2210 Nways Multiprotocol Router

Introduction and Planning Guide

IBM

2210 Nways Multiprotocol Router

Introduction and Planning Guide

> **Note**
>
> Before using this information and the product it supports, be sure to read the general information under
> Appendix C, "Notices" on page C-1.

Sixth Edition (November 1998)

This edition applies to the IBM 2210 Nways Multiprotocol Router.

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About This Guide

This guide contains information you will use to plan your network and define hardware you want to purchase. It also contains specifications for the IBM 2210 Nways Multiprotocol Router (hereafter referred to as the *IBM 2210*).

Who Should Read This Guide

The intended user of this guide is the person responsible for planning the setup and configuration of the IBM 2210

How To Proceed

You will determine which adapters and cables to order when you plan a network configuration. Document all of the network information that will be required to install, connect, and configure the IBM 2210.

Use the following manuals and take the following steps to plan and install your IBM 2210:

Planning and Preparation

__ **1** Get familiar with the capabilities of the IBM 2210 (See Chapter 1, "Introduction to the IBM 2210" on page 1-1.)

__ **2** Determine which adapters and cables you will need. Chapter 3, "Physical Planning and Prerequisites," has details about available options. Design your network and place your order for your IBM 2210s and cables.

__ **3** If necessary, obtain and install the required common carrier equipment and services including ATM.

__ **4** Obtain and install the required LAN equipment and services.

__ **5** Order and install any required cables not included with the IBM 2210, such as ATM multimode and single-mode fiber cables that you will need to set up your network.

__ **6** Obtain and install the hardware and software required to run the Configuration Program, as described in Chapter 3, "Physical Planning and Prerequisites" on page 3-1.

__ **7** Prepare your site physically, ensuring that you meet the necessary power and environmental requirements. See Chapter 3, "Physical Planning and Prerequisites" on page 3-1.

Installation and Initial Configuration

  __ **1** Install the IBM 2210 using the *IBM 2210 Nways Multiprotocol Router Installation and Initial Configuration Guide* provided with the product. (Alternatively, installation by IBM service personnel is available. Contact your IBM representative for additional information.)

  __ **2** Connect a terminal or 14.4 modem to the serial port and complete the initial configuration steps.

  __ **3** Run the "Quick Configuration" program to perform the initial configuration and activate your IBM 2210.

Configuration

  __ **1** Perform final configuration. See the *Configuration Program User's Guide* and the *Software User's Guide*.

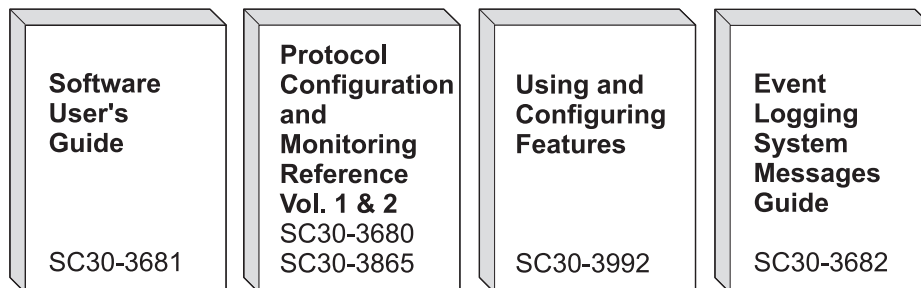| Planning and Installation	**Introduction and Planning Guide** GA27-4068	**Installation and Initial Configuration Guide** GC30-3867		
Configuration	**Configuration Program User's Guide** **GC30-3830**	**Configuration Program READ.ME**	Configuration Help	
Diagnostics/ Maintenance	**Service and Maintenance Manual** SY27-0345			
Operations and Network Administration	**Software User's Guide** SC30-3681	**Protocol Configuration and Monitoring Reference Vol. 1 & 2** SC30-3680 SC30-3865	**Using and Configuring Features** SC30-3992	**Event Logging System Messages Guide** SC30-3682

Figure   0-1. IBM 2210 Nways Multiprotocol Router Library Overview

Library Description

Introduction and Planning

GA27-4068 *IBM 2210 Nways Multiprotocol Router Introduction and Planning Guide*

This book is shipped with the 2210. It explains how to prepare for your network and for installation.

This book provides translations of danger notices and other safety information.

GC30-3867 *IBM 2210 Nways Multiprotocol Router Installation and Initial Configuration Guide*

It explains how to prepare for installation, install the 2210, perform an initial configuration and verify that the installation is successful.

This book provides translations of danger notices and other safety information.

Diagnostics and Maintenance

SY27-0345 *IBM 2210 Nways Multiprotocol Router Service and Maintenance Manual*

This book is shipped with the 2210. It provides instructions for diagnosing problems with and repairing the 2210.

Operations and Network Management

SC30-3681 *Software User's Guide for Multiprotocol Routing Services*

This book explains how to:

- Configure, monitor, and use the IBM Multiprotocol Routing Services software shipped with the router.

- Use the Multiprotocol Routing Services command-line router user interface to configure and monitor the network interfaces and link-layer protocols shipped with the router.

SC30-3680 *Protocol Configuration and Monitoring Reference Volume 1 for Multiprotocol Routing Services*

SC30-3865 *Protocol Configuration and Monitoring Reference Volume 2 for Multiprotocol Routing Services*

These books describe how to access and use the Multiprotocol Routing Services command-line router user interface to configure and monitor the routing protocol software shipped with the router.

They include information about each of the protocols that the devices support.

SC30-3682 *IBM Nways Event Logging System Messages Guide*

This book contains a listing of the error codes that can occur, along with descriptions and recommended actions to correct the errors.

SC30-3992 *Using and Configuring Features for Multiprotocol Routing Services*

This book details how to configure and use the features for Multiprotocol Routing Services. These features include bandwidth reser-

vation, WAN restoral, WAN reroute, DIALs, and Network Address Translation (NAT).

Configuration

Online help The help panels for the Configuration Program assist the user in understanding the program functions, panels, configuration parameters, and navigation keys.

GC30-3830 *Configuration Program User's Guide for Multiprotocol Routing Services*

This book discusses how to use the Configuration Program.

GG24-4446 *IBM 2210 Nways Multiprotocol Router Description and Configuration Scenarios*

This book contains examples of how to configure protocols using IBM Multiprotocol Routing Services.

Safety

SD21-0030 *Caution: Safety Information - Read This First*

This book provides translations of caution and danger notices applicable to the installation and maintenance of an IBM 2210.

Library Ordering Information

All 2210 publications can be ordered separately.

These publications are shipped in hardcopy with the 2210:

IBM 2210 Nways Multiprotocol Router Introduction and Planning Guide

IBM 2210 Nways Multiprotocol Router Installation and Initial Configuration Guide

IBM 2210 Nways Multiprotocol Router Service and Maintenance Manual

Configuration Program User's Guide for Multiprotocol Routing Services

Caution: Safety Information - Read This First

These publications are shipped with the Configuration Program in softcopy on a CD-ROM:

IBM 2210 Nways Multiprotocol Router Introduction and Planning Guide

IBM 2210 Nways Multiprotocol Router Installation and Initial Configuration Guide

IBM 2210 Nways Multiprotocol Router Service and Maintenance Manual

Software User's Guide for Multiprotocol Routing Services

Protocol Configuration and Monitoring Reference Volume 1 for Multiprotocol Routing Services

Protocol Configuration and Monitoring Reference Volume 2 for Multiprotocol Routing Services

IBM Nways Event Logging System Messages Guide

Using and Configuring Features for Multiprotocol Routing Services

IBM Multiprotocol Routing Services and IBM 2210 Softcopy Library

Obtaining Softcopy Information

Softcopy BookManager READ library information is available for many of the 2210 publications in the *IBM Networking Systems Softcopy Collection Kit.* To place a single order for the CD-ROM, use form number SK2T-6012.

Yearly subscriptions to the *IBM Networking Systems Softcopy Collection Kit*, product number 5636-PUB, are available through your branch office representative. Order feature code 2003 and media code 5003 for CD-ROM format.

System Library Subscription Service

The 2210 publications are available via the System Library Subscription Service (SLSS). Use machine type 2210 and program number 5765-B86 to receive 2210 publications.

Visit Our Web Site

Visit the IBM 2210 Web site at `http://www.networking.ibm.com/220/220prod.html` for:

- Storage Estimator
- Performance testing results
- Configuration programs and MRS code
- Publications
- Questions and answers

Summary of Changes

Changes to the *IBM 2210 Nways Multiprotocol Router Introduction and Planning Guide* include:

- Obtaining Multiprotocol Routing Services (MRS) Software
- Revised Access Methods Section
- Network Planning for ISDN and Virtual Private Networks
- The 4- and 8-Port Dial Access Adapters

The technical changes and additions are indicated by a vertical line (|) to the left of the change.

Chapter 1. Introduction to the IBM 2210

The IBM 2210 Nways Multiprotocol Router (hereafter referred to as the *IBM 2210*) provides a method of routing and bridging across LANs and WANs. Routing is supported for multiple network protocols over a variety of media.
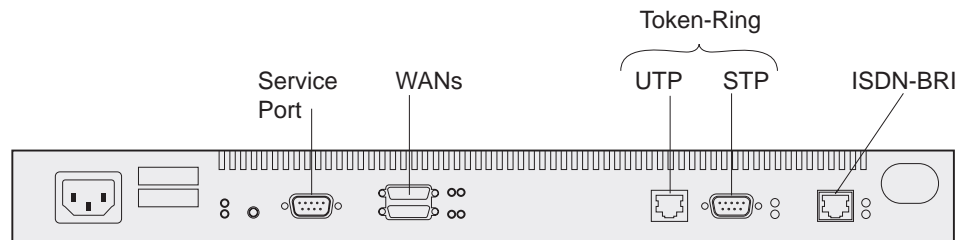
Figure   1-1. Model 127

The IBM 2210 functions as a Simple Network Management Protocol (SNMP) agent and can be managed by network managers that implement certain SNMP management information base (MIB) standards.

The software that supports the IBM 2210 is the IBM Multiprotocol Routing Services, a licensed program (program number 5765-B86). The IBM Multiprotocol Routing Services has three components:

- The code that provides the routing, bridging, data link switching, and SNMP agent functions for the IBM 2210. The base code is installed at the factory on the IBM 2210.

- The Configuration Program with a graphical user interface that allows you to configure the IBM 2210 from a stand-alone workstation.

- A monitoring system that allows you to perform change management, network management, problem determination, and configuration.

Models of the IBM 2210

The IBM 2210 is available in several models, based on the types of networks you want to support. In addition, you can tailor your software package, depending upon your needs. Table 1-1 on page 1-2 shows the different models available.

Note that the only difference between some of the models is the amount of flash or DRAM memory. Flash memory is used to store a compressed version of the router's software. Flash memory is not upgradable on the 1x4, 1x8, or 12x models of the IBM 2210.

You can add an additional 4 or 8 MB of flash memory to the 14T and 24x models of the IBM 2210 by adding the 4 or 8 MB Flash Upgrade Feature. The 4 MB Flash Upgrade Feature provides a total of 8 MB of flash memory for those models. The 8 MB Flash Upgrade Feature provides a total of 12 MB of flash memory for the same models.

If you need to maintain multiple copies of software for various releases, you need to consider having sufficient flash memory for the copies. Use flash upgrades to

increase your software capacity. For help determining your flash or DRAM requirements use the IBM 2210 Storage Estimator program available on the Web at:
http://www.networking.ibm.com/220/220stor.html

IBM 2210's DRAM provides the working memory for the router programs and the router network tables. The amount of required DRAM in a IBM 2210 is determined by the size and complexity of the network the IBM 2210 must support. As you increase the number of protocols, transports, and features that you are using on the IBM 2210, you will need to increase the installed DRAM.

You cannot upgrade the DRAM for models 1S4, 1S8, 1U4, or 1U8. You can upgrade the DRAM for any of the 12x models up to 16 MB. You can upgrade the DRAM for x4x models up to 32 MB.

Note: If you upgrade the DRAM for x4x models up to 32 MB you must have or install the PROM Load/Dump Program revision level 2.34 or higher.

Certain models of the IBM 2210 support ISDN.

The following table lists the current 2210 models:

Table   1-1. IBM 2210 Models

Model	LAN	No. of Integrated WANs (see note)	ISDN BRI	Base Flash Memory	Base DRAM	Supports Adapter Features
1S4*	Ethernet	1	1	2 MB	4 MB	No
1S8*	Ethernet	1	1	4 MB	8 MB	No
1U4*	Ethernet	1	1	2 MB	4 MB	No
1U8*	Ethernet	1	1	4 MB	8 MB	No
12T	Token-Ring	2	0	4 MB	8 MB	No
12E	Ethernet	2	0	4 MB	8 MB	No
127	Token-Ring	2	1	4 MB	8 MB	No
128	Ethernet	2	1	4 MB	8 MB	No
14T	Token-Ring	4	0, 1, or 4 (optional)	4 MB	16 MB	Yes
24T	2 Token-Ring	4	0, 1, or 4 (optional)	4 MB	16 MB	Yes
24E	2 Ethernet	4	0, 1, or 4 (optional)	4 MB	16 MB	Yes
24M	1 Token-Ring 1 Ethernet	4	0, 1, or 4 (optional)	4 MB	16 MB	Yes

Note:

The standard WAN ports on the IBM 2210 will support any of these physical interfaces:

- EIA 232-D/V.24
- V.35
- V.36
- X.21

Expandable base DRAM:

- Base DRAM for the 12x can expand to 16 MB.
- Base DRAM for the 14x can expand to 32 MB.

*The 1S4, 1S8, 1U4, and 1U8 can use both ISDN BRI B channels, or the WAN port, or one ISDN BRI B channel and the WAN port at any given time.

Obtaining Multiprotocol Routing Services (MRS) Software

Software is pre-loaded on the IBM 2210 at the factory. (Note that if you purchase the IBM 2210 through an IBM reseller, the code is sometimes loaded at the reseller's location and not at the factory.) The Configuration Program is also shipped with each software or hardware order.

Visit the IBM 2210 Web site at:
`http://www.networking.ibm.com/support/2210` for:

- Additional code loads

- The Configuration Program

- Versions of code loads with data encryption support

- Code loads for the Network Dispatcher

- The PROM Load/Dump Program for 1Ux/1Sx and x4x models

- IBM DIALs client code loads

Availability of a particular encryption option depends upon the import/export restrictions in your country.

Chapter 2. Functions of the IBM 2210

The current software that supports the IBM 2210 is the IBM Multiprotocol Routing Services, a licensed program. The IBM Multiprotocol Routing Services has three components:

- The code that provides the routing, bridging, data link switching, and SNMP agent functions for the IBM 2210. The base code is installed at the factory on the IBM 2210.

- The Configuration Program with a graphical user interface that allows you to configure the IBM 2210 from a stand-alone workstation.

- A monitoring system that allows you to perform change management, network management, problem determination, and configuration.

Networks Supported by the IBM 2210

The LANs supported by the IBM 2210 are:

- Token-Ring (IEEE 802.5) with STP or UTP connection
- Ethernet (IEEE 802.3) with AUI or 10BASE-T connection

The interfaces supported by every IBM 2210 are:

- EIA 232D/V.24
- V.35
- V.36
- X.21

WAN Net Handlers

- V.25bis (not supported on X.21)
- X.25
- PPP
- FR
- SDLC
- SDLC Relay
- Tunneled binary synchronous communication (BSC)
- V.34 (supported only on EIA 232)

Note: Only V.34 supports the 4- and 8-port Dial Access Adapters.

In addition to these interfaces, some models also support ISDN and ATM.

Note: If you use the V.34 Net Handler, or the dial-in and dial-out functions of the DIALs feature you must have the appropriate PROM Load/Dump Program version. Models 12x require PROM Load/Dump revision level 1.6 or higher. If you have an earlier version you must order a PROM upgrade. Models x4x require revision level 2.20 or higher. The code is available on the Web at:
`http://www.networking.ibm.com/support/downloads/2210`

Protocols Supported by the IBM 2210

Table 2-1 shows the protocols supported by each IBM 2210 interface.

Table 2-1. IBM 2210 Supported Routing and Bridging Protocols

	WANs						LANs		
					V.25bis, V.34, and ISDN				
Framing Methods	PPP	FR	X.25	SDLC	Dial on Demand	Dial Backup	Token-Ring	Ethernet	ATM
Protocols									
IPv4	yes	yes	yes	no	yes	yes	yes	yes	yes[2]
IPv6	yes	no	no	no	yes	yes	yes	yes	no
Banyan VINES	yes	yes	yes	no	yes	yes	yes	yes	yes
DECnet IV	yes	yes	yes[3]	no	yes	yes	yes	yes	yes
DECnet V/OSI	yes	yes	yes[1]	no	yes	yes	yes	yes	yes
BGP	yes	yes	yes	no	yes	yes	yes	yes	yes
NetBIOS	yes	yes	yes	no	yes	yes	yes	yes	yes
LNM	yes	yes	yes	no	yes	yes	yes	no	yes
IPX	yes	yes	yes	no	yes	yes	yes	yes	yes[2]
AppleTalk	yes	yes	yes[1]	no	yes	yes	yes	yes	yes
SNA	yes	yes	yes	yes	yes	yes	yes	yes	yes
SRB	yes	yes	yes[4]	no	yes	yes	yes	no	yes
TB	yes	yes	yes[4]	no	yes	yes	yes	yes	yes
SRT	yes	yes	yes[4]	no	yes	yes	yes	yes	yes
SR/TB	yes	yes	yes[4]	no	yes	yes	yes	yes	yes

Notes:

1. Routing of this protocol is not supported on X.25 interfaces; however, if this protocol is bridged, the IP tunnel function can be used to send bridge packets over an X.25 interface.
2. IPv4 and IPX are supported using Token-Ring and Ethernet LAN emulation. In addition, IPv4 and IPX are supported between routers that support RFC 1483 encapsulation.
3. Support for DECnet IV is on X.25 only in the IBM modes of operation, not in the DEC compatibility modes.
4. Bridging is not supported directly on X.25 interfaces; however, you can use the IP bridge tunnel function to send bridge packets over X.25 interfaces.

Hardware Features Supported by 14T and 24x Models

The following features are supported only by the 14T and 24x Models.

Second Service Port This additional service port can provide another way to contact an IBM 2210 that is experiencing problems through a second line. The second service port can be a:

- 14.4 Kbps Modem Port Feature (North America Only)
- EIA 232 Service Port Feature

Optional Adapter Feature This feature allows you to use the 2210 with different transports. Available interface adapters include the:

- 1- and 4-port ISDN Basic Rate Interface Adapter
- 1-port E1 120-ohm ISDN PRI Adapter
- 1-port T1/J1 ISDN PRI Adapter
- 4-port WAN Concentration Adapter
- 8-port WAN Concentration Adapter

- 1-port 25-Mbps ATM Interface Adapter
- 4-port Dial Access (Modem) Adapter
- 8-port Dial Access (Modem) Adapter
- 4-port Dial Access Modem Card Upgrade feature

To install the adapters, your IBM 2210 must be equipped with the Adapter Enablement Feature.

Adapter Enablement Feature

This feature consists of the hardware items required to install an additional interface adapter in these models.

Additional Flash Feature   This feature allows you to increase the amount of flash on the IBM 2210. The 4 MB Additional Flash Feature and 8 MB Additional Flash Feature are the two available options.

Memory Expansion Feature   This feature allows you to increase the amount of memory/DRAM on the IBM 2210. The 16 M DRAM Memory Expansion Feature and 32 M DRAM Memory Expansion Feature are the two available options.

Note: When using 32 MB of memory with a 14T or 24x model you must use the PROM Load/Dump revision level 2.34 or higher. The 4- and 8-port Dial Access Adapters require the PROM Load/Dump revision level 2.40 or higher. The PROM Load/Dump code is available on the Web at:
`http://www.networking.ibm.com/support/downloads/2210`

Chapter 3. Physical Planning and Prerequisites

Placement Options - Tabletop or Rack

The 1S4, 1S8, 1U4, and 1U8 models can only be placed on a tabletop. The other IBM 2210 models can be placed on a tabletop or in a rack.

Tabletop Placement

If the IBM 2210 is placed on a tabletop, the table must meet the requirements for service and operating clearances listed under "Physical Requirements" on page 3-2.

Rack Placement

If you choose rack-mounting, you must provide the rack; it is not provided with the 2210.

You can use any EIA standard 19-inch rack. The rack can be open or closed. However, if you choose a closed rack, you must make sure that enough air flows through the 2210. Covers on the front of the rack that would not let air reach the 2210 must be removed or modified to let air pass. Similarly, unvented rear rack covers that would not let air exit the 2210 or would cause back pressure to build up from several machines must not be used.

The attachment holes along each side of a rack are usually divided into units of measure called *EIA units.* Each EIA unit equals 44.5 mm (1.75 in.). See Table 3-1 on page 3-2 for the approximate height of the various IBM 2210 models. There is no requirement for clearance between IBM 2210 units in a rack; multiple units can be spaced 1 EIA unit apart.

Physical Specifications

This section describes the physical characteristics and specifications for the IBM 2210.

Table 3-1. Physical Characteristics of the IBM 2210 Models

Model	Front	Side	Height	Weight
1Sx	279.4 mm (11 in.)	133 mm (5.25 in.)	41.4 mm (1.63 in.)	1.24 kg (2.75 lb.)
1Ux	279.4 mm (11 in.)	133 mm (5.25 in.)	41.4 mm (1.63 in.)	1.24 kg (2.75 lb.)
12x	439 mm (17.3 in.)	254 mm (10 in.)	43.7 mm (1.74 in.)	3.2 kg (7 lb.)
14T	440 mm (17.3 in.)	305 mm (12 in.)	87.4 mm (3.48 in.)	5.16 kg (11.4 lb.) without Adapter Enablement Feature 5.66 kg (12.5 lb.) with Adapter Enablement Feature
24x	440 mm (17.3 in.)	305 mm (12 in.)	88 mm (3.48 in.)	5.16 kg (11.4 lb.) without Adapter Enablement Feature 5.57 kg (12.5 lb.) with Adapter Enablement Feature

Physical Requirements

This section describes the physical requirements for operating and servicing the IBM 2210.

Environment

Operating Environment
Temperature[1] : 10° to 40° C (50° to 104° F)
Relative humidity: 8% to 80%
Maximum wet bulb[2] : 26.7° C (80° F)

Power Source Loading
0.2 kVA maximum

Maximum Current
2 A at 100V
1 A at 240V

---

[1] The upper temperature limit must be lowered 1° C for every 137 meters of elevation above 915 meters.

[2] The upper wet bulb temperature must be lowered 1° C for every 274 meters of elevation above 305 meters.

Power Supply
35 watts

The second power supply that is provided as part of the Adapter Enablement Feature is the same as the base power supply.

Operating Voltage
100 to 250 V ac

Heat Output
32 watts/hr (113 BTUs) without Adapter Enablement Feature

39 watts/hr (137 BTUs) with Adapter Enablement Feature

Clearance

Operating Clearance
Front: 760 mm (30 in.)
Rear: 150 mm (6 in.)

Service Clearance
For placement with cables at the front
Front: 760 mm (30 in.)

For placement with cables at the rear
Front: 760 mm (30 in.)
Rear: 760 mm (30 in.)
Left: 760 mm (30 in.)
Right: 760 mm (30 in.)

Hardware and Software Requirements for the Configuration Program

Table 3-2 on page 3-4 lists the minimum requirements for the operating systems supported by the configuration program.

Table 3-2. Configuration Program Requirements for Supported Operating Systems

Requirement	IBM AIX	IBM Operating System/2	Microsoft Windows 95 or Windows NT
Workstation	RS/6000 Model 250/410 or higher with minimum 80-Mhz CPU	IBM-compatible PC with Intel Pentium 166-MHz or higher processor[1]	IBM-compatible PC with Intel Pentium 166-MHz or higher processor[1]
RAM (minimum)	64 MB	48 MB	48 MB
CD-ROM	yes	yes	yes
Free Disk Space	54 MB Additionally, you will need 1 to 3 MB for each configuration file.	37 MB Additionally, you will need 1 to 3 MB for each configuration file.	54 MB Additionally, you will need 1 to 3 MB for each configuration file.
Swapper Size	N/A	10 MB	N/A
Display (minimum)	Graphics (1024 x 768 x 256 colors)	SVGA (1024 x 768 x 256 colors)	SVGA (1024 x 768 x 256 colors)
Mouse	3-button	2-button[2]	2-button[2]
Software	AIX for RS/6000 V4.1.5 or higher AIXWindows Environment/6000	OS/2 3.0 or higher IBM TCP/IP 1.2.1 for OS/2 or higher	Microsoft Windows 95 or Windows NT

Notes:

1. More memory and faster processors improve the program's performance.
2. Functionally equivalent to a 3-button mouse.
3. You must make sure that TCP/IP is **installed** and **running** before using the "Single Send or Retrieve" or "Multiple Send or Retrieve" functions. On Microsoft Windows platforms, the configuration program will hang if TCP/IP is not installed and running.

Chapter 4. Access and Configuration Methods

This chapter explains how to access, either locally or remotely, the IBM 2210's operational and configuration software. The network administrator or the IBM Support Center can access the IBM 2210 locally or remotely for configuration or diagnostics.

Access Methods

The IBM 2210 software must be configured as part of the installation process. Therefore, you have to access the software in one of the following ways:

- Locally through a null-modem adapter and serial cables supplied with this product that are attached to the EIA-232 service port using an ASCII connection. See Figure 4-1.

- Remotely using dial-in (over telephone lines) through a modem attached to the EIA-232 primary service port or the secondary service port, if installed. You can use an ASCII connection. The secondary service port can be either an EIA-232 Service Port Feature or a 14.4 Kbps Modem Port Feature. See Figure 4-2 on page 4-2 and Figure 4-3 on page 4-2.

Table 4-1. User Console Attachment Options

Physical Attachment	Line Protocol	Access Protocol	Default IP Address
Service port + null modem Service port + external modem	Asynchronous characters	ASCII terminal emulation	Not applicable
Any IP network interface	IP	Telnet	No defaults

An ASCII connection requires an ASCII terminal or workstation running an ASCII terminal emulator.

Once the IBM 2210 is operational in the network, you can access the IBM 2210 by Telnetting from a network-connected workstation. This workstation must be attached to any of the IBM 2210's IP-capable network interfaces. The network interface can be on a LAN adapter or WAN adapter because both support IP routing. The Telnet workstation can be locally or remotely connected.
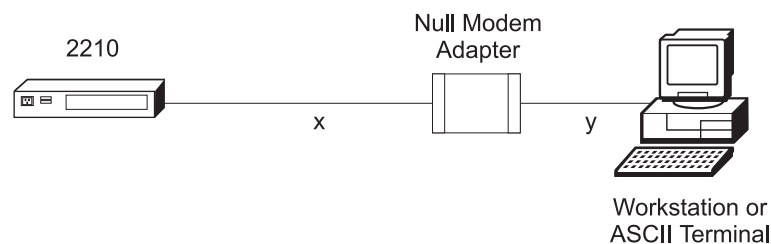

Figure 4-1. Local Terminal Connection to the EIA-232 Service Port

2210

Modem

y

Workstation or
ASCII Terminal
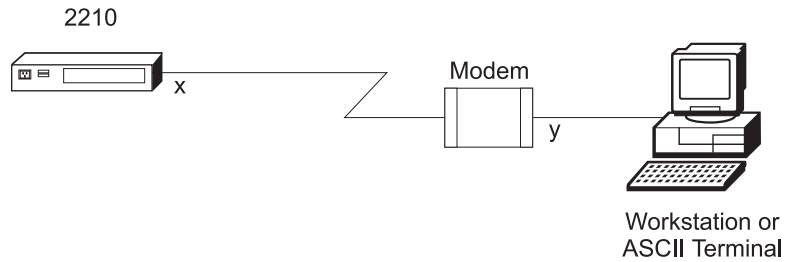
Figure 4-2. Remote Connection to 14.4 Kbps Modem Port Feature (14T and 24x Models)

2210

x

Modem

Modem

y

z

Workstation or
ASCII Terminal
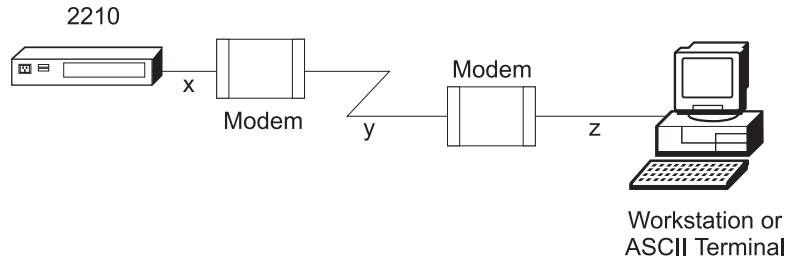
Figure 4-3. Remote Terminal Connection to the Primary or Secondary EIA-232 Service Port

Service Port Default Settings

These are the default settings for the EIA-232 serial port:

Speed 9600 bps
Parity None
Data Bits 8
Stop Bits 1

You can configure the EIA-232 service port speed for the following bit rates; however, the speed must match the speed configured for the ASCII terminal. The IBM 2210 also supports auto-baud.

300
1200
2400
4800
9600
19 200
38 400

Modem Support

Modem Requirements

The modem must be connected to the service port on the IBM 2210, use asynchronous operation, and be compatible with the Attention (AT) command set. A modem connected to a 2210 service port must be configured with the following characteristics:

- No echo
- Suppress results code
- Auto-answer

- Hardware (RTS/CTS) flow control
- Modem DTE speed fixed to match 2210 service port speed (9600 recommended).

Consult your modem documentation on how to configure and save these settings.

Remote Connection for Service

To resolve a problem with your IBM 2210, IBM service personnel may request permission to establish a temporary, remote connection to the IBM 2210. In most situations, the IBM service personnel will not be at a remote workstation that is connected to your IP network. Consequently, remote access must be established using a modem. Whenever you authorize IBM service personnel to establish such a remote connection, you must:

- Connect and configure the modem before the remote service session can begin

- Provide the service personnel with the telephone number of a modem connected to the service port of the target IBM 2210 or to a modem that is connected to the service port on an IBM 2210 that is on the same network as the target IBM 2210

- Provide service personnel with the password or other necessary information for access to any security protection features

Modem Settings

The following modems have been tested for use with the IBM 2210:

IBM 7852, Model 400
Zoom/FaxModem 56Kx
Atlas 33.6 External PC Data/Fax Modem

For instructions on setting-up these and possibly other modems to operate with your IBM 2210, see: `http://www.networking.ibm.com/support/2210`

Configuration Methods

The IBM 2210 supports four types of configuration methods:

- Quick Configuration

  Quick Configuration allows you to configure selected devices, bridging protocols, and routing protocols without entering a separate configuration environment to use the Configuration Program. After creating a minimal configuration, you must transfer a complete configuration to the IBM 2210 using TFTP or the configuration program's communications feature. To use Quick Configuration for the initial configuration, you must attach an ASCII terminal to the IBM 2210.

- EasyStart

  EasyStart mode automatically downloads the configuration of the router from a BOOTP server. During the process, the router displays the `EasyStart>` prompt and ELS messages that track the process. See the *Software User's Guide for Multiprotocol Routing Services* for more information about EasyStart.

- Configuration Program

  The Configuration Program allows you to configure the IBM 2210 completely once Quick Configuration has taken place. The Configuration Program is run on a stand-alone workstation and has a graphical user interface. Once you

have established remote access to the IBM 2210, you can transfer the complete configuration using TFTP or the send option of the configuration program's communication feature. The configuration program's communication feature uses SNMP to send the configuration data to the IBM 2210. It also has a restart router option that restarts the IBM 2210 and initializes it with the new configuration data.

Alternatively you can use the communication feature's timed configuration option to program a time at which the IBM 2210 will be restarted with the new configuration. For more information, see the *Configuration Program User's Guide for Multiprotocol Routing Services*.

- Command Line Interface

  The IBM 2210's command line interface allows you to configure the router completely. You can access the command line interface by using one of the access methods described in "Access Methods" on page 4-1. You must use quick configuration to perform a basic IP configuration and restart the IBM 2210 before you can Telnet to access the command line interface.

Use either the IBM Multiprotocol Routing Services command line interface or the Configuration Program for Multiprotocol Routing Services to make changes to configuration parameters.

Chapter 5. Network Planning

This chapter details how to plan for ISDN and virtual private networks.

Planning for ISDN

The ISDN interface provides you with a scalable solution if you require high-capacity dial backup between remote sites or cost-effective consolidation of dozens of leased line connections. ISDN interfaces can also be used for implementing the DIALs remote access function.

Planning for ISDN in the IBM 2210

IBM 2210 models have four adapter slots, which can be populated with any combination of the ISDN adapters listed in Table 5-1.

Table 5-1. Number of B-Channels per ISDN Adapter

Number of B-Channels Supported	Model and/or Adapter Type
2	1S4, 1S8, 1U4, 1U8, 127, and 128
2	x4x with 1-port ISDN BRI
8	x4x with 4-port ISDN BRI
23	x4x with 1-port ISDN PRI T1/J1
30	x4x with 1-port ISDN PRI E1

Note: For ISDN BRI, X.25 on the D-channel is also supported.

Planning for ISDN with your Service Provider

Contact your telephone company to plan for T1/J1, E1, and ISDN line service. The sections that follow list information to provide and gather.

Information to Provide to your Telephone Company

When leasing lines from your public telephone service provider, provide the following information:

For ISDN Connections:

Service on the line
> Either primary rate interface (PRI) ISDN or basic rate interface (BRI) ISDN.

Telephone numbers per line
> The number of telephone numbers to associate with each line.

Hunt groups A hunt group associates one phone number with several channels on a line. When a user dials in, connection occurs over any channel that is free. Note that a single hunt group can be set up over multiple T1 or E1 lines; furthermore, it is not necessary for all hunt group lines to connect into the same IBM 2210. As an alternative to a hunt group, each of the 23 T1 or 30 E1 bearer channels in a line can be called using separate phone numbers.

For ISDN Connections

Number of lines
> You will need one line for each port (to determine how many ports are needed, see Table 5-1 on page 5-1).

Service agreement
> An E1 or T1 line provides continuous signaling. Some service providers detect when signaling is broken and terminate service to the line. Specify in your service agreement the conditions under which it is appropriate to terminate line support.

Information to Gather from Your Telephone Company

You will need to gather the following information from your telephone company:

For ISDN BRI Connections:

Note: The ISDN BRI U interface is for use only in North America. The ISDN BRI S/T interface is for worldwide usage. S/T can be used in North America with external NT1.

Switch variant
> The kind of switch your telco will be using to connect to the IBM 2210 ISDN BRI line. The IBM 2210 supports:
>
>> AT&T 5ESS (United States)
>> Northern Telecom DMS 100 (United States)
>> USNI1 (United States National ISDN1)
>> USNI2 (United States National ISDN2)
>> NET 3 (European ETSI)
>> INS 64 (Japan)
>> VN3 (France Telecom)
>> AUS TS 013 (Australia)
>> I.430

Telephone numbers
> SPID, TEI (auto or fixed), and directory numbers.

For ISDN PRI Connections:

Switch variant
> The kind of switch your telco will be using to connect to the IBM 2210 ISDN PRI line. The IBM 2210 supports:
>
>> AT&T 5ESS (United States)
>> AT&T 4ESS
>> Northern Telecom (DMS PRI)
>> Australia (AUSTEL) TS-014
>> INS-Net 1500 (Japan, NTT)
>> National ISDN 2
>> NET 5 (Euro-ISDN, ETSI)
>> I.431

Telephone numbers
> Assigned by the telco to your channels.

Line type In Europe, South America, and certain other countries, use an E1 line. In Canada, the U.S.,and Mexico, use a T1 line. Japan requires a T1 or J1 line.

Line build out (LBO)

Line build out is the voltage level on the connector that terminates your line at the IBM 2210. LBO accounts for the distance between the IBM 2210 and the telco, the quality of the line, and the intermediate amplification specified in dB.

Line coding For T1, Bipolar 8 Zero Substitution (B8ZS). For E1, High Density Bipolar 3 (HDB3). AMI for both.

Time slot inversion

Enabled or disabled Zero Byte Time Slot Inversion (ZBTSI).

Data link Super frame (D4) and extended super frame (ESF) are supported. For ESF, your service subscription will specify ANSI-T1.403, ANSI-IDLE, or AT&T IDLE.

CRC4 Enabled or disabled E1 CRC4 packet checking mechanism.

Planning for Virtual Private Networks

The support that the IBM 2210 provides for virtual private networks (VPNs) and for virtual private dial-up networks (VPDNs) are strong components of IBM's overall strategy for ensuring the security of your organization's data. However, they are only components of a larger solution. A single piece of hardware or software cannot ensure complete network security, just as a stand-alone firewall cannot completely protect your network. IBM's security solutions encompass multi-platform VPN-enabled clients and servers, routers, controllers, ISP services, and consulting services. For more information about creating an end-to-end virtual private network, visit the IBM Security Services Web site at
http://www.ibm.com/security/html/consult.html

Appendix A. Cable Specifications

This appendix describes the signals associated with the pins on the cable connectors for the service port and the WANs supported by the IBM 2210. This information will assist you in obtaining custom cables from your supplier.

LAN and ISDN ports use industry-standard cables.

Disclaimer: The information in this chapter does not guarantee function or compliance with radio frequency interference (RFI) or electromagnetic interference (EMI) regulations.

Service Port

The service port provides an EIA 232/V.24-compatible DTE interface on a 9-pin male D connector with the following signal definitions:

Table   A-1. Service Port Signal Definitions

Pin No.	Signal	Driven by IBM 2210	Received by IBM 2210
1	Carrier Detect		x
2	Receive Data		x
3	Transmit Data	x	
4	Data Terminal Ready	x	
5	Ground		
6	Data Set Ready		x
7	Request To Send	x	
8	Clear To Send		x
9	Ring Indicate		x

A null modem adapter is required for attachment to a terminal having a male connector.

Wide Area Networks (WANs)

For a custom cable, use a 26-pin dual slimline male connector (AMP P/N 750850-2 and 750833-1) and the appropriate connector for the DCE/DTE. The following list gives the conformity for the EIA and CCITT connectors:

- EIA 232-D/CCITT V.24 connector must conform to ISO 2110.2
- CCITT V.35 connector must conform to ISO 2593
- CCITT V.36 connector must conform to ISO 4902
- CCITT X.21 connector must conform to ISO 4903

Bulk cable consists of the appropriate numbers of 28 American Wire Gauge (AWG) tin-plated copper individually shielded pairs, with an overall shield. The nominal characteristic impedance of the bulk cable should be 85 ohms. The cable should meet the safety requirements of the appropriate local safety organization.

The length of the connection from the IBM 2210 to the attaching equipment should not exceed 15 m (50 ft.).

The same cable and interface is used for the WAN ports on the planar and the adapter slot.

EIA 232-D/V.24

Table   A-2. EIA 232/V.24 Connector Pin Assignments, 25-pin D, Male, Modem-Attach

Signal	Machine End Pin Number	DCE End Pin Number
Send Data	16	2
Signal Ground	23,26,21,19	7
Receive Data	2	3
Data Set Ready	13	6
Transmit Clock	12	15
Receive Clock	4	17
Clear To Send	14	5
Local Loopback	15	18
Call Indicate	17	22
Data Terminal Ready	20	20
Request To Send	22	4
Data Carrier Detect	24	8
DTE Clock	18	24

Table   A-3. EIA 232/V.24 Connector Pin Assignments, 25-pin, D, Female, Direct-Attach

Signal	Machine End Pin Number	DTE End Pin Number
Send Data	2	2
Signal Ground	23,26,21,19	7
Receive Data	16	3
Data Set Ready	20	6
Transmit Clock	18	15
Receive Clock	18	17
Clear To Send	15	5
Data Terminal Ready	13	20
Request To Send	24	4
Data Carrier Detect	22,14	8

V.35

Table A-4. V.35 Connector Pin Assignments, 34-pin Block, Male, Modem-Attach

Signal	Machine End Pin Number	DCE End Pin Number
Send Data	6,5	P,S
Signal Ground	19,23,26	B
Receive Data	2,1	R,T
Data Set Ready	13	E
Send Timing	12,11	Y,AA
Receive Timing	4,3	V,X
Terminal Timing	8,7	U,W
Clear To Send	14	D
Local Loopback	15	L
Call Indicator	17	J
Data Terminal Ready	20	H
Request To Send	22	C
Data Carrier Detect	24	F

Table A-5. V.35 Connector Pin Assignments, 34-pin Block, Female, Direct-Attach

Signal	Machine End Pin Number	DTE End Pin Number
Send Data	2,1	P,S
Signal Ground	19,23,26	B
Receive Data	6,5	R,T
Data Set Ready	13,20	E
Send Timing	8,7	Y,AA
Receive Timing	8,7	V,X
Clear To Send	15	D
Request To Send	24	C
Data Carrier Detect	22,14	F

V.36

Table A-6. V.36 Connector Pin Assignments, 37-pin D, Male, Modem-Attach

Signal	Machine End Pin Number	DCE End Pin Number
Send Data	6,5	4,22
Signal Return DCE	19	20
Signal Return DTE	23	25,30,37
Receive Data	2,1	6,24
Data Set Ready	13	11
Send Timing	12,11	5,23
Receive Timing	4,3	8,26
Clear To Send	14	9
Local Loopback	15	10
Call Indicator	17	15
Data Terminal Ready	20	12
Request To Send	22	7
Data Carrier Detect	24,26	13,31

X.21

Table A-7. X.21 Connector Pin Assignments, 15-pin D, Male

Signal	Machine End Pin Number	DCE End Pin Number
Send Data	6,5	2,9
Signal Ground	23	8
Receive Data	2,1	4,11
Control	10,9	3,10
Indicate	24,26	5,12
Signal (Clock)	4,3	6,13
Terminal Timing	8,7	7,14

X.21 Direct Connect Cable

Table   A-8. X.21 Connector Pin Assignments, 26-pin D, Male to 15-pin Female

Signal	26-pin Connector	15-pin Connector
Receive Data A, B	6, 5	4, 11
Indicate A, B	10, 9	4, 12
Send Data A, B	2, 1	2, 9
Control A, B	24, 26	3, 10
Receive Timing A, B	4, 3	7, 14
Signal A, B	8, 7	6, 13
Ground	23, 19	8
Cable ID jumper	22, 13	

Note: Each line in the table is a twisted pair. Connect the first pin in the first column to the first pin in the second column.

T1, J1, and E1 Custom Cable Specifications

For a custom cable, use a 26-pin, three-row, male connector (Positronics P/N ODD26F4R8NOX) and the appropriate connection at the network end; RJ-48C that meets ISO 8877, ANSI 408 and EIA/TIA 547 for T1 and J1; country specific for E1.

Bulk cable must have the following characteristics:

- Two twisted pairs

- Shielding on each twisted pair plus overall shielding

- Cable must meet the safety requirements of the appropriate local safety organization

- Twisted pair shielding carried through on connector as shown in appropriate tables.

- Maximum length depends on cable gauge and installation, contact your service provider.

T1 Connector Pin Assembly

Table   A-9. T1 Connector Pin, 26-pin D, to RJ-48L

Signal	26-pin Connector	RJ-48L
Transmit Data	11,13	5,4
Transmit Data Shield	Connector Shell	6
Receive Data	15,17	2,1
Receive Data Shield	Connector Shell	3

J1 Connector Pin Assembly

Table   A-10.   J1 Connector Pin, 26-pin D, to RJ-48L

Signal	26-pin Connector	RJ-48L
Transmit Data	11,13	6,3
Receive Data	15,17	5,4

E1 Connector Pin Assembly

Table   A-11.   E1 Connector Pin, 26-pin

Signal	Machine End	Network End
Transmit Data	11,13	Country Specific
Receive Data	15,17	Country Specific
Shield	Connector Shell	Country Specific

Appendix B. Management of Routing Networks

This appendix describes the management of routing networks and covers the following topics:

- Network characteristics
- Basic principles
- The network organization
- Configuration management
- Router changes (configuration and hardware)
- Network changes

Network Characteristics

The routing network includes many components and has the following characteristics:

- The network is an open system.
- There are many similar but different components.
- Each configuration file must complement many others.
- Many different approaches can be used.
- Each configuration file contains many parameters (1300+ available).
- Many failures are dependent on specific application loads.
- Some configuration errors appear to be box problems.
- One configuration error can bring down the network.

The network is a complex system that must be managed. There are:

- Many interdependences
- Few absolutes

Basic Principles

Configuration Control

Configuration control requires a consistent approach that is best achieved by one person, referred to in this appendix as the *Network Engineer*, or by a unified team. This person or team should work in conjunction with a central control point, referred to as the *Network Management Center (NMC)*.

The Network Engineer
To ensure consistency throughout the network, a single individual or a unified team must establish an approach and define or approve the configuration for each network box. Routing networks are defined by a large number of parameters specified in a number of different network boxes. The parameters specified in the different boxes must complement each other to form a unified and functioning network. The configuration program specifies these network parameters for the IBM 2210.

There is no "right" set of parameters and box configurations for a network. There are many possible configuration combinations.

Central Control Point (Network Management Center)

All configurations and updates should be loaded and updated from a central control point, usually the Network Management Center (NMC). This allows a single individual (or team) to monitor, test, and coordinate activities at several locations or sites from a single location. This is easily accomplished using TCP/IP Telnet methods in combination with the remote access features in the IBM routers.

An exception to loading all configurations directly from a central control point is the initial configuration for a new router or the reconnection of a router to the network following a repair or hardware change. However, all these configurations should be supplied by, and controlled by, the NMC.

When problems occur, all activities should be coordinated with the Network Management Center. The NMC involves the Network Support Team, network engineer, and box support/service organizations as needed.

Step-by-Step Configurations

Maintain a solid base by configuring the network step-by-step. The key factors are:

- IP connectivity (direct routes only)
- One protocol at a time
- Patience

IP Connectivity

Each router should be configured initially with only IP direct routes. With this configuration installed, it is easy to verify that each port on the router is connected to the device specified. Simply "ping" through the port to the attached device. If the ping is not successful, it is clear that the link being pinged has a problem. If dynamic routing protocols are active, they may route the ping around the problem, making it difficult to detect and identify the problem.

One Protocol at a Time

After IP connectivity has been established, enable one protocol at a time and test each to verify the router is functioning in the network as expected. This step-by-step approach applies to application protocols such as IPX and NetBIOS as well as network protocols such as OSPF and RIP.

In established well-controlled networks where step-by-step configurations have been applied consistently without corrections, you can combine several protocols into one step. However, if you encounter problems, return to a single protocol per step until consistency is reestablished.

Patience

It may take considerable time for some configurations to load and become functional, especially if the advanced network protocols such as OSPF are used in a large network. For large networks with thousands of devices, it is not unusual for this to take from 15 minutes to an hour or more.

Configuration and Network Debugging

Reestablishes a solid base:

- Expect many types of errors.
- Limit time attempting a "quick fix."
- Generate new configurations from scratch.

Many Types of Errors

Errors in the configuration program can cause many different types of problems. They may initially appear to be router hardware problems because the router will not complete booting or data will not flow through an adapter port. Also, configuration errors may not cause a problem initially, but will cause a problem when specific conditions are encountered.

Generate New Configurations

If a problem is not resolved after you make a few changes to a configuration file, it is highly recommended that you generate a new configuration file from scratch following the step-by-step approach already defined.

A few changes to the configuration will often create additional errors which compounds the problem and requires a number of hours to debug and resolve. Also, some parameters may have been activated or changed by accident. It may take over an hour to check all 1300+ parameters in the questionable configuration file. A new configuration can usually be generated and tested step-by-step within an hour. Also, there is a high probability that this new configuration will function as desired or a defect in the network configuration or the network devices will be identified.

The Network Organization

The key is to have structure and control. A typical organization consists of:

- The Network Management Center (NMC)
- The Network Engineer
- The Network Support Team
- The Network Manager

Note: Many other structures can be used, and these functions can be combined with others.

Network Management Center

The Network Management Center (NMC) provides network monitoring, network coordination, and network control.

Network Monitoring

For large networks, the NMC:

- Provides support 24 hours a day, 7 days a week, with operators present. This may be combined with the Help Desk.

- Uses NV/6000 or a similar tool.

- Monitors network capacity measurements.

- Takes all calls relative to network problems.

- Maintains network diagram and associated databases.
- Maintains data and service procedures for:
  - Network external connections (T1, Frame Relay, and so on)
  - Equipment used in the network
  - Service and support organizations

For small networks, the NMC:

- Provides support 24 hours a day, 7 days a week. This function may be combined with the Network Engineer function.
- Takes or records all calls relative to network problems.
- Maintains network diagram and associated data.
- Maintains data and service procedures as needed.

Network Coordination

The NMC:

- Calls and dispatches the Network Support Team to investigate problems. The Network Engineer or IBM systems engineering operations specialist may replace the Support Team for small networks.
- Calls suppliers and others for problem resolution.
- Negotiates network down time between network users and the problem solvers or network changers.
- Coordinates and schedules planned network down time and maintenance.
- Coordinates requests for network improvements and expansions. This activity includes:
  - Receiving requests from users and management
  - Forwarding requests to the Network Engineer
  - Informing users and requesters of planned actions
- Schedules and coordinates network changes as defined by the Network Engineer.

Network Control

The NMC:

- Implements and documents all changes to the network. The Network Support Team or Network Engineer make the changes, but the NMC controls and documents them.
- Coordinates all maintenance, test, and diagnostics activities:
  - Before activity starts
  - After activity is complete, with results reported even if previously scheduled and on-time
- Ensures that network procedures are followed ... "network police."
  - For problem determination, maintenance, and changes
  - Procedures provided by the Network Engineer

    Note: The Network Engineer must also follow the procedures.
- Escalates issues to the correct person:
  - Users to area coordinator or area management

- Service providers to their management
- Network support team to the Network Engineer
- Network Engineer to the Network Manager

Network Engineer

The Network Engineer:

- May be replaced by a team of people that function as a single unit
- May be the IBM systems engineering operations specialist for small networks
- Obtains recommendations from many sources.

The Network Engineer is responsible for:

1. Network design, function, and cost:

   - Defines or approves all network changes
   - Tracks and analyzes network performance and issues
   - Defines NMC and other procedures associated with the network

2. Network problem resolution:

   - Resolves problems reported by the NMC, management, or network users
   - Coordinates all activity through the NMC

3. Training and education:

   - NMC personnel
   - Network support team personnel
   - Network users
   - Managers, both users and network support
   - Service and other related personnel
   - New network engineers

   Note: Other agencies may actually deliver the training.

Network Support Team

The Network Support Team is responsible for:

1. Network maintenance and debugging:

   - Box connectivity and interface connectors, converters, and adapters
   - Workstations, servers, terminals, printers
   - Bridges, routers
   - Facilities, space, and security as required for each item
   - Location and access to each box, cable, and set of documentation

2. Identification and correction of problems or concerns:

   - Resolves issues directly when possible
   - Requests support from component or box supplier when needed
   - Provides Network Engineer or others with data relative to the problem or concern
   - Implements tests or corrections as defined by Network Engineer or equipment supplier
   - Keeps NMC informed of all activities and results

3. Assistance and coordination of equipment suppliers:

4. Implementation of measurements, tests, and changes according to directions provided by the Network Engineer.

Network Manager

The Network Manager is responsible for:

1. Network management and operation:

   - Sets priorities
   - Resolves disputes
   - Ensures quality

2. Finances:

   - Funding
   - Expense Recovery

3. Staffing:

   - Obtains the skills needed
   - Deals with personnel issues and evaluations
   - Responsible for organization and controls

4. Interfacing to the organization and users:

   - Ensures continued funding
   - Identifies changes in requirements

5. Supporting the "network police"

Configuration Management

Configuration management involves:

- Configurations
- Configuration sets
- Naming conventions
- Router configuration changes
- Hardware changes that affect the network
- Hardware changes that do not affect the network
- Router code updates

Configurations

These are maintained:

1. On the Configuration Workstation in the NMC for each router:

   - An IP direct route only configuration to verify router connectively
   - A complete protocol configuration based on current functions
   - Individual protocol test configurations
   - A history of previous configurations

   Different configuration files must be clearly labeled or named.

2. At each router:

   - PC terminal emulator and IP direct route diskettes

     or
   - Data and instructions for configuring an IP direct route plus ASCII terminal, cables, and so on.

   Alternatively, a telephone line and modem can be connected to a service port and the NMC can install configuration files as needed.

3. On additional configuration workstations or files:

- Backup files are needed for NMC configuration workstation
- Multi-configuration workstations may be needed for large or geographically dispersed networks, but must be closely coordinated and controlled.

Configuration Sets

Configuration sets are maintained in configuration database (CDB) files created by configuration programs.

Different configuration sets can be maintained for:

- Current network operations (production)
- Previously-used CDBs
- Special applications or events
- Tests for special functions, performance, and so on
- Planned improvements and expansions

Naming Conventions

Concepts

Name each configuration file so that it can be quickly and directly identified relative to:

- Router
- Configuration type (IP only, IP routing protocols, and so on)
- Configuration set

A naming convention may be required to use special programs for configuration set transfer and import.

Configuration Database Names

The following example is an approach used for AIX workstations. It uses an 8-character name with the following format:
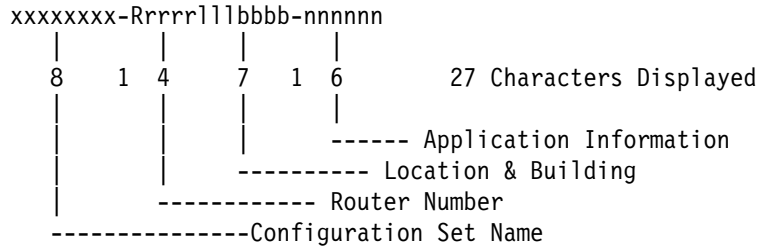
```
xxxxxxxx.CDB
```

Examples:

`CURPROD_.CDB`   Current production configuration set

`CURIPDIR.CDB`   Current IP Direct Route configuration set

`H930814_.CDB`   History production configuration from 8/14/93

`E1103TST.CDB`   Enhancement configuration set tested 11/03

`BLDAPPN_.CDB`   Building configuration set for APPN.

Configuration File Names

An approach used for AIX workstations:

```
xxxxxxxx-Rrrrrlllbbbb-nnnnnn
   |      |   |   |    |
   8    1 4   7 1 6              27 Characters Displayed
   |      |   |   |
   |      |   |    ------ Application Information
   |      |    ---------- Location & Building
   |       ------------ Router Number
    --------------Configuration Set Name
```

Examples of CDB files:

```
CURPROD_-R0023ALT0063-ENG
CURPROD_-R0102NYC953K-ACTPAY
CURPROD_-R1031RAL016A-DIVHQ
CURPROD_-R0527TKO_ASC-MFG001
```

⋮

```
CURIPDIR-R0023ALT0063-ENG
CURIPDIR-R0102NYC953K-ACTPAY
CURIPDIR-R1031RAL016A-DIVHQ
CURIPDIR-R0527TKO_ASC-MFG001
```

Examples of router directory *(names)*

```
CURPROD_-R0023ALT0063-ENG
CURIPDIR-R0023ALT0063-ENG
H930814_-R0023ALT0063-ENG
E1103TST-R0023ALT0063-ENG
BLDAPPN_-R0023ALT0063-ENG
```

Router Configuration Changes

Router configuration changes include:

- Adjustment of cost factors, filters, etc.
- Adjustment of data collection or tracking
- Addition of protocol features
- Adjustment for a network addition

Make configuration changes as follows:

1. The Network Engineer defines or approves all changes, specifying the time and/or prerequisites for implementation:

   - Schedule for non-critical or off-shift periods
   - Stable network defined as no problems within xx hours

2. All changes include a description of:

   - The expected events during the configuration change
   - The expected results or impact on the router and network

3. All changes include a "bail-out" plan:

   - How to keep the network operational if problems develop
   - When to implement the plan

4. The NMC applies configuration changes:

   - Follow established procedures.
   - Document changes and results.

- Network engineer and others may observe or assist.

Note: If problems are encountered, obtain assistance from:

  - The Network Support Specialist
  - The Network Engineer
  - The IBM 2210 Level II Support

Changes to a Router

Changes to a router include hardware changes that do or do not affect the network, and router code updates.

Hardware Changes that Affect the Network

These changes include:

  - Adapter, port, or interface cable changes
  - Connection of a new router into the network
  - System board replacement

Make hardware changes that affect the network as follows:

1. The Network Engineer defines or approves all network changes, including:

   - Change instructions
   - Time and prerequisites for changes
   - Results and impact of changes
   - A "bail-out" plan, and when to implement it

2. The NMC schedules all changes to the network.

3. The service representative contacts the NMC and verifies planned activities, including the "bail-out" plan.

4. The service representative implements the hardware changes and runs diagnostics as needed.

5. The NMC and service representative verify that:

   - Cables are connected to the ports according to the configuration.
   - The operating system level and Configuration Program are compatible.

6. The service representative connects the router to the network by configuring an IP direct route to the network using the instructions and data provided.

7. The NMC completes the IP direct route configuration.

8. The NMC verifies network connectivity by testing connectivity to and from each attached port using the network diagram and change instructions.

9. The NMC installs IP routing protocol configurations and verifies them.

   Note: The service representative may leave the site at this point.

10. The NMC installs application protocol configurations and verifies them.

11. The NMC documents the changes and their impact, and monitors function for a significant time.

Hardware Changes that Do Not Affect the Network

These changes include, for example, replacement of a fan or power supply in a router that was functioning in the network prior to the hardware problem. Hardware changes that do not affect the network are made as follows:

1. The NMC schedules all changes to the network.

2. The service representative contacts the NMC and verifies planned activities:

   - "Bail-out" plan
   - Availability of hardware and configuration files

3. The service representative implements the hardware changes and runs diagnostics as needed.

4. The service representative informs the NMC that the router is ready for network reconnection.

5. The service representative connects the router to the network by plugging in the power cord and verifying that the system and ports are active without errors.

6. The NMC verifies that the router is functioning as before.

7. The NMC documents the changes.

Router Code Updates

Update the router code as follows:

1. The Network Engineer defines or approves all network changes. The definition includes:

   - Update instructions
   - Time and prerequisites for update
   - Results and impact of update
   - A "Bail-out" plan, and when to implement it

2. The NMC loads PTFs to the router. If the update cannot be installed remotely by the NMC, the NMC controls the activity at the router.

3. If the current configuration is not compatible with updated router level:

   - Update the configuration files using the configuration program:

     – IP direct route only configuration
     – Functional configuration with all protocols
     – Test configurations such as IP routing protocol

   - Load configurations into the router.

   - Update local configuration data sources (verify that instructions and data for configuring IP direct routes are available).

4. Commit PTFs according to instructions. The router reboots with the current configuration.

5. The NMC verifies that the router is functioning according to the update instructions and previous data, documents the update and results, and monitors function for a significant time.

6. New functional configurations are generated and installed by the NMC. After the network is verified as stable at new code level, configurations are changed to use the new capability.

Network Changes

Configuration Build Sequence

Use the following configuration build sequence:

1. Generate router configurations. A typical sequence is:

   a. IP direct routes
   b. IP routing protocols
   c. IP filter and exports
   d. Application 1 protocol
   ⋮
   e. Application *n* protocol

2. Test and/or analyze:

   a. Test bed with load/traffic

      or

      Network engineer with direct experience

   b. Non-critical subnets or segments

      • Implement according to procedure (NMC)
      • Operate for significant time
      • Do three segments without errors or problems

3. Schedule remaining subnets or segments:

   • The NMC implements the changes.
   • When problems occur, drop back to the test bed.

Network Configuration Changes

Update the router code as follows:

1. The Network Engineer defines or approves each configuration.

   • Configurations are named according to established conventions.
   • Each configuration set is in the CDB file by router type.
   • Configuration change instructions are available.
   • A "bail-out" plan is available.

2. The NMC transfers configuration files to the routers. This may require a special feature[1] or shell scripts.

3. Import the configuration for each router. This requires a defined plan, including router sequence, to:

   • Maintain connectivity
   • Minimize exposure to significant network down time:
     – One router or subset at a time
     – One router every xxx minutes
     – All routers at same time

4. Monitor the network to verify the changes.

---

[1] A Multi-Transmit Feature is included in V1R3 AIX Configuration Program.

5. Document configuration changes and effects.

Network Code Updates

Apply network code updates as follows:

1. Test and/or analyze:

   a. Test bed with load/traffic

      or

      Network engineer with direct experience

   b. Non-critical subnet or segment

      - Implement according to procedure (NMC)
      - Operate for significant time
      - Do three segments without errors or problems

   c. You may use special features or shell scripts:

      - To transmit PTFs to all routers
      - To apply and commit either one at a time (sequence important) or all at once.

2. Schedule remaining subnets or segments:

   - The NMC implements the changes.
   - When problems occur, drop back to the test bed.

3. Stabilize at single code level (single configuration level).

Network Expansion Example

This example involves connecting additional LANs and WANs to the network.

Assumptions:

- This is a tested and established procedure.
- NMC personnel are experienced.
- This is a large network with hundreds of routers.

1. Preparation by the NMC

1. Network Change Instructions are available and approved.

2. The NMC verifies that:

   - Telco links are active between routers Ii and Ni.
   - Telco links are connected to correct ports in Ii.
   - The LAN connections are available and active for Ni.
   - The new routers (Ni) are at the site.

3. The NMC schedules the service representative or network support specialists for each site. Each service representative or support specialist has:

   - A plan and procedures to be used, including information about what to use when.

   - Documentation needed:

     – Phone number for NMC
     – Network diagram and/or data needed
     – Installation and other procedures
     – Port locations

– Physical location data

   • Equipment needed

          – IP direct route Configuration Diskette
          – Diagnostics diskettes
          – Modem and associated cables
          – Terminal and associated cables

Note: Some or all of these items may be available at the site.

2. Key Installation Steps

1. Each service representative (or support specialist) contacts the NMC from the site and verifies the plan.

2. Each service representative sets up the router at the site:

   • Verifies that ports are as specified
   • Runs diagnostics if required
   • Positions router in specified location
   • Connects network cables as specified

3. The NMC installs expansion configurations in the interface routers:

   • Previous functional configurations with new connections added.
   • They may be installed in advance or during previous change.

4. The service representative contacts the NMC to coordinate the connection of the router (Ni) to the network, and then:

   • Plugs in the power cord with the terminal connected.
   • Configures an IP direct route to the network according to the instructions and data provided.

5. The NMC completes the direct route configuration.

6. The NMC verifies connectivity for router (Ni):

   • Tests connectivity to and from each attached port.
   • Tests using network diagram and change instructions.

7. The NMC multiplexes with all sites to verify connectivity. Problems are debugged and resolved if possible. If problems are not resolved:

   • Expansion proceeds using the connections available.
   • Allowable delays are defined by change instructions.
   • Service call is initiated to resolve the problem.

8. The NMC installs IP Routing Protocols on each router:

   • Transfers and commits configurations for each router.
   • Tests to verify IP routing for the expanded network:
       – Using the Network Change Instructions
       – Checking routing tables, processes running, and so on

   Note: The service representative may leave the site when IP routing is verified.

9. The NMC installs application protocols on each router, transfers and commits configurations for each router, and tests to verify that the expanded network is functioning.

10. The NMC documents the expansion and the effect, continues to monitor function for a significant time, and schedules further expansions when stability is verified.

3. Network Roll-Out Plan
This plan summarizes the activities and costs for the network expansion example.

NMC operator (1/2 day):
Adds two to six routers to the network (number dependent on complexity).

Schedules future expansion project:

- Service representative and Telco activity
- Network cable availability

Configuration specialist (1/2 day):
Generates configuration files needed for project (most configurations are generated in advance).

Generates new configurations as needed to:

- Debug or verify a problem
- Correct problems identified

Service representative for each router:
Requires 2 to 5 person-hours per site (each router is at a different site).

NMC user interface specialists (1/2 day x 2 specialists):

- Coordinate new function or change with user groups.
- Prepares users for the change.
- Schedules the change.
- Handles questions and problems.

Roll-out rate and costs:
Based on 16 to 48 routers per week:

8 half-days for adding routers
2 half-days for follow-up problems

Four NMC personnel:

1 Operator
1 Configuration specialist
2 User interface specialists

Total roll-out costs per router:
3 to 10 NMC hours per router

2 to 5 service representative (or network specialist) hours per router

Network Expansion Requirements
This section summaries the network expansion requirements in terms of personnel experience and network controls that must be in place.

1. Experienced Network Installer/Designer

- More than four networks designed, each supported for more than one year
- Hands-on full-time support for a time on each network

2. Experienced Network Installer for the NMC

- More than 4 years hands-on full-time installation and maintenance
- Four different network types including network expansions
- Can quickly generate network diagram from routing tables
- Can recognize symptoms from many different types of problems

3. Network Controls in Place and Working

- Approval of all network changes by the Network Engineer
- Coordination of all network support activity through the NMC
- Network police active and backed by network management
- Documented procedures and controls with flowcharts

4. Local Network Support

- Support personnel with quick access to each node
- Can set up, test, and repair routers and related products
- Can assist network installer and the Network Engineer

Network Configuration Changes

Make network configuration changes as follows:

1. The Network Engineer defines or approves each configuration.

   - Configurations are named according to established conventions.
   - Each configuration set is in the CDB file by router type.
   - Configuration change instructions are available.
   - A "bail-out" plan is available.

2. The NMC transfers configurations to the routers. This may require a special program or shell scripts.

3. Import configuration for each router using the special program.

4. Import the configuration for each router using the special program. This requires a defined plan, including router sequence, to:

   - Maintain connectivity
   - Minimize exposure to significant network down time:
     - One router or subset at a time
     - One router every xxx minutes
     - All routers at same time

5. Monitor the network to verify the changes:

   - Observe router status changing as configurations take effect.
   - Check routing tables and other parameters.
   - Check compliance with configuration change instructions.

6. The NMC documents the changes and their impact, and monitors function for a significant time.

Appendix C. Notices

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Glossary

This glossary includes terms and definitions from:

- The *IBM Dictionary of Computing* (New York; McGraw-Hill, Inc., 1994).

- The *American National Standard Dictionary for Information Systems*, ANSI X3.172-1990, copyright 1990 by the American National Standards Institute (ANSI). Copies may be purchased from the American National Standards Institute, 11 West 42nd Street, New York, New York 10036. Definitions are identified by the symbol (A) after the definition.

- The *Information Technology Vocabulary*, developed by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions of published parts of this vocabulary are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers being developed by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.

- The Network Working Group Request for Comments: 1208.

The following cross-references are used in this glossary:

Contrast with: This refers to a term that has an opposed or substantively different meaning.

Synonym for: This indicates that the term has the same meaning as a preferred term, which is defined in its proper place in the glossary.

Synonymous with: This is a backward reference from a defined term to all other terms that have the same meaning.

See: This refers the reader to multiple-word terms that have the same last word.

See also: This refers the reader to terms that have a related, but not synonymous, meaning.

A

A. Ampere.

active. (1) Operational. (2) Pertaining to a node or device that is connected or is available for connection to another node or device.

agent. A system that assumes an agent role.

AIS. Access Integration Services software.

analog. (1) Pertaining to data consisting of continuously variable physical quantities. (A) (2) Contrast with *digital*.

AppleTalk. A network protocol developed by Apple Computer, Inc. This protocol is used to interconnect network devices, which can be a mixture of Apple and non-Apple products.

attachment unit interface (AUI). In a local area network, the interface between the medium attachment unit and the data terminal equipment within a data station. (I) (A)

AUI. Attachment unit interface.

auto-baud. Automatic baud rate detection. A process by which a receiving device determines the speed, code level,and stop bits of incoming data by examining the first character, usually a preselected sign-on character. Auto-baud allows the receiving device to accept data from a variety of transmitting devices operating at different speeds without needing to establish data rates in advance.

autonomous system (AS). A group of networks and routers that use the same interior gateway protocol and for which one administrative authority has responsibility.

B

bps. Bits per second.

bridge. A functional unit that interconnects multiple LANs (locally or remotely) that use the same logical link control protocol but that can use different medium access control protocols. A bridge forwards a frame to another bridge based on the medium access control (MAC) address.

bridging. In LANs, the forwarding of a frame from one LAN segment to another. The destination is specified by the medium access control (MAC) sublayer address encoded in the destination address field of the frame header.

BSC. Binary Synchronous communication.

C

CCITT. International Telegraph and Telephone Consultative Committee. This was an organization of the International Telecommunication Union (ITU). On 1 March 1993 the ITU was reorganized, and responsibilities for standardization were placed in a subordinate organization named the Telecommunication Standardization Sector of the International Telecommunication Union (ITU-TS). "CCITT" continues to be used for recommendations that were approved before the reorganization.

circuit. (1) One or more conductors through which an electric current can flow. See *physical circuit* and *virtual circuit*. (2) A logic device.

circuit switching. (1) A process that, on demand, connects two or more data terminal equipment (DTEs) and permits the exclusive use of a data circuit between them until the connection is released. (I) (A) (2) Synonymous with *line switching*.

configuration. (1) The manner in which the hardware and software of an information processing system are organized and interconnected. (T) (2) The devices and programs that make up a system, subsystem, or network.

connection. In data communication, an association established between functional units for conveying information. (I) (A)

D

data circuit. (1) A pair of associated transmit and receive channels that provide a means of two-way data communication. (I) (2) See also *physical circuit* and *virtual circuit*.

Notes:

1. Between data switching exchanges, the data circuit may include data circuit-terminating equipment (DCE), depending on the type of interface used at the data switching exchange.

2. Between a data station and a data switching exchange or data concentrator, the data circuit includes the data circuit-terminating equipment at the data station end, and may include equipment similar to a DCE at the data switching exchange or data concentrator location.

data circuit-terminating equipment (DCE). In a data station, the equipment that provides the signal conversion and coding between the data terminal equipment (DTE) and the line. (I)

Notes:

1. The DCE may be separate equipment or an integral part of the DTE or of the intermediate equipment.

2. A DCE may perform other functions that are usually performed at the network end of the line.

data link control (DLC). A set of rules used by nodes on a data link (such as an SDLC link or a token ring) to accomplish an orderly exchange of information.

data link switching (DLSw). A method of transporting network protocols that use IEEE 802.2 logical link control (LLC) type 2. SNA and NetBIOS are examples of protocols that use LLC type 2. See also *encapsulation* and *spoofing*.

data terminal equipment (DTE). That part of a data station that serves as a data source, data sink, or both. (I) (A)

data terminal ready (DTR). A signal to the modem used with the EIA 232 protocol.

DCE. Data circuit-terminating equipment.

device. A mechanical, electrical, or electronic contrivance with a specific purpose.

digital. (1) Pertaining to data that consist of digits. (T) (2) Pertaining to data in the form of digits. (A) (3) Contrast with *analog*.

DLS. Data link switching.

DTE. Data terminal equipment. (A)

E

EIA. Electronic Industries Association.

EIA 232. In data communications, a specification of the Electronic Industries Association (EIA) that defines the interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE), using serial binary data interchange.

Electronic Industries Association (EIA). An organization of electronics manufacturers that advances the technological growth of the industry, represents the views of its members, and develops industry standards.

encapsulation. In communications, a technique used by layered protocols by which a layer adds control information to the protocol data unit (PDU) from the layer it supports. In this respect, the layer encapsulates the data from the supported layer. In the Internet suite of protocols, for example, a packet would contain control information from the physical layer, followed by control information from the network layer, followed by the

application protocol data. See also *data link switching (DLSw)*.

Ethernet. A 10-Mbps baseband local area network that allows multiple stations to access the transmission medium at will without prior coordination, avoids contention by using carrier sense and deference, and resolves contention by using collision detection and transmission. Ethernet uses carrier sense multiple access with collision detection (CSMA/CD).

F

flash memory. A data storage device that is programmable, erasable, and does not require continuous power. The chief benefit of flash memory over other programmable and erasable data storage devices is that it can be reprogrammed without being removed from the circuit board.

frame relay. (1) An interface standard describing the boundary between a user's equipment and a fast-packet network. In frame-relay systems, flawed frames are discarded; recovery comes end-to-end rather than hop-by-hop. (2) A technique derived from the integrated services digital network (ISDN) D channel standard. It assumes that connections are reliable and dispenses with the overhead of error detection and control within the network.

frequency. The rate of signal oscillation, expressed in hertz.

G

gateway. (1) A functional unit that interconnects two computer networks with different network architectures. A gateway connects networks or systems of different architectures. A bridge interconnects networks or systems with the same or similar architectures. (T) (2) In the IBM Token-Ring Network, a device and its associated software that connect a local area network to another local area network or a host that uses different logical link protocols.

I

IEEE. Institute of Electrical and Electronics Engineers.

impedance. The combined effect of resistance, inductance, and capacitance on a signal at a given frequency.

integrated services digital network (ISDN). A digital end-to-end telecommunication network that supports multiple services including, but not limited to, voice and data.

Note: ISDNs are used in public and private network architectures.

interface. (1) A shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics, as appropriate. The concept includes the specification of the connection of two devices having different functions. (T) (2) Hardware, software, or both, that links systems, programs, or devices.

International Organization for Standardization (ISO). An organization of national standards bodies from various countries established to promote development of standards to facilitate international exchange of goods and services, and develop cooperation in intellectual, scientific, technological, and economic activity.

internet. A collection of networks interconnected by a set of routers that allow them to function as a single, large network. See also *Internet*.

Internet. The internet administered by the Internet Architecture Board (IAB), consisting of large national backbone networks and many regional and campus networks all over the world. The Internet uses the Internet suite of protocols.

Internet Protocol (IP). A connectionless protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network. However, this protocol does not provide error recovery and flow control and does not guarantee the reliability of the physical network.

Internetwork Packet Exchange (IPX). The network protocol used to connect Novell's servers, or any workstation or router that implements IPX, with other workstations. Although similar to the Internet Protocol (IP), IPX uses different packet formats and terminology.

IP. Internet Protocol.

IPX. Internetwork Packet Exchange.

ISDN. Integrated services digital network.

ISO. International Organization for Standardization.

K

kVA. kilovolt amperes.

L

LAN. Local area network.

line switching. Synonym for *circuit switching*.

link. The combination of the link connection (the transmission medium) and two link stations, one at each end of the link connection. A link connection can be shared among multiple links in a multipoint or token-ring configuration.

link connection. The physical equipment providing two-way communication between one link station and one or more other link stations; for example, a telecommunication line and data circuit-terminating equipment (DCE). Synonymous with *data circuit*.

local. Pertaining to a device accessed directly without use of a telecommunication line.

local area network (LAN). (1) A computer network located on a user's premises within a limited geographical area. Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary may be subject to some form of regulation. (T) (2) A network in which a set of devices are connected to one another for communication and that can be connected to a larger network. See also *Ethernet* and *token ring*. (3) Contrast with *metropolitan area network (MAN)* and *wide area network (WAN)*.

M

MAN. Metropolitan area network.

Management Information Base (MIB). (1) A collection of objects that can be accessed by means of a network management protocol. (2) A definition for management information that specifies the information available from a host or gateway and the operations allowed. (3) In OSI, the conceptual repository of management information within an open system.

metropolitan area network (MAN). A network formed by the interconnection of two or more networks which may operate at higher speed than those networks, may cross administrative boundaries, and may use multiple access methods. (T) Contrast with *local area network (LAN)* and *wide area network (WAN)*.

MIB. (1) MIB module. (2) Management Information Base.

modem (modulator/demodulator). (1) A functional unit that modulates and demodulates signals. One of the functions of a modem is to enable digital data to be transmitted over analog transmission facilities. (T) (A) (2) A device that converts digital data from a computer to an analog signal that can be transmitted on a telecommunication line, and converts the analog signal received to data for the computer.

N

network. (1) A configuration of data processing devices and software connected for information interchange. (2) A group of nodes and the links interconnecting them.

network architecture. The logical structure and operating principles of a computer network. (T)

Note: The operating principles of a network include those of services, functions, and protocols.

network management. The process of planning, organizing, and controlling a communication-oriented data processing or information system.

P

packet mode operation. Synonym for *packet switching*.

packet switching. (1) The process of routing and transferring data by means of addressed packets so that a channel is occupied only during transmission of a packet. On completion of the transmission, the channel is made available for transfer of other packets. (I) (2) Synonymous with *packet mode operation*. See also *circuit switching*.

physical circuit. A circuit established without multiplexing. See also *data circuit*. Contrast with *virtual circuit*.

Point-to-Point Protocol (PPP). A protocol that provides a method for encapsulating and transmitting packets over serial point-to-point links.

port. (1) An access point for data entry or exit. (2) A connector on a device to which cables for other devices such as display stations and printers are attached. Synonymous with *socket*. (3) The representation of a physical connection to the link hardware. A port is sometimes referred to as an adapter; however, there can be more than one port on an adapter. There may be one or more ports controlled by a single DLC process. (4) In the Internet suite of protocols, a 16-bit number used to communicate between TCP or the User Datagram Protocol (UDP) and a higher-level protocol or application. Some protocols, such as File Transfer Protocol (FTP) and Simple Mail Transfer Protocol (SMTP), use the same well-known port number in all TCP/IP implementations. (5) An abstraction used by transport

protocols to distinguish among multiple destinations within a host machine.

PPP.   Point-to-Point Protocol.

problem determination.   The process of determining the source of a problem; for example, a program component, machine failure, telecommunication facilities, user or contractor-installed programs or equipment, environmental failure such as a power loss, or user error.

R

ring.   See *ring network*.

ring network.   (1) A network in which every node has exactly two branches connected to it and in which there are exactly two paths between any two nodes. (T) (2) A network configuration in which devices are connected by unidirectional transmission links to form a closed path.

route.   (1) An ordered sequence of nodes and transmission groups (TGs) that represent a path from an origin node to a destination node traversed by the traffic exchanged between them. (2) The path that network traffic uses to get from source to destination.

router.   (1) A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses. (2) An attaching device that connects two LAN segments, which use similar or different architectures, at the reference model network layer. Contrast with *bridge* and *gateway*. (3) In OSI terminology, a function that determines a path by which an entity can be reached.

routing.   (1) The assignment of the path by which a message is to reach its destination. (2) In SNA, the forwarding of a message unit along a particular path through a network, as determined by parameters carried in the message unit, such as the destination network address in a transmission header.

S

SDLC.   Synchronous Data Link Control.

Simple Network Management Protocol (SNMP).   In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SNA.   Systems Network Architecture.

SNMP.   Simple Network Management Protocol.

socket.   The abstraction provided by the University of California's Berkeley Software Distribution (commonly called Berkeley UNIX or BSD UNIX) that serves as an endpoint for communication between processes or applications.

source route bridging.   In LANs, a bridging method that uses the routing information field in the IEEE 802.5 medium access control (MAC) header of a frame to determine which rings or token-ring segments the frame must transit. The routing information field is inserted into the MAC header by the source node. The information in the routing information field is derived from explorer packets generated by the source host.

spoofing.   For data links, a technique in which a protocol initiated from an end station is acknowledged and processed by an intermediate node on behalf of the final destination. In IBM 6611 data link switching, for example, SNA frames are encapsulated into TCP/IP packets for transport across a non-SNA wide area network, unpacked by another IBM 6611, and passed to the final destination. A benefit of spoofing is the prevention of end-to-end session timeouts.

synchronous.   (1) Pertaining to two or more processes that depend upon the occurrence of specific events such as common timing signals. (T) (2) Occurring with a regular or predictable time relationship.

Synchronous Data Link Control (SDLC).   A discipline conforming to subsets of the Advanced Data Communication Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization, for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop. (I) Contrast with *binary synchronous communication (BSC)*.

system.   In data processing, a collection of people, machines, and methods organized to accomplish a set of specific functions. (I) (A)

Systems Network Architecture (SNA).   The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through, and controlling the configuration and operation of, networks. The layered structure of SNA allows the ultimate origins and destinations of information, that is, the end users, to be independent of and unaffected by the specific SNA network services and facilities used for information exchange.

T

TCP.   Transmission Control Protocol.

TCP/IP.   Transmission Control Protocol/Internet Protocol.

Trivial File Transfer Protocol (TFTP).   In the Internet suite of protocols, a protocol for file transfer that requires minimal overhead and minimal capability. TFTP uses the connectionless datagram delivery services of the User Datagram Protocol (UDP), which allows hosts that have no disk storage to implement TFTP in read-only memory (ROM) and use it to boot themselves.

token.   (1) In a local area network, the symbol of authority passed successively from one data station to another to indicate the station temporarily in control of the transmission medium. Each data station has an opportunity to acquire and use the token to control the medium. A token is a particular message or bit pattern that signifies permission to transmit. (T) (2) In LANs, a sequence of bits passed from one device to another along the transmission medium. When the token has data appended to it, it becomes a frame.

token ring.   (1) According to IEEE 802.5, network technology that controls media access by passing a token (special packet or frame) between media-attached stations. (2) A FDDI or IEEE 802.5 network with a ring topology that passes tokens from one attaching ring station (node) to another. (3) See also *local area network (LAN)*.

Transmission Control Protocol (TCP).   A communications protocol used in Internet and in any network that follows the U.S. Department of Defense standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packet-switched communications networks and in interconnected systems of such networks. It assumes that the Internet protocol is the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP).   A set of communications protocols that support peer-to-peer connectivity functions for both local and wide area networks.

transparent bridging.   In LANs, a method for tying individual local area networks together through the medium access control (MAC) level. A transparent bridge stores the tables that contain MAC addresses so that frames seen by the bridge can be forwarded to another LAN if the tables indicate to do so.

U

UTP.   Unshielded twisted pair.

V

V.24.   In data communications, a specification of the CCITT that defines the list of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE).

V.25.   In data communications, a specification of the CCITT that defines the automatic answering equipment and parallel automatic calling equipment on the General Switched Telephone Network, including procedures for disabling of echo controlled devices for both manually and automatically established calls.

V.35.   In data communications, a specification of the CCITT that defines the list of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) at various data rates.

V.36.   In data communications, a specification of the CCITT that defines the list of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) at rates of 48, 56, 64, or 72 kilobits per second.

Vac.   Volts alternating current.

version.   A separately licensed program that usually has significant new code or new function.

virtual circuit.   (1) In packet switching, the facilities provided by a network that give the appearance to the user of an actual connection. (T) See also *data circuit*. Contrast with *physical circuit*. (2) A logical connection established between two DTEs.

W

WAN.   Wide area network.

wide area network (WAN).   (1) A network that provides communication services to a geographic area larger than that served by a local area network or a metropolitan area network, and that may use or provide public communication facilities. (T) (2) A data communications network designed to serve an area of hundreds or thousands of miles; for example, public and private packet-switching networks, and national telephone networks. Contrast with *local area network (LAN)* and *metropolitan area network (MAN)*.

X

X.21.   An International Telegraph and Telephone Consultative Committee (CCITT) recommendation for a general-purpose interface between data terminal equipment and data circuit-terminating equipment for synchronous operations on a public data network.

X.25.   An International Telegraph and Telephone Consultative Committee (CCITT) recommendation for the interface between data terminal equipment and packet-switched data networks. See also *packet switching*.

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Numerics

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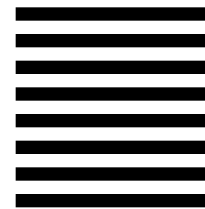
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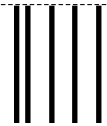
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