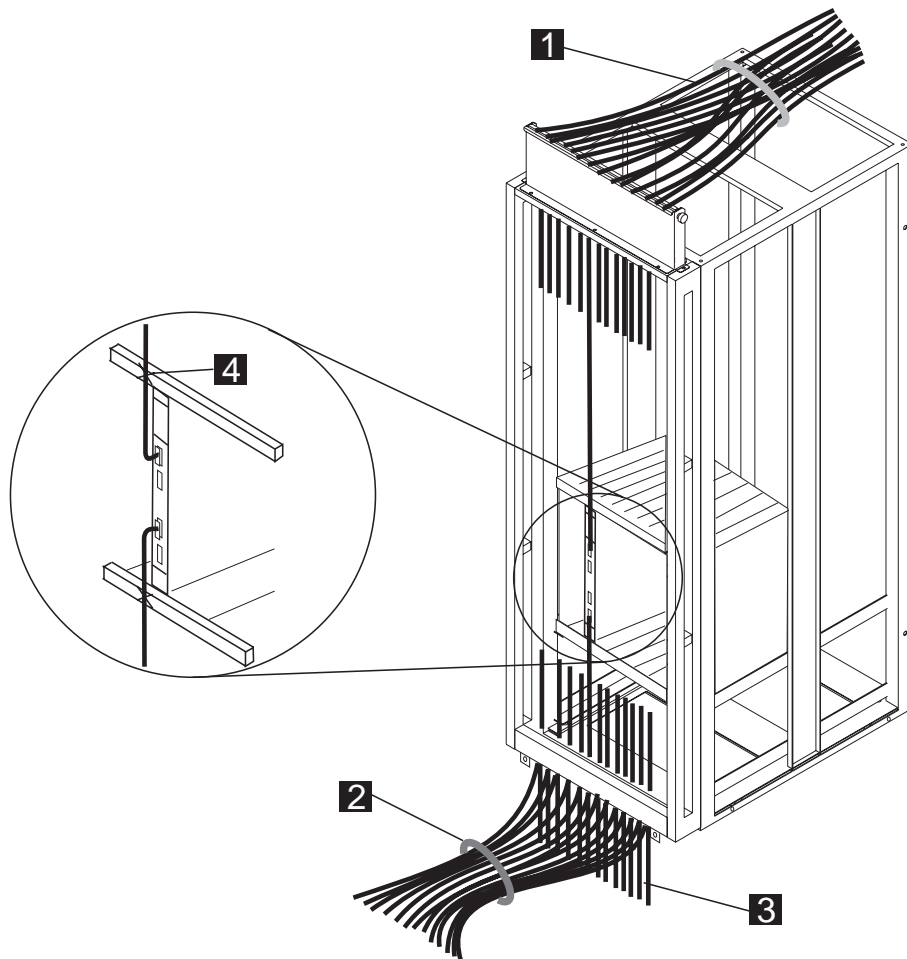
Figure 34. Cable Routing in the Nways Switch

Legend:

- **1**: Upper cable exit
- **2**, **3**: Lower cable exit (two possibilities)

Seismic Hardening Kit Installation

The Nways Switch meets the U.S. West Coast and Class 4 requirements when it is ordered with the following features and installed accordingly:

2220 Model 300 or Model 500
> Feature code 4502

2220 Model 501
> Feature code 4602.

These features must be specified when ordering the machine and *cannot* be ordered separately. They provide stiffened racks and a parts kit to fasten the machine to the floor.

The Nways Switch can be fastened to:
- An earthquake-proof raised floor

- A concrete floor.

Figure 35 shows the positioning for the fastening of bolts on the Nways Switch rack frame.

Note: It is your responsibility to have the holes drilled according to the drawing before the machine installation.

Front
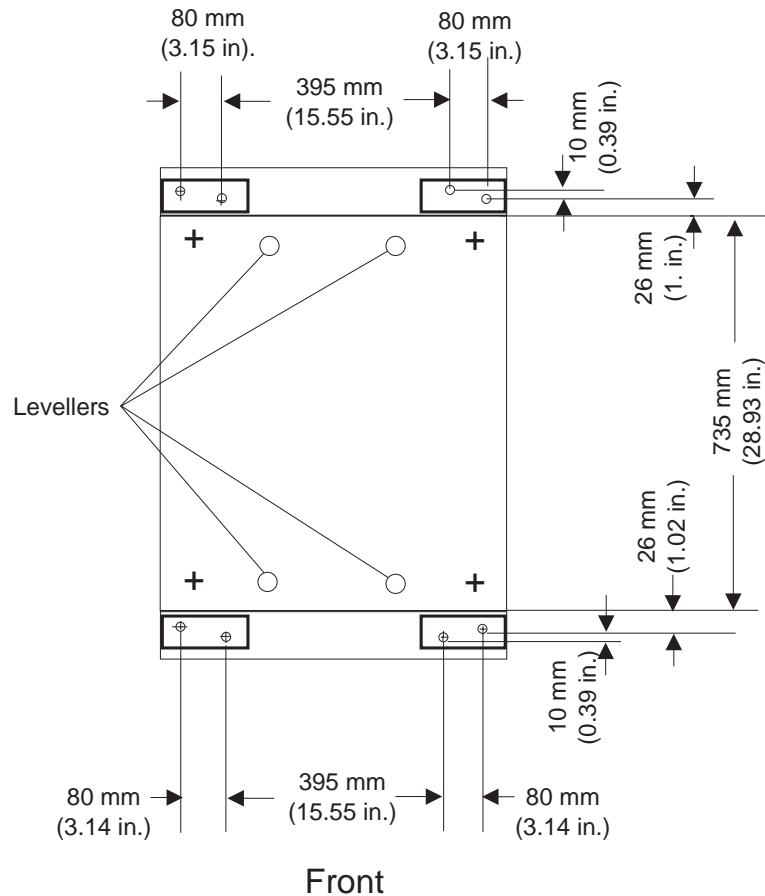
Figure 35. Diagram for Drilling Fastening Bolt Holes

Depending on the type of installation, the holes must have the following dimensions:

Raised floor
Diameter from 14 mm to 17 mm (9/16 in. to 11/16 in.)

No raised floor
Diameter 18 mm (0.7 in.), 120 mm (4.72 in.) deep. Metallic pegs included in the kit will be inserted in the holes.

Notes:

1. Four holes must be drilled for every machine frame. As shown in the drilling diagram, 8 hole positions are available on the machine. According to the machine location and site considerations, select them so that there is one fastening bolt at each corner.
2. The drilling must be done very accurately so that fasteners face the drilled holes exactly when installing the machine.

3. Should one of the drilled holes not be at the right place, you may use the alternate hole.

Specifications

Weight

Table 31. Nways Switch Model Weight

Model	Weights Less than:
Model 300 and Model 500	400 kg (880 lb.)
Model 500 with Model 501	780 kg (1716 lb.)

Heat Output

Table 32. Nways Switch Heat Output

Model	Maximum Heat Output		
	kW	kVA	kBTU/hr
Model 300	1.39	1.46	4.74
Model 500	1.73	1.82	5.90
Model 500 with Model 501	3.46	3.64	11.81

Airflow

A multiple-fan (forced air) ventilation system is installed in each Nways Switch. The airflow is 7.2 m³/min (425 cfm) for all machines.

Acoustical Data

The acoustical data is given according to the *IBM Acoustical Product Specifications*, CS1-1710-6.

Table 33. Nways Switch Acoustical Data

Model	L_{WAd} (ref: 1 pW)	L_{pAd} (ref: 20 µP)
Model 500	7 Bels	64 dB
Model 500 with Model 501	7.2 Bels	64 dB

Environment

The environmental specifications are the same for all the Nways Switch models.

Table 34. Nways Switch Operating Environment

	Operating Environment	Nonoperating Environment
Temperature	4.5°C to 40°C (40°F to 104°F)	-40°C to 66°C (-40°F to 150°F)
Relative Humidity	5% to 95%	10% to 90%
Maximum Wet Bulb	27°C (81°F)	29°C (85°F)

Lightning Protection

The power supplies of the Nways Switch are protected against lightning.

Contact an electrical contractor to determine if lightning protection is needed for your power distribution system.

The line interface coupler (LIC) cables are not protected against lightning and must be placed in the same building as the Nways Switch units.

Electromagnetic Interference

The Nways Switch is compatible with the following classes of interference:
- CISPR Publication 22, class A
- FCC, Part 15, Subpart J, class A (U.S.)
- VCCI-1, class 1 (Japan).

Preparing for Connection to External Power Sources

This section gives information on the grounding of the machine, types of power sources needed, and requirements for connecting the machine to power sources.

Grounding/Earthing

> **Ground Leakage Current**
> The ground leakage current for the Nways Switch does not exceed 3.5 mA rms per cord.

The Nways Switch Model 300, Model 500, and Model 501 must be grounded by connecting the grounding point located on their frame to a ground source. This connection can be made via either:

- The 10-meter (32 ft 10in.) long jumper delivered with the machine. This jumper comes equipped with termination at both ends for connection to the equipment. Use screw with a 6-mm (or 1/4in.) diameter screens.

or
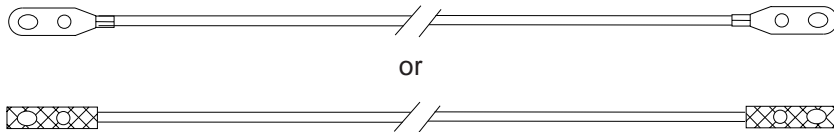
- A user-supplied wire. The grounding point location and grounding wire diameter are given on Figure 36 on page 118.

Ground Source Characteristics and Availability

1. In all cases, the voltage measured between the machine frame and the ground (not the ground source connection) must be less than 1 Volt as shown in Figure 36.

2. Because correct grounding is mandatory, the ground source (and the ground jumper when the one supplied with the machine is not used) must be ready before machine installation.
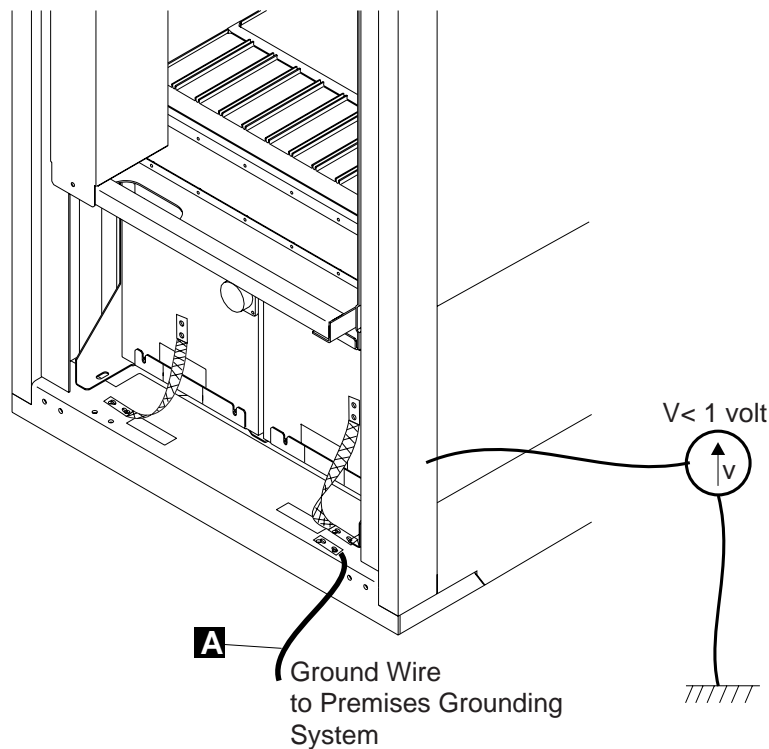
Figure 36. Nways Switch Grounding Requirements

Power Source Types

All the Nways Switch models can have one or two power supplies each. They can be either ac, dc, or both.

Table 35. Nways Switch Power Module Configurations

Power Input 1	Power Input 2	Comments
AC or DC	None	No redundancy
AC	AC	AC power redundancy
DC	DC	DC power redundancy
AC	DC	Refer to "Mixing AC and DC Power Inputs" on page 119
DC	AC	

If a Model 501 is installed, it must have the same power inputs as the Model 500.

In Case of AC Power Outage

The ac power supply has an internal backup battery which provides up to five
minutes of power supply in case of an ac power outage.

Mixing AC and DC Power Inputs

When an Nways Switch is powered from one ac source and one dc source, you
can do one of the following:

- Connect each power input directly to its power source. The full load of the
  machine will then be taken by the dc input because its nominal output voltage is
  greater than that of the ac input.

  The battery charger must be able to sustain the maximum dc input (1550 W) plus
  the power needed to keep the external battery at its floating level.

- Connect the dc input to its power source through the normally-open contact of a
  relay held by the presence of the ac source. You may then use a smaller battery
  charger because it is only used to maintain the battery.

  The relay and the ac source monitoring must be supplied by the user.

  Figure 37 illustrates this type of installation.
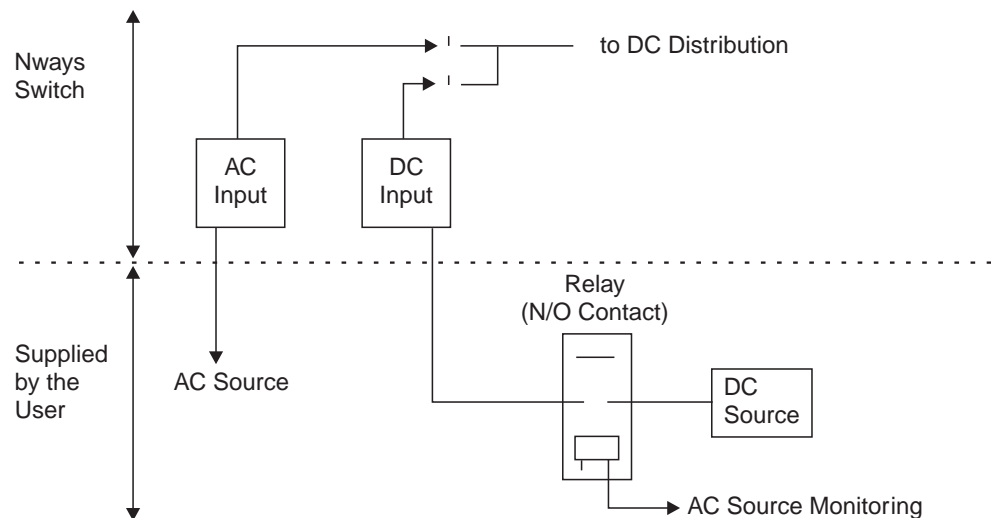
Figure 37. Example of AC plus DC Power Inputs

AC Power Input Requirements and Characteristics

The ac power source must be able to supply:

- 200 to 240 V ac at 50 or 60 Hz, single phase
- 1.82 kVA power
- 20 A peak inrush current for two half-cycles.

The ac power input delivers a -48 V dc output (1350 W).

DC Power Input Requirements and Characteristics

The dc power source must be able to supply:

- -39 to -60 V dc
- 43 A maximum continuous current at 39 V dc and 1550 W output
- 50 A peak inrush current during 10 ns

It delivers a -48 V dc output (1550 W).

Wiring

There are five wires: two positive, two negative, and a ground wire. The positive and ground wires are connected to the dc common and the machine frame.

Power Consumption Limitations

2220 Power Consumption

2220 Power Limits: The total power consumption depends on the type of power source (ac or dc) and the number of power supply. Table 36 shows the maximum total power consumption allowed.

Table 36. Maximum total consumption allowed.

Power supply type	Quantity	Total allowed (Watt)	Battery backup support (Watt)
ac	1 or 2	1350	1350 (note)
dc (-48v)	1 or 2	1550	n/a

Note: Every ac power has a battery backup. In this mode, the power consumption is up to 675 Watts per battery during 3 to 5 minutes.

2220 Base Machine and Modules Power Consumption: Table 37 shows the base machine and modules power consumption.

Table 37. Base Machine and Module Power Consumption

Types	Feature Code	Consumption (Watt)

Base machine
 	
  2220 Model 300
  2220 Model 500
  2220 Model 501
	N/A	150
		178
		175

Table 37. Base Machine and Module Power Consumption (continued)

Types	Feature Code	Consumption (Watt)
Trunk/Port Adapter		
Low-speed Type 1 (LSA1)	5410	35
Low-speed Type 2 (LSA2)	5440	45
Low-speed Type 3 (LSA3)	5460	38
High-speed Type 1 (HSA1)	5415	42
High-speed Type 2 (HSA2)	5445	55
High-speed Type 3 (HSA3)	5446	44
ATM Type 1 (ATMA1)	5450	41
ATM Type 2 (ATMA2)	5451	41
Voice Server Adapter (VSA)	5400	44
Switch		
2220 Model 300	5350	29
2220 Model 500	5340	57
2220 Model 501 (redrive)	5341	54
Clock		
2220 Model 300	5355	20
2220 Model 500	5355	20
2220 Model 501 (redrive)	5356	10
Voice Server Expansion		
Type 1 (VSE1)	5501	35
Type 2 (VSE2)	5502	64

Table 37. Base Machine and Module Power Consumption (continued)

Types	Feature Code	Consumption (Watt)
Line Interface Coupler		
511	5511	9
512	5512	17
513	5513	23
514	5514	18
515/516	5515/5516	19
517	5517	18
522/525	5522/5525	20
523	5523	26
530	5530	0
544	5544	43
545	5545	41
546	5546	40
551	5551	36
552	5552	53
553	5553	40
554	5554	26
555	5555	26
556	5556	26
562	5562	20
567	5567	24
Line Connection Box with:		
10m RVX cable + 15 x V.24 ARCs	5600/5601 + 5024	9.8
100m RVX cable + 15 x V.24 ARCs	5600/5601 + 5024	10.5
10m RVX cable + 15 x V.35 ARCs	5600/5601 + 5035	20
100m RVX cable + 15 x V.35 ARCs	5600/5601 + 5035	23.5
10m RVX cable + 15 x X.21 ARCs	5600/5601 + 5021	20
100m RVX cable + 15 x X.21ARCs	5600/5601 + 5021	23.5

Power Cord Characteristics

The ac power cord is supplied with a country-dependent plug, and the dc power cord is supplied without the plug. The Nways Switch power cord characteristics are given in Table 38:

Table 38. Nways Switch Power Cord Characteristics

	AC Cord	DC Cord
Voltage	200 to 240 V single phase	-39 to -60 V
Cable Outside Diameter	US/Japan 9.5 mm (0.4 in.) All others 8.5 mm (0.37 in.)	All Countries 22.5 mm (0.88 in.)
Number of Conductors	2 plus ground	4 plus ground
AWG Number	14 (2 mm²/.003 sq.in)	8 (8 mm²/.012sq.in.)

Power Cord Length

A 4.3 m (14 ft) power cord is shipped with each machine, except in Chicago, Illinois, U.S.A, where a 1.8 m (6 ft.) ac power cord is used.

Power Cord Plug and Receptacle

A receptacle must be provided for each machine. Its type can be identified by referring to Figure 38 on page 124, and Table 39 and Figure 38 on page 124 .

Note: You must also provide ac power receptacles for the NAS and its display, and the modem, as explained in "NAS, Display, and Modem Requirements" on page 124 . The receptacle rating must match the circuit rating.

Table 39. Power Cord Plug and Receptacle Information (U.S., Canada, Mexico, Japan)

Type	Plug Supplied	Receptacle (User-supplied)
Moisture Resistant	Russelstoll 3720DPU-2	Russelstoll 3913U-2 (inline) or 3743U-2 (box-type)
Locking	NEMA L6-15P	NEMA L6-15R
Nonlocking	NEMA 6-15P	NEMA 6-15R

Notes:

1. For Chicago, you must use a special specify code to order the special short cord needed there.
2. The moisture resistant plug is not available in Japan.

Table 40. Power Plugs per Country

Country	Number
Argentina	29
Australia	54
Canada	5, 10, or 34
Denmark	46
France	18
Israel	32
Italy	25
Mexico	10
New Zealand	49
South Africa	22
Sweden	46
U.K.	46
U.S.A	5, 10, or 34
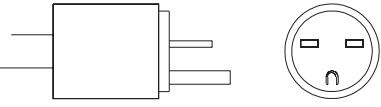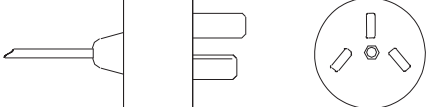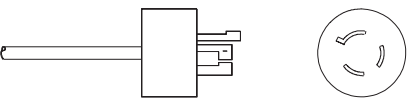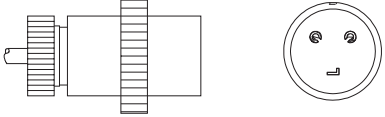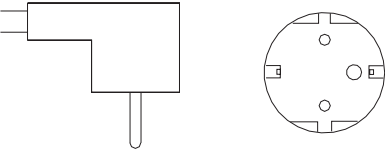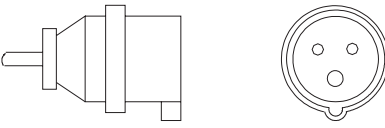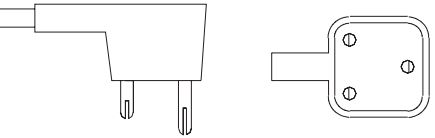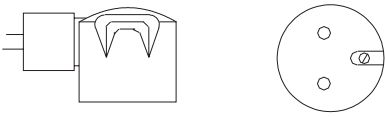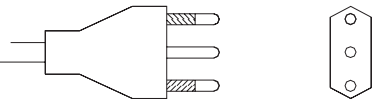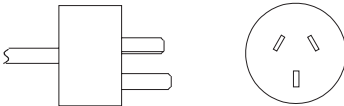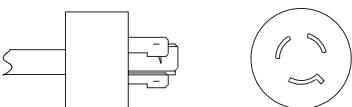
5 250 V 15 A		**32** 250 V 16 A	
10 250 V 15 A		**34** 250 V 15 A	
18 250 V 16 A		**46** 250 V 16 A	
22 250 V 16 A		**49** 250 V 16 A	
25 250 V 16 A		**54** 250 V 15 A	
29 250 V 18 A			

Figure 38. Power Plugs per Country

NAS, Display, and Modem Requirements

Power Requirements

The NAS, its display, and the modem each has its own separate power cord with an appropriate country-dependent plug. Each of them requires an ac voltage receptacle.

Due to the location of the NAS, display, and modem inside the Nways Switch, and the limited length of their ac power cord, it is advisable to locate the corresponding ac power receptacles in the immediate vicinity of the Nways Switch.

Connection of the Modem

The modem is delivered with a cable for connection to the external line. The connector type is country-dependent. You must provide the appropriate receptacle to connect the modem to the switched network.

Note: You may have to contact your local telephone service or carrier.

Space Requirements

The NAS display and modem are located inside the Nways Switch. No additional space is required for their use.

Distance between the Ethernet LAN Link and the NAS

The NAS in the entry-point Nways Switch is attached to the Ethernet LAN by a 9 m (29.5 ft) cable. In the Nways Switch, this cable is connected to a tailgate located at approximately 1 m (39.5 in.) from the ground. You should consider this, and the routing of the cable, when planning for the location of the machine. If the distance between the tailgate and the Ethernet LAN connector (cable routing included) exceeds 9 m (29.5 ft), you must supply a cable of the appropriate length.

Chapter 14. Planning for Model Migration and Feature Installation

This chapter gives information on planning for:

- Migrating from a Model 300 to a Model 500
- Adding a Model 501 to a Model 500
- Adding a physical resource to an Nways Switch
- Upgrading a NAS.

This information includes:

- Identification of the hardware and software features to be ordered
- Identification of the changes you must prepare via the NCT2
- Possible additional space planning
- Down-time (when applicable) to be planned for installation of the feature.

Refer to "Chapter 11. Ordering from IBM" on page 99 for additional information on the various tasks you may have to perform.

Migrating from an Nways Switch Model 300 to a Model 500

Migrating from a Model 300 to a Model 500 increases the throughput of the machine. Traffic is interrupted during the installation of the modules affected by the migration.

The Model 500 has a higher connectivity than the Model 300. There is no direct impact on the features to be installed but the model change is an opportunity to install additional adapters and lines if required. For more information, refer to Table 43 on page 130.

Space Planning

There is no need for additional space when migrating from a Model 300 to a Model 500. Therefore, because a Model 501 may be added to a Model 500, it might be wise to allow for future expansion, as explained in Table 42 on page 129.

Software Features

To migrate from a Model 300 to a Model 500 you need to change the Nways Switch Control Program. Depending on your choice (one-time charge or monthly license charge) you must order:

One-time
Feature 0359 (group 50), and Remove feature 0358 (group 30)

Monthly
Feature 0378 (group 50), and Remove feature 0377 (group 30).

Depending on the other hardware features to be installed at the same time, you may have to order additional software features. These features, which are not specific to Model 300 to Model 500 migration, are listed in Table 43 on page 130.

Note: Any software change must be handled via the change control server (CCS).

NCT2 Configuration Changes

You must plan for the following configuration changes:

- Changing the Nways Switch model
- Adding possible additional adapters.

Depending on your configuration strategy, the configuration changes can be done either from an Nways Switch configuration station or from the NAS. In the latter case, do not forget to update the central configuration data base.

Summary of the Model 300 to Model 500 Migration

Table 41. Migrating from a Model 300 to a Model 500

Feature Name	Feature Cable	Down Time	NCT2	Add Space	Comments
Model 500 switch	n/a	Yes	Yes	No	Must be associated with software feature 0359 or 0378 (Nways Switch Control Program group 50)
Nways Switch Control Program (Model 500 group 50)	0359 or 0378	Yes	No	No	n/a
Additional physical resources (adapters, LICs)	n/a	No	Yes	No	(Refer to Table 43 on page 130 for details)
Optional power duplication (if not already installed)	n/a	No	Yes	No	It is **not** mandatory to install this feature (Refer to Table 43 on page 130 for details)
Optional redundancy (if not already installed)	n/a	No	Yes	No	It is **not** mandatory to install this feature (Refer to Table 43 on page 130 for details)

Adding a Model 501 to an Existing Model 500

To add a Model 501, you must:

- Plan for additional space
- Order an additional software feature
- Make configuration changes using the NCT2.

The machine must be powered off for some time. Therefore, plan for some traffic outage.

Space Planning

Additional space is required when adding a Model 501 to a Model 500, as shown in Table 42 on page 129. The side clearance for the machine varies according to the

acceptable floor load. Refer to "Chapter 13. Site Preparation" on page 109 for more information on site planning, and the Nways Switch specifications.

Software Features

To add a Model 501 to a Model 500, change the Nways Switch Control Program. Depending on your choice (one-time charge or monthly license charge), order:

One-time
Feature 0376 (group 50)

Monthly
Feature 0379 (group 50).

Depending on the other hardware features to be installed at the same time, you may have to order additional software features. These features, which are not specific to Model 300 to Model 500 migration, are listed in Table 43 on page 130.

Note: Any software change must be handled via the change control server (CCS).

NCT2 Configuration Changes

You must plan for the following changes, including:
- Changing the Nways Switch model.
- Physically configuring the new adapters, LICs, and lines located in the Model 501.
- Logically configuring any new ports and trunks.
- Configuring any new connections.

Depending on your configuration strategy, you can do this either from an Nways Switch configuration station or from the NAS. In the latter case, do not forget to update the central configuration data base.

Adding a Model 501 to an Existing Model 500

Table 42. Adding a Model 501 to an Existing Model 500

Feature Name	Feature Code	Down Time	NCT2	Add Space	Comments
Model 501		Yes	Yes	Yes	• Must be associated with software feature 0359 or 0378 (Nways Switch Control Program group 50) • Needs additional space planning (Refer to "Chapter 13. Site Preparation" on page 109 for details)
Nways Switch Control Program (Model 500 group 50)	0359 or 0378	Yes	No	No	
Additional physical resources (adapters, LICs)		No	Yes	No	(Refer to Table 43 on page 130 for details)

Table 42. Adding a Model 501 to an Existing Model 500 (continued)

Feature Name	Feature Code	Down Time	NCT2	Add Space	Comments
Optional power duplication (if not already installed)		No	Yes	No	It is **not** mandatory to install this feature (Refer to Table 43 for details)
Optional redundancy (if not already installed)		No	Yes	No	It is **not** mandatory to install this feature (Refer to Table 43 for details)

Adding Physical Resources

This section applies to any already installed Nways Switch Model 300, Model 500, or Model 501.

Physical resources can be added to an existing Nways Switch without disturbing the existing traffic. Depending on the initial Nways Switch configuration and the type and number of additional resources, one or more software features might be required and ordered.

Space Planning

Additional physical resources are installed inside existing frames and therefore do not require any additional space.

NCT2 Configuration Changes

You must plan for the following changes:
- Physically configuring the new adapters, LICs, and lines.
- Logically configuring any new ports and trunks.
- Configuring the new connections, if any.

According to your configuration strategy, you can do this either from an Nways Switch configuration station or from the NAS. In the latter case, do not forget to update the central configuration data base.

Summary of Physical Resources Addition

Table 43. Adding Physical Resources to a Model 300 or Model 500

Feature Name	Feature Code	Down Time	NCT2	Add Space	Comments
Additional physical resources (adapters, LICs)		No	Yes	No	
Optional power duplication		No		No	
Optional redundancy		No		No	

Upgrading a NAS

Starting with the Nways Switch Control Program Version 2 Release 1, in order to support the dual code-level management feature and benefit from the improved performance of the Control Program, the Nways Switches must be equipped with a more powerful NAS. Two migration paths are possible. You can either:

- Replace the hard disks by larger disks in order to use the new functions.
- Replace the NAS in order to benefit from the new functions and performance.

You can visually check the level of a NAS. If the rear of the NAS is equipped with six adapter slots, and if there is no connector on the left side of the mouse and keyboard connectors, the NAS must be upgraded.

Glossary

The following are the abbreviations and technical terms used in the 2220 Nways Switch library.

2220. The IBM 2220 Nways BroadBand Switch (also called Nways Switch) is a fast packet switch enabling high-speed communications over a broadband network. It implements the functions of the IBM Networking BroadBand Services (NBBS) architecture.

2220-300. 2220 Nways Switch Model 300.

2220-500. 2220 Nways Switch Model 500.

2220-501. 2220 Nways Switch Model 501.

2220 NSM. 2220 Nways Switch Manager

AAL. ATM adaptation layer.

ABR. Availability bit rate. A best effort service with a minimum bit rate and a maximum cell loss value.

ac. Alternating current.

access services. Functions that are performed by a port adapter of the IBM 2220 Nways BroadBand Switch to:
- Support the attachment of external user devices through port lines
- Prepare user data packets
- Control the input traffic on port lines
- Manage line protocols.

active remote connector (ARC). A connector that supplies the electrical and physical interfaces between a line interface coupler type 511 (LIC511) in an Nways Switch subrack and data circuit-terminating equipment (DCE) or data terminal equipment (DTE). ARCs are housed in line connection boxes (LCBs).

adapter. An Nways Switch module that can be used, depending on its hardware type and the code that it runs, as:

> Control point adapter
> Port adapter
> Trunk adapter
> Voice server adapter.

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

ADPCM. Adaptive differential pulse code modulation.

AIS. Alarm indicator signal.

AIX. Advanced Interactive Executive.

alarm and power control (APC). In an Nways Switch, a module that connects the NAS, reports alarms, and controls the power supplies.

Alert Manager. An application that processes the SNA alerts received from IBM 3746s operating in IP mode.

AMI. Alternate mark inversion.

ANSI. American National Standards Institute.

APC. Alarm and power control (module).

AR. Access rate.

ARC. Active remote connector.

asynchronous transfer mode (ATM). A high-speed, connection-oriented switching and multiplexing protocol that transmits different types of traffic (voice, video, and data) simultaneously.

ATM. Asynchronous transfer mode.

ATMAn. ATM adapter type n (module).

ATM adaptation layer (AAL). In ATM devices, a set of protocols that adapt non-ATM devices to an ATM network. There are several classes of ATM adaptation layers which represent the main traffic types (for example, data, voice, and video).

ATM network interface. A logical resource generated by the Nways Switch Control Program to provide access services to a physical ATM port or trunk line. An ATM network interface sets up and maintains predefined ATM virtual connections.

AT&T. American Telephone & Telegraph (Company).

B8ZS. Bipolar eight-zero substitution.

Bc. Burst committed.

Be. Burst in excess.

bearer service profile (BSP). A set of parameters that defines a type of ISDN traffic (speech, audio, data, or video). One BSP is associated with each ISDN numbering plan table.

BECN. Backward explicit congestion notification.

B-ICI. Broadband inter-carrier interface.

BMI. Byte multiplexer interface.

BNC. Bayonet Niell-Concelman.

bps. Bit per second.

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bridge. A functional unit that interconnects two local area networks. A bridge works at the data link level (layer 2) of the OSI reference model.

broadband network. A network that uses a large frequency band to transport different kinds of traffic (such as coded voice, video, and data) at the same time.

BS. Bearer services.

BSC. Binary synchronous communication.

BSP. Bearer service profile.

BT. Burst tolerance.

bursty. Refers to transmission at variable bit rate where the time between data transmissions is not always the same.

CAC. Connection admission control.

CAS. Channel associated signaling.

CBR. Constant bit rate.

CCS. (1) Common channel signaling (2) Change control server (also called CC server).

CDB. Configuration database.

CDV. Cell delay variation.

CDVT. Cell delay variation tolerance.

cell loss priority (CLP). A priority bit in the ATM cell header. When set, it indicates that the cell can be discarded during traffic congestion.

centralized configuration database. A database prepared with the Nways Switch Configuration Tool Version 2 (NCT2) on a configuration station. It stores the parameters of a 2220 network.

CES. Circuit emulation services.

change control server (CCS or CC server). A station that runs the IBM NetView Distribution Manager for AIX to store the Nways Switch Control Program and to manage code changes.

CIR. Committed information rate.

circuit emulation services (CES). An access service that emulates a leased line. It transports information with a constant bit rate at the source and destination. The traffic can be PCM voice, video, fax, multimedia, or real-time synchronous data (such as BSC).

CLIP. Calling line identification presentation.

CLIR. Calling line identification restriction.

CLK. Clock (module).

CLKRD. Clock redrive (module).

clock module (CLK). A module of the 2220 Model 300 or 500 that transmits clock signals to the line interface couplers (LICs). It is optional and can have a backup.

clock redrive (CLKRD). A module of the 2220 Model 501 that drives the signals from the Model 500 clock module to the adapters of the Model 501. The clock redrive is optional and can have a backup.

clock references. In an Nways Switch, the software function that controls the transmission of clock signals to the LICs where they are used for bit synchronization.

CLP. Cell loss priority.

CMIP. Common management information protocol.

CMIS. Common management information services.

CMOT. CMIP over TCP/IP.

CNM. Communication network management.

code file. A named set of records stored as a unit in a change control server. An Nways Switch code file can include data or internal code.

COLP. Connected line identification presentation.

COLR. Connected line identification restriction.

configuration station. See Nways Switch configuration station.

control point (CP). In an Nways Switch, a logical resource that provides network control functions. It can have a backup.

CP. Control point.

CPA. Control point adapter (module).

CPE. Customer premises equipment.

CP spanning tree. In a 2220 network, a distribution tree that connects the Nways Switch control points through trunk lines. The CP spanning tree supplies a very fast and efficient way to multicast control messages such as network topology data.

CRC. Cyclic redundancy check.

CSU. Channel access unit.

CTD. Cell transfer delay.

data circuit-terminating equipment (DCE). An equipment installed on a user premises that provides all the functions required to establish, maintain, and terminate a connection, and to do the signal conversion

and coding between a data terminal equipment (DTE) and a line. A DCE can be separate piece of equipment or part of other equipment.

data terminal equipment (DTE).   That part of a data station that serves as data source, data sink, or both, and provides the data communication control function depending on the type of protocol used.

dB.   Decibel.

dBm.   Decibel based on 1 milliwatt.

DC48.   Dc power input type -48V

dc.   Direct current.

DCD.   Dc distribution (module).

DCE.   Data circuit-terminating equipment.

DDI.   Direct dialing-in.

DE.   Discard eligibility.

decibel (dB).   (1) One tenth of a bel. (2) A unit that expresses the ratio of two power levels on a logarithmic scale. (3) A unit for measuring relative power. The number of decibels is 10 times the logarithm (base 10) of the ratio of the measured power levels; if the measured levels are voltages (across the same or equal resistance), the number of decibels is 20 times the log of the ratio.

decibel based on 1 milliwatt (dBm).   A unit of absolute power measurement that is scaled such that 0 dBm equals 1 milliwatt.

dialog box.   On the screen of a station, an area with entry fields and push buttons. (Also called dialog.)

DLCI.   Data link connection identifier.

DNPT.   Destination numbering plan table.

DSP.   Digital service processor.

DSU.   Data service unit.

DTE.   Data terminal equipment.

DTMF.   Dual-tone modulation frequency.

DTR.   Data terminal ready.

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

E1 standard.   A European standard for TDM digital transmission service at 2.048 Mbps.

E3 standard.   A European standard for TDM digital transmission service at 34.368 Mbps. An E3 line can transport up to 16 E1 circuits.

E&M.   Earth & mark.

ECMA.   European Computers Manufacturers Association.

EIA.   Electronics Industries Association.

equivalent capacity.   The minimum amount of bandwidth needed by a connection to ensure that the packet loss ratio is below a specified threshold.

ESF.   Extended status flags.

ETS.   European telecommunication standard.

FANB.   Fan box.

FAT.   File allocation table.

fax.   Document received from a facsimile machine. Synonym for telecopy.

FCS.   Frame check sequence.

FDDI.   Fiber Distributed Data Interface.

FE1.   Fractional E1.

FECN.   Forward explicit congestion notification.

FEP.   Front-end processor.

fiber.   Synonym for optical fiber.

fiber budget.   The optical power loss as result of the number of connections in the optical fiber link subtracted from the working budget. The loss as a result of connections includes connector loss and splice loss. The fiber budget is expressed in decibels.

Fiber Distributed Data Interface (FDDI).   A U.S. standard for 100 Mbps token-ring LANs using optical fiber cables over distances of several kilometers.

fiber optic cable.   Synonym for optical fiber.

FR.   Frame relay.

FRAD.   Frame-relay access device.

frame relay (FR).   A connection-oriented protocol to transport data frames over a fast packet-network with guaranteed end-to-end quality of service.

FRFH.   Frame-relay frame handler.

front-end processor (FEP).   A processor, such as the IBM 3745, 3746 Model 900 or 950, or 3174, that relieves a main frame from communication control tasks.

FRTE. Frame-relay terminal equipment.

FRU. Field replaceable unit.

FT1. Fractional T1.

FTP. File transfer protocol.

Gbps. Gigabit per second (10 to the power of 9 bits per second).

GCRA. Generic cell rate algorithm.

GFP. Generic function protocol.

GFT. Generic function transport.

GSM. Group special mobile.

GUI. Graphical user interface.

HDB3. High-density bipolar 3.

HDLC. High-level data link control.

high-level data link control (HDLC). A data network protocol.

hot pluggable. Refers to a hardware component that can be installed or removed without disturbing the operation of any other resource that is not connected to, or dependent, on this component.

HPFS. High-performance file system.

HPRI. High priority.

HSAn. High-speed adapter type n (module).

HSDS. High-speed digital services.

HSSI. High-speed serial interface.

hub (intelligent). A wiring concentrator, such as the IBM 8260, that supplies bridging and routing functions for LANs with different cables and protocols.

hunt group. See X.25 hunt group.

IDNX. Integrated Digital Network Exchange.

IE. Information element.

ILMI. Interim local management interface.

IMU. Inverse multiplexing unit

Integrated Digital Network Exchange (IDNX). A processor integrating voice, data, and image applications. It also manages transmission resources and connects to multiplexers and network management support systems. It permits integration of equipment from different vendors.

integrated services digital network (ISDN). A digital end-to-end public or private network that supports multiple services including, but not limited to, voice and data.

IP. Internet Protocol.

IP gateway adapter. In an Nways Switch, a port adapter that routes the IP control between the NAS and the network management station.

ISDN. Integrated services digital network.

ISDN network interface. A logical resource generated by the Nways Switch Control Program to provide access services to a physical ISDN or QSIG port line. An ISDN network interface sets up and maintains connections between calling ISDN terminal equipments and called terminal equipments attached through other Nways Switches.

ISO. International Organization for Standardization.

isochronous. Refers to transmission at a constant bit rate where there is a clock relationship between source and destination. The bit rates are the same on the destination and source.

ITU-T. International Telecommunication Union - Telecommunication (replaces CCITT).

jitter. Undesirable variations in the transmission delay of a digital signal. Also called cell delay variation (CDV).

KB. Kilobyte (storage capacity, 1024 bytes).

kbps. Kilobit per second (1000 bits per second).

LAN. Local area network.

LAPB. Link access procedure for B-channel.

LAPD. Link access procedure for D-channel.

LCB. Line connection box.

LCBB. Line connection box, base (LCEB and LCPB).

LCBE. Line connection box, expansion (LCEE and LCPE).

LCEB. Line connection enclosure, base.

LCEE. Line connection enclosure, expansion.

LCPB. Line connection power, base.

LCPE. Line connection power, expansion.

LCR. Least cost routing.

LED. Light-emitting diode.

LICn. Line interface coupler type n (module).

line. In a 2220 network, any physical medium, such as a telephone wire, microwave beam, or optical fiber, that transmits information. A line can be a trunk line or a port line.

line connection box (LCB). A metallic box that:

- Multiplexes up to 15 low-speed lines. There can be up to four LCBs per LIC type 511 for a total of 60 lines (two LCBs and 30 lines per LIC connector).
- Reduces cable lengths between Nways Switch and DCE or DTE locations.

An LCB fits in a standard 19-inch rack. Each one houses up to 15 active remote connectors (ARCs).

line interface coupler (LIC). In an Nways Switch, a module that physically attaches trunk or port lines. Each line interface coupler is associated with a trunk or port adapter, and supports specific line interfaces.

LIV. Link integrity verification.

LMI. Local management interface.

local area network (LAN). A computer network located on a user premises in a limited geographical area.

logical port. (Also called NBBS port.) A logical resource generated by the Nways Switch Control Program to provide access services to a physical port line (or channel of a TDM port line) using HDLC, FR, or CES protocol. A logical port sets up and maintains its predefined connections.

logical trunk. (Also called NBBS trunk.) A logical resource generated by the Nways Switch Control Program to provide transport services to a physical trunk line (or channel of a TDM trunk line). A logical trunk is mainly responsible for optimizing bandwidth and maintaining the CP spanning tree.

LSAn. Low-speed adapter type n (module).

MA/SR. Multi-access/sub-rate.

management access. Refers to an Nways Switch that connects a network management station or a change control server to a 2220 network through its service bus, which is a dedicated Ethernet LAN.

MB. Megabyte (storage capacity, 1 048 576 bytes).

Mbps. Megabit per second (10 to the power of 6 bits per second).

MBS. Maximum burst size.

MLT. Multiple logical trunks.

module. In an Nways Switch, a hardware unit plugged in a slot of the logic subrack. It houses, for example, an adapter, a line interface coupler, or a voice server extension. All modules are hot pluggable.

ms. Millisecond (1/1000 second).

NAS. Nways Switch administration station.

NBBS. Networking BroadBand Services (architecture).

NBBS architecture. See Networking BroadBand Services.

NBBS connection. See potential connection and virtual connection.

NBBS network. A network built with IBM 2220 Nways BroadBand Switches and conforming to the IBM Networking BroadBand Services (NBBS) architecture.

NBBS port. See logical port.

NBBS trunk. See logical trunk.

NCT2. Nways Switch Configuration Tool Version 2.

NDPS. Non-disruptive path switching.

NEM. Nways Enterprise Manager (see 2220 Nways Switch Manager).

network control. Functions that are performed by an Nways Switch control point to:

- Allocate and control the Nways Switch resources
- Provide topology and directory services
- Select routes
- Control congestion.

network management station (NMS). A station that runs IBM NetView for AIX and the 2220 Nways Switch Manager. It is used to manage network topology, accounting, performance, configuration, and error reporting.

network node interface (NNI). An interface between nodes in a communication network.

Network Support Center (NSC). A location from which IBM remotely supports 2220 networks.

Networking BroadBand Services (NBBS). An IBM architecture for high-speed networking that complements ATM standards and provides access services, transport services, and network control to user traffic.

NIC. Network Information Center.

NMS. Network management station.

NNI. Network node interface.

NPT. Numbering plan table.

NR. Non-reserved.

NRT. Non-real-time.

NRZI. Non-return-to-zero inverted recording.

NRZ-1. Non-return-to-zero change-on-ones recording.

NSAP. Network service address point.

NSC. Network Support Center.

NSM. (See 2220 Nways Switch Manager)

NVDM. NetView Distribution Manager for AIX.

NTT. Nippon Telegraph & Telephone (Corporation).

numbering plan table (NPT). A set of parameters, organized in origin NPT and destination NPT, that defines a type of called ISDN numbers. A numbering plan table is associated with each ISDN network interface.

Nways 2220 Switch Manager (2220 Switch Manager). An IBM licensed program that runs under NetView for AIX to manage the 2220 Nways Switch operation and configuration from a network management station. It replaces the Nways Enterprise Manager (NEM) which is no longer available.

Nways BroadBand Switch. Synonym for 2220 Nways BroadBand Switch.

Nways Enterprise Manager (NEM). An IBM licensed program that was used under NetView for AIX in a network management station to manage Nways Switches, routers, and bridges in a 2220 network (see 2220 Nways Switch Manager).

Nways Switch. Synonym for 2220 Nways BroadBand Switch.

Nways Switch administration station (NAS). A station attached to each 2220 to run the Control Program, and control and service the Nways Switch locally.

Nways Switch configuration station. A mandatory OS/2 or AIX station that runs a stand-alone version of the Nways Switch Configuration Tool Version 2 (NCT2) and stores the centralized configuration database of the NBBS network. An OS/2 station can be used as a remote user console.

Nways Switch Configuration Tool Version 2 (NCT2). A component of the Nways Switch Control Program that is used to configure physical and logical resources. It is also used in stand-alone version under OS/2 or AIX .

Nways Switch Control Program. The IBM licensed program that runs in the NAS and adapters of the 2220 Nways Switch. It includes a CMIP agent to work with the 2220 Switch Manager.

Nways 2220 Switch Manager for AIX. (See Nways 2220 Switch Manager)

Nways Switch Resource Control. A component of the Nways Switch Control Program. It is used from the NAS of an Nways Switch or from a remote user console to control resources and configuration files.

OAM. Operation, administration, and maintenance.

OC3. Optical carrier level 3.

ONPT. Origin numbering plan table.

operation, administration, and maintenance (OAM). A group of functions coded in specific ATM cells to handle alarms and loopback tests on ATM connections.

optical fiber. In fiber optics technology, a wave guide that propagates optical signals from light-generating transmitters to light-detecting receivers.

OSI. Open systems interconnection.

packet loss ratio. The probability that a packet will not reach its destination or not reach it in a specified time. It is obtained by dividing the number of packets lost in transmission by the total number transmitted.

packet transfer mode (PTM). The native transfer mode of the NBBS architecture. PTM divides the traffic into packets of variable length.

PBX. Private branch exchange.

PCM. Pulse code modulation.

PCR. Peak cell rate.

PDH. Plesiochronous digital hierarchy.

permanent virtual circuit (PVC). A virtual circuit that has a logical channel permanently assigned to it at each item of data terminal equipment. It is activated by a program or by a network operator request.

plesiochronous. Refers to transmission at a nominal bit rate where the source and destination are controlled by different clocks. The bit rates are nearly the same.

PLP. Packet layer protocol.

PNP. Private numbering plan.

port. See logical port.

port adapter. In an Nways Switch, a module that provides access services to one or more port lines. Each port adapter is associated with a line interface coupler (LIC).

port line. A communication line that connects a device on user premises to an Nways Switch and serves as a port to the 2220 network. Port lines have different protocols and interfaces.

position. When configuring an Nways Switch, the position parameter indicates the line attachment number on the LIC module (1 to 8, depending on the LIC type).

potential connection. A predefined connection through a 2220 network between two HDLC, CES, or frame-relay devices.

PPP. Point-to-point protocol.

PRA. Primary Rate Access.

private branch exchange (PBX). A switching system located on a user premises that relays inside lines (extensions) and provides access to the public telephone network.

PRS. Primary reference source.

PSDN. Packet switched data network.

PSN. Public switched network.

PSTN. Public switched telephone network.

PTF. Program temporary fix.

PTM. Packet transfer mode.

PTNX. Private telecommunications network exchange.

pulse code modulation (PCM). A standard adopted for the digitalization of analog voice signals. In PCM, voice is sampled at a rate of 8 kHz and each sample is coded in an 8-bit frame.

PVC. Permanent virtual circuit.

Q signaling (QSIG). An international standard for signaling procedures in private telecommunication networks. It applies to the PBX-to-Nways Switch interface, which is called the Q reference point.

QoS. Quality of service.

QSIG. Q signaling.

quality of service (QoS). In a 2220 network, a set of parameters that guarantees the characteristics of a connection, mainly its end-to-end delay, delay variation, and packet loss tolerance.

RABM. Router and Bridge Manager.

rack. A metallic structure, with a standard 19-inch width, that houses the hardware elements of an Nways Switch, that is, logic subrack with modules, fan boxes, and power units. When configuring an Nways Switch, the rack parameter indicates the 2220 Model (rack A is the Model 300 or 500, and rack B is the Model 501).

RDI. Remote defect indication.

real-time processing. Refers to the manipulations of data that are required, or generated, by certain process while the process is in operation. Usually, the results influence the process and, perhaps, related processes.

remote user console. A station running OS/2, TCP/IP, and Nways Switch Resource Control. It can be connected to the NAS of an Nways Switch to remotely control and service it.

resource. In an Nways Switch, a hardware element or a logical entity created by the Control Program. Adapters, modules, and line attachments are examples of physical resources. Control points, logical trunks, logical ports, and network interfaces are examples of logical resources.

resource profile. A record of the characteristics of an Nways Switch resource. It includes (for example) the part number or module name, the change level, and the name and phone number of the person to contact when a problem occurs.

RETAIN. Remote Technical Assistance Information Network

RIP. Route Information Protocol.

router. An attaching device that connects two LAN segments of the same or different architectures. It can also be connected to a wide area network. A router works at the network level (layer 3) of the OSI reference model by determining the best paths for network traffic flows.

Router And Bridge Manager. An application that provides distributed management for routers such as the IBM 2210 or 2216, bridges such as the IBM 8229, and communication controllers such as the IBM 3746 in IP mode.

RS. Recommended specification.

RSF. Remote support facility.

RSN. Receive sequence number.

RT. Real-time.

RVX. RS/EIA-232, V.24/V.35, X.21.

s. Second.

SCR. Sustainable cell rate.

SDH. Synchronous digital hierarchy.

SDLC. Synchronous data link control.

SDT. Structured data transfer.

serial line internet protocol (SLIP). A TCP/IP protocol used on a point-to-point connection between two IP hosts over a serial line (for example, an RS/EIA-232 connection to a modem over a telephone line).

SLA. Serial link architecture.

SLIP. Serial line internet protocol.

slot. When configuring an Nways Switch, the slot parameter indicates the module location (1 to 12) in the logic subrack.

SNA. Systems Network Architecture.

SNMP. Simple Network Management Protocol.

SONET. Synchronous optical network.

spanning tree. See CP spanning tree.

SRC. System reference code.

SSN. Send sequence number.

station. A microcomputer that is connected to a host or a network and at which a user can run applications.

STM-1. Synchronous transport module type 1.

STS-3c. Synchronous transport signal type 3 concatenated.

SUB. Subaddress.

subrack. A metallic structure installed in an Nways Switch rack. A logic subrack holds modules. A power subrack holds power supply components.

SVC. Switched virtual circuit.

SW. Switch (module).

switch module (SW). A module of the 2220 Model 300 or 500 that interconnects the adapters through an ATM cell switch. It can have a backup.

switch redrive (SWRD). 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. It can have a backup.

SWRD. switch redrive (module)

switched virtual circuit (SVC). A connection set up from a calling address to a called address following a call establishment protocol. It is released when a clear request signal is received.

synchronous digital hierarchy (SDH). A international recommendation for the internal operation of carrier optical networks.

synchronous optical network (SONET). A U.S. standard for transmitting digital information over optical interfaces. It is closely related to the international recommendation for synchronous digital hierarchy (SDH).

T1 standard. A TDM digital transmission service with a basic rate of 1.544 Mbps. Also called DS-1.

T3 standard. A TDM digital transmission service with a basic rate of 44.736 Mbps. A T3 line can transport up to 28 T1 circuits. Also called DS-3.

TCPA. Trunk and control point adapter.

TCP/IP. Transmission Control Protocol/ Internet Protocol.

TDM. Time division multiplexing.

TE. Terminal equipment.

Telnet. In TCP/IP, an application protocol that allows a user at one site to access a remote system as if the display station were locally attached. Telnet uses the Transmission Control Protocol (TCP) as the underlying protocol.

time division multiplexing (TDM). The process of breaking the bandwidth on a communication line into a number of channels, possibly of different size.

TME. Tivoli Management Environment.

TMN. Telecommunication Management Network.

TPA. Trunk or port adapter.

Transmission Control Protocol/ Internet Protocol (TCP/IP). A set of communication protocols that support peer-to-peer connections over both local and wide area networks.

transport services. Functions that are performed by a trunk adapter of an Nways Switch to:
- Support the attachment of trunk lines
- Maximize bandwidth utilization
- Guarantee the quality of service of a connection
- Transfer packets between Nways Switches
- Manage logical queues and schedule transmission.

trunk. See logical trunk.

trunk adapter. In an Nways Switch, a module that provides transport services to one or more trunk lines. Each trunk adapter is associated with a line interface coupler (LIC).

trunk line. In a 2220 network, a high-speed line connecting two Nways Switches. It can be, for example, a copper cable, optical fiber, or radio wave guide and can be leased from telecommunication companies.

UBR. Unspecified bit rate. A best effort service with no quality commitment.

UNI. User network interface.

UPC. Usage parameter control.

URL. Uniform resource locator.

user network interface (UNI). A standardized interface between a user and a communication network.

UTC. Universal time, coordinated.

UUS. User-user signaling.

VBR. Variable bit rate.

VC. Virtual channel.

VCC. Virtual channel connection.

VCI. Virtual channel identifier.

VCN. Virtual circuit number.

virtual channel (VC). In ATM, a unidirectional route between two ATM devices. Virtual channels always come in pairs, one in each direction. They follow virtual paths.

virtual channel connection (VCC). In ATM, a unidirectional connection established over a virtual channel. Virtual channel connections always come in pairs, one VCC in each direction.

virtual channel identifier (VCI). In ATM, the unique numeric tag that identifies every channel. It is defined by a 16-bit field in the ATM cell header.

virtual connection. In frame relay, the return path of an FR potential connection.

virtual path (VP). In ATM, a group of virtual channels that are switched together as one unit. (Also called VC service.)

virtual path connection (VPC). In ATM, a connection established over a virtual path. Virtual path connections always come in pairs, one VPC in each direction. (Also called VP service.)

virtual path identifier (VPI). In ATM, an 8-bit field in the ATM cell header that indicates the virtual path over which the cell is to be routed.

voice server adapter (VSA). In an Nways Switch, a module that supplies additional voice functions to voice connections operating in pulse code modulation at 64 kbps. It can attach a voice server extension (VSE).

voice server extension (VSE). In an Nways Switch, a module associated with a voice server adapter (VSA) to supply voice functions to an extended number of PCM voice connections.

VP. Virtual path.

VPC. Virtual path connection.

VPD. Vital product data.

VPI. Virtual path identifier.

VPN. Virtual private network.

VSA. Voice server adapter (module).

VSEn. Voice server extension type n (module).

WAN. Wide area network.

wide area network (WAN). A network that provides communication services to a large geographic area. It can use or provide public communication facilities.

window. On the screen of a station, an area with a title bar, a menu bar, and scroll bars.

X.25 hunt group. A group of X.25 network interfaces associated with one common subscriber address. If an interface is busy, the connection searches (hunts) for the other interfaces of the group until a free one is found.

X.25 network interface. A logical resource generated by the Nways Switch Control Program to provide access services to a physical X.25 port line. An X.25 network interface sets up and maintains connections between calling X.25 subscribers and called subscribers attached to other Nways Switches.

X.25 Recommendation. An international standard for the interface between data terminal equipments and packet-switched networks.

X.25 subscriber. An X.25 end-user connected to an X.25 network interface through a DTE. A subscriber is defined by an address and a logical name.

Bibliography

This section lists prerequisite and related publications.

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- *2220 Nways BroadBand Switch At a Glance, an Overview*, GA33-0292
- *2220 Nways BroadBand Switch Planning Guide*, GA33-0293
- *2220 Nways BroadBand Switch Configuration Guide*, GA33-0474
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- *2220 Nways BroadBand Switch X.25 Interface Specifications*, GA33-0413
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- *How to use the NAS*, online tutorial[1]

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- *IBM Nways 2220 Switch Manager for AIX Installation Guide*, SH11-3088
- *IBM Nways 2220 Switch Manager for AIX: Performance Monitoring and Accounting*, GA33-0366
- *IBM Nways 2220 Switch Manager User's Guide*, online manual[2]

TME 10 NetView for AIX Version 5 Publications

- *NetView for AIX Installation and Configuration* , SC31-8163

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1. Online documentation delivered with the 2220 Nways Switch Control Program.
2. Online documentation delivered with the Nways 2220 Switch Manager product.

- *NetView for AIX V4R1 User's Guide* , SC31-8158

TMN 2.2 Publications

- *TMN 2.2 General Information* , GT01-0458
- *TMN 2.2 Agent User's Guide* SC31-8157

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- *Software Distribution for AIX Concepts* , GH19-4161
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- *Software Distribution for AIX User's Guide* , GH19-4163
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OSI System Management Standards for CMIP

OSI stands for Open Systems Interconnection

OSI Management Framework and Overview

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- *Part 3: Attributes for Representing Relationships* ISO 10164-3
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- *Part 9: Objects and Attributes for Access Control* ISO 10164-9
- *Accounting Management* , SC 21 N 4971
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- *Part 1: Management Information Model* , ISO 10165-1
- *Part 2: Definition of Management Information* , ISO 10165-2
- *Part 5: Generic Managed Information* , ISO 10165-5

Related Publications

- *Planning for Enterprise Systems Connection Links* GA23-0367

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