

IBM 2216 Nways Multiaccess Connector
IBM Network Utility



Introduction and Planning Guide

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IBM Network Utility



Introduction and Planning Guide

Note

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

Fifth Edition (December 1998)

This edition applies to the IBM 2216 Nways Multiaccess Connector Model 400 and Network Utility Models TN1 and TX1.

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Contents

About This Guide	ix
Who Should Read This Guide	ix
How to Proceed	ix
Library Overview	x
Ordering IBM Publications	xiii
Visit our Web Sites	xiv
Information, Updates, and Corrections	xiv
Product Support	xiv
Summary of Changes	xv
Chapter 1. Introduction to the IBM 2216 Nways Multiaccess Connector	
Model 400 and the IBM Network Utility	1-1
The IBM Network Utility	1-3
The IBM 2216 Model 400	1-6
Features Common to 2216 Model 400 and Network Utility	1-9
Chapter 2. Functions of the 2216 Model 400 and Network Utility	2-1
Hardware	2-1
2216 Model 400 and Network Utility code	2-1
Networks Supported	2-3
Protocols Supported	2-4
Hardware Features	2-9
Code Features	2-10
Options	2-12
Chapter 3. Physical Planning and Prerequisites	3-1
Placement Options	3-1
Preparing the Machine Area	3-1
Hardware Requirements	3-2
Hardware and Software Requirements for the Configuration Program	3-3
Physical Specifications of the IBM 2216 Nways Multiaccess Connector Model 400	3-4
Physical Specifications of the Network Utility	3-5
Power Cord Characteristics	3-7
Chapter 4. Configuration and Monitoring Tools	4-1
Configuration Methods	4-1
Monitoring Methods	4-2
2216 Model 400 and Network Utility Firmware	4-4
Chapter 5. Network Planning	5-1
Planning for ESCON and Parallel Channel Connections	5-1
Planning for ISDN	5-35
Planning for FasTR	5-38
Planning for Network Dispatcher	5-39
Planning for Web Server Cache	5-40
Planning for Thin Server	5-41
Appendix A. Charts and Worksheets	A-1

Hardware Configuration Quick Reference for 2216 Model 400	A-1
Initial Configuration Worksheets	A-2
Quick Configuration Worksheets	A-5
Appendix B. Cable Pin Assignments	B-1
Disclaimer	B-1
Service Port	B-1
Wide Area Networks (WANs)	B-2
EIA 232-E/V.24 (FC 2705 and 2706)	B-2
V.35 (FC 2707 and 2708)	B-4
V.36 (FC 2709 and 2710)	B-6
X.21 (FC 2711 and 2712)	B-8
HSSI	B-9
1-port ISDN T1 (FC 2714), E1 (FC 2715), J1 (FC 2716)	B-11
4-port ISDN PRI/Channelized T1 (FC 2717)	B-12
4-port ISDN PRI/Channelized E1 (FC 2718)	B-12
4-port ISDN PRI/Channelized J1 (FC 2719)	B-12
Appendix C. Adapter Plugging Defaults	C-1
Model 400 Plugging Sequences	C-1
Model 400 Slots and Adapters	C-1
Appendix D. Notices	D-1
Notice to Users of Online Versions of This Book	D-1
Trademarks	D-2
Glossary	X-1
Index	X-11

Tables

0-1.	Hardcopy Publications that Are Shipped with the product	xii
0-2.	Publications that Are Shipped as Softcopy on the CD-ROM	xiii
2-1.	LANs supported by the 2216 Model 400 and Network Utility	2-3
2-2.	WANs supported by the 2216 Model 400 and Network Utility	2-3
2-3.	Server attachments supported by the 2216 Model 400 and Network Utility	2-3
2-4.	2216 Protocol and Feature Support	2-4
2-5.	2216 Model 400 Media and Protocol Support, by Interface	2-6
2-6.	Network Utility Media and Protocol Support, by Interface	2-7
2-7.	Framing Method Support on WAN Interfaces	2-8
2-8.	Comparison of 2216 Model 400 and Network Utility Hardware Characteristics	2-9
2-9.	Code Features supported in the 2216 Model 400 and Network Utility	2-10
2-10.	2216 Model 400 and Network Utility Adapters and Feature Codes	2-12
2-11.	Cables available for the 2216 Model 400 and Network Utility	2-20
3-1.	PCMCIA Modem, By Country	3-2
3-2.	Configuration Program Requirements for Supported Operating Systems	3-3
3-3.	Power Cords and Power Plug Standards	3-7
5-1.	Feature Support	5-1
5-2.	Differences for MPC+ Terminology Between Host and Router	5-3
5-3.	Channel Support for 2216 Model 400 and Network Utility	5-5
5-4.	Cabling for the Parallel Channel Adapter	5-28
5-5.	Maximum Cabling Distances for Copper Channel Cables Connecting a 2216 Model 400 or Network Utility to a Host	5-31
5-6.	LAN Adapter Maximum Frame Sizes and Channel Adapter Maximum Block Sizes	5-33
5-7.	Connections per ISDN Adapter	5-35
5-8.	FasTR Requirements	5-39
A-1.	Initial Configuration Worksheet, 2216 Model 400	A-3
A-2.	Initial Configuration Worksheet, Network Utility	A-4
B-1.	Service Port Signal Definitions	B-1
B-2.	EIA 232/V.24 Connector Pin Assignments, 25-pin D, Male, Modem-Attach	B-2
B-3.	EIA 232/V.24 Connector Pin Assignments, 25-pin, D, Female, Direct-Attach	B-3
B-4.	V.35 Connector Pin Assignments, 34-pin Block, Male, Modem-Attach	B-4
B-5.	V.35 Connector Pin Assignments, 34-pin Block, Female, Direct-Attach	B-5
B-6.	V.36 Connector Pin Assignments, 37-pin D, Female to Female, Modem-Attach	B-6
B-7.	V.36 Connector Pin Assignments, 37-pin D, Female to Male, Direct-Attach	B-7
B-8.	X.21 Connector Pin Assignments, 15-pin D, Male	B-8
B-9.	X.21 Connector Pin Assignments, 26-pin D, Male to 15-pin Female	B-8
B-10.	HSSI Connector Pin Assignments, 50-pin Male, Modem-Attach	B-9
B-11.	HSSI, 50-pin Block, Male, Null Modem Cable Pin Assignments	B-10
B-12.	26-pin Cables for ISDN 1-port T1, E1, and J1	B-11
B-13.	4-port ISDN PRI/Channelized T1 Connector Pin Assignments, 8-pin Male	B-12

B-14.	4-port ISDN PRI/Channelized E1 Connector Pin Assignments, 8-pin Male	B-12
B-15.	4-port ISDN PRI/Channelized J1 Connector Pin Assignments, Keyed 8-pin Male	B-12
C-1.	Slot Numbering	C-1
C-2.	FC 2280s (LIC 280s) and FC 2281s (LIC 281s)	C-1
C-3.	All Other Adapters	C-1

Figures

1-1.	Using the 2216 Model 400 and Network Utility	1-2
1-2.	The IBM Network Utility	1-3
1-3.	Using the Network Utility TN3270E Server (Model TN1)	1-4
1-4.	The IBM 2216 Nways Multiaccess Connector Model 400	1-6
1-5.	Using 2216 Model 400 for WAN Concentration	1-7
1-6.	Using the 2216 Model 400 for High-speed Server Access and Load Balancing	1-7
3-1.	Power Cord Plugs by Country	3-8
5-1.	Representative Network Containing the 2216 Model 400 or Network Utility	5-2
5-2.	2216 Model 400 and Network Utility with ESCON or Parallel Channel in a Network	5-7
5-3.	2216 Model 400 and Network Utility Parallel Channel Attachment Examples	5-9
5-4.	Single System ESCON Connection Example	5-11
5-5.	Multiple System ESCON Connections Example	5-12
5-6.	2216 Model 400 or Network Utility EMIF Attachment Example	5-13
5-7.	Rules for LAN/WAN Gateway Definitions for LCS and LSA Subchannels	5-16
5-8.	Rules for Definitions for MPC+	5-18
5-9.	2216 Model 400 or Network Utility and Host Backup Using Two LAN Segments	5-20
5-10.	2216 Model 400 or Network Utility and Host Backup Using One LAN Segment	5-21
5-11.	2216 Model 400 or Network Utility and Host Backup - APPN over Multi-Path Channel+	5-24
5-12.	Parallel Channel Adapter cables	5-29
5-13.	Cable Distances for the 3044 Fiber-Optic Channel Extender Link Models C02 and D02	5-31
5-14.	Cable Distances for the 9034 Enterprise Systems Connection Converter	5-32
5-15.	Using FasTR	5-38
5-16.	Web Server Cache	5-40

About This Guide

This guide provides planning information for the IBM 2216 Nways Multiaccess Connector Model 400 and the Network Utility Models TN1 and TX1. It also provides information on the management of routing networks.

Who Should Read This Guide

The intended user is the person responsible for planning the setup and configuration of one or more 2216 Model 400 or Network Utility machines.

How to Proceed

You will need to determine which adapters and cables to order and what your network configuration will be. Document all of the network information that will be required to install, connect, and configure the 2216 Model 400 or Network Utility.

Take the following steps to plan, install, and configure your 2216 Model 400 or Network Utility:

Note: If you are upgrading the IBM 2216 Model 400 from one version of Multiprotocol Access Services (the operating system code) to another version of system software, see the upgrading and migrating information in the *Service and Maintenance Manual*. If you are upgrading a Network Utility, refer to the "Software Maintenance" chapter in the *Service and Maintenance Manual*.

Planning and Preparation

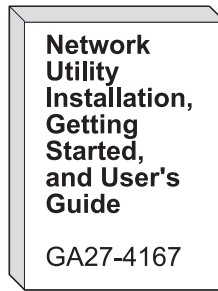
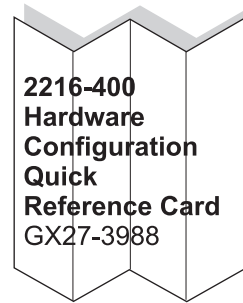
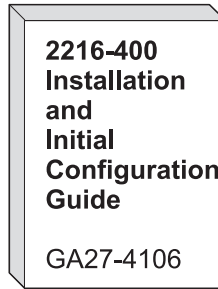
1. Become familiar with the capabilities of the 2216 Model 400 or Network Utility. (See Chapter 1, "Introduction to the IBM 2216 Nways Multiaccess Connector Model 400 and the IBM Network Utility" on page 1-1.)
2. Determine which adapters and cables you will need. Chapter 2, "Functions of the 2216 Model 400 and Network Utility" on page 2-1, has details about available options. Design your network and place your order for your 2216 Model 400 or Network Utility and cables. (Cables are described in "Cables" on page 2-20.)
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 2216 Model 400 or Network Utility, 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 "Hardware and Software Requirements for the Configuration Program" on page 3-3.
7. Prepare Quick Configuration and Initial Configuration worksheets. These worksheets are in Appendix A, "Charts and Worksheets" on page A-1.

8. Prepare your site physically, ensuring that you meet the necessary power and environmental requirements. See “Preparing the Machine Area” on page 3-1.

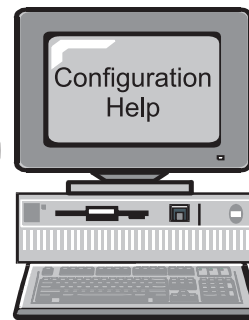
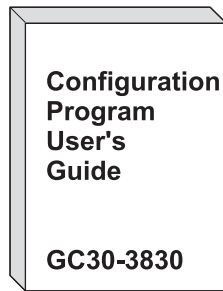
Library Overview

The Network Utility and the IBM 2216 Model 400 share many of the same publications. The following figure shows the publications in the library, arranged according to tasks.

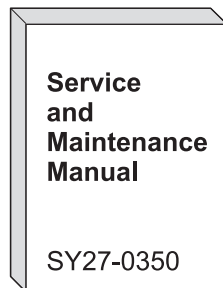
Planning and Installation



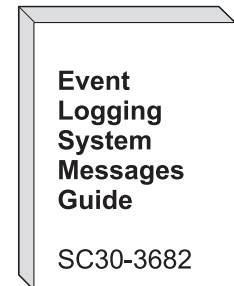
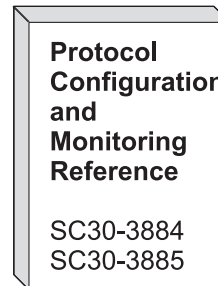
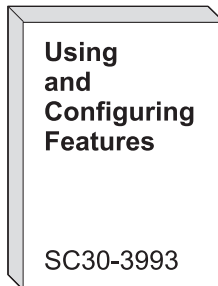
Configuration



Diagnostics/Maintenance



Operations and Network Administration



Common Tasks and the Library for the IBM 2216 Model 400 and Network Utility

Table 0-1. Hardcopy Publications that Are Shipped with the product. These documents are shipped in hardcopy and are also contained on this product's Documentation CD-ROM, SK2T-0405.

Planning

GA27-4105 *2216 Nways Multiaccess Connector and Network Utility Introduction and Planning Guide*

This book explains how to prepare for installation and select the hardware that you want to purchase. It includes specifications for the hardware and software for your network. It also provides information on the management of routing networks.

Installation and Learning

GA27-4167 Network Utility only:
Network Utility Installation, Getting Started, and User's Guide

This book explains how to install a Network Utility and verify its installation. In addition it explains how to use the product and has sample configurations for the product.

GA27-4106 2216 Model 400 only:
2216 Nways Multiaccess Connector Model 400 Installation and Initial Configuration Guide

This booklet explains how to install the 2216 Model 400 and verify its installation.

GX27-3988 2216 Model 400 only:
2216 Nways Multiaccess Connector Hardware Configuration Quick Reference

This reference card is used for entering and saving hardware configuration information used to determine the correct state of an IBM 2216 Model 400.

Diagnostics and Maintenance

SY27-0350 *2216 Nways Multiaccess Connector and Network Utility Service and Maintenance Manual*

This book provides instructions for diagnosing problems with and repairing the Model 400 and the Network Utility.

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 a device.

Configuration

GC30-3830 *Configuration Program User's Guide*

This book discusses how to use the Nways Multiprotocol Access Services Configuration Program.

Table 0-2. Publications that Are Shipped as Softcopy on the CD-ROM. These publications are also separately orderable as hardcopy.

Operations and Network Management

The following books support the Nways Multiprotocol Access Services program.

SC30-3886 *Nways Multiprotocol Access Services Software User's Guide*

This book explains how to:

- Configure, monitor, and use the Nways Multiprotocol Access Services software and microcode.
- Use the Nways Multiprotocol Access Services command-line router user interface to configure and monitor the network interfaces and link-layer protocols shipped with the 2216 base.

SC30-3993 *Nways Multiprotocol Access Services Using and Configuring Features*

This book describes Multiprotocol Access Services (MAS) features and explains the commands to use them. Features are any functions that enhance protocols or stand alone. Some examples are: MAC Filtering, which filters frames based on their MAC addresses, Bandwidth Reservation System, which enables you to reserve bandwidth for chosen types of traffic over a PPP or Frame Relay serial interface, or Network Address Translation, which enables you to represent one IP address with another when you are running IP.

SC30-3884 *Nways Multiprotocol Access Services Protocol Configuration and Monitoring Reference, Volume 1*

SC30-3885 *Nways Multiprotocol Access Services Protocol Configuration and Monitoring Reference, Volume 2*

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

They include information about each of the protocols that the device supports.

SC30-3682 *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.

Ordering IBM Publications

In the U.S.A., you can order IBM publications by calling 1 800 879-2755. Within or outside the U.S.A., you can order IBM publications through the IBM Publications Direct Catalog on the World Wide Web at:

<http://www.elink.ibm.link.ibm.com/pb1/pb1>

IBM translates many publications into a variety of languages. The publications you need may be available in your language.

Visit our Web Sites

These IBM web pages provide product information:

For the Network Utility: <http://www.networking.ibm.com/networkutility>

For the Model 400: <http://www.networking.ibm.com/216/216prod.html>

This IBM web page provides 2216 base and Network Utility books online:

<http://www.networking.ibm.com/did/2216bks.html>

Information, Updates, and Corrections

This page provides information on engineering changes, clarifications, and fixes that were implemented after the books were printed:

<http://www.networking.ibm.com/216/216changes.html>

Product Support

These pages provide downloads and additional support information:

For the Network Utility:

<http://www.networking.ibm.com/support/networkutility>

For the Model 400: <http://www.networking.ibm.com/support/2216>

Summary of Changes

The hardware changes that are included in the 2216 base library and product since the previous edition of this product information consist of:

- Addition of a new system card for 2216 Model 400 and Network Utility
- Addition of optional 128-MB and 256-MB memory modules

The new code (IBM Nways Multiprotocol Access Services V3.2) has the following enhancements:

- New functions:
 - IP Version 6
 - TCP6, UDP6, Telnet, PING-6 and traceroute-6, ICMPv6, and IPsec
 - Neighbor discovery protocol (NDP) for host auto-configuration
 - Static routes, RIPng, Protocol Independent Multicast-Dense Mode (PIM-DM), and Multicast Listener Discovery (MLD)
 - Configured or automatic tunneling of IPv6 packets over IPv4 networks
 - Support for Ethernet (10 and 100 Mbps), Token Ring, FDDI, FasTR, channel (ESCON and Parallel with LCS), and PPP interfaces
 - Thin Server Support (2216-400 only)
 - Acts as boot server for network stations
 - Servers supported include Network Station Manager (NSM) R2.5 and 3.0 on OS/400 and NSM R3.0 for NFS servers such as Windows NT, OS/390, AIX, and VM
 - Web Server Caching (2216-400 only)

Allows the 2216 to function as a cache in support of a web server and provides high-speed user access to web pages while reducing server overhead. This is a separately priced code image
- Enhanced functions:
 - ESCON/PCA Channel Enhancements
 - IP Multicast Support over LAN Channel Station (LCS)
 - LCS Bridging and Passthrough over LCS

Chapter 1. Introduction to the IBM 2216 Nways Multiaccess Connector Model 400 and the IBM Network Utility

A proven system for routing and bridging across LANs and WANs, anchored in the award-winning Multiprotocol Access Services code, the IBM 2216 Nways Multiaccess Connector and IBM Network Utility answer the problem of interconnecting networks.

- The 2216 Model 400 offers eight adapter slots for flexibility across a wide range of protocols, devices, and lines.
- The Network Utility offers two adapter slots and handles high volumes of connections targeted to a TN3270E Server, APPN, Enterprise Extender, or Data Link Switching (DLSw) functions.

The 2216 Model 400 and Network Utility can play a vital role in your network. Figure 1-1 on page 1-2 illustrates how to use them to:

- Integrate IP and SNA in your network
- Build high-speed access gateways to high-end host servers
- Concentrate heavy WAN traffic entering your data center or regional site

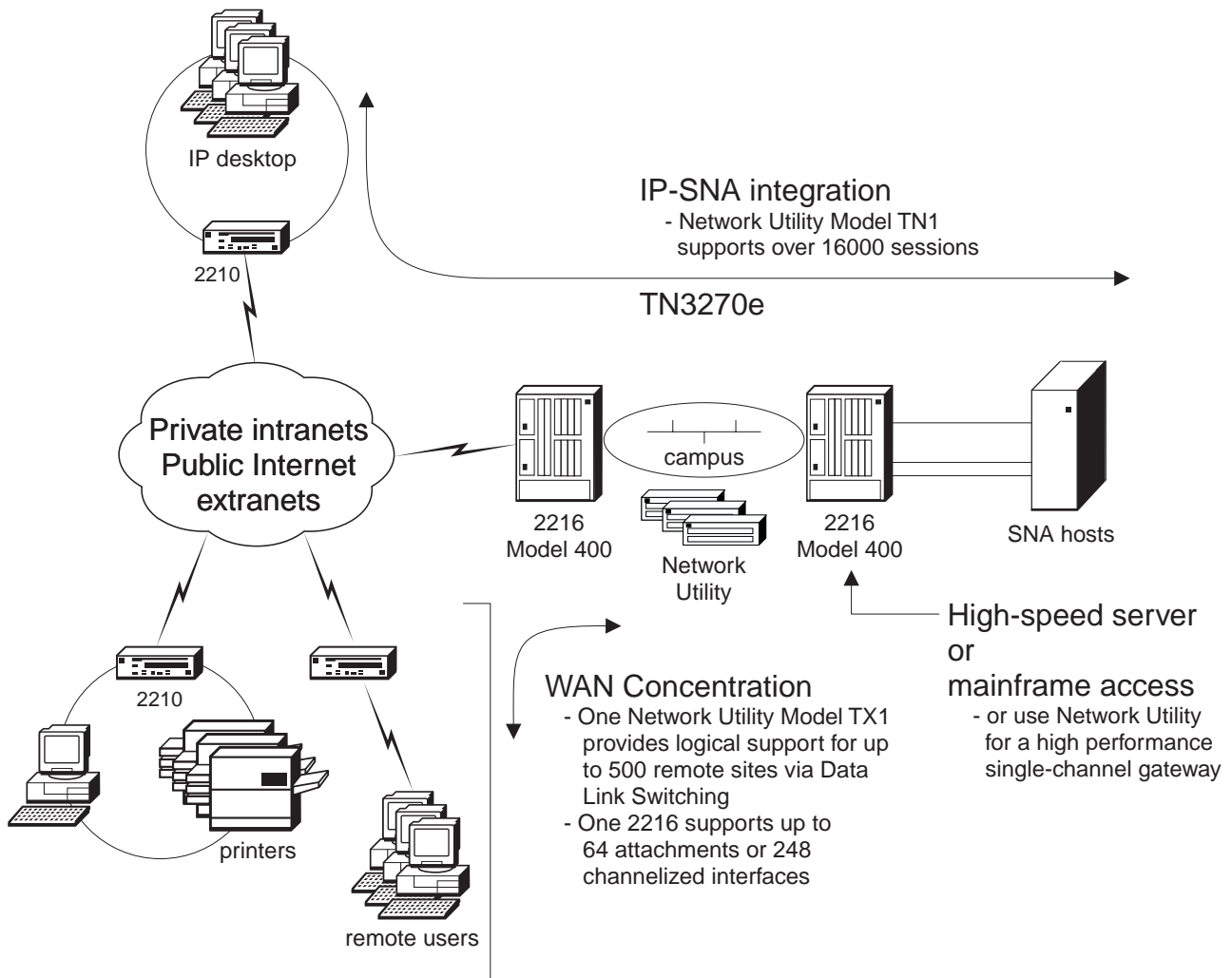


Figure 1-1. Using the 2216 Model 400 and Network Utility

This chapter includes the following sections:

- “The IBM Network Utility” on page 1-3
- “The IBM 2216 Model 400” on page 1-6
- “Features Common to 2216 Model 400 and Network Utility” on page 1-9

The IBM Network Utility

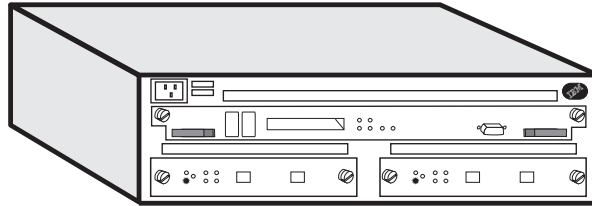


Figure 1-2. The IBM Network Utility

Growth in user connections drives a need for higher levels of physical connectivity such as traditional connections to phone lines and LANs. The 2216 Model 400, which is discussed beginning on page 1-6, supports the physical growth of a network. But growth also drives a need for higher processing capacity as routers perform memory-intensive tasks such as IP-SNA integration, TN3270E Server functions, Data Link Switching, Enterprise Extender services, or APPN high-performance routing. **IBM's new Network Utility server specializes in increasing a network's processing capacity, or logical connectivity.**

Network Utility is available in two models, Network Utility TN3270E Server (Model TN1) and Network Utility Transport (Model TX1). Each model provides two slots for physical connections, carries from 256 MB to 512 MB of memory, and offers hardware and code as a one-price package¹.

The two models of the Network Utility are ideal for these situations:

- Use Model TN1 as a TN3270E Server to connect IP desktop users to SNA host applications.
- Use Model TX1 for high performance in networks carrying SNA traffic over IP (via DLSw or Enterprise Extender) or in native SNA-over-APPN networks.
- Use Model TX1 as a high-performance connection in environments requiring few physical connections.
- Use Model TX1 as a cost-effective, load-balancing transport connection to a cluster of IP application servers (such as web, FTP, or TN3270E Servers).
- Use either model to increase the logical connectivity available for WAN concentration at a data center or regional site.

Network Utility is a cost-effective way to scale the logical connectivity of routers you already have. It is compatible with the IBM 2210, 2216 Model 400, and 3745/6 and with other manufacturers' channel-attached gateways. Or, use Network Utility as a high-performance, standalone server in environments that require few physical connections.

¹ Adapters are priced separately.

Integrate IP and SNA Infrastructures with Network Utility TN3270E Server

Connect IP desktop users to your SNA host applications using the Network Utility TN3270E Server. Figure 1-3 illustrates using Model TN1 as a departmental or data center TN3270E Server.

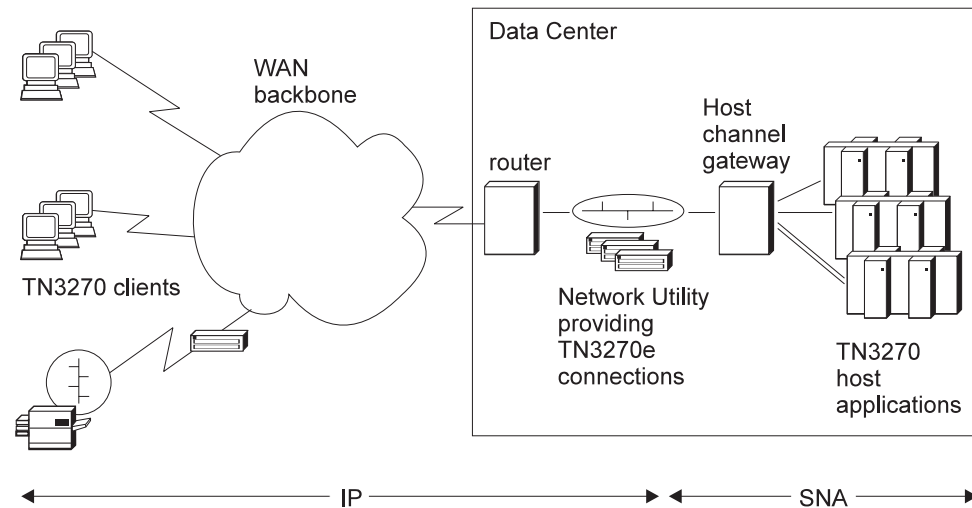


Figure 1-3. Using the Network Utility TN3270E Server (Model TN1)

Aggregate memory (up to 512MB) enables thousands of TN3270E sessions per server. Network Dispatcher function directs traffic to the least-utilized server for traffic-load balancing, redundancy, and availability. With Network Dispatcher, several servers appear to the network as one. TN3270E Server supports Token-Ring, Ethernet, Frame Relay, ATM, and S/390 channel traffic over IP and SNA protocols. For more information, see "Protocols Supported" on page 2-4.

Increase the Logical Capacity of Traditional SNA and SNA-IP Networks with Network Utility Transport

The Network Utility Transport (Model TX1) provides logical connectivity for SNA host traffic over IP or SNA. Model TX1 is ideal in the following situations:

- As a cost-effective alternative to multiple IBM 2210 routers in regional and headquarters sites. In a migration scenario, the 2210 is re-used in the network to provide greater capacity at the branch office or local site.
- As a peer router specializing in logical concentration and leaving physical connections to the 2216 Model 400 and other routers.
- As a 2-slot, single-channel gateway
- As a high-capacity connector, such as a high-speed FDDI-to-HSSI (LAN-to-WAN) bridge.
- With Network Dispatcher to distribute load among S/390 IP servers or any IP file, web, or print server using a TCP socket.

Data Link Switching (DLSw)

DLSw is a leading industry choice to transport SNA traffic over an IP router intranet network. Network Utility provides the logical concentration that large networks require for this traffic.

APPN HPR and DLUr

Model TX1 can also increase the logical capacity of large, all-SNA networks connecting traditional SNA controllers to SNA terminals, or connecting desktops to an S/390 parallel sysplex. Model TX1 is complementary with any vendor's APPN host gateway product and especially synergistic with IBM's 3746, 2216 Model 400, and Open Systems Adapter (OSA) for S/390. Network Utility provides processing support for 16 000 LU-LU sessions with APPN DLUr. It also supports APPN High-Performance Routing (HPR) and Enterprise Extender for SNA priority and reliable delivery in IP networks.

The IBM 2216 Model 400

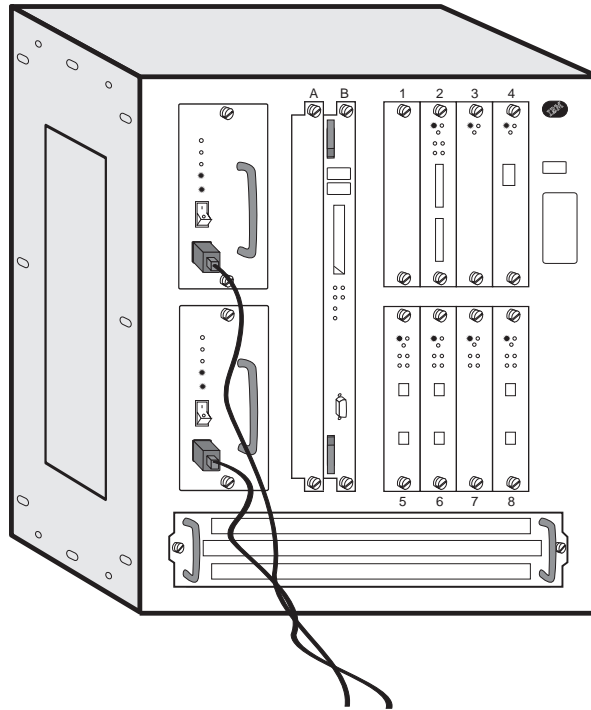


Figure 1-4. The IBM 2216 Nways Multiaccess Connector Model 400

The 2216 Model 400 provides WAN concentration and server access.

WAN Concentration

The IBM 2216 Model 400 fits naturally between IBM's workgroup and campus routers and switches and provides exciting high-capacity network access. With more than five times the WAN capacity of the largest 2210 Nways router, the 2216 Model 400 can support up to sixty-four 2.048-Mbps attachments for device access or network consolidation. With channelized interfaces, the 2216 Model 400 can support up to 248 connections, each routing traffic at 64 Kbps. This makes it an excellent choice for regional concentration of remote branch offices. Eight adapter slots accommodate new technologies as needed. Use the 2216 Model 400 when your network requires high-capacity WAN concentration:

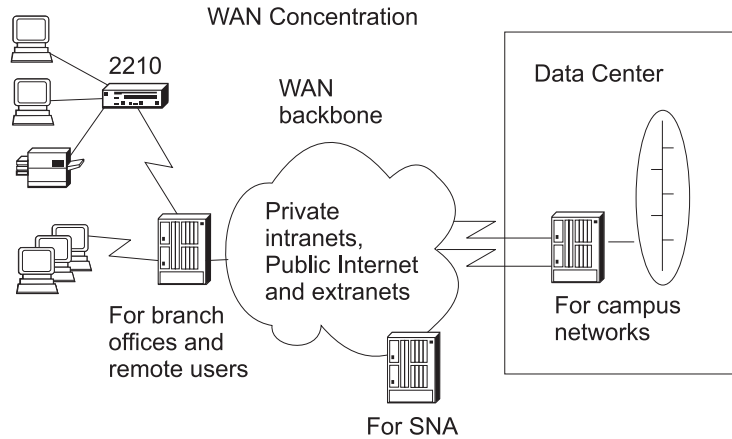


Figure 1-5. Using 2216 Model 400 for WAN Concentration

Server Access

The 2216 Model 400 offers high-speed access to high-end servers such as the IBM S/390 from campus backbones and remote sites. The 2216 Model 400 offers TN3270E Server function, multiple channel attachments, and TCP/IP server load balancing using Network Dispatcher.

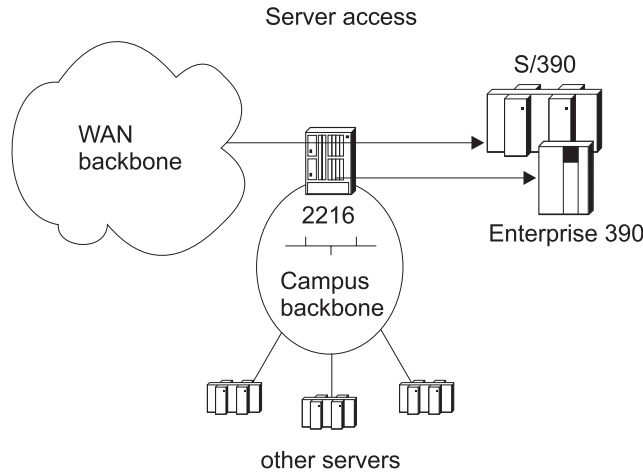


Figure 1-6. Using the 2216 Model 400 for High-speed Server Access and Load Balancing

Strengths of 2216 Model 400

The 2216 Model 400 provides:

- Simultaneous accommodation of many kinds of traffic
- Support for all common protocols
- Migration support
- High availability and excellent serviceability

Simultaneous Accommodation of Many Kinds of Traffic

2216 Model 400 offers the functions of a multiprotocol router and functions similar to a FRAD and SNA controller in a single product. The high port density of the 2216 Model 400 and its ability to connect and concentrate diverse networks reduces acquisition and operating costs. Multiple SNA options include Frame Relay Boundary Access Node (BAN), DLSSw, Enterprise Extender, and APPN high-performance routing (HPR).

Support for All Common Routing Protocols

2216 Model 400 supports all common routing protocols including IPv4, IPv6, SNA, IPX, AppleTalk 2, Banyan VINES, DECnet IV, and DECnet V/OSI.

Migration Support

Because the decision to migrate should belong to you – not your hardware – the 2216 Model 400 provides strong support for legacy *and* cutting-edge technologies. Take advantage of 155-Mbps Fast Token Ring (FasTR) function while retaining proven legacy connection methods such as parallel channel.

High Availability and Excellent Serviceability

The 2216 Model 400 is designed to maximize its availability and the availability of the networks to which it connects. The hardware supports a high degree of redundancy and non-disruptive operation with the features listed in “Designed for Reliability and Serviceability” on page 1-11 and below:

- Optional dual power supplies share the 2216 Model 400 power load. Each has its own power cord for connection to independent power sources. If a power supply fails, the router continues with the operational supply.
- Adapters, the power supply, the cooling subsystem, and processor card are accessible from the front panel, allowing replacement in seconds without having to remove the router from a rack or remove its covers.
- System cooling with multiple fans can maintain safe operating temperatures if a fan fails. The cooling subassembly is removable and hot pluggable.
- With the appropriate optional adapters, dial backup is available to bypass failed connections.

Features Common to 2216 Model 400 and Network Utility

Some features are common to both the 2216 Model 400 and the Network Utility. Use either machine when you need a solution that:

- Is adaptable to a wide range of network configurations
- Supports an extensive set of network interfaces
- Is easy to install, configure, and manage
- Is designed for reliability
- Offers high capacity and performance

Adaptable to a Wide Range of Network Configurations

The 2216 Model 400 and Network Utility use the same routing, bridging, IP, and SNA capabilities proven in the 2210 Nways router and the 2212 Access Utility . In the 2216 Nways Multiaccess Connector Model 400, these functions are called *Multiprotocol Access Services* (MAS) and include standards-based, interoperable support for routing and bridging, with security and rerouting, on leased and switched networks. Network Utility code draws on Multiprotocol Access Services technology. The 2216 Model 400 and the Network Utility feature:

- IPv4 routing, including ICMP, TCP, UDP, RIP, OSPF V2, BGP-4, DVMRP, IGMP, static routes, Multicast Extensions to OSPF (MOSPF), RSVP, VRRP, ARP, InARP, and Access Controls
- IPv6 routing, including ICMPv6, TCP6, UDP6, RIP6, Protocol-Independent Multicast Dense Mode (PIM-DM), Neighbor Discovery Protocol (NDP), Multicast Listener Discovery Protocol (MLD), static routes, and manual or automatic tunneling over IPv4
- Advanced SNA data transport with APPN network node (NN), high-performance routing (HPR), dependent LU requester (DLuR), Branch Extender, Enterprise Extender, Extended Border Node, Data Link Switching (DLSw, or RFC 1795, including NetBIOS support), and support for LAN Network Manager protocols
- TN3270E Server for IP access to SNA host applications²
- All common bridging techniques, including transparent, source-route, source-route transparent, source-route to transparent translational bridging, and IP bridging tunnels
- The forms of handling data traffic over ATM links: ATM Forum-compliant LAN Emulation (LANE), Classical IP, bridging, and native routing of APPN HPR
- Frame relay (RFC 1490 including boundary access node [BAN] support), PPP, X.25 DTE, both primary and secondary SDLC, SDLC relay, and XTP
 - Bandwidth reservation to assign traffic priority is supported over Frame Relay and PPP

2216 Model 400 also supports the following:

- IP security
- Other common routing protocols including IPX, AppleTalk 2, Banyan VINES, DECnet IV, and DECnet V/OSI.
- V.25bis and ISDN PRI switched network access with worldwide ISDN software options, dial backup, and dial-on-demand.

- WAN reroute for recovery from Frame Relay, PPP, or X.25 link failures
- Thin Server Support (2216-400 only)
 - Acts as boot server for network stations
 - Servers supported include Network Station Manager (NSM) R2.5 and 3.0 on OS/400 and NSM R3.0 for NFS servers such as Windows NT, OS/390, AIX, and VM
- Web Server Caching (2216-400 only)

Allows the 2216 to function as a cache in support of a web server and provides high-speed user access to web pages while reducing server overhead

The 2216 Model 400 and Network Utility deliver compatibility with the IBM 2210, 2212, 3745/6, and the IBM campus MSS solution as well as with the solutions of many other vendors.

Support for an Extensive Set of Network Interfaces

Build your network from the 20 adapters and 11 interface types that the 2216 Model 400 and Network Utility support. Each supports most of the interfaces that follow. See the support matrix on page 2-12 for details.

- 2-port Token-Ring
- 2-port Ethernet (10 Mbps)
- 1-port 10/100-Mbps Ethernet
- 8-port EIA 232E/V.24
- 6-port V.35 or V.36
- 8-port X.21
- 1-port 155-Mbps ATM single-mode fiber³
- 1-port 155-Mbps ATM multimode fiber³
- 1-port ESCON Channel
- 1-port Parallel Channel
- 1-port FDDI
- 1-port HSSI
- 2216 Model 400 only:
 - 1-port ISDN PRI for E1 (30 B+D)
 - 1-port ISDN PRI for T1/J1 (23 B+D)
 - 4-port ISDN PRI/Channelized T1/J1⁴
 - 4-port ISDN PRI/Channelized E1⁵

Easy to Install, Configure, and Manage

The 2216 Model 400 and Network Utility minimize the cost of operation with easy-to-use tools for rapid installation and configuration and integrated, remote, graphical management tools.

The 2216 Model 400 takes on average less than two hours to install. Installing the Network Utility is even faster.

² Available as a feature on the 2216 Model 400 and integrated as part of Model TN1 in the Network Utility.

³ When used in the 2216 Model 400, all ATM adapters also support Fast Token Ring encapsulated over ATM (FasTR).

⁴ Scalable to 8 ports with the addition of 4-port daughter card FC 2251.

⁵ Scalable to 8 ports with the addition of 4-port daughter card FC 2252.

Initial configuration to connect the 2216 Model 400 or Network Utility to a network is done using either a local ASCII terminal or an ASCII terminal connected via a modem. Subsequent configuration can be done using a graphical configuration program running on AIX, OS/2, or Windows.

Once configured, the 2216 Model 400 or Network Utility can be managed by an SNMP manager. IBM provides comprehensive, easy-to-use graphical administration, management, problem analysis, and reporting software as a component of its Nways Managers which are available for AIX, Windows NT, and HP-UX.

Designed for Reliability and Serviceability

- Individually-powered adapters can be inserted or removed while the Model 400 or Network Utility is operational. Failed adapters can be replaced without taking down the system or rebooting the software. A replaced adapter assumes the configuration of the adapter it replaces.
- Environmental monitoring tracks system operation and allows operators to correct potentially critical situations before they cause outages.
- The 2216 Model 400 and Network Utility maintain configuration and operating history in nonvolatile storage, speeding problem identification and diagnostics.
- An integrated modem is available in most countries for remote diagnostics. These features are combined with globally available, on-site support and field replacement of failed components 24 hours a day, 7 days a week.
- A 10BASE-T Ethernet PCMCIA adapter is provided with the Network Utility for faster servicing.
- Fast reboot supports rapid reconfiguration.
- Supports routing around failed Frame Relay, PPP, or X.25 links.
- Model 400 offers additional availability and serviceability features. For details, see "High Availability and Excellent Serviceability" on page 1-8.

High Capacity and Performance

The 2216 Model 400 and Network Utility are designed to provide the high capacity and performance needed in networks that perform IP-SNA integration, WAN concentration, and high-speed, high-end server access. The 2216 Model 400 and Network Utility support a tremendous set of protocols and interfaces and are compatible with networking products offered by IBM as well as other companies. For more information about the 2216 Model 400 and the Network Utility, visit our web site at:

<http://www.networking.ibm.com/netprod.html>

Chapter 2. Functions of the 2216 Model 400 and Network Utility

This chapter includes the following sections:

- “Hardware”
- “2216 Model 400 and Network Utility code”
- “Networks Supported” on page 2-3
- “Protocols Supported” on page 2-4
- “Hardware Features” on page 2-9
- “Code Features” on page 2-10
- “Options” on page 2-12
- “Cables” on page 2-20

Hardware

The IBM 2216 Nways Multiaccess Connector is available in one model, Model 400. The Network Utility is available in two models, Model TN1 and Model TX1. When ordering the Network Utility, you will need to specify a model.

2216 Model 400 and Network Utility code

The code that supports the 2216 Model 400 is IBM Nways Multiprotocol Access Services (MAS). MAS includes the code that provides the routing, bridging, APPN box services, and SNMP agent functions for the 2216 Model 400. The code also includes a monitoring system that allows you to perform change management, network management, problem determination, and configuration. The Configuration Program for MAS is a graphical user interface that allows you to configure the device offline. It includes error checking and online help information.

The base code IBM Nways Multiprotocol Access Services (MAS) on the 2216 Model 400 is factory-installed. The version of the MAS code must be specified at the time the machine is ordered.

Additional code loads are available:

- Base code + TN3270E: This code load must be separately ordered and is also available from the 2216 web site.
- Web Server Cache: This code load must be separately ordered and is also available from the 2216 web site.
- Encryption code loads: There are three encryption versions of the base, TN3270E, and Web Server Cache code loads:
 - 40-bit encryption code loads support the CDMF algorithm for Frame Relay and IP Security and the RC4 algorithm with 40 bit keys for Microsoft Point-to-Point Encryption (MPPE).
 - 56-bit encryption code loads support the 40-bit encryption functions plus the DES algorithm for IP security and the PPP Encryption Control Protocol (ECP).

- 128-bit encryption code loads support the 40- and 56-bit encryption functions, plus the Triple DES algorithm for IP Security and the RC4 algorithm with 128 bit keys for MPPE.

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

Network Utility code is based on MAS technology and is included as part of the one-price Network Utility package¹.

The configuration program is shipped as part of a 2216 Model 400 and Network Utility order. It is also downloadable from Web using the product support URLs listed in “Product Support” on page xiv.

¹ Adapters and cables are sold separately.

Networks Supported

The 2216 Model 400 and Network Utility support the following LANs:

Table 2-1. LANs supported by the 2216 Model 400 and Network Utility

Interface	2216 Model 400	Network Utility
Token-ring (IEEE 802.5) with STP or UTP connection	yes	yes
Ethernet IEEE 802.3 with 10BASE2 (coax) or 10BASE-T (RJ-45) connection	yes	yes
100-Mbps Ethernet (IEEE 802.3u with RJ-45 connection)	yes	yes
FDDI (multimode fiber)	yes	yes
ATM 155-Mbps multimode fiber	yes	yes ²
ATM 155-Mbps single-mode fiber	yes	yes ²
Fast Token Ring Encapsulated in ATM (FasTR)	yes	–

The 2216 Model 400 and Network Utility support the following WANs:

Table 2-2. WANs supported by the 2216 Model 400 and Network Utility

Interface	2216 Model 400	Network Utility
EIA-232E/V.24	yes	yes
V.35	yes	yes
V.36	yes	yes
X.21	yes	yes
ISDN Primary/Channelized (T1/J1)	yes	–
ISDN Primary/Channelized (E1)	yes	–
HSSI	yes	yes

The 2216 Model 400 and Network Utility support the following channel attachments:

Table 2-3. Server attachments supported by the 2216 Model 400 and Network Utility

Interface	2216 Model 400	Network Utility
ESCON	yes	yes
Parallel Channel	yes	yes

² Network Utility supports the high-performance ATM interfaces FC 2294 and FC 2295.

Protocols Supported

Table 2-4 (Page 1 of 2). 2216 Protocol and Feature Support

Protocol			Network Utility	2216
<i>IP Version</i>	<i>IPv4</i>	<i>IPv6</i>		
TCP	yes	yes	yes	yes
UDP	yes	yes	yes	yes
ICMP	yes	yes	yes	yes
Neighbor Discovery Protocol (NDP)	no	yes	yes	yes
IPv6 over IPv4 with manually configured tunneling	yes	yes	yes	yes
IGMP/Multicast Listener Discovery Protocol (MLD)	yes	yes	yes	yes
static routes	yes	yes	yes	yes
RIP	yes	yes	yes	yes
Open Shortest Path First (OSPF) V2	yes	no	yes	yes
Multicast extensions to OSPF (MOSPF)	yes	no	yes	yes
Distance Vector Multicast Routing Protocol (DVMRP)	yes	no	yes	yes
Border Gateway Patrol (BGP-4)	yes	no	yes	yes
Protocol Independent Multicast Dense Mode	no	yes	yes	yes
VRRP	yes	no	yes	yes
IPSec	yes	yes	no	yes
Network Address Translation (NAT)	yes	no	no	yes
RSVP	yes	no	yes	yes
IP Access Control	yes	yes	yes	yes
BOOTP/DHCP Forwarding	yes	no	yes	yes
ping	yes	yes	yes	yes
Traceroute	yes	yes	yes	yes
Telnet	yes	yes	yes	yes
<i>SNA, including IP integration</i>				
APPN			yes	yes
TN3270E Server ⁵			yes	yes
Data Link Switching (DLSw) ¹			yes	yes
Boundary Access Node (BAN)			yes	yes
Branch Extender			yes	yes
Dependent LU Requester (DLUR)			yes	yes
Enterprise Extender			yes	yes
Extended Border Node			yes	yes
High-Performance Routing (HPR)			yes	yes
Network node (NN)			yes	yes
<i>Bridging</i>				
Source-route bridging (SRB)			yes	yes
Source-route transparent (SRT) bridging			yes	yes
Source Route to transparent translational bridging (SR/TB)			yes	yes
Transparent bridging (TB)			yes	yes
IP bridging tunnels			yes	yes
<i>Channel Protocols</i>				
MPC + (including TCP, UDP, and SNA HPR)			yes	yes
LSA			yes	yes
LCS			yes	yes

Table 2-4 (Page 2 of 2). 2216 Protocol and Feature Support

Protocol		Network Utility	2216
<i>ATM</i>			
Classical IP		yes	yes
Native Routing of HPR		yes	yes
Bridging using RFC 1483 encapsulation		yes	yes
Routing of IPX using RFC 1483 encapsulation		yes	yes
Next Hop Resolution Protocol (NHRP)		yes	yes
LAN Emulation (LANE)		yes	yes
<i>Network Management Protocols</i>			
SNMP (Simple Network Management Protocol)		yes	yes
LNM (LAN Network Manager)		yes	yes
<i>Other Protocols</i>			
AppleTalk2		no	yes
ARP (Address Resolution Protocol)		yes	yes
InARP (Inverse Address Resolution Protocol)		yes	yes
Banyan VINES		no	yes
DECnet IV		no	yes
DECnet V / OSI		no	yes
IPX		no	yes
NetBIOS		yes	yes
2216 Features			
Thin Server		no	yes
Network Dispatcher		yes	yes
Dial-in/Dial-out access for LANs (DIALs)		no	yes
Bandwidth reservation and Priority queuing ³		yes	yes
MAC filtering		yes	yes
WAN restoral		no	yes
WAN reroute ²		no	yes
Data compression		yes	yes
Encryption ³		no	yes
Virtual Private Networking, including IP Security		no	yes
L2TP (Virtual Private Dial-up Networking)		no	yes
AAA (Authentication, Authorization, and Accounting Security) ⁴		yes	yes

1. Including NetBIOS support (RFCs 2166, 1795 and 1434)

2. For recovery from FR, PPP, or X.25 link failures

3. Over FR and PPP

4. For PPP and for login users

5. This is a separately priced feature for 2216 and is not included in the base code load.
For Network Utility this feature is only supported on the TN1 model.

Protocol Support by Interface

Table 2-5 illustrates protocol support by interface for the 2216 Model 400.

Table 2-6 illustrates support for the Network Utility. For the ESCON and parallel channel interfaces, see "Channel Function Support in the 2216 Model 400 and Network Utility" on page 5-4.

Table 2-5. 2216 Model 400 Media and Protocol Support, by Interface

WANs							LANs				
Framing Methods	PPP	FR	X.25	SDLC	V.25bis and ISDN		Ethernet	Token Ring	FasTR	ATM	FDDI
					Dial on Demand	Dial Backup					
Protocols											
Banyan VINES	yes	yes	yes	–	yes	yes	yes	yes	–	yes ⁴	yes
IPv4	yes	yes	yes	–	yes	yes	yes	yes	yes	yes ²	yes
IPv6	yes	–	–	–	yes	yes	yes	yes	yes	–	yes
DECnet IV	yes	yes	yes ³	–	yes	yes	yes	yes	–	yes ⁴	yes
DECnet V/OSI	yes	yes	yes ¹	–	yes	yes	yes	yes	–	yes ⁴	yes
NetBIOS	yes	yes	yes	–	yes	yes	yes	yes	–	yes ⁴	yes
IPX	yes	yes	yes	–	yes	yes	yes	yes	–	yes ²	yes
AppleTalk	yes	yes	yes ¹	–	yes	yes	yes	yes	–	yes ⁴	yes
SNA	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
SRB	yes	yes	yes ⁵	–	yes	yes	–	yes	yes	yes ⁴	–
TB	yes	yes	yes ⁵	–	yes	yes	yes	–	–	yes ⁴	yes
SRT	yes	yes	yes ⁵	–	yes	yes	yes	yes	–	yes ⁴	–
SR/TB	yes	yes	yes ⁵	–	yes	yes	yes	yes	–	yes ⁴	–

Notes:

1. Routing of this protocol is not supported on X.25 interfaces; however, if the protocol is being bridged, the IP tunnel function can be used to send bridge protocol 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. DECnet IV is supported on X.25 only in the IBM modes of operation. The DEC compatibility modes of operation are configurable but not intended for operation on this product.
4. Supported through LAN Emulation or bridging only
5. Bridging is not supported natively on X.25; however, the IP bridge tunnel function can be used to send bridge packets over an X.25 interface.

Table 2-6. Network Utility Media and Protocol Support, by Interface

WANs					LANs			
Framing Methods	PPP	FR	X.25	SDLC	Ethernet	Token Ring	ATM	FDDI
SNA								
NetBIOS	yes	yes	yes	–	yes	yes	yes	yes
SRB	yes	yes	yes	–	–	yes	yes ¹	–
TB	yes	yes	yes ²	–	yes	–	yes ¹	yes
SRT	yes	yes	yes ²	–	yes	yes	yes ¹	–
SR/TB	yes	yes	yes ²	–	yes	yes	yes ¹	–
IPv4	yes	yes	yes ²	–	yes	yes	yes ³	yes
IPv6	yes	–	–	–	yes	yes	–	yes

Notes:

1. Supported through LAN Emulation or bridging only
2. Bridging is not supported natively on X.25; however, the IP bridge tunnel function can be used to send bridge packets over an X.25 interface.
3. IPv4 is supported using Token-Ring and Ethernet LAN emulation. In addition, IPv4 and IPX are supported between routers that support RFC 1483 encapsulation.

Framing Support for the 2216 Model 400 and the Network Utility

Table 2-7 lists the framing methods supported by each router on WAN interfaces.

Framing Method	2216 Model 400	Network Utility Models TN1 and TX1
PPP	yes	yes
Multilink PPP	yes	–
Frame Relay	yes	yes
X.25/XTP	yes	yes
V.25bis	yes	–
SDLC	yes	yes
SDLC Relay	yes	yes

Hardware Features

The base 2216 Model 400 and Network Utility consist of:

Feature	2216 Model 400	Network Utility
Cabinet	Fits 19-inch rack. Height: 13U (576.1 mm or 22.7 in.) Tabletop or rack installation.	Fits 19-inch rack. Height: 3U (133 mm or 5.2 in.) Tabletop or rack installation.
Power supply	One (with redundant power option)	One
Cooling subsystem	Cooling fan tray assembly housing four fans (n + 1 cooling)	Two fans
System card	A 604E PowerPC 200-MHz PowerPC microprocessor with: <ul style="list-style-type: none"> • 64-MB DRAM (can be upgraded to 256-MB) • A 512-KB L2 cache • A hard drive A 740 PowerPC 233-MHz PowerPC microprocessor with: <ul style="list-style-type: none"> • two open DIMM sockets for 64-MB up to 512-MB of total DRAM • A 512-KB L2 cache • A hard drive 	A 740 PowerPC 233-MHz PowerPC microprocessor with: <ul style="list-style-type: none"> • 256-MB DRAM (can be upgraded to 512-MB) • A 512-KB L2 cache • A hard drive
Adapter slots	8	2
PCMCIA slots	Two slots for adapters of Type II or I/II.	same as Model 400
PCMCIA modem (where available)	<ul style="list-style-type: none"> • A 33.6-Kbps V.34 data modem with integrated DAA for the U.S. and Canada • A V.34 data modem with programmable DAA for most other countries. Depending on the country, this modem is available at 28.8 or 33.6 Kbps. (See Table 3-1 on page 3-2). 	same as Model 400
PCMCIA 10BASE-T Ethernet adapter	–	The IBM EtherJet adapter provides faster service access to the Network Utility.

Code Features

Table 2-9 lists the code protocols and features that are available for the 2216 Model 400 and the Network Utility. Correlate the functions you need with the appropriate hardware model of the Network Utility. For more information about these features, refer to the *Multiprotocol Access Services Software User's Guide*, the *MAS Using and Configuring Features*, the *MAS Protocol Configuration and Monitoring Reference Volume 1*, or the *MAS Protocol Configuration and Monitoring Reference Volume 2*.

Table 2-9 (Page 1 of 2). Code Features supported in the 2216 Model 400 and Network Utility

Feature or Protocol	Available for 2216 Model 400 Base	Available for 2216 Model 400 Web Server Cache	Available for Network Utility Model TN1	Available for Network Utility Model TX1
TN3720E	yes ¹	—	yes	—
Network Dispatcher	yes	yes	yes	yes
TN3270 Server Advisor (for Network Dispatcher) ²	yes	yes	yes	yes
Bandwidth reservation and Priority queuing	yes	yes	yes	yes
MAC filtering	yes	yes	yes	yes
WAN restoral	yes	yes	—	—
WAN reroute	yes	yes	—	—
Data compression	yes	yes	yes	yes
Data Link Switching (DLSw)	yes	—	yes	yes
Encryption	yes	yes	—	—
Quality of Service (QoS)	yes	yes	yes	yes
IPsec (IP Security)	yes	yes	—	—
L2TP	yes	yes	—	—
Network Address Translation	yes	yes	—	—
AAA (Authentication, Authorization, and Accounting Security)	yes	yes	yes	yes
RSVP	yes	yes	yes	yes
IPv6	yes	—	yes	yes
Thin Server	yes	—	—	—
Web Server Cache	—	yes ¹	—	—
IPX	yes	—	—	—
AppleTalk	yes	—	—	—
DECnet IV	yes	—	—	—
OSI	yes	—	—	—
Banyan Vines	yes	—	—	—
DIALs	yes	yes	—	—

Table 2-9 (Page 2 of 2). Code Features supported in the 2216 Model 400 and Network Utility

Feature or Protocol	Available for 2216 Model 400 Base	Available for 2216 Model 400 Web Server Cache	Available for Network Utility Model TN1	Available for Network Utility Model TX1
APPN features				
Branch Extender	yes	—	yes	yes
Dependent LU Requestor (DLuR)	yes	—	yes	yes
Enterprise Extender	yes	—	yes	yes
Extended Border Node	yes	—	yes	yes
High-performance routing (HPR)	yes	—	yes	yes
Network node (NN)	yes	—	yes	yes
1. This is a separately priced feature 2. When communicating with a TN3270E Server on an IBM routing product				

Options

With some restrictions, you can:

- Insert or remove adapters while the 2216 Model 400 or Network Utility is operational
- Replace failed adapters without taking the system down
- Replaced failed adapters without rebooting the software

A replaced adapter assumes the configuration of the failed adapter. See the “Configuration Process” chapter and the reset command in the *Multiprotocol Access Services Software User’s Guide*.

The following adapters are available.

Table 2-10. 2216 Model 400 and Network Utility Adapters and Feature Codes

Adapters	Feature Code (FC)	Support		Page
		Model 400	Network Utility	
<i>LAN Adapters</i>				
2-port Token-Ring	2280	yes	yes	2-13
2-port Ethernet	2281	yes	yes	2-13
1-port 10/100-Mbps Ethernet	2288	yes	yes	2-15
1-port FDDI	2286	yes	yes	2-14
1-port ATM 155-Mbps MMF	2284	yes	–	2-14
1-port ATM 155-Mbps SMF	2293	yes	–	2-17
1-port high-performance ATM 155-Mbps MMF	2294	yes	yes	2-14
1-port high-performance ATM 155-Mbps SMF	2295	yes	yes	2-17
<i>WAN Adapters</i>				
8-port EIA-232E/V.24	2282	yes	yes	2-13
6-port V.35/V.36	2290	yes	yes	2-16
8-port X.21	2291	yes	yes	2-17
1-port ISDN/PRI (T1/J1 interface)	2283	yes	–	2-13
1-port ISDN/PRI (E1 interface)	2292	yes	–	2-17
4-port ISDN PRI/Channelized T1/J1	2297	yes	–	2-18
4-port ISDN PRI/Channelized E1	2298	yes	–	2-18
4-port ISDN PRI/Channelized T1/J1 daughter card ³	2251	yes	–	see FC 2297
4-port ISDN PRI/Channelized E1 daughter card ³	2252	yes	–	see FC 2298
1-port HSSI	2289	yes	yes	2-16
<i>Channel Adapters</i>				
1-port ESCON Channel	2287	yes	yes	2-15
1-port Parallel Channel	2299	yes	yes	2-18

Plugging rules for using these adapters in the Model 400 can be found in Appendix C, “Adapter Plugging Defaults” on page C-1. There are no plugging rules associated with using the adapters in the Network Utility.

³ This daughter card expands the capacity of a 4-port ISDN/PRI adapter from four to eight ports.

(FC 2280) 2-Port Token-Ring

Provides for two attachments to Token-Ring LANs. This adapter can continually process frames of data to and from system memory and the Token Ring at a speed of either 4 Mbps or 16 Mbps. It supports the use of either shielded twisted-pair or unshielded twisted-pair cable through a single connector. Cable 2713 is available for this adapter.

(FC 2281) 2-Port Ethernet

Provides for two attachments to Ethernet LANs. It supports the use of either 10BASE-T cable or 10BASE2 cable. Cable 2713 is available for this adapter.

(FC 2282) 8-Port EIA-232E/V.24 Adapter

Provides eight attachments to EIA-232E/V.24 WANs. Each attachment provides:

- Support for receiving clocking (modem-attached) at a line speed from 2.4 Kbps to 64 Kbps
- Support for providing clock (directly attached) from 9.6 Kbps to 64 Kbps
- Software selectable to receive clock (modem-attached) or provide clock (directly attached) with the appropriate cable
- A 100-pin D-shell female connector
- Support for cables FC 2701, FC 2705, and FC 2706

(FC 2283) 1-Port ISDN PRI (T1/J1) Adapter

Provides one attachment to an ISDN Primary Rate service at T1/J1 speed.

Note: With the MAS Version 2 Release 2 PTF, this can also be used for channelized T1/J1.

This attachment provides:

- Support for T1/J1 line speed of 1.544 Mbps
- Twenty-three 64-Kbps B-channels for data and one 64-Kbps D-channel for signaling
- Selectable framing to D4 (SF) format
- Detection and generation of yellow and blue alarms
- Facility Data Link (FDL) support
- Generation of DSX-1 and CSU line build outs
- Generation and detection of CSU loop codes
- Line error counters for BPV, CV, CRC6, and framing-bit errors
- Monitoring and enforcing of ANSI ones density requirement
- B8ZI and AMI line coding
- DB-26 (26-pin D-shell) female connector
- Support for cables FC 2714 and FC 2716
- Two separate loopbacks for testing: payload and line. The diagnostics program provides a local loopback, as well.

(FC 2284 and 2294) 1-Port ATM 155-Mbps Multimode Fiber Adapter

This adapter can be used for either of two functions: ATM or Fast Token-Ring encapsulated over ATM (FasTR). For more information about FasTR, see “Planning for FasTR” on page 5-38.

Both FCs provide identical function; however, FC 2294 has higher throughput.

Provides one attachment to an ATM switch or a direct-attached FasTR device over a multimode fiber-optic cable. This attachment provides:

- 8 MB of packet memory and 2 MB of control memory for high-performance support
- A specialized ATM support chip to perform the segmentation and reassembly (SAR) function for ATM Adaptation Layer 5 (AAL-5)
- SONET OC3c framing
- Nominal operating wavelength of 1300 nm using LED-based technology
- Support for a 62.5/125µm multimode fiber
- Transceiver support for a maximum cable length of 2 km (1.24 miles)
- A multimode duplex SC connector

Note: A cable is not provided with the 2216 Model 400 or Network Utility for this adapter. The IBM fiber optic cables that can be used with this adapter include the 4-m cable PN 19G4864 and the 6-m cable PN 19G4865.

(FC 2286) 1-Port FDDI

Provides one attachment to an FDDI dual-attaching system (DAS) connection. This attachment provides:

- One FDDI DAS port on the card
- 4-KB entry hardware Transparent Bridging (to support bridging at media speed)
- Networking support for standard: “Fiber Distributed Data Interface (FDDI)”
 - Part 1: Token Ring Physical Layer Protocol ISO 9314-1: 1989
 - Part 2: Token Ring Media Access Control (MAC) ISO 9314-2: 1989
 - Part 3: Token Ring Physical Layer Medium Dependent (PMD) ISO/IEC 9314-3: 1990
- External cabling:
 - Fiber cabling standard: ANSI X3.T9.5
- FDDI DAS port media connectors: Multimode fiber SC
- FDDI DAS Optical Bypass Connector

Note: A cable is not provided with the 2216 Model 400 or Network Utility for this adapter. The IBM fiber optic cables that can be used with this adapter include the 4-m cable PN19G4864 and the 6-m cable PN 19G4865.

(FC 2287) 1-Port ESCON Channel Adapter

Provides the 2216 Model 400 or Network Utility with access to SNA and TCP/IP host applications from LANs, WANs, and ATM over a duplex-to-duplex multimode fiber-optic cable. The adapter features:

- High-performance IP and SNA host-application access, featuring Multi-Path Channel+ (MPC+) support for high-throughput APPN high-performance routing (HPR) to VTAM 4.4 (or higher) SNA applications or OS/390 V2R5 TCP/IP applications.
- APPN intermediate session routing (ISR) to VTAM 3.4 (or higher) SNA applications.
- APPN HPR support for VTAM 4.4 (or higher) SNA applications.
- APPN and IP routing over any other 2216 Model 400 or Network Utility interface.
- Dependent LU Requester (DLUR) in APPN to provide connectivity between dependent downstream SNA devices and VTAM SNA applications.
- Boundary access node (BAN) support to provide connectivity between downstream BAN Frame Relay Access Devices (FRADs) and VTAM SNA applications.
- IP route selection based on static, RIP, OSPF, and BGP-4 routes and filtering of IP frames coming from or destined for the channel.
- Data link switching (DLSw) support for VTAM 3.4 (or higher) SNA applications. DLSw allows for local (single 2216 Model 400 or single Network Utility) conversion from SDLC and LANs to the channel and remote (via DLSw partners) connectivity to SNA devices on SDLC, LANs, and ATM forum-compliant LAN emulation (LANE).
- ESCON channel connectivity for Token Ring, Ethernet, FDDI, and ATM LAN emulation.

The 2216 Model 400 or Network Utility supports:

- Up to 32 ESCON logical addresses (subchannels) per adapter for access to up to 32 hosts for Link Services Architecture (LSA) or 16 hosts for Logical Channel Station (LCS) or 16 hosts for MPC+ (assuming these types are not mixed on the adapter) when used with an IBM 9032 or 9033 ESCON Director or access to up to 15 logical host images in EMIF-capable processors operating in a logically partitioned (LPAR) mode.
- Up to four adapters in any combination of ESCON and Parallel Channel interfaces.

(FC 2288) 1-Port 10/100-Mbps Ethernet

Provides one port for 10/100 Mbps Ethernet connections using an RJ-45 connector. This attachment provides:

- 4-KB entry hardware Transparent Bridging (to support bridging at the media speed)
- IEEE 802.3 10-Mbps Ethernet
- IEEE 802.3u 100-Mbps Ethernet

Cable 2713 is available for this adapter.

(FC 2289) 1-Port High-Speed Serial Interface HSSI Adapter

Provides one port for HSSI connection through a 5-m (16 ft, 5 in.) STP cable that is included with the adapter. The cable uses 2-row 50-pin SCSI connectors. Two types of HSSI cables can be used with the HSSI adapter: One cable for DTE-to-DCE attachment where the HSSI adapter is the DTE, and one cable for back-to-back direct connection of one HSSI adapter to another HSSI adapter. (The second cable is called a null-modem or cross-over cable).

The HSSI attachment provides:

- Support for network standards:
 - ANSI/EIA/TIA 613-1993, “High-speed Serial Interface for Data Terminal equipment and Data Circuit-Terminating Equipment”
 - ANSI/EIA/TIA 612-1993, “Electrical Characteristics for an Interface at Data Signaling Rates up to 52 Mbps”
- DTE interface for applications
- DCE interface for test
- Support for STP cable type
- Receive clocking at line speeds of 1.544 Mbps (T1 speed) to 52 Mbps
- Clocking at the following speeds:
 - 44.736 Mbps
 - 22.368 Mbps

(FC 2290) 6-Port V.35/V.36 Adapter

Provides six attachments to ITU-T V.35 or V.36 WANs. Each attachment provides:

- Support for receiving clocking (modem-attached) at a line speed from 2.4 Kbps to 2.048 Mbps
- Support for providing clock (directly attached) from 9.6 Kbps to 460.8 Kbps as well as 1.544 Mbps and 2.048 Mbps
- Software selectable to receive clock (modem-attached) or provide clock (directly attached) with the appropriate cable
- A 100-pin D-shell female connector
- Support for cables FC 2702, FC 2703, FC 2707, FC 2708, FC 2709 FC 2710, and FC 2799

With the V.35/V.36 you can use the following combination of cables:

- FC 2702 with FC 2707, FC 2708, and FC 2799 (for V.35)
- FC 2703 with FC 2709 and FC 2710 (for V.36)

Note: Cabling to mix V.35 and V.36 interfaces on adapter FC 2290 is not provided.

(FC 2291) 8-Port X.21 Adapter

Provides eight attachments to ITU-T X.21 WANs. Each attachment provides:

- Support for receiving clocking (modem-attached) at a line speed from 2.4 Kbps to 2.048 Mbps
- Support for providing clock (directly attached) from 9.6 Kbps to 460.8 Kbps as well as 1.544 Mbps and 2.048 Mbps
- Software selectable to receive clock (modem-attached) or provide clock (directly attached) with the appropriate cable
- A 100-pin D-shell female connector
- Support for cables FC 2704, FC 2711, and FC 2712

(FC 2292) 1-Port ISDN PRI (E1) Adapter

Note: With the MAS Version 2 Release 2 PTF, this can also be used for channelized E1.

Provides one attachment to an ISDN Primary Rate service at E1 speed. This attachment provides:

- Support for E1 line speed of 2.048 Mbps
- Thirty 64-Kbps B-channels for data and one 64-Kbps D-channel for signaling
- Selectable framing to FAS and CRC4 formats
- Detection and generation of remote and AIS alarms
- Generation of line build outs for a 120-ohm line
- Two separate loopbacks for testing: payload and line. The diagnostics program provides a local loopback, as well.
- Line error counters for bipolar and code violations, CRC4 code word errors, FAS errors, and E-bits
- B8ZI, AMI, and HDB3 line encoding
- DB-26 (26-pin D-shell) female connector
- Support for cable FC 2715.

(FC 2293 and 2295) 1-Port ATM 155-Mbps Single-Mode Fiber Adapter

This adapter can be used for either of two functions: ATM or (for 2216 Model 400) Fast Token-Ring encapsulated over ATM (FasTR). For more information about FasTR, see "Planning for FasTR" on page 5-38.

Both FCs provide identical function; however, FC 2295 has higher throughput.

Provides one attachment to an ATM switch or a direct-attached FasTR device over a multimode fiber-optic cable. This attachment provides:

- 8 MB of packet memory and 2 MB of control memory for high-performance support
- A specialized ATM support chip to perform the segmentation and reassembly (SAR) function for ATM Adaptation Layer 5 (AAL-5)
- SONET OC3c framing

- Nominal operating wavelength of 1310 nm using laser-based technology
- Support for a 9/125µm single-mode fiber
- Transceiver support for a maximum cable length of 20 km (12.4 miles)
- A single-mode polarized duplex SC connector

Note: A cable is not provided with the 2216 Model 400 or Network Utility for this adapter. The IBM fiber optic cables that can be used with this adapter include the 4-m cable PN 19G4864 and the 6-m cable PN 19G4865.

(FC 2297) 4-port ISDN PRI/Channelized T1/J1 Adapter

Provides four ports to an ISDN Primary Rate or channelized service at T1 speed. An additional four ports can be added via a separately-orderable daughter card (FC 2251).

This attachment provides the same functions as “(FC 2283) 1-Port ISDN PRI (T1/J1) Adapter” on page 2-13.

Support for cables FC 2717 and FC 2719.

(FC 2298) 4-port ISDN PRI/Channelized E1 Adapter

Provides four ports to an ISDN Primary Rate or channelized service at E1 speed. An additional four ports can be added via a separately-orderable daughter card (FC 2252).

This attachment provides the same functions as “(FC 2292) 1-Port ISDN PRI (E1) Adapter” on page 2-17.

Support for cable FC 2718.

(FC 2299) 1-Port Parallel Channel Adapter

Provides an attachment to a mainframe through the Original Equipment Manufacturer's Information (OEMI) parallel channel interface. Gives the 2216 Model 400 or Network Utility access to SNA and TCP/IP host applications from LANs, WANs, and ATM with the Original Equipment Manufacturer's Information (OEMI) parallel channel interface. The adapter features:

- IP and SNA host-application access, featuring Multi-Path Channel+ (MPC+) support for high-throughput APPN high-performance routing (HPR) to VTAM 4.4 (or higher) SNA applications or OS/390 V2R5 TCP/IP applications.
- APPN intermediate session routing (ISR) to VTAM 3.4 (or higher) SNA applications.
- APPN HPR support for VTAM 4.4 (or higher) SNA applications.
- APPN and IP routing over any other 2216 Model 400 or Network Utility interface.
- Dependent LU Requester (DLUR) in APPN to provide connectivity between dependent downstream SNA devices and VTAM SNA applications.
- Boundary access node (BAN) support in APPN to provide connectivity between downstream BAN Frame Relay Access Devices (FRADs) and VTAM SNA applications.

- IP route selection based on static, RIP, OSPF, and BGP-4 routes and filtering of IP frames coming from or destined for the channel.
- Data link switching (DLSw) support for VTAM 3.4 (or higher) SNA applications.
DLSw allows for local (single 2216 Model 400 or Network Utility) conversion from SDLC and LANs to the channel and remote (via DLSw partners) connectivity to SNA devices on SDLC, LANs, and ATM forum-compliant LAN emulation (LANE).
- Parallel channel connectivity for Token Ring, Ethernet, FDDI and ATM LAN emulation.

The 2216 Model 400 or Network Utility supports up to four adapters in any combination of ESCON and Parallel Channel interfaces.

The parallel channel attachment:

- Operates in direct-coupled interlock (DCI) or data-streaming mode.
- Supports data streaming rates of 3.0 and 4.5 MB per second.
- Supports extensions via connections to the 3044 Fiber-Optic Channel Extender Link Models C02 and D02.

The Parallel Channel adapter can be used with the following restrictions. For a complete list of restrictions, see “Limits for 2216 Model 400 or Network Utility ESCON and Parallel Channel Network Interfaces and Subchannels” on page 5-15.

- Up to 4 Parallel Channel Adapters per 2216 Model 400 and 2 per Network Utility
- Up to 32 subchannels per Parallel Channel adapter
- Up to 16 virtual nethandlers per Parallel Channel adapter

Cables

The following cables are available for use with the 2216 Model 400 or Network Utility.

Cable	FC	Available for 2216 Model 400	Available for Network Utility
Terminal Attachment Cable	No FC (PN 10H5569); ships with every 2216 Model 400 or Network Utility	yes	yes
EIA-232E/V.24 Fanout Cable	2701	yes	yes
V.35 Fanout Cable	2702	yes	yes
V.36 Fanout Cable	2703	yes	yes
X.21 Fanout Cable	2704	yes	yes
EIA-232E/V.24 Serial Interface Cable	2705	yes	yes
EIA-232E/V.24 Direct Attach Cable	2706	yes	yes
V.35 Serial Interface Cable	2707	yes	yes
V.35 Direct Attach Cable	2708	yes	yes
V.36 Serial Interface Cable	2709	yes	yes
V.36 Direct Attach Cable	2710	yes	yes
X.21 Serial Interface Cable	2711	yes	yes
X.21 Direct Attach Cable	2712	yes	yes
Attachment Cable for V.35 DCE (for France)	2799	yes	yes
RJ-45 Cable for PCMCIA 10BASE-T Ethernet adapter (Network Utility only)	No FC; ships with Network Utility	–	yes
Multipurpose RJ-45 Adapter Cable	2713	yes	yes
RJ-48 Cable for T1 1-port ISDN PRI Adapter	2714	yes	–
Unterminated Cable for E1 1-port ISDN PRI Adapter	2715	yes	–
RJ-48 Cable for J1 1-port ISDN PRI Adapter	2716	yes	–
RJ-48C Cable for T1 4-port ISDN PRI/Channelized Adapter	2717	yes	–
RJ-48C Cable for E1 4-port ISDN PRI/Channelized Adapter	2718	yes	–
RJ-48C Keyed Cable for T1/J1 4-port ISDN PRI/Channelized Adapter	2719	yes	–
HSSI cable	No FC; ships with HSSI adapter	yes	yes

⁴ In some publications these cables are known as bus-and-tag upstream and bus-and-tag downstream cables.

<i>Table 2-11 (Page 2 of 2). Cables available for the 2216 Model 400 and Network Utility</i>			
Cable	FC	Available for 2216 Model 400	Available for Network Utility
Cable Group for ESCON Channel Adapter	varies by country	yes	yes
2216 V-Cable	No FC; ships with all Parallel Channel Adapters	yes	yes
Channel Interface-In cables ⁴	2720	yes	yes
Channel Interface-Out cables ⁴	2721	yes	yes

- Terminal Attachment Cable (PN 10H5569)

This cable provides a 3-m (9.8 ft), 9-pin serial to 25-pin connection. The cable ships as part of the base package of each 2216 Model 400 or Network Utility and is intended for attaching the machine to a modem or a null modem block that attaches to an ASCII terminal. For the Network Utility, two cables are included. When attaching to laptop computers or other machines that do not carry 25-pin ports, the second cable can be matched to the modem or null modem block to provide a 9-pin connection to the ASCII terminal. The null modem block also is included as part of the ship group as PN 10H5570. For most countries, a PCMCIA modem and its cable ship, as well (see Table 3-1 on page 3-2).

- EIA-232E/V.24 Fanout Cable (FC 2701)

This fanout cable provides eight connections (25-pin D-shell male) each of which is 1.8 m (5 ft 11 in.) in length. Each connection is suitable for connection to a EIA-232/V.24 modem.

Cables 2705 and 2706 are available to complement this cable. FC 2705 attaches to the FC 2701 and extends the cable length an additional 3 m (9 ft 10 in.) for attachment to a modem. FC 2706 attaches to FC 2701 and provides clocking to allow devices to be directly attached to the 2216 Model 400 or Network Utility without having to use a modem. It is 3 m (9 ft 10 in.) in length and provides a female 25-pin D-shell connector.

- V.35 Fanout Cable (FC 2702)

This fanout cable is a 1.2-m (3 ft 10 in.) cable to a distribution box containing six 25-pin D-shell male connectors.

Cables 2707 and 2708 are available to complement this cable. FC 2707 provides a 3-m (9 ft 10 in.) extension cable with a 34-pin male block connector for attachment to a modem. FC 2708 provides a 2-m (6 ft 7 in.) cable with a 34-pin female block connector for direct-device attachment.

- V.36 Fanout Cable (FC 2703)

This fanout cable provides six connections (37-pin D-shell male) each of which is 3 m (9 ft 10 in.) in length. Each connection is suitable for connection to a V.36 modem.

Cables 2709 and 2710 are available to complement this cable. FC 2709 provides a 3-m (9 ft 10 in.) extension cable with a 37-pin male D-shell connector for attachment to a modem. FC 2710 provides a 3-m (9 ft 10 in.) cable with a 37-pin female D-shell connector for direct-device attachment.

- X.21 Fanout Cable (FC 2704)

This fanout cable provides eight connections (15-pin D-shell male) each of which is 1.8 m (5.9 ft) in length. Each connection is suitable for connection to an X.21 modem.

Cables 2711 and 2712 are available to complement this cable. FC 2711 provides a 3-m (9 ft 10 in.) extension cable with a 15-pin D-shell male connector for attachment to a modem. FC 2712 provides a 3-m (9 ft 10 in.) cable with a 15-pin D-shell female connector for direct-device attachment.
- EIA-232E/V.24 Serial Interface Cable (FC 2705)

This cable provides a 3-m (9 ft 10 in.) extension cable with a 25-pin male D-shell connector for attachment to a modem.
- EIA-232E/V.24 Direct Attach Cable (FC 2706)

This cable is a 3-m (9 ft 10 in.) cable with a 25-pin D-shell female connector for direct-device attachment.
- V.35 Serial Interface Cable (FC 2707)

This cable is a 3-m (9 ft 10 in.) extension cable with a 34-pin male block connector for attachment to a modem.
- V.35 Direct Attach Cable (FC 2708)

This cable is a 2-m (6.6-ft) cable with a 34-pin female block connector for direct-device attachment.
- V.36 Serial Interface Cable (FC 2709)

This cable is a 3-m (9 ft 10 in.) extension cable with a 37-pin male D-shell connector for attachment to a modem.
- V.36 Direct Attach Cable (FC 2710)

This cable is a 3-m (9 ft 10 in.) cable with a 37-pin female D-shell connector for direct-device attachment.
- X.21 Serial Interface Cable (FC 2711)

This cable is a 3-m (9 ft 10 in.) extension cable with a 15-pin D-shell male connector for attachment to a modem.
- X.21 Direct Attach Cable (FC 2712)

This cable is a 3-m (9 ft 10 in.) cable with a 15-pin D-shell female connector for direct-device attachment.
- Attachment Cable for V.35 DCE (FC 2799) - for France

This cable is a 30-cm (1-ft) cable that adapts the standard V.35 34-pin male block connector to the connector required for attachment to V.35 modems in France.
- RJ-45 Cable (no feature code) for PCMCIA 10BASE-T Ethernet PC Card

The Ethernet card ships with a 3-m, 10BASE-T cable with a male RJ-45 connector. This adapter-cable set is part of the base package of the Network Utility only.

- Multipurpose RJ-45 Adapter Cable (FC 2713)

This cable is a 7.6-m (25-ft) Category 5 cable with an RJ-45 connector for attachment to token-ring hubs or switches or Ethernet 10BASE-T hubs or switches.

Cables for 1-port ISDN Adapters

- RJ-48 Cable for T1 1-port ISDN PRI Adapter (FC 2714)

This cable is a 15-m (49-ft) cable with an RJ-48 connector for attachment to 1-port T1 ISDN PRI switches. This cable carries a 26-pin D-shell connector on the 2216 Model 400 side.

Note: Installation should be in accordance with all local ordinances and regulations.

- Unterminated Cable for E1 1-port ISDN PRI Adapter (FC 2715)

This cable is a 30-m (100-ft) cable for the 2216 Model 400 with “flying leads” suitable for wiring to 1-port E1 ISDN PRI switches. This cable carries a 26-pin D-shell connector on the 2216 Model 400 side.

- RJ-48 Cable for J1 1-port ISDN PRI Adapter (FC 2716)

This cable is a 15-m (49-ft) cable with an RJ-48 connector for attachment to 1-port J1 ISDN PRI switches. This cable carries a 26-pin D-shell connector on the 2216 Model 400 side.

Cables for 4-port ISDN PRI/Channelized Adapters

- RJ-48C Cable for T1 4-port ISDN PRI/Channelized Adapter (FC 2717)

This cable is a 15-m (49-ft), straight-through, unshielded twisted pair, Category 3 cable. The cable terminates with two RJ-45 plugs, each wired for RJ-48C, suitable for attachment to the 4-port ISDN PRI/Channelized T1 adapter.

Note: Installation should be in accordance with all local ordinances and regulations.

- RJ-48C Cable for E1 4-port ISDN PRI/Channelized Adapter (FC 2718)

This cable is a 15-m (49-ft), unshielded twisted pair, Category 3 cable. One end of the cable is terminated with flying leads, the other with an RJ-45 plug wired for RJ-48C, suitable for attachment to the 4-port ISDN PRI/Channelized E1 adapter.

- RJ-48C Keyed Cable for T1/J1 4-port ISDN PRI/Channelized Adapter (FC 2719)

This cable is a 15-m (49-ft), straight-through, unshielded twisted pair, Category 3 cable. The cable terminates with a keyed RJ-45 plug wired for ISO10173, suitable for attachment to the 4-port ISDN PRI/Channelized T1/J1 adapter.

Cables for the ESCON Channel Adapters

- The cable for each 2216 Model 400 or Network Utility ESCON Channel Adapter must be ordered separately.
 - In the U.S.A., Canada, and Latin America, order cable group #3797 or PN 14F3797 in the following standard lengths:

- 4 m (12 ft)
 - 7 m (20 ft)
 - 13 m (40 ft)
 - 22 m (70 ft)
 - 31 m (100 ft)
 - 46 m (150 ft)
 - 61 m (200 ft)
 - 77 m (250 ft)
 - 92 m (300 ft)
 - 107 m (350 ft)
 - 122 m (400 ft)

For additional information on planning for ESCON Channel Adapter cable installations, refer to *Fiber Optic Link Planning*, GA23-0367.

- In EMEA or AP, see “ESCON Cabling Information” in publication number GC22-7064 to order the cables.

Cables for the Parallel Channel Adapter

- The Parallel Channel adapter is cabled using the 2216 V-Cable, a 1.8-m (6-ft) copper cable. Depending on your configuration, you may also need to order additional host-channel cabling and one or both of the channel interface-in and channel interface-out cables. For more information, see “Parallel Channel Cabling Considerations” on page 5-28.

Cables that IBM does not offer: The following cables are not provided as options for the 2216 Model 400 or Network Utility. You must obtain them, if they are required:

- Token-Ring STP network adapter cable
- Ethernet 10BASE2 cable
- ATM multimode fiber adapter cable
- ATM single-mode fiber adapter cable
- FDDI cable

For more information, see Appendix B, “Cable Pin Assignments” on page B-1.

Chapter 3. Physical Planning and Prerequisites

Placement Options

The 2216 Model 400 or Network Utility can be placed on a table top or in a rack.

Table Top

If the 2216 Model 400 or Network Utility is placed on a table top, the table must meet the requirements for service and operating clearances listed under “Service Clearances” on page 3-4.

Rack

If you choose rack-mounting, you must provide the rack; it is not provided with the 2216 Model 400 or Network Utility.

You can use any EIA standard 19-inch rack. 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.).

The rack can be open or closed. However, if you choose a closed rack, you must make sure that enough air flows through the 2216 Model 400 or Network Utility. Covers on the front of the rack that would not let air reach the 2216 Model 400 or Network Utility must be removed or modified to let air pass. Similarly, unvented rear rack covers that would not let air exit the 2216 Model 400 or Network Utility or that would cause back pressure to build up from several machines must not be used.

Preparing the Machine Area

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

- The physical dimensions of the machine
- The area that must be left free around the machine for easy access to any cables, connectors, and parts that can be replaced.
- Environmental constraints

Access to the Device

All cables are attached at the front of the unit. In addition, all LEDs are on the front. For the Model 400, all features are installed from the front as well. This simplifies setup and maintenance of the unit and minimizes the service area required to access it.

Hardware Requirements

You must provide the following hardware to operate the 2216 Model 400 or Network Utility:

- Any cables that are not provided with the 2216 Model 400 or Network Utility. See Appendix B, Cable Pin Assignments for a list of IBM cable feature numbers.
- A modem for the 2216 Model 400 or Network Utility. In most cases, this is a PCMCIA modem that is provided with the initial order. Modems are available for the following countries:

Table 3-1. PCMCIA Modem, By Country

Feature Code	Country
2900	Argentina, Bahamas, Bangladesh, Barbados, Bolivia, Canada, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, El Salvador, Guatemala, Honduras, Iran, Jamaica, Lebanon, Nepal, Netherlands Antilles, Nicaragua, Pakistan, Panama, Paraguay, Peru, Surinam, Thailand, Tobago, Trinidad, Venezuela, Saudi Arabia, Syria, U.S.A., Yemen
2901	Austria
2902	Australia
2903	Belgium
2904	Denmark
2905	Finland
2906	France
2907	Germany
2908	Hong Kong
2909	Ireland
2910	Italy, Croatia
2911	Japan
2912	South Korea
2913	Luxembourg
2914	Netherlands
2915	New Zealand
2916	Norway
2921	Sweden
2922	Switzerland
2925	Brunei, Ghana, United Kingdom, Zambia
2927	Israel

- If the modem is not shipped with your 2216 Model 400 or Network Utility, you will need to supply a modem that connects to the serial port. It must support the AT command set and one of the following protocols:
 - ITU-T V.32 at 9.6 Kbps

- ITU-T V.32 bis at 14.4 Kbps
- ITU-T V.34 at 28.8 Kbps

Whether you use the IBM modem or provide your own modem, you must set up a communications (telephone) line to the modem to use it. A workstation is required to access the 2216 Model 400 or Network Utility.

The required operational code is shipped preloaded on each unit.

Hardware and Software Requirements for the Configuration Program

You can use the Configuration Program to prepare configuration files and then upload them to the 2216 Model 400 or Network Utility. This method of configuration enables you to use the change management functions of the unit.

Note: Using the Configuration Program is recommended for the final configuration of the 2216 Model 400 or Network Utility (after running the “Quick Configuration” program during the installation of the unit). The Configuration Program enables you to save and track configuration files. You can also make an ASCII copy of the completed configuration file to check its parameters before you download it to the 2216 Model 400 or Network Utility.

Table 3-2 lists the minimum requirements for the operating systems supported by the MAS 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 (see Note 1)	IBM-compatible PC with Intel Pentium 166-MHz or higher processor (see Note 1)
RAM (minimum)	64 MB	48 MB	48 MB
CD-ROM	yes	yes	yes
Free Disk Space	54 MB	37 MB	54 MB
	Additionally, you will need 1 to 3 MB for each configuration file.	Additionally, you will need 1 to 3 MB for each configuration file.	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 (see Note 2)	2-button (see Note 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 better processors will 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 MS Windows platforms, the configuration program will be hung if TCP/IP is not installed and running.

Physical Specifications of the IBM 2216 Nways Multiaccess Connector Model 400

The dimensions of the 2216 Model 400 are as follows:

Width

440 mm (17.3 in.) without rack-mounting flange
480 mm (18.9 in.) with rack-mounting flange

Depth

358 mm (14.1 in.)

Height

572 mm (22.5 in.) (13U) without rubber feet pads
576.1 mm (22.7 in.) (13U) with rubber feet pads

Weight

The base box of the Model 400 (with one power supply), system card, no adapters, a power supply filler plate, and no adapter filler plates weighs 31.6 kg (69.7 lb).

- Each adapter weighs approximately 1 kg (2.2 lb).
- Each filler plate for an unoccupied adapter slot weighs 0.1 kg (0.2 lb).
- A filler plate for a second power supply weighs 0.2 kg (0.4 lb)
- A second power supply weighs 3.5 kg (7.7 lb).

A fully populated Model 400 with a second power supply and eight adapters will weigh about 43.1 kg (95 lb).

Note: During installation, two people will be required to lift the 2216.

Service Clearances

You must leave free space for service around the machine as follows:

Front 750 mm (30 in.)
Sides No clearance required
Rear No clearance required

Airflow

A multiple-fan (forced air) ventilation system is installed in each unit. The airflow is 2.0 cubic meters per minute (71 cubic feet per minute).

Note: Airflow is dependent on keeping the vents on the front and rear unobstructed.

Operating Environment

Temperature 10°C to 40.6°C (50°F to 105°F)
Relative Humidity 8% to 80%
Max Wet Bulb 26.7°C (80°F)

Lightning Protection

The power supplies of the Model 400 are protected against lightning.

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

Electromagnetic Interference

For more information, refer to the *2216 Nways Multiaccess Connector and Network Utility Service and Maintenance Manual, SY27-0350*.

Power Supply

The Model 400 can have one or two power supplies. A single power supply can provide power for a fully configured unit. If you use two supplies, they will share the power load. The first power supply will remain fully operational while a second is either being installed or removed. The second power supply must have its power switch in the off position while it is being installed or removed. If a second power supply is not installed, a filler plate is used to cover the position where it would have been installed.

The power supply uses a voltage sensing system that converts line current of 100—240 volts ac, 50/60 Hz single-phase, to dc input as required by the system card, the adapters, and the fan tray.

Power Supply Requirements

For the Model 400, the ac power source must be able to supply:

- 100 to 240 V ac (nominal voltage)
- 50 or 60 Hz
- Single phase
- 0.62 kVA power
- 70 amps peak inrush current for one quarter cycle per supply

Power Cord

See “Power Cord Characteristics” on page 3-7 for detailed information regarding the operating environment of the Model 400.

Physical Specifications of the Network Utility

The dimensions of the Network Utility are as follows:

Width

440 mm (17.3 in.) without rack-mounting flange
480 mm (18.9 in.) with rack-mounting flange

Depth

457.2 mm (18 in.)

Height

133 mm (5.2 in.) (3U) with rubber feet pads (as shipped)

Weight

The Network Utility base box (mechanical chassis with backplane, a power supply, system card, and fan assembly) weighs 13 kg (28.5 lb).

- Each adapter weighs approximately 1 kg (2.2 lb).
- Each filler plate for an unoccupied adapter slot weighs 0.1 kg (0.2 lb).

A Network Utility populated with two adapters weighs about 15 kg (33 lb).

Service Clearances

You must leave free space for service around the Network Utility as follows:

Front	750 mm (30 in.)
Sides	No clearance required
Rear	No clearance required

Airflow

A dual-fan (forced air) ventilation system is installed in the Network Utility. Volumetric flow is 0.99 m³/min. (35 ft³/min.).

Note: Airflow is dependent on keeping the vents on the front, sides, and rear unobstructed.

Operating Environment

See “Operating Environment” on page 3-4 for detailed information regarding the operating environment of the Network Utility.

Lightning Protection

See “Lightning Protection” on page 3-5 for detailed information regarding the operating environment of the Network Utility.

Electromagnetic Interference

For more information, see the *2216 Nways Multiaccess Connector and Network Utility Service and Maintenance Manual*, SY27-0350.

Power Subsystem

The Network Utility power subsystem consists of two supplies mounted in an enclosure. It is secured by four locking slots and two screws and connects to the backplane assembly with two cable assemblies which provide power for a fully configured unit.

The power subsystem uses a voltage sensing system that converts line current of 100 to 240 volts ac, 50/60 Hz single-phase, to dc input as required by the system card, the adapters, and the fan assembly.

Power Supply Requirements

For the Network Utility, the ac power source must be able to supply:

- 100 to 240 V ac (nominal voltage)
- 50 or 60 Hz
- Single phase
- 0.26 kVA power
- 100 amps peak inrush current for one quarter cycle

Power Cord

See “Power Cord Characteristics” for detailed information regarding the operating environment of the Network Utility.

Power Cord Characteristics

Both Model 400 and Network Utility use the ac power cord. The cord is supplied with a country-dependent plug. For each of the cords listed in Table 3-3, find its plug type in Figure 3-1 on page 3-8 by comparing *index* numbers. (The index number is displayed below each plug type in Figure 3-1.)

Index	Part Number	Feature Code	Countries	Power Cord	Plug Standard
1	1838574	9833	Canada, Japan, Philippines, Taiwan, Thailand, Bolivia, Brazil, Ecuador, Peru, Venezuela, United States	250 V, 10 A, 2.7 m (9 ft)	NEMA WD-1 6-15P
2	6952300	9810	United States (except Chicago), Puerto Rico, Canada, Japan, South Korea, Philippines, Taiwan, Saudi Arabia, Mexico, Bolivia, Brazil, Colombia, Ecuador, Peru, Venezuela, Panama	125 V, 10 A, 2.7 m (9 ft)	NEMA WD-1 5-15P
2	6952301	9815	United States (Chicago only)	125 V, 10 A, 1.8 m (6 ft)	NEMA WD-1 5-15P
2	1838576	9818	United States (Chicago only)	250 V, 10 A, 1.8 m (6 ft)	NEMA WD-1 5-15P
3	13F9979	9820	Indonesia, South Korea, Macau, Austria, Belgium, Finland, France, Germany, Greece, Norway, Portugal, Saudi Arabia, Spain, Sweden, Turkey, Netherlands, China, Brazil	250 V, 10 A, 2.7 m (9 ft)	CEE7 VII
4	14F0033	9825	Brunei, China, Hong Kong, India, Malaysia, Singapore, Ireland, Kuwait, United Arab Emirates, United Kingdom	250 V, 10 A, 2.7 m (9 ft)	BS 1363
5	14F0051	9828	Switzerland, Liechtenstein	250 V, 10 A, 2.7 m (9 ft)	SEV 24507

Table 3-3 (Page 2 of 2). Power Cords and Power Plug Standards					
Index	Part Number	Feature Code	Countries	Power Cord	Plug Standard
6	14F0069	9830	Italy, Chile	250 V, 10 A, 2.7 m (9 ft)	CEI 23-16
7	13F9997	9821	Denmark	250 V, 10 A. 2.7 m (9 ft)	Normblad 4
8	14F0087	9827	Israel	250 V, 10 A, 2.7 m (9 ft)	SII-32-1971
9	13F9940	9831	Australia, New Zealand, Argentina, China	250 V, 10 A, 2.7 m (9 ft)	AS 3122-1981 NZS 198
9	6952291	9834	Argentina, Colombia, Brazil, Paraguay, Uruguay	250 V, 10 A, 2.7 m (9 ft)	IEC 83-A5 1957
10	14F0015	9829	Bangladesh, Myanmar, Sri Lanka, Pakistan, South Africa	250 V, 10 A, 2.7 m (9 ft)	SABS 164 BS 546

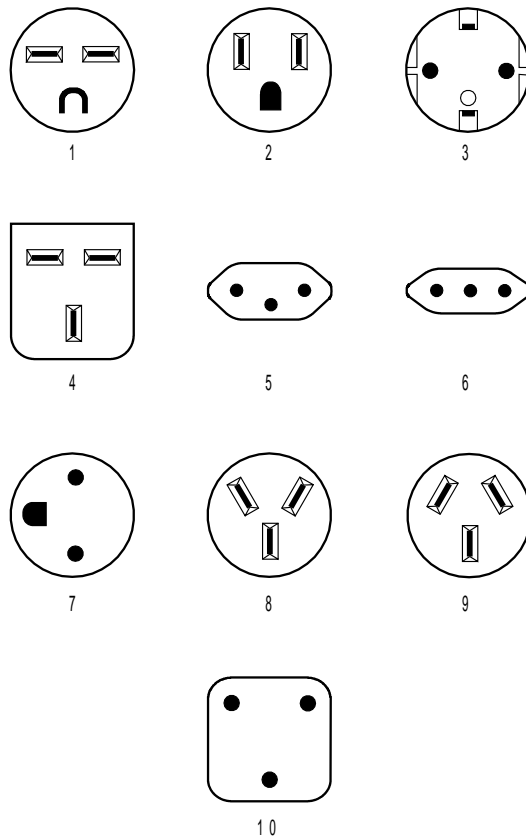


Figure 3-1. Power Cord Plugs by Country

Chapter 4. Configuration and Monitoring Tools

This chapter introduces the methods and products you can use to configure a 2216 Model 400 or Network Utility, and monitor its operation.

Configuration Methods

A product (2216 Model 400 or Network Utility) configuration is a collection of data items that control how the code operates, including such elements as:

- What interfaces to activate
- What links to bring up
- What protocols and features to make active
- What functions in a given protocol or feature to make active
- What network addresses and names to use

When you boot up the product, the system reads its configuration information from a file on its hard disk, and activates interfaces and protocols according to the information in that file. You create the file in one of two ways:

1. Using a graphical configuration program that runs on a PC or workstation.

You create the configuration on the workstation, then transfer it to the product's hard disk.

2. Using the command-line interface from a user terminal console

You type commands to create configuration data items in product memory, then write the configuration to the product's hard disk.

MAS Configuration Program

The MAS Configuration Program provides a user-friendly way to configure both a 2216 Model 400 and a Network Utility offline through a graphical user interface. A version of the MAS Configuration Program is available for each of these operating systems:

- Microsoft Windows 95 or Windows NT
- IBM AIX
- IBM OS/2

Once you have created a configuration, you send it to the 2216 Model 400 or Network Utility using Xmodem, TFTP over an IP network interface or SLIP, or by using the Communications Option feature of the Configuration Program. After sending the configuration to the product, you activate it by rebooting the product.

IBM distributes major releases of the Configuration Program on CD-ROM and on the Web. Regular maintenance PTFs are available only on the Web. The *Configuration Program User's Guide* describes system requirements and contains instructions for installing and using the program. For Network Utility users, the publication *Network Utility Installation, Getting Started, and User's Guide* documents key procedures for using the Configuration Program, and includes example configurations for common Network Utility uses.

Command-Line Interface

To use the command-line interface, you must first bring up a local or remote console to the product using one of the following methods:

- ASCII terminal emulation, through either direct attachment to the system card service port, or dialed into the PCMCIA modem or an external modem
- Telnet, through either an IP-capable network interface, the PCMCIA LAN card (Network Utility only), or a SLIP connection to the service port or modem

Once you have a user console, you can navigate through command menus and type commands to configure the product's interfaces and protocols. When you are done, you activate the configuration either by saving it to disk and rebooting the product, or by typing commands to do dynamic configuration activation.

If you use the Configuration Program, you must also use the command-line interface to enable the very first transfer of a configuration from the Configuration Program. There is a "Quick Config" utility to help with this procedure. The command-line interface is also the only way to make dynamic configuration changes.

For more background information on using the command-line interface, refer to:

- *Network Utility Installation, Getting Started, and User's Guide*
- *MAS Software User's Guide*

For the details of the commands you use to configure interfaces, protocols, and features, refer to:

- *MAS Software User's Guide*
- *MAS Protocol Configuration and Monitoring Reference Volume 1* and *MAS Protocol Configuration and Monitoring Reference Volume 2*
- *MAS Using and Configuring Features*

Monitoring Methods

There are a number of ways to monitor and control what is going on with an active 2216 Model 400 or Network Utility. These ways include:

- Typing commands on a local or remote console, to query status and change the state of interfaces and protocols
- Monitoring a running log of event messages, either through the same console or at a server for remote logging
- Using an SNMP-based management product and its applications, to monitor and control interfaces and the functions of the box that have associated SNMP MIB support
- Using an SNMP-based management product to monitor SNMP traps sent by the box to report error conditions
- Using an SNA alert focal point product (such as NetView/390) to monitor SNA alerts sent by the box to report error conditions
- Using an SNA management product (such as NetView/390) to control SNA resources

Command-Line Console Commands

To enter commands to query and change box status, you must first bring up a local or remote console attachment to an active product to access the command-line configuration.

Once you have an active console, you can navigate menus and issue commands to query the status of interfaces and protocols, and to make dynamic operator changes such as:

- Disabling and enabling interfaces
- Recycling connections
- Activating configuration changes

For background information and command details, see the same publications cited in “Command-Line Interface” on page 4-2.

Event Messages

Console commands provide a snapshot of product status, but cannot produce a log or trace of events happening inside the box. For this you use ELS, the Event Logging System. By activating the right ELS messages and monitoring the event log, you can follow in real time such events as:

- Interfaces going through test phases, coming up, and going down
- Packets for a particular protocol being sent and received
- DLC links coming up and going down
- CPU utilization changing in response to network activity
- Higher-level protocol connections (for example, DLSw partner and circuit connections) coming up and going down

To use ELS messages, you first tell the system from the command line which of its thousands of predefined events you want it to report to you. You can specify the set of active messages by subsystem names, individual event number, or severity level.

When you activate ELS messages, you choose one of the following destinations for the messages:

- A rolling log viewable from the command-line interface
- A remote logging server
- An SNMP trap, sent to an SNMP management station

Network Management Products

The 2216 Model 400 and Network Utility support the open standard network management protocol (SNMP), and can be managed using SNMP management applications. IBM's Nways Manager family of products for Windows NT, OS/2, AIX, and HP-UX provide SNMP applications for managing and monitoring the 2216 Model 400 and Network Utility. These applications are packaged as part of:

- Nways Manager for AIX Version 1.2.2
- Nways Manager for HP-UX Version 1.2
- Nways Workgroup Manager for Windows NT Version 1.1.2

These separately purchasable products are custom-designed to provide high-powered graphical management of IBM products and other IBM and non-IBM networking products. For more information on these products, refer to the *Network Utility Installation, Getting Started, and User's Guide*. For the latest information and full details, see: <http://www.networking.ibm.com/netmgt>

In addition to SNMP, the APPN function in the 2216 Model 400 and Network Utility can generate SNA alerts and forward alerts from adjacent SNA nodes. You can use NetView/390 both as an alert focal point and to control SNA network resources attached to a 2216 Model 400 and Network Utility. These functions are summarized in the *Network Utility Installation, Getting Started, and User's Guide*.

2216 Model 400 and Network Utility Firmware

Although it is not one of the main configuration or monitoring methods, the 2216 Model 400 and Network Utility both support a user interface to low-level "firmware" that drives the power-on and boot logic of the system. You access the firmware user interface using ASCII terminal emulation through the system card service port, or dialed into the PCMCIA modem or an external modem. You must boot the product partially to reach the firmware interface.

The firmware interface consists of a set of menus supporting the following types of functions:

- Reading and setting hardware vital product data
- Formatting the hard disk
- Loading new operational code, configurations, or firmware (in case there is a problem with the operational code methods for doing this)
- Setting low-level passwords and boot modes

Chapter 5. Network Planning

This chapter includes sample network diagrams and planning considerations. It includes the following sections:

- “Planning for ESCON and Parallel Channel Connections”
- “Planning for ISDN” on page 5-35
- “Planning for FasTR” on page 5-38
- “Planning for Network Dispatcher” on page 5-39
- “Planning for Web Server Cache” on page 5-40
- “Planning for Thin Server” on page 5-41

Table 5-1 lists support for these functions by model:

<i>Table 5-1. Feature Support</i>		
Function	2216 Model 400	Network Utility
ESCON and Parallel Channel	yes	yes
ISDN	yes	–
FasTR	yes	–
Network Dispatcher	yes	yes
Web Server Cache	yes	–
Thin Server	yes	–

Planning for ESCON and Parallel Channel Connections

Both the 2216 Model 400 and the Network Utility support ESCON and parallel channel attachments.

A channel attachment provides the 2216 Model 400 and Network Utility with a host connection. The 2216 Model 400 and Network Utility each support two channel attachment types: ESCON and parallel. This section describes how to plan for the installation of ESCON Channel Adapters and Parallel Channel Adapters. It includes the following topics:

- “ESCON and Parallel Channel Adapter Functions”
- “Introduction to Host Planning for the 2216 Model 400 and Network Utility” on page 5-7
- “Determining Your System Requirements” on page 5-8
- “Channel Planning Considerations” on page 5-25

The *Multiprotocol Access Services Software User’s Guide* provides details about configuring the host and the 2216 Model 400 or Network Utility for use with the ESCON and Parallel Channel adapters.

ESCON and Parallel Channel Adapter Functions

The ESCON Channel Adapter (FC 2287) and Parallel Channel Adapter (FC 2299) provide the 2216 Model 400 or Network Utility with access to SNA and TCP/IP host applications from LANs, WANs, and ATM. ESCON carries traffic over a duplex-to-duplex multimode fiber-optic cable. A Parallel Channel Adapter attaches via copper cabling to a host channel.

The 2216 Model 400 or Network Utility LAN/WAN Gateway

A 2216 Model 400 or Network Utility with a channel adapter that provides access for LAN-to-host applications is called a *LAN/WAN gateway*.

The 2216 Model 400 or Network Utility LAN gateway gives LAN devices concurrent access to VTAM and TCP/IP programs running on host computers.

Figure 5-1 represents a possible environment consisting of 2216 Model 400s or Network Utilities, hosts, and LAN devices (note that this configuration is only a sample).

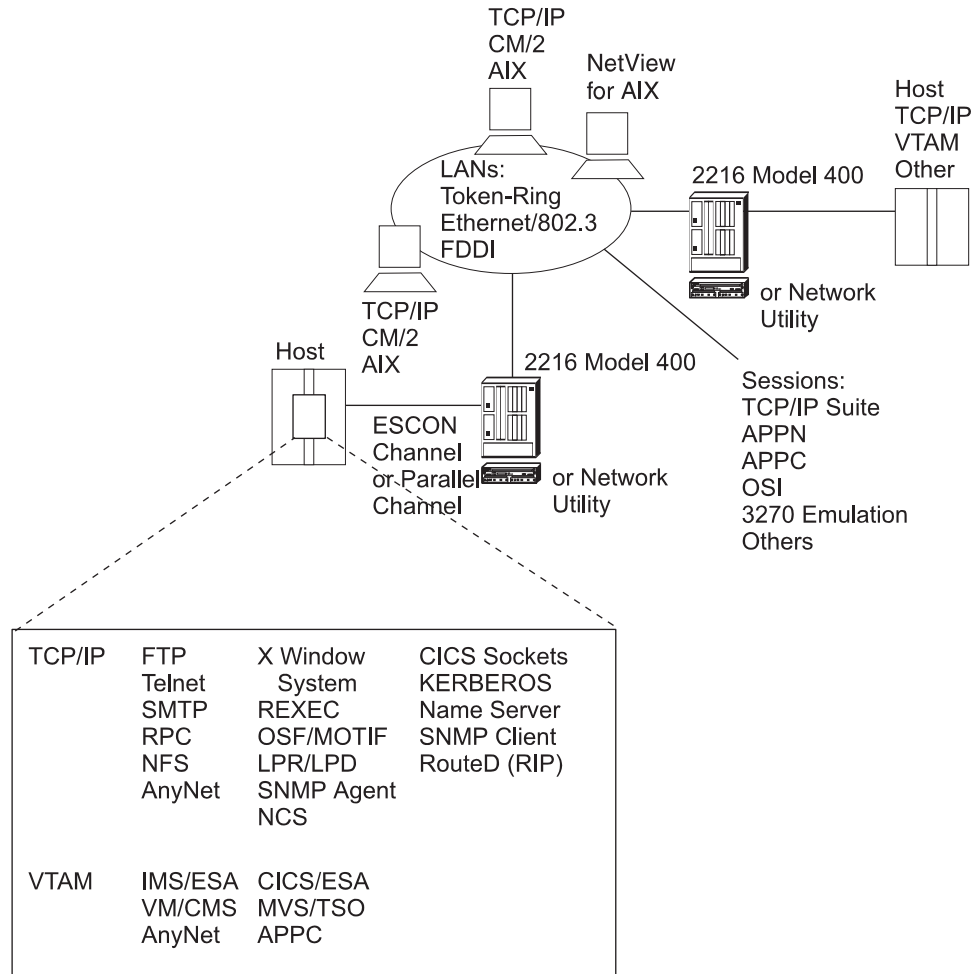


Figure 5-1. Representative Network Containing the 2216 Model 400 or Network Utility

The 2216 Model 400 or Network Utility LAN/WAN gateway with an ESCON Channel Adapter or Parallel Channel Adapter supports the following communications:

- Between a LAN/WAN device and a host, through a 2216 Model 400 or Network Utility (LAN/WAN-to-host)
- From a device on one LAN/WAN to a device on a different LAN/WAN, with host routing support.

See Table 5-3 on page 5-5 for more information on LAN/WAN devices.

In both cases, LAN/WAN-to-channel connections in the 2216 Model 400 or Network Utility are defined as part of the host and 2216 Model 400 or Network Utility configurations. Each host program (using either one subchannel or a pair of subchannels, depending on the host program type) communicates through a LAN/WAN adapter in the 2216 Model 400 or Network Utility.

- The host and LAN/WAN device can each be a TCP/IP client, server, or IP router.
 - Note:** This support is provided by Logical Channel Station (LCS) or MPC+ virtual network handlers in the 2216 Model 400 or Network Utility.
- The host side of an SNA connection can be VTAM (acting as a PU 5), APPN End Node (EN), or Network Node (NN). The remote device (across the LAN/WAN) can be any of the above as well as a PU 2.0 or PU 2.1 device, or it can be a PU 4 with the IBM Network Control Program (NCP) on any of the following devices:
 - IBM 3720
 - IBM 3725
 - IBM 3745
 - APPN on the IBM 3746 Communication Controller.

Both APPN ISR and HPR flows are supported.

Note: This support is provided by Link Services Architecture (LSA) or MPC+ (for APPN) virtual net handlers in the 2216 Model 400 or Network Utility.

Multi-Path Channel+ (MPC+) Support

The 2216 Model 400 or Network Utility provides one level of MPC support, *High Performance Data Transfer (HPDT)*, also referred to as *MPC+*.

Note: IBM host documentation and software refer to MPC+ using different terminology. Table 5-2 shows the differences:

Table 5-2. Differences for MPC+ Terminology Between Host and Router

Host terminology	2216 Model 400 or Network Utility terminology
HPDT MPC	MPC +
HPDT UDP	UDP +

HPDT MPC connections provide more efficient transfer of data than non-HPDT MPC connections.

The 2216 Model 400 or Network Utility Multi-Path Channel support, which is called Multi-Path Channel+ (MPC+), provides more efficient transfer of data by using high-performance data transfer (HPDT) services (in VTAM) to provide data packing without data movement and chain scheduling of programs.

The level of MPC used for an MPC connection is automatically determined by negotiation between the partner nodes.

When MPC+ Is Used

If both partner nodes support MPC+, MPC+ is automatically used.

- The 2216 Model 400 and Network Utility only support MPC+.
- You can control the level used in VTAM by coding the MPCLEVEL operand on the TRLE definition statement that defines the MPC connection. VTAM supports MPC+ if it is defined as an HPR APPN node that provides RTP-level HPR support.

Note: Keep in mind that pre-V4R4 VTAMs do not support MPC+.

When Non-HPDT MPC Is Used

If either partner node does not support MPC+, non-HPDT MPC is automatically used.

The 2216 Model 400 and Network Utility do not support non-HPDT MPC.

MPC+ connections allow you to code a single transmission group (TG) that uses multiple write-direction and read-direction subchannels. Because each subchannel operates in only one direction, the half-duplex turnaround time that occurs with other channel-to-channel connections is reduced. The 2216 Model 400 and Network Utility MPC+ do not allow the subchannels of an MPC+ group to be on more than one physical channel.

If at least one read and one write path are allocated successfully, the MPC+ channel connection is activated. Additional paths (defined but not online) in an MPC+ group can later be dynamically added to the active group using the MVS VARY ONLINE command. For example, if there is a need for an increase in capacity to allow for extra traffic over a channel, additional paths can be added to the active group without disruption. Similarly, paths can be deleted from the active group when no longer needed using the MVS command VARY device OFFLINE.

MPC+ in the 2216 Model 400 and Network Utility supports APPN HPR and TCP/IP. For ESCON, MPC+ also supports HPDT for UDP.

Note: For either channel adapter, the terms *MPC+ Group* and *MPC+ Virtual Interface* mean the same thing.

Channel Function Support in the 2216 Model 400 and Network Utility

Depending on the environment, an 2216 Model 400 or Network Utility with a channel adapter gives host applications access to different types of LANs/WANs. The particular networks supported depend on the communication protocols being used, which host applications they are used with, and which operating systems are supported.

2216 Model 400 software and Network Utility channel code provide support for TCP/IP applications and VTAM applications to LAN/WAN devices including Token-Ring, IEEE 802.3, FDDI, and Ethernet V2.

Table 5-3 on page 5-5 illustrates the 2216 Model 400 and Network Utility connections provided for each host program. The supported environments are grouped by protocol. The table shows the host programs and adapters that provide each protocol support. For each of these host environments, the adapters that can be used are indicated with a Y in the table.

Planning for ESCON and Parallel Channel Connections

Table 5-3. Channel Support for 2216 Model 400 and Network Utility

	TCP/IP ¹ (LCS) Gateway and Bridging	HPDT for UDP MPC+ ⁴	TCP/IP for MPC+ ⁵	VTAM ²			
				SNA (LSA) Gateway	APPN ISR	APPN HPR MPC+ ^{3,6}	DLSw
Token-Ring	Y	Y	Y	Y	Y	Y	Y
Ethernet V2	Y	Y	Y	N	Y	Y	Y
Ethernet 802.3	Y	Y	Y	Y	Y	Y	Y
FDDI	Y	Y	Y	Y	Y	Y	Y
Serial PPP	Y	Y	Y	N	Y	Y	Y
Serial FR: bridged routed	Y	Y	Y	N	Y	Y	Y
	Y	Y	Y	N	Y	Y	N
SDLC	N	N	N	N	Y	N	Y
X.25	Y	Y	Y	N	Y	Y ⁷	Y
ATM LANE	Y	Y	Y	Y	Y	Y	Y
ATM Clas- sical IP	Y	Y	Y	N	N	Y ⁷	Y

Notes:

1. TCP/IP 2.2 or higher. TCP/IP also supports VSE for ESCON channel connections.
2. ESCON support requires an ESA operating system (V3R4 or higher).
3. APPN HPR over MPC+ requires VTAM V4R4 or higher and APPN HPR. VTAM V4R4 requires the following PTFs:

UW36478	UW36159	UW36490	UW36495	UW36245	UW36265	UW36540
UW36537	UW36564	UW36612	UW36614	UW36861	UW37958	UW38105
4. HPDT for UDP is supported for ESCON only. HPDT for UDP over MPC+ requires: VTAM at the level described for APPN in step 3; TCP/IP OpenEdition with APAR/PTF PQ03737; and OS/390 APAR OW31305.
5. TCP/IP for MPC+ requires: VTAM at the level described for APPN in step 3 with the addition of APAR/PTF OW26845 and TCP/IP OpenEdition with APAR/PTF OW04890.
6. HPR over LSA requires: VTAM APAR number OW26732. It is supported on VTAM V4R4 or higher. Native HPR over ATM is also supported
7. When using Enterprise Extender

Planning for ESCON and Parallel Channel Connections

Channel and Network Connections: The following ESCON channel connections are supported:

- ES/3090J Processor (selected models)
- 9021 ES/9000 Processor
- 9121 ES/9000 Processor
- 9221 ES/9000 Processor
- 9032 and 9033 ESCON Directors
- 9036 ESCON Remote Channel Extender
- 9672 System/390 Parallel Enterprise Server
- 9729 Optical Wavelength Division Multiplexor
- 2003 System/390 Multiprise 2000

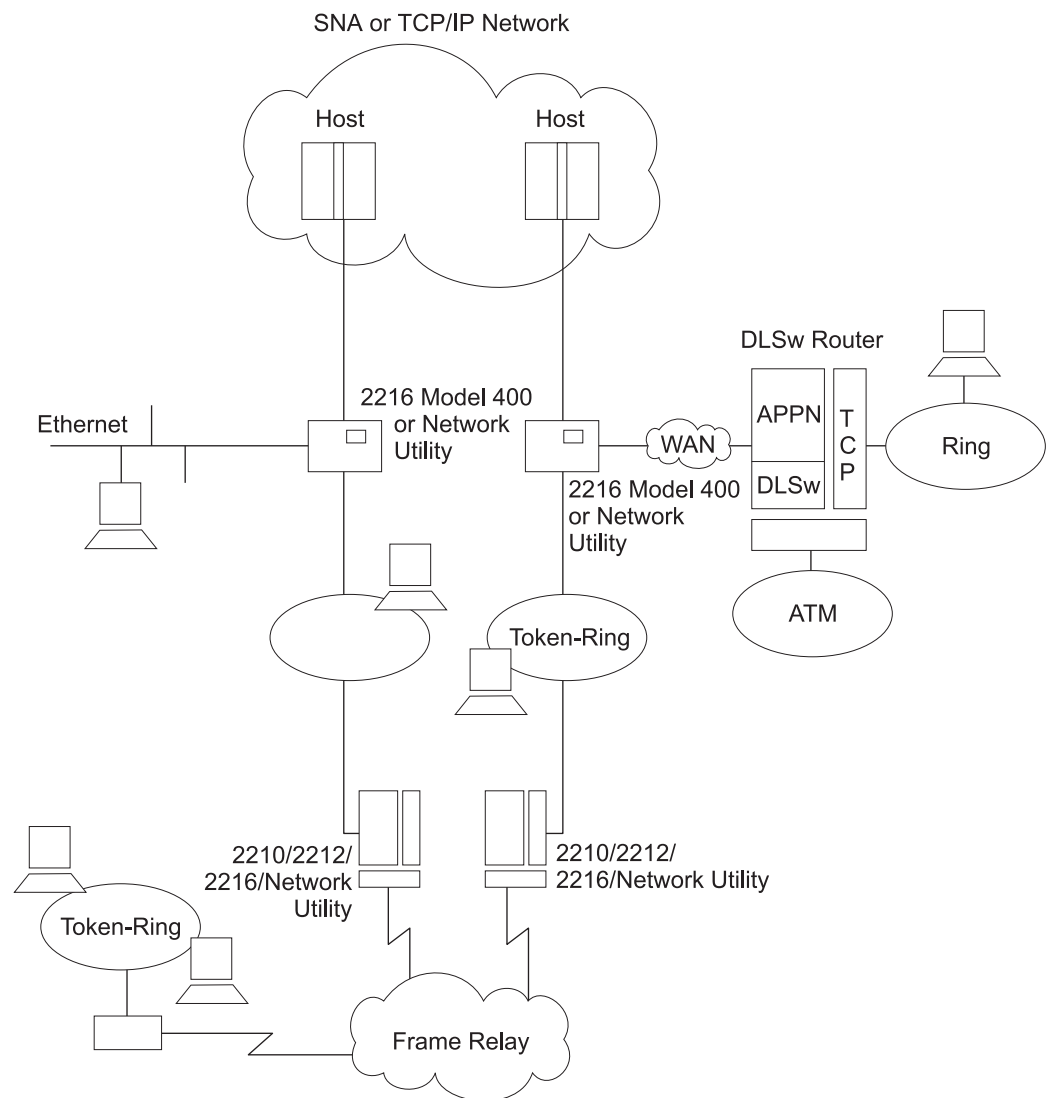
The following parallel channel connections are supported:

- ES/3090
- 308x and 309x processor series
- ES/9021
- ES/9121
- ES/9221
- 3044 Fiber-Optic Channel Extender Link Models C02 and D02
- ESCON Converter Model 1 (9034)

Introduction to Host Planning for the 2216 Model 400 and Network Utility

Table 5-3 on page 5-5 summarizes the protocols, channels, and networks supported by the 2216 Model 400 and Network Utility with an ESCON or Parallel Channel Adapter. The SNMP Client gathers management information for both interfaces. Additional management information for ESCON is provided via the ESCON MIB.

The 2216 Model 400 and Network Utility offer a solution for customers with traditional hierarchical (host-centric) networks as well as those customers who are migrating to flat (network-centric) networks. Figure 5-2 illustrates the latter, showing a local LAN and remote LAN gaining access to an existing hierarchical network (depicted by the cloud) through a 2216 Model 400 or Network Utility with an ESCON Channel Adapter or Parallel Channel Adapter.



- All workstations can talk to all hosts.
- All workstations can talk to each other.

Figure 5-2. 2216 Model 400 and Network Utility with ESCON or Parallel Channel in a Network

Determining Your System Requirements

To help you determine the number of 2216 Model 400 or Network Utility machines that you require, consider:

- What channel support is required?
- How many hosts, host programs, and users do you need to support?
- How many physical channel and LAN connections do you need to make?
- How many LAN/WAN gateway connections do you need to define?
- How can you achieve high 2216 Model 400 or Network Utility availability and hardware backup?
- How many logical host images will require connection to the unit?

The following sections provide information to help you determine how many 2216 Model 400s or Network Utilities you need.

Channel Support

This section describes the characteristics of host channel support to help you understand how your host connection choices affect your 2216 Model 400 or Network Utility needs.

Parallel Channel Characteristics and Configuration Examples

The 2216 Model 400 or Network Utility with a Parallel Channel Adapter provides the following support:

- Data streaming at 3.0 or 4.5 MB per second.
- Direct-Coupled Interlock (DCI).
- Extension of the parallel channel up to an additional 3 km (1.86 mi) with optical fiber using either of two channel extenders: the 9034 Enterprise Systems Connection Converter or the 3044 Fiber-Optic Channel Extender Link Models C02 and D02.
- Attachment of a parallel channel device to a dedicated ESCON channel through the ESCON Converter (9034 Enterprise Systems Connection Converter).
- Up to 32 subchannels to the connected host per Parallel Channel Adapter and up to 16 associated virtual network handlers.
- The 2216 Model 400 supports up to four Channel Adapters in any combination of parallel and ESCON. The Network Utility supports up to two.
- A host channel can support up to six 2216 Model 400 or Network Utility Parallel Channel Adapters.

The following example illustrates the various parallel channel configurations:

- Multiple attachments between an S/370 or S/390 processor and a 2216 Model 400 or Network Utility
- Single attachment using the 3044 Fiber-Optic Channel Extender Link Models C02 and D02
- Attachment to ESCON using the ESCON Converter (9034 Enterprise Systems Connection Converter)

Planning for ESCON and Parallel Channel Connections

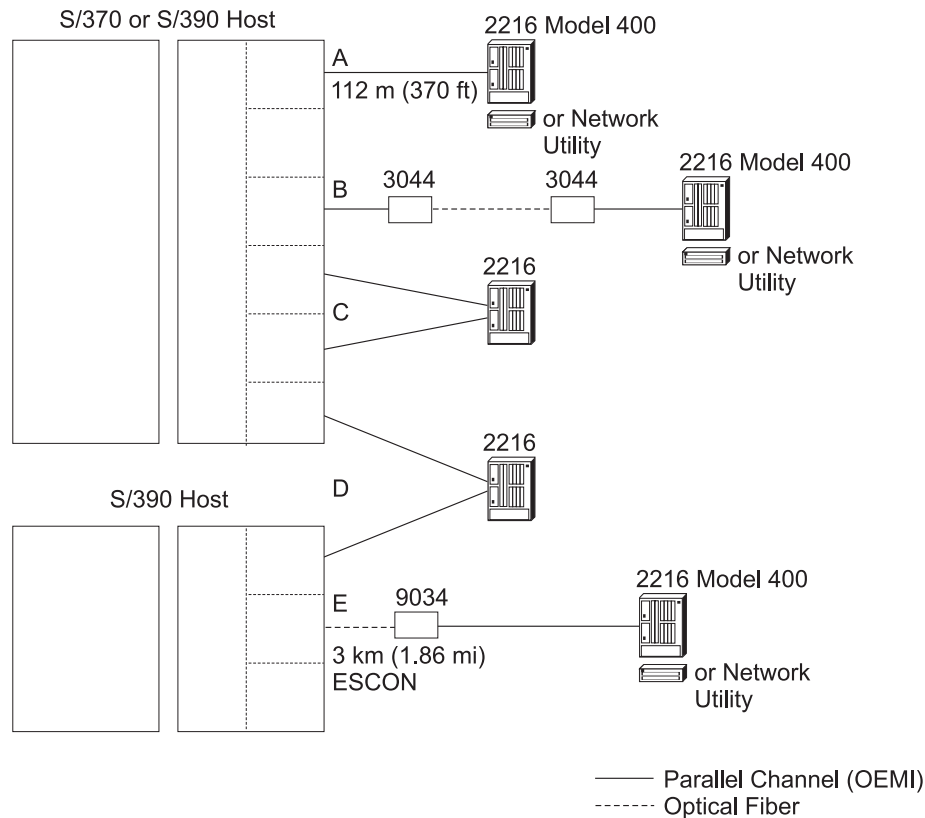


Figure 5-3. 2216 Model 400 and Network Utility Parallel Channel Attachment Examples

Single Attachment between an S/370 or S/390 Processor and a 2216 Model 400 or Network Utility: In Figure 5-3, connection A consists of a 2216 Model 400 or Network Utility with one Parallel Channel Adapter and an S/370 or S/390 host. The protocol is based on the IBM 3088 Channel-to-Channel (CTC) protocol. The router appears to host systems as an IBM 3088 Multisystem Channel Communications Unit. The maximum distance between the host and the router is 122m (400 ft). With multiple parallel channel adapters, the distance will be less. For more information, see Table 5-5 on page 5-31.

Single Attachment Using the IBM 3044 Fiber-Optic Channel Extender Link Models C02 and D02: Connection B enables the parallel channel to be extended to a maximum of 3 km (1.86 mi) using the 3044 Fiber-Optic Channel Extender Link Models C02 and D02.

The 2216 Model 400 and Network Utility support connection to the 3044 Fiber-Optic Channel Extender Link Models C02 and D02.

Multiple Attachments of up to Four Hosts or Four Logical Partitions (LPs): Connections C and D illustrate a subset of the "four connections" rule. C and D illustrate a 2216 Model 400 with two Parallel Channel Adapters where each adapter can be connected to the same host, to two different hosts, or to two LPs in a host. The maximum distance between the host and the 3172 is 112m (370 ft), adjusted according to the number of adapters on the channel. For more information, see Table 5-5 on page 5-31.

Attachment to ESCON Using the IBM ESCON Converter: Connection E enables the attachment of a Parallel Channel Adapter and 2216 Model 400 or Network Utility to an ESCON channel on the host using the ESCON Converter (9034 Enterprise Systems Connection Converter). In this configuration, the ESCON channel must be dedicated to the converter connection. No other ESCON control units may be attached. The ESCON Converter can be located a maximum of 3 km (1.86 mi) from the host.

ESCON Channel Characteristics and Configuration Examples

The 2216 Model 400 or Network Utility with an ESCON adapter provides the following support:

- Up to 32 logical paths (ESCON subchannels) per 2216 Model 400 or Network Utility ESCON Channel Adapter to the connected hosts. These logical paths can be defined to the same ESCON channel or divided among multiple ESCON channels.
- EMIF support for sharing ESCON channels for connection to multiple host images in LP-capable hosts. This support can be used with the IBM ESCON Directors connecting to multiple hosts, or for direct connection to a single host processor.
- Up to two IBM 9032 or 9033 ESCON Directors (ESCDs) in the path between the ESCON Channel Adapter and the host.
- Distances of up to 43 km (26.7 miles) using the ESCON Extended Distance Feature (XDF) available on host processors, ESCDs, and ESCON Remote Channel Extenders.

The following examples illustrate various ESCON configurations:

- Single and direct attachment between a S/370 or S/390 processor and 2216 Model 400s or Network Utility units.
See Figure 5-4 on page 5-11.
- Multiple systems attachment with ESCDs
See Figure 5-5 on page 5-12.
- EMIF attachment between an S/370 or S/390 processor and 2216 Model 400 or Network Utility units
See Figure 5-6 on page 5-13.

Direct Attachment Between an S/390 Host and a 2216 Model 400 or Network Utility: In Figure 5-4, connection A shows a 2216 Model 400 or Network Utility directly attached to a S/390 host channel. The separation of the host and the 2216 Model 400 or Network Utility can be up to 3 km (1.86 miles).

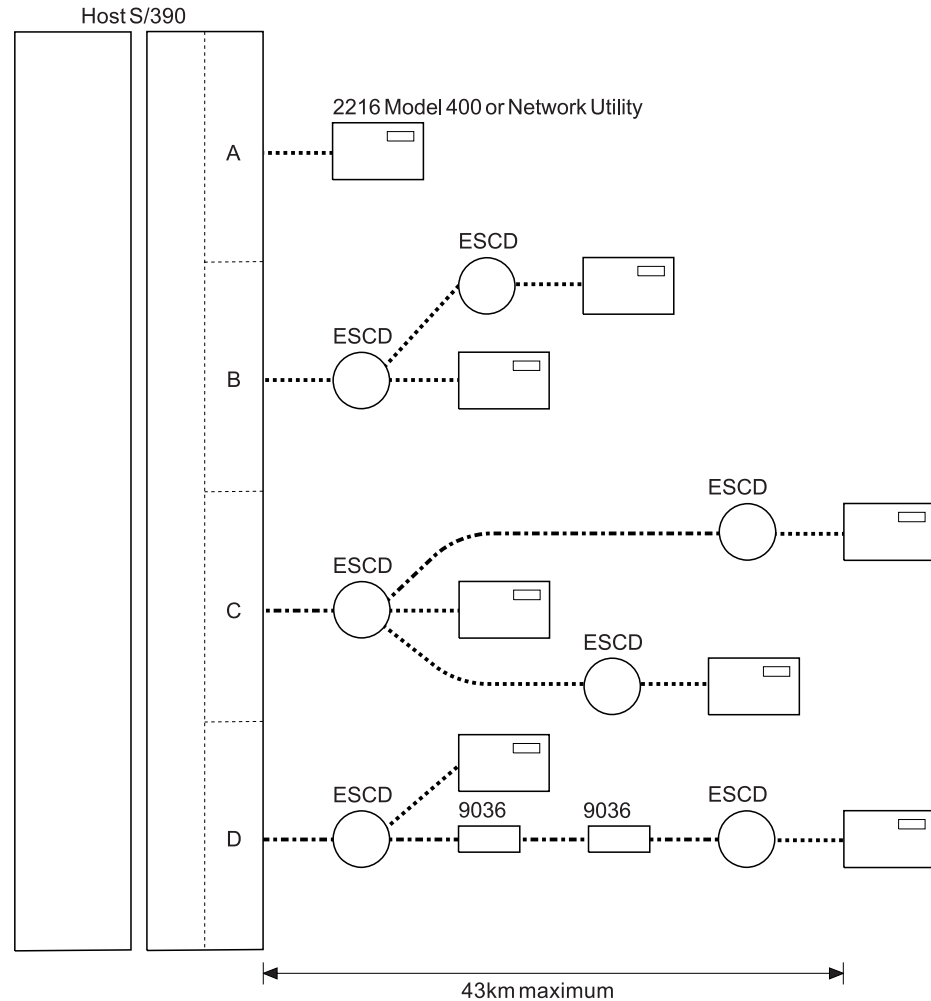
Single Attachment Between a S/390 Processor and a 2216 Model 400 or Network Utility: Connections A, B, C, and D show 2216 Model 400 or Network Utility units attached to a single host.

The maximum distance between the S/390 host and 2216 Model 400 or Network Utility can vary from 3 km (1.86 miles) to 43 km (26.7 miles). For connection A, a maximum distance of 3 km (1.86 miles) can be achieved without ESCDs between the host and 2216 Model 400 or Network Utility. For connection B, a maximum distance of 9 km can be achieved with two ESCDs connected with multimode fiber. As

Planning for ESCON and Parallel Channel Connections

shown in connections C and D, distances of up to 43 km can be achieved by using 9032 or 9033 ESCDs with the XDF or a combination of ESCDs and 9036 Remote Channel Extenders. The host must also have the XDF.

When two ESCON Directors are serially attached, the connection through one of the directors must be dedicated.



- ☐ 2216 Model 400 or Network Utility with an ESCON Channel Adapter
- ESCON Director (ESCD) (9032/9033)
- ▭ ESCON Remote Channel Extender (9036)
- ⋯ Multi-mode ESCON Channel (3km maximum)
- XDF Single-mode ESCON Channel (20km maximum)

Figure 5-4. Single System ESCON Connection Example

Multiple Systems Attachment with ESCDs: Figure 5-5 shows the connection of multiple S/390 hosts to single and multiple 2216 Model 400 or Network Utility units, with possible backup paths. A fault-tolerant solution can be designed using backup channels, multiple ESCDs, or multiple 2216 Model 400 or Network Utility units.

For additional information, see “2216 Model 400 and Network Utility Availability and Backup” on page 5-19.

Planning for ESCON and Parallel Channel Connections

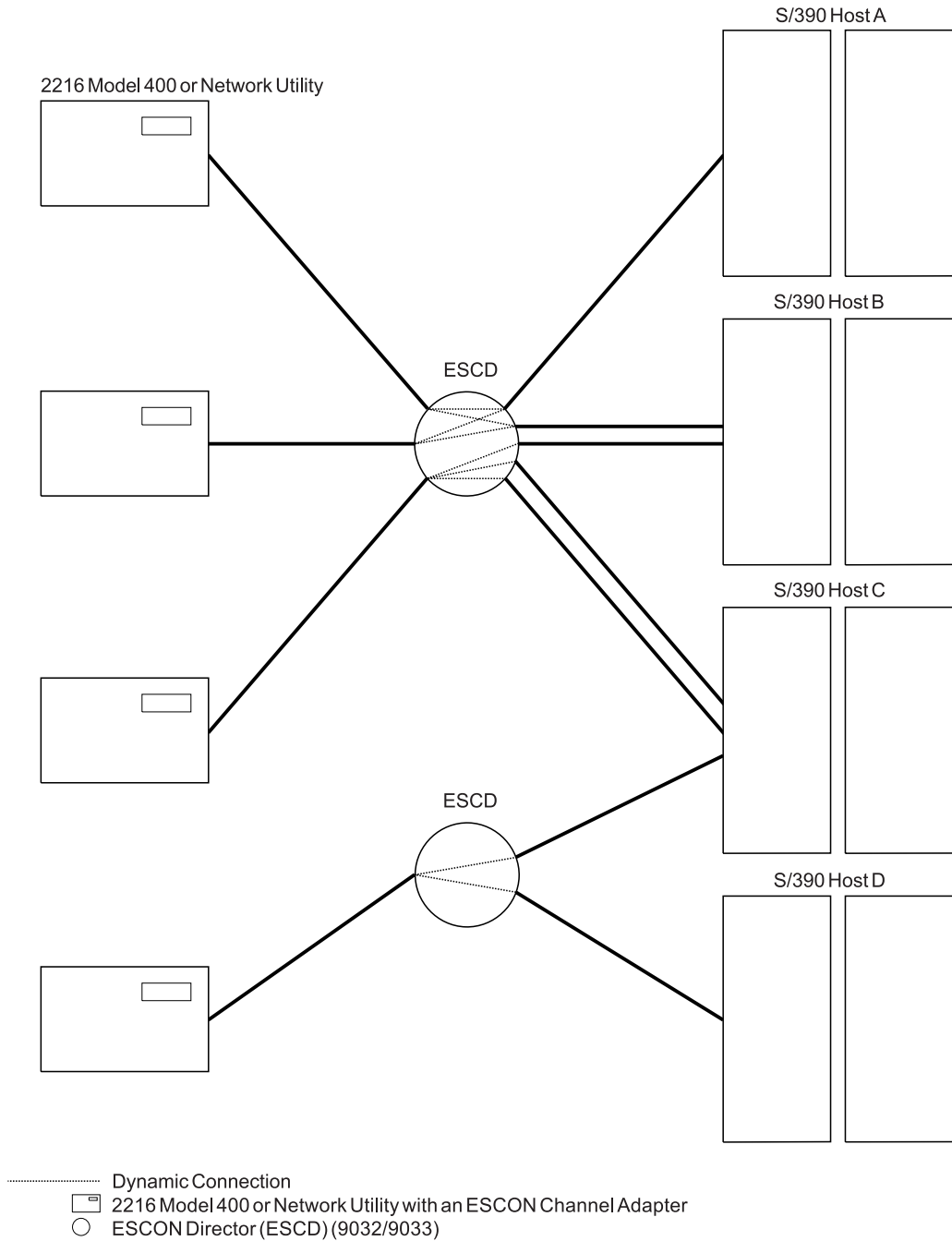


Figure 5-5. Multiple System ESCON Connections Example

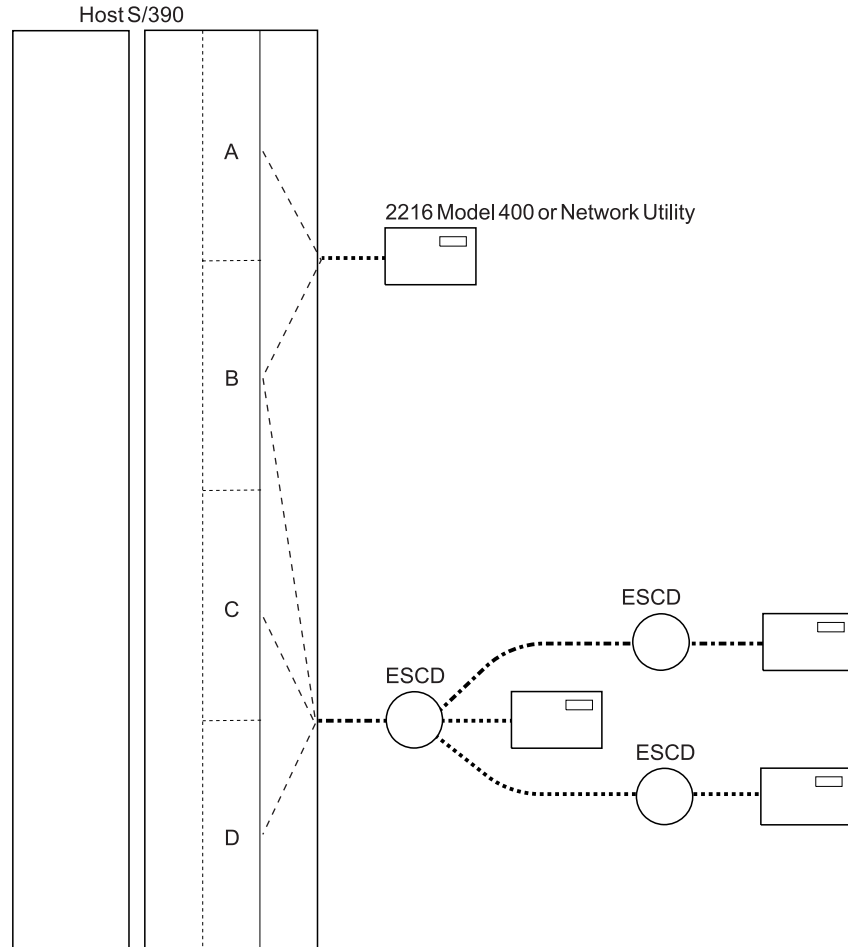
EMIF Attachment Between an ES/9000 Processor and a 2216 Model 400 or Network Utility: The ESCON Multiple Image Facility (EMIF) allows the sharing of ESCON channels across Processor Resource/Systems Manager (PR/SM) logical partitions (LPs). Prior to EMIF, dedicated channels to each logical partition were required.

EMIF is supported on all ES/9000 Model 511/711-based processors, and on the Model 520-based processors.

Planning for ESCON and Parallel Channel Connections

The 2216 Model 400 or Network Utility ESCON Channel Adapter supports EMIF connectivity. This connection can be either direct host attachment or through an ESCD, and the logical hosts can be on the same or different physical hosts.

Figure 5-6 shows 2216 Model 400 or Network Utility connectivity to an LP host. Logical hosts A and B are connected directly to the 2216 Model 400 or Network Utility. Logical hosts B, C, and D are connected to multiple 2216 Model 400 or Network Utility units with a single ESCON connection from the ESCON Director. Each of these 2216 Model 400 or Network Utility units can be connected to logical hosts B, C, and D.



- ☐ 2216 Model 400 or Network Utility with an ESCON Channel Adapter
- ESCON Director (ESCD) (9032/9033)

Figure 5-6. 2216 Model 400 or Network Utility EMIF Attachment Example

Number of Hosts and Host Programs

Your channel and LAN/WAN choices affect the number of hosts and host programs that each 2216 Model 400 or Network Utility can support. Also, your host program choice affects the number of users who can be supported by each 2216 Model 400 or Network Utility.

Number of Hosts: The number of hosts you can configure (in the case of ESCON, this may be extended to the number of logical partitions in a single host) to use with one 2216 Model 400 or Network Utility is influenced by several factors.

For parallel channel attachments, there must be at least one channel from the 2216 Model 400 or Network Utility for each host or LP.

For ESCON and Parallel Channel attachments, the 2216 Model 400 or Network Utility must have at least:

- One LSA subchannel for each host (for ESCON this may also be one logical partition) running VTAM programs that are not using MPC+
- One LCS interface (two subchannels) for each host (for ESCON this may also be one logical partition) connecting to TCP/IP using LCS
- Two subchannels for each host (for ESCON this may also be one logical partition) that will be communicating with the 2216 Model 400 or Network Utility using MPC+

Refer to “Limits for 2216 Model 400 or Network Utility ESCON and Parallel Channel Network Interfaces and Subchannels” on page 5-15 for more information about the limits mentioned here.

Number of Host Programs: The number of host programs that can run using a 2216 Model 400 or Network Utility is less restrictive than the number of hosts that can use a 2216 Model 400 or Network Utility. This allows you to run more than one VTAM or TCP/IP host program on the same host (or in the same logical partition) using the same 2216 Model 400 or Network Utility.

For host programs that need to access a 2216 Model 400 or Network Utility, the 2216 Model 400 or Network Utility must have at least:

- One subchannel (or subchannel pair) for each host program instance
- One LCS interface for each TCP/IP program using an LCS interface.

Be aware that multiple VTAMs can share an LSA interface. If more than one VTAM needs to use the same LSA interface, each VTAM needs to open a different SAP.

Refer to “Limits for 2216 Model 400 or Network Utility ESCON and Parallel Channel Network Interfaces and Subchannels” on page 5-15 for more information about the limits mentioned here.

Limits for 2216 Model 400 or Network Utility ESCON and Parallel Channel Network Interfaces and Subchannels

Subchannels will be associated with network interfaces when you configure the 2216 Model 400 or Network Utility with either channel adapter.

The following rules govern the network interfaces:

1. Up to 16 interfaces can be configured per ESCON adapter.
2. Up to 32 subchannels can be configured per adapter.
3. One LCS interface is required for each host (for ESCON this may be a logical partition) connecting to TCP/IP with the LCS interface.
4. One or more subchannels are used for each VTAM host LAN/WAN gateway (LSA).
5. Two or more subchannels are required for each MPC+ interface.
6. Up to four channel adapters are supported in the 2216 Model 400 in any combination of ESCON channel adapters and Parallel Channel adapters. For the Network Utility, up to two channel adapters are supported.
7. Up to six Parallel Channel Adapters are configurable per host channel.
8. Single or multiple 2216 Model 400, Network Utility, and 3172 units attaching via parallel channel must be physically located at the end of a channel with no other machine types downstream.
Note: However, if a Parallel Channel adapter is configured for data streaming at 3.0 MB per second, the 2216 Model 400 or Network Utility in which that adapter is seated can be located anywhere on the channel. (Remember that the adapter is not the only device that would need to be configured for 3.0 MB data streaming: all devices on a channel must be configured for the same channel speed).
9. Maximum instantaneous data rate of 4.5 MB per second is supported for the Parallel Channel Adapter when data streaming on a 400 ft (122 m) cable.
10. The parallel channel-attached 2216 Model 400 or Network Utility can be extended using the 3044 Fiber-Optic Channel Extender Link Models C02 and D02 or 9034 Enterprise Systems Connection Converter extender products. However, only one parallel-channel-attached device of any type (2216 Model 400, Network Utility, 3172, or other) that attaches via twisted pair connection cables can be extended per channel using a 3044 or 9034 device.
11. UDP+ is not supported on the Parallel Channel Adapter.
12. EMIF provides attachment to multiple host images in LP-capable processors using a single host ESCON port. Attachment to multiple hosts including LP hosts is provided using an IBM 9032 or 9033 ESCON Director.
13. VTAM (LSA) interfaces must be defined as either SNA gateway (TR, EN, FDDI, ATM LANE) or loopback (APPN or DLSw). Gateway LSA interfaces are associated with a specific LAN or LANE interface. LSA loopback interfaces can be used for both APPN (with ISR and HPR) and DLSw. An LSA interface cannot be both loopback and SNA gateway.
14. Each LCS interface must have a unique subnet address.
15. Each MPC+ interface (also known as an MPC+ group) must have at least two subchannels, one for reading and one for writing. If VTAM has the subchannel

Planning for ESCON and Parallel Channel Connections

configured as “read,” then the MPC+ group in the 2216 Model 400 or Network Utility must have the subchannel configured as “write.”

16. MPC+ groups cannot share subchannels with other MPC+ groups.
17. If the MPC+ Group is going to be used for UDP+, it must be coded for the exclusive use of that protocol. The MPC+ Group cannot be shared with APPN or TCP/IP. Note that UDP+ is available for ESCON only.
18. Each LSA interface can support up to 10 240 LLC link stations per SAP. An LSA interface can support multiple SAPs.

Sample Illustration of the Rules for LCS and LSA Subchannels: Figure 5-7 illustrates valid uses of subchannels by LAN adapters, according to these rules, for LCS and LSA¹.

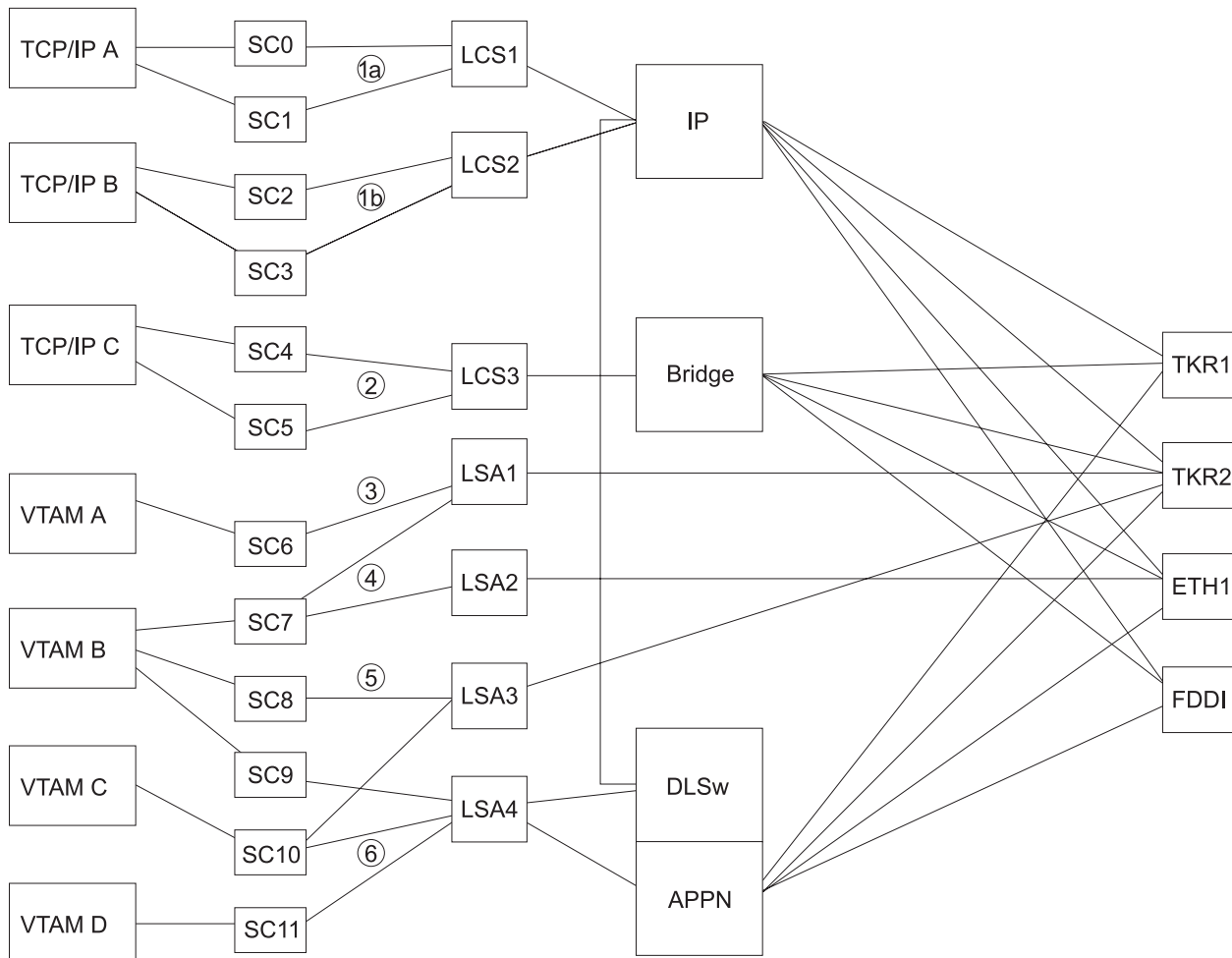


Figure 5-7. Rules for LAN/WAN Gateway Definitions for LCS and LSA Subchannels

- 1a** LCS interface 1 uses subchannels 0 and 1 and provides access to all LAN interfaces for TCP/IP host A.

¹ Support for multiple host programs may require the use of EMIF, an ESCON director, or multiple channel adapters.

Planning for ESCON and Parallel Channel Connections

- 1b** LCS interface 2 uses subchannels 2 and 3 and provides access to all LAN interfaces for TCP/IP host B.
- 2** LCS interface 3 uses subchannels 4 and 5 and provides access to all LAN interfaces for TCP/IP host C.
- 3** LSA interface 1 uses subchannels 6 and 7 and provides access to TKR2 for VTAM hosts A and B, respectively.
- 4** LSA interface 2 uses subchannel 7 and provides access to ETH1 for VTAM host B.
- 5** LSA interface 3 uses subchannels 8 and 10 and provides access to TKR2 for VTAM hosts B and C.
- 6** LSA interface 4 uses subchannels 9, 10, and 11 and provides APPN ISR and DLSw access to all LAN interfaces for VTAM hosts B, C, and D, respectively.

Sample Illustration of the Rules for MPC+ Subchannels: Figure 5-8 on page 5-18 illustrates valid uses of subchannels for MPC+.

Planning for ESCON and Parallel Channel Connections

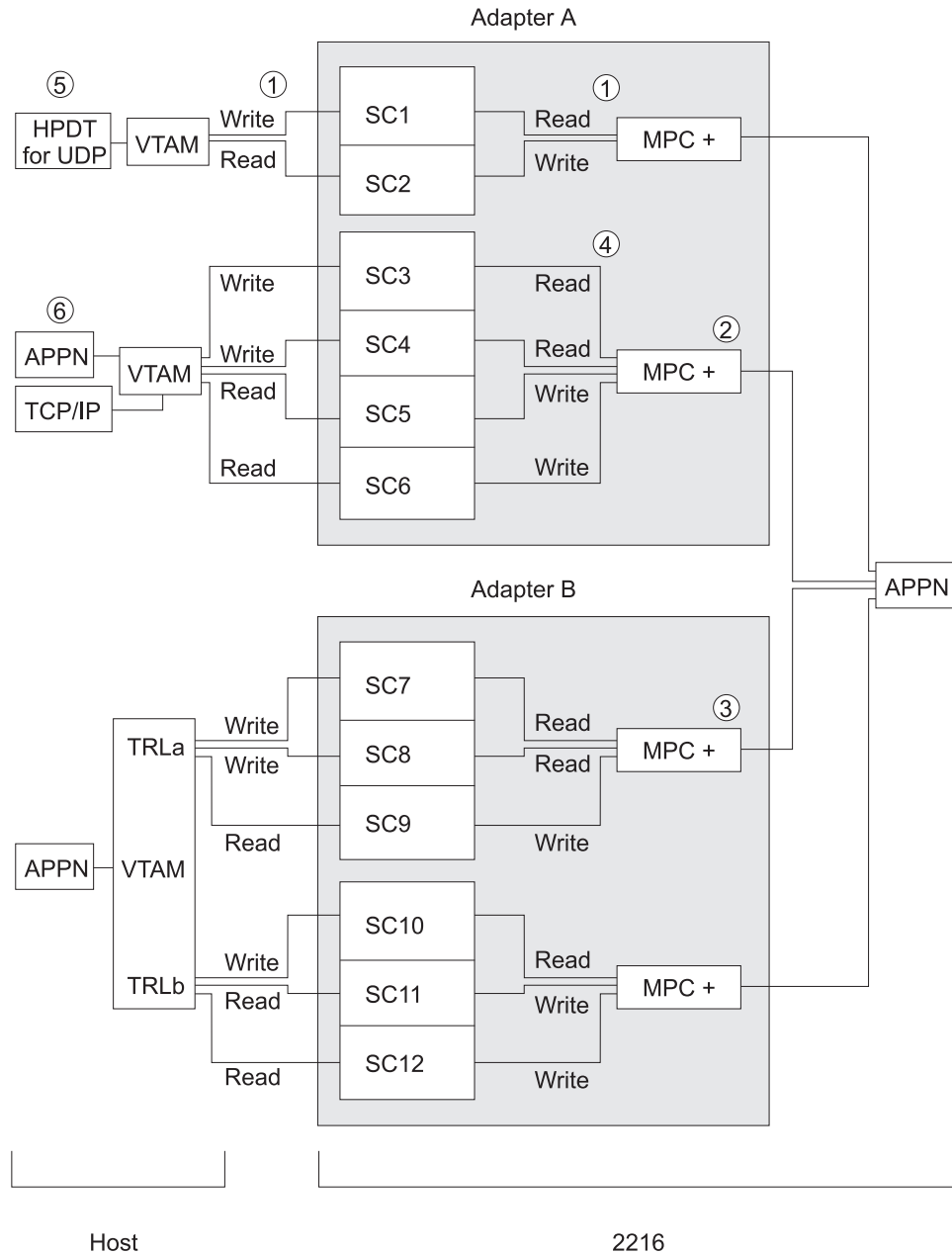


Figure 5-8. Rules for Definitions for MPC+

- 1 A subchannel that is configured as a “write” subchannel in VTAM is a “read” subchannel in the 2216 Model 400 or Network Utility configuration.
- 2 There can be multiple MPC+ Groups on the same channel adapter.
- 3 Parallel MPC+ groups are supported but each must be placed in a separate TRL entry in the VTAM definition.
- 4 Although you must have at least two subchannels (one read and one write) you can have more if there is at least one read subchannel and one write subchannel.
- 5 UDP+ cannot share its MPC+ Group with other protocols. Note that HPDT for UDP is available for ESCON only.

- 6 Define UDP+ as a separate group. Otherwise, an MPC+ Group can be shared by multiple protocols.

2216 Model 400 and Network Utility Availability and Backup

In an environment where high availability is required, redundant 2216 Model 400 or Network Utility units can be used for backup.

LCS, LSA, and IP over MPC+ Examples:

Note: The examples in this section illustrate 2216 Model 400 backup scenarios, but the same scenarios apply for Network Utility.

To recover from host failures, a secondary host and a path to that host are required. In Figure 5-9, if Host A fails, users have access to Host B through 2216B. When Host A recovers, user access to Host A can be restored. This is just one example of recovering from a host failure. For host failures, other factors should also be considered, such as availability of applications and data on the secondary host.

To recover from 2216 Model 400 or Network Utility failures, a second 2216 Model 400 or Network Utility must be in the path to your hosts. In Figure 5-9, when 2216A fails, users of Host A could be rerouted through 2216B, because there are two paths to Host A. When 2216A recovers, users of Host A could be rerouted back through 2216A. There is only one path to Host B; and if 2216B fails, users will not be able to access Host B. This could be resolved by connecting and configuring Host B to 2216A. When 2216B recovers, user access to Host B could be restored. Again, other variations of this example could be employed to recover from 2216 Model 400 or Network Utility failure.

The backup configuration in Figure 5-9 on page 5-20 is designed as follows:

- Host A has access to LAN Segment A through 2216A, and to LAN Segment B through 2216B or 2216A.
- Host B has access to LAN Segment A and to LAN Segment B through 2216B.
- The node address for 2216A and 2216B is the same address. The node addresses can be different for TCP/IP, but not for SNA.
- The IP addresses for 2216A and 2216B are the same address.
- LAN Segment A and LAN Segment B are connected by a bridge or router.

For TCP/IP, a router cannot be used. Using a router would, by design, require the IP addresses for 2216A and 2216B to be different. The IP addresses for the 2216s (or for two Network Utility units) must be the same so that the LAN devices can rediscover the route to the secondary router.

Figure 5-9 on page 5-20 and Figure 5-10 on page 5-21 show sample Token-Ring LAN segments, but the same principles apply to all the LAN types supported by the 2216 Model 400 or Network Utility.

Planning for ESCON and Parallel Channel Connections

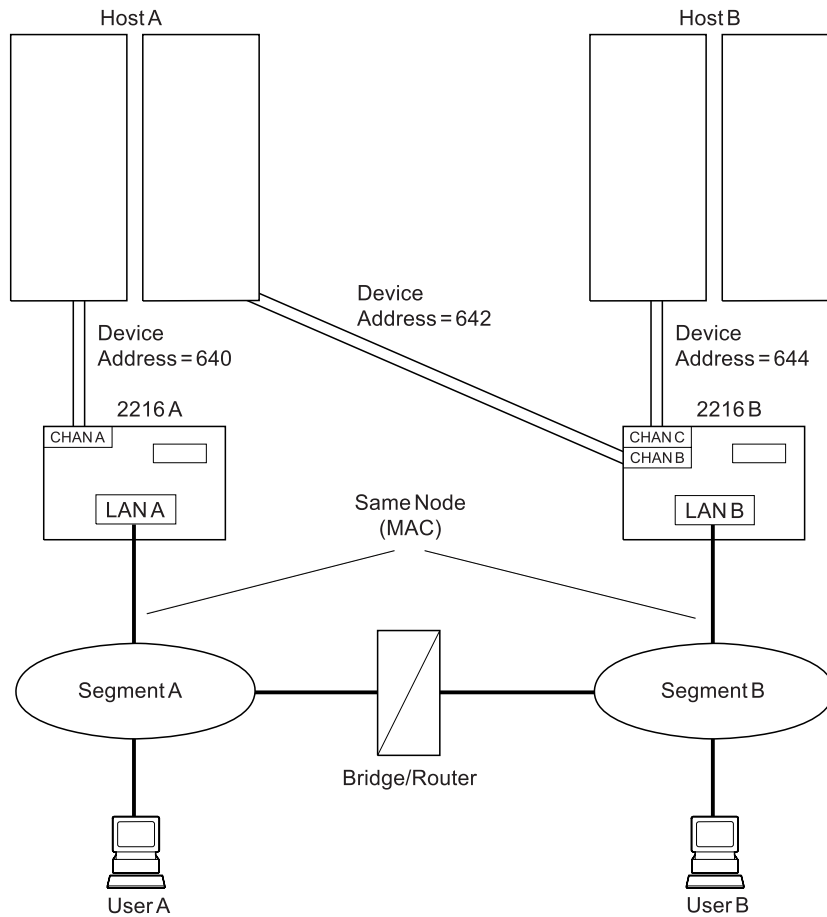


Figure 5-9. 2216 Model 400 or Network Utility and Host Backup Using Two LAN Segments

Figure 5-10 provides the same host and 2216 Model 400 or Network Utility backup as Figure 5-9 on page 5-20, except that:

- 2216A and 2216B are connected to the same LAN segment.
- The primary 2216 Model 400 or Network Utility must finish IPL before the secondary 2216 Model 400 or Network Utility is restarted. Then the secondary LAN adapter will not become active on the LAN because the node addresses are the same.

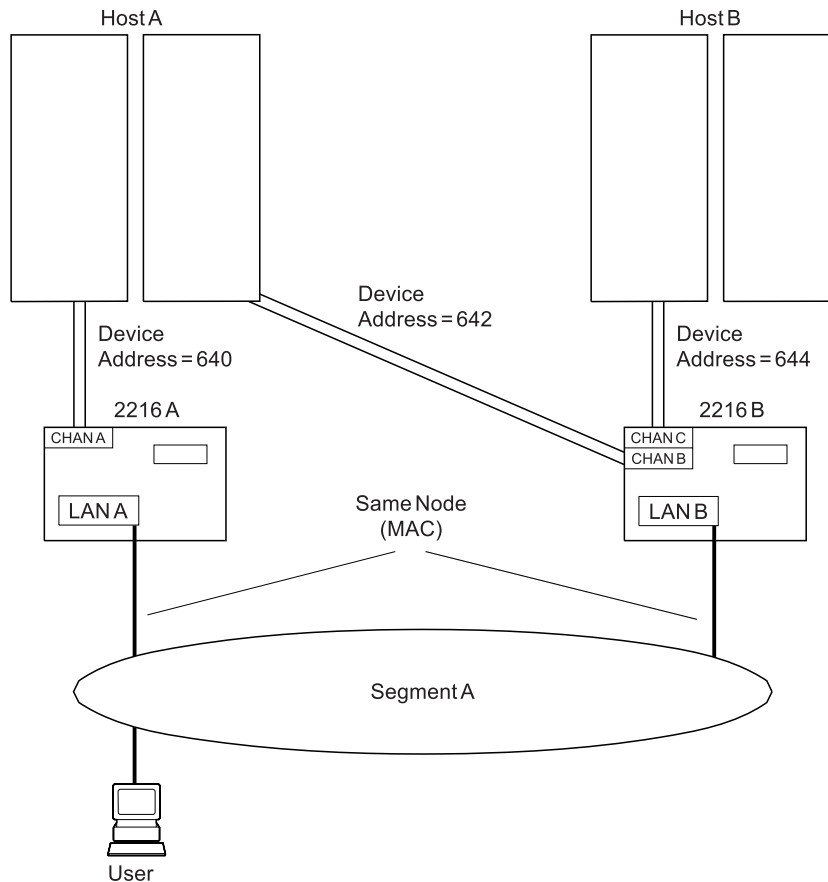


Figure 5-10. 2216 Model 400 or Network Utility and Host Backup Using One LAN Segment

Increasing Availability in VTAM Environments

Note: Examples of 2216 Model 400 backups in this section also apply to Network Utility.

To demonstrate backup in the VTAM environment using the system in Figure 5-9 on page 5-20, assume that both routers and hosts are operational and that 2216A and Host A are being used as the primary system. Only the XCA major node for 2216A is active.

If 2216A fails:

1. From Host A, deactivate the XCA major node for 2216A.
2. From Host A, activate the XCA major node for 2216B.
3. Host A users experience a temporary session loss, but connect through 2216B using the same node address.

If Host A fails:

1. 2216A detects the inactive host.
2. From Host B, activate the XCA major node for 2216B.
3. Host A users experience a temporary session loss, but connect to Host B through 2216B using the same node address.

In both cases, after the failure is corrected, sessions can be moved from 2216B to 2216A in a similar manner.

Planning for ESCON and Parallel Channel Connections

To demonstrate backup in the VTAM environment using the system in Figure 5-10 on page 5-21, assume that both hosts and both 2216s are operational, and that host A and 2216A are being used as the primary system.

If 2216A fails:

1. From 2216A, issue a 2216 command to remove 2216A from the LAN (stop the LAN-A adapter).
2. From 2216B, issue a 2216 command to attach 2216B to the LAN (start the LAN-B adapter).
3. From host A, activate the XCA major node for 2216B.
4. Host A users experience a temporary session loss, but reconnect through 2216B using the same node address.

If Host A fails:

1. From 2216A, issue a 2216 command to remove 2216B from the LAN (stop the LAN-A adapter).
2. From 2216B, issue a 2216 command to attach 2216B to the LAN (start the LAN-B adapter).
3. From Host B, activate the XCA major node for 2216B.
4. Host A users experience a temporary session loss, but connect to Host B through 2216B using the same node address.

In both cases, after the failure is corrected, sessions can be moved from 2216B to 2216A in a similar manner.

Increasing Availability in a TCP/IP Environment

Note: Examples of 2216 Model 400 backups in this section also apply to Network Utility.

To demonstrate backup in a TCP/IP environment using the system in Figure 5-9 on page 5-20, assume that both routers and hosts are operational and that 2216A and host A are being used as the primary system.

The TCP/IP Profile data set in the host includes the following statements:

Note: The default name for the TCP/IP profile data set is TCPIP.PROFILE.TCPIP for MVS and PROFILE TCPIP for VM.

- DEVICE statements for both 2216s attached to host A (subchannels 640 and 642)
- LINK statements for the LAN adapters in both 2216s
- A HOME statement only for the LAN-A adapter
- A GATEWAY statement for your routing table that includes the LAN-A adapter
- A START statement for the device using the LAN-A adapter.

If 2216A fails, the OBEYFILE command can be executed from host A to give users access to host A through 2216B. You will need to issue a PING command to one device **after** the obey file has been used. You will need an obey file that contains:

- A STOP statement for the LAN-A adapter

The STOP statement deactivates **all** LAN adapters that are associated with that device. Therefore, if another LAN adapter was defined in 2216A for device 640, a STOP for device 640 would stop both the LAN-A adapter and the other adapter. Depending on the type of failure, you may have to stop the LAN-A adapter using a 2216 command and execute the OBEYFILE command again.

- A HOME statement for the LAN-B adapter with the same IP address as that used for the LAN-A adapter
- A GATEWAY statement for your routing table that includes the LAN-B adapter
- A START statement for the device using the LAN-B adapter.

A similar obey file can be used to restore user access to host A when it recovers.

These steps can also be followed using the system in Figure 5-10 on page 5-21.

TCP/IP host backup is not illustrated in Figure 5-9 on page 5-20 or Figure 5-10 on page 5-21. Because each TCP/IP host requires its own LAN adapter, you will not be able to recover from TCP/IP host failures as you can with VTAM hosts. You can, however, add a LAN adapter to either 2216 Model 400 (or both if you want a backup for both hosts) and define a connection between the host and LAN adapters.

- These new adapters will not have the same node (or MAC) address as the adapters for your primary hosts (shown in Figure 5-9 on page 5-20 and Figure 5-10 on page 5-21).
- The adapters for the backup host will need to use the same IP addresses that you used for the primary hosts. You can switch the IP/LAN adapter association

Planning for ESCON and Parallel Channel Connections

when one host fails in a similar manner as you do for 2216 Model 400 failures described above.

For more information about TCP/IP configuration, see “Channel-Related Publications” on page 5-33. Refer to “Host Definition Planning” in the *Multiprotocol Access Services Software User's Guide* for information related to configuring.

Increasing Availability in a UDP+ Environment: For the system in Figure 5-9 on page 5-20, assume that both 2216s and hosts are operational and that 2216A and host A are being used as the primary system. One would increase availability by detaching the UDP+ connection between host A and 2216A and bringing up a UDP+ connection between host A and 2216B. For details, refer to the *OS/390 TCP/IP Update Guide*, GC31–8553.

Examples of APPN over MPC+: Figure 5-11 shows an example of backup for APPN over MPC+.

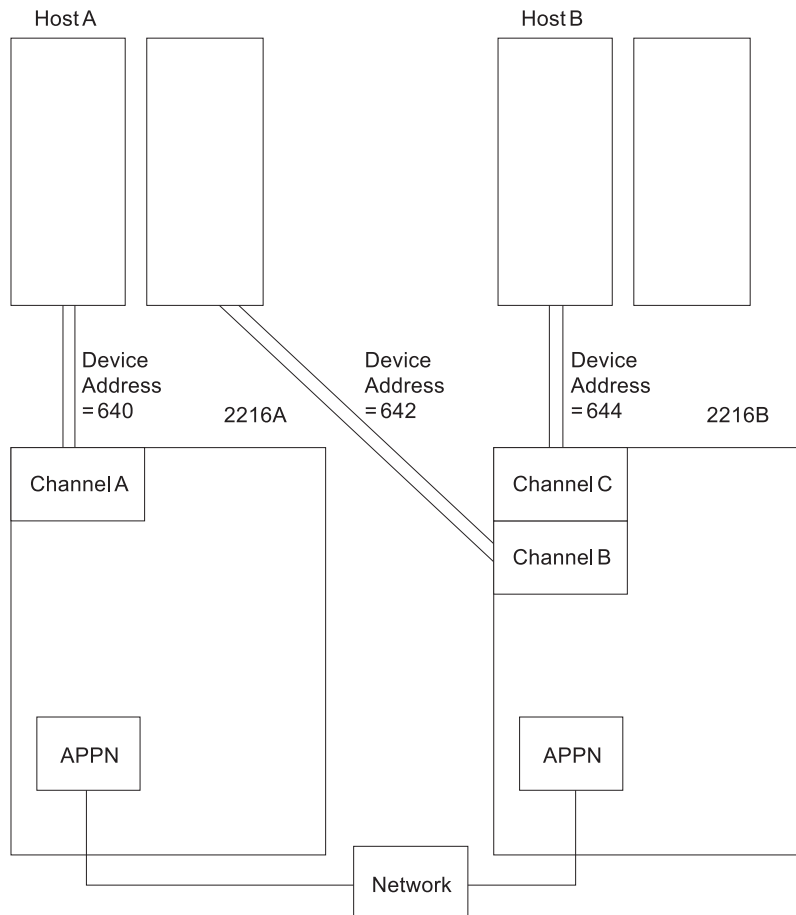


Figure 5-11. 2216 Model 400 or Network Utility and Host Backup - APPN over Multi-Path Channel+

Note: Examples of 2216 Model 400 backups in this section also apply to Network Utility.

If one of the 2216s goes down, any HPR traffic should route around that down box. It is a property of APPN HPR to route around the down box. For example, if 2216A

goes down, the APPN HPR will path-switch around the down box and any session that was going between host A and the network will now all go through 2216B.

To allow this path switching to occur, you need to make sure that 2216B has an APPN PORT/LINK set up to both host A and host B.

Channel Planning Considerations

This section discusses planning considerations for installing and configuring a 2216 Model 400 or Network Utility. It includes:

- What activities you need to plan for before installing and configuring the 2216 Model 400 or Network Utility in your network
- What to consider about how the 2216 Model 400 or Network Utility fits into your network
- What you will need to have available before you begin installation and configuration
- What to consider for supporting the 2216 Model 400 or Network Utility in the network

Network Planning

You will need to plan for the following activities prior to installing and configuring the 2216 Model 400 or Network Utility in a network:

- Defining the 2216 Model 400 or Network Utility for channel attachment
- Defining the 2216 Model 400 or Network Utility for LAN attachment
- Supporting the 2216 Model 400 or Network Utility in the network
- Site planning for the parallel channel-attached 2216 Model 400 or Network Utility

Defining the 2216 Model 400 or Network Utility for Channel Attachment: Your system programmer will need to determine configuration and system generation (SYSGEN) parameter values for the following program types at the host:

- Control programs and operating systems (including IOCP, HCD for MVS, MVS, VSE, and VM)
- Host programs (including VTAM, TCP/IP and UDP+). Note that UDP+ is available for ESCON only.
- Applications
- Network management (including SNA management services and NetView).

The system generations and configurations should be done before the 2216 Model 400 or Network Utility hardware is installed and released for customer use. "Host Definition Planning" in the *Multiprotocol Access Services Software User's Guide* contains detailed information about host parameter definition for the 2216 Model 400 or Network Utility.

Defining the 2216 Model 400 or Network Utility for LAN Attachment: Defining the 2216 Model 400 or Network Utility for LAN attachment involves several tasks:

- Administering LAN adapter addresses
- Changing LAN device configurations to optimize performance
- Matching 2216 Model 400 or Network Utility configuration parameters to those of your LAN or host devices.

Supporting the 2216 Model 400 or Network Utility in the Network

- Determining 2216 Model 400 or Network Utility problem reporting and resolution procedures
- Updating procedures, instructions, and network documentation
- Defining requirements for 2216 Model 400 or Network Utility reconfiguration.

Considerations for Including the 2216 Model 400 or Network Utility in a Network: Host and LAN planners and administrators will need to be involved in integrating the 2216 Model 400 or Network Utility into your network. System and application programmers will also participate in defining configuration parameters and installing code.

Configuration Considerations

Before configuring the 2216 Model 400 or Network Utility in your network, consider:

Addresses

Group, functional, multicast, and node (universally or locally administered individual) addresses need to be assigned by the network administrator for each 2216 Model 400 or Network Utility LAN adapter. These addresses may need to be specified in the configurations for LAN devices that will access a 2216 Model 400 or Network Utility.

SAPs

For VTAM communication, the network administrator needs to decide the SAPs to be used for each 2216 Model 400 or Network Utility LAN adapter.

Each VTAM host program that uses a 2216 Model 400 or Network Utility LAN adapter is assigned a different SAP value. The SAP for each adapter can be used once on the adapter; VTAM can use the same SAP on different LAN adapters.

Note: If APPN and LSA are configured to use the same LAN adapter, they must use different SAPs.

The network administrator and system programmer must determine how to change the SAP value used by each LAN adapter, if necessary.

MPC+ Timers

Reply TO Timer

This is the amount of time that the MPC+ Group will wait to hear from across the channel during XID2 and DISC exchanges before it decides that the other end of the channel is not answering and that this side should continue with the bring-up or bring-down of the MPC+ group.

Sequencing Interval timer

Used to determine whether connection-oriented data is flowing smoothly across the connection on an MPC+ Group. The MPC+ control flows and the APPN activation/deactivation flows are connection-oriented. Because these commands must have guaranteed delivery at the link level, they flow connection-oriented. The Sequencing Interval timer determines when it is time to check delivery of connection-oriented traffic.

Planning for ESCON and Parallel Channel Connections

Note: This value can be overwritten for each APPN PORT on an MPC+ Group. This is done during the APPN PORT configuration.

LLC Timers

If a 2216 Model 400 or Network Utility supports remote SNA connections (using a remote bridge, for example), consider what values are needed for LLC timers T1, Ti, and T2 on the LAN adapters.

LAN Number

This number distinguishes between multiple network interfaces of the same type within one 2216 Model 400 or Network Utility. Link number for TCP/IP and ADAPNO for VTAM specify the LAN number to the host program. These definitions must be the same if both programs use the same network interface.

Subchannels

The subchannels (logical paths for ESCON, device address for Parallel Channel Adapter) must be defined for all 2216 Model 400 or Network Utility LAN/WAN gateway definitions to associate channel adapters with LAN adapters. Define one or more subchannels for LSA, a subchannel pair for LCS, and a minimum of one read and one write subchannel for an MPC+ group.

PMF Password

The Parameter Management Frames (PMF) password protects the station from an unauthorized setting of MIB attributes by a remote station using Simple Mail Transfer Protocol (SMTP) PMF frames.

Transfer Mode and Channel Transfer Speed (parallel channel only)

All devices that use the same parallel channel must use the same channel speed. The Parallel Channel Adapter supports 4.5 MB per second data streaming, 3.0 MB per second data streaming, and direct-coupled interlock.

LAN Data Transfer Rate

The Token-Ring Adapter can be configured to transfer data at 4 Mbps or 16 Mbps. Select the data transfer rate to match your LAN.

Receive Mode

Determines which frames will be received by the Ethernet adapter.

Transceiver Type

Identifies the type of transceiver that the Ethernet adapter uses.

Parallel Channel Cabling Considerations

Note: It is recommended that an engineer qualified to perform bus-and-tag channel connection install the cabling associated with the Parallel Channel Adapter². Because attaching any device to a parallel channel disrupts the channel and the devices on the channel, it may be preferable to cable the Parallel Channel Adapter to the host channel during a planned network downtime.

Table 5-4 lists the cables associated with the Parallel Channel Adapter. Figure 5-12 on page 5-29 illustrates the cabling.

Table 5-4. Cabling for the Parallel Channel Adapter

Cable Type	Feature Code
V-Cable, terminator, and wrap plug	Ships with Parallel Channel Adapter
Channel Interface-In Cable	FC 2720
Channel Interface-Out Cable	FC 2721
Host Channel Cables	Cable group number 0185 and connector ID 1-3-5-7-9-11

² Contact your servicing branch office.

Planning for ESCON and Parallel Channel Connections

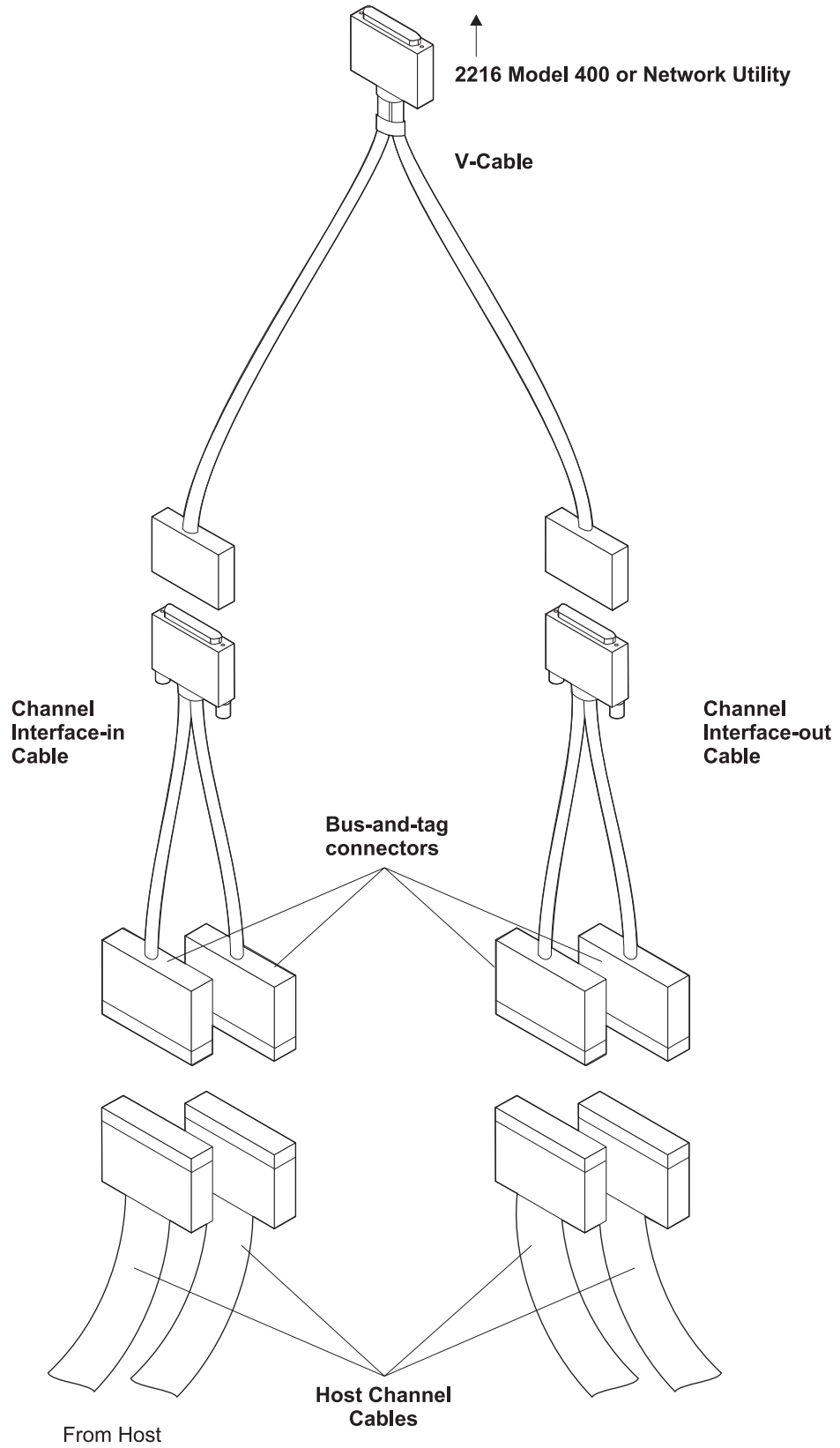


Figure 5-12. Parallel Channel Adapter cables

V-Cable

The Parallel Channel Adapter always requires a 2216 V-Cable (regardless of whether the adapter will be used in the 2216 Model 400 or in the Network Utility). This cable ships with the Parallel Channel Adapter.

Channel Interface Cables

Order channel interface cables only if there is a need to connect directly to the host channel cabling. A host connection can often be achieved by cabling the adapter to some device already attached to the host channel. Such a connection is made using the V-cable that ships with the adapter.

Use a **channel interface-in cable** if:

- The control unit immediately upstream (that is, toward the host) is not a 3172, 2216 Model 400, or Network Utility.

or

- The control unit immediately upstream is a 3172, 2216 Model 400, or Network Utility but is too far away to cable directly to the 2216 Model 400 or Network Utility via V-cable.

Use a **channel interface-out cable** if:

- The control unit immediately downstream (that is, away from the host) is not a 3172, 2216 Model 400, or Network Utility.

Note: This is a valid configuration only at 3.0 MB per second.

or

- The control unit immediately downstream is a 3172, 2216 Model 400, or Network Utility but is too far away to cable directly to the 2216 Model 400 or Network Utility via V-cable.

Note that although they may appear compatible with other cables and devices, channel interface cables are designed to maintain connections to host channel cables only³.

Host Channel Cables

Host channel cables are the main cables running from the mainframe along the length of a channel. You will need to order host channel cables if those you are already using are not long enough to support adding a Parallel Channel Adapter. For more information, see Table 5-4 on page 5-28 and Table 5-5 on page 5-31.

3172 Cables

Parallel Channel function in the 2216 Model 400 and Network Utility offer migration paths for 3172 users. However, the 3172 Interconnect Controller V-Cable is not functionally equivalent to the 2216 V-Cable. Do **not** re-use the 3172 cable with the 2216 Model 400.

All cables must conform to the restrictions on page 5-15.

³ Or, in the case of a channel interface-out cable, to a standard bus-and-tag terminator.

⁴ The Parallel Channel Adapter may be directly connected to a 3172 Interconnect Controller V-Cable, provided that the 3172 cable is not part number 25F9397.

Planning for ESCON and Parallel Channel Connections

Correct planning can greatly reduce cabling costs and installation time. Try to use only V-Cables when multiple Parallel Channel Adapters are located on the same channel. The V-Cable supplied with the Parallel Channel Adapter has been designed to directly connect to other Parallel Channel Adapter V-Cables without the need of the Channel Interface-In and Channel Interface-Out cables⁴. In order to use a V-cable, the Parallel Channel Adapter must be within 3.6 m (12 ft.) of the other Parallel Channel Adapters on the same channel. (Typically such a connection would connect units in the same rack).

When planning for parallel channel cabling between the 2216 Model 400 or Network Utility and the host, ensure that you are not exceeding the maximum cable length allowed. This length varies according to the mix of copper and fiber cabling you use.

For copper cabling, maximum distances are shown in Table 5-5. Note that the distance varies according to the number of Parallel Channel Adapters installed on the channel.

Table 5-5. Maximum Cabling Distances for Copper Channel Cables Connecting a 2216 Model 400 or Network Utility to a Host

Number of Parallel Channel Adapters on the Host Channel	Maximum Cable Length between a host and 2216 Model 400 or Network Utility
1	113 m (370 ft)
2	104 m (340 ft)
3	94 m (310 ft)
4	85 m (280 ft)
5	76 m (250 ft)
6	67 m (220 ft)

Note: The distances provided here are for 2216 Model 400 or Network Utility connections only. Other control units may place additional restrictions on cabling.

For fiber cabling, the maximum length is 3 km (1.86 mi). Figure 5-13 and Figure 5-14 on page 5-32 illustrate fiber and fiber-copper cabling with the 3044 Fiber-Optic Channel Extender Link Models C02 and D02 and the 9034 Enterprise Systems Connection Converter.

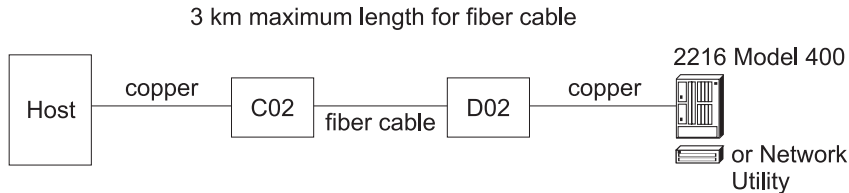


Figure 5-13. Cable Distances for the 3044 Fiber-Optic Channel Extender Link Models C02 and D02

Planning for ESCON and Parallel Channel Connections

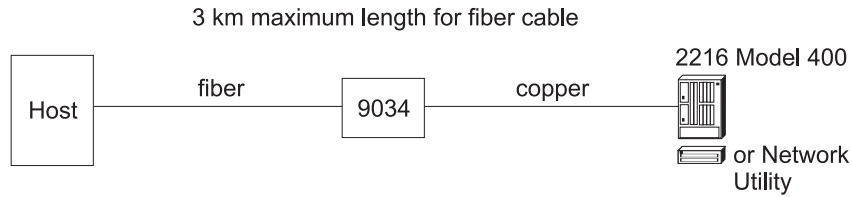


Figure 5-14. Cable Distances for the 9034 Enterprise Systems Connection Converter

Optimizing Performance

There are many parameters that affect the overall performance of a host-to-LAN network. The parameters that affect 2216 Model 400 or Network Utility throughput are discussed in this section.

In planning the volume and flow of traffic over the network, consider the following configuration parameters. It is recommended that the default 2216 Model 400 or Network Utility host parameters be used initially. You can then tune the network to optimize overall performance.

TCP/IP Window Size

A larger TCP/IP window size allows more frames to be sent before requiring acknowledgement. This helps move frames through devices faster and requires less frequent processing of acknowledgements.

VTAM I/O Buffer Size

Frames are segmented into more than one buffer when the frame size exceeds the VTAM I/O buffer size, causing additional processing overhead. Make the VTAM buffers large enough to contain the largest average frame size.

Also consider the following concepts:

Sharing Subchannels

When defining a LAN/WAN gateway, dedicate a subchannel or subchannel pair for each network interface to ensure maximum performance.

Trace

Using the 2216 Model 400 or Network Utility trace function may affect performance noticeably.

Frame Size

Most protocols segment data into packets based on restrictions of the network to which they are attached. Bridges, for example, may restrict the size of forwarded frames to the smaller of the two maximum sizes that can be handled by the LANs they connect. Frames that traverse different LAN types can be limited in size by the maximum frame size of the most restrictive LAN. Frames that are larger than the specified maximum size can get segmented into two or more packets for network transmission; the packets must be reassembled by the receiver into their original size. Some programs and devices discard frames that are too large or too small.

Protocols and applications take these frame size limits into consideration when they determine their maximum frame size; some can negotiate to the largest common frame size that both sender and receiver can handle. (The 2216 Model 400 and Network Utility do not negotiate frame size.) To reduce the effects of segmenting data

into smaller frame sizes, you need to be aware of how devices on the network affect protocol packet size.

Table 5-6 shows the size of the largest frame that can be transferred by each type of 2216 Model 400 or Network Utility LAN adapter.

Table 5-6. LAN Adapter Maximum Frame Sizes and Channel Adapter Maximum Block Sizes

Adapter Type	Largest Frame Size	Maximum Block Size
Token-Ring (4 Mbps)	4.5 KB	
Token-Ring (16 Mbps)	17.5 KB	
Ethernet V2/IEEE 802.3,IEEE 802.3u	1.5 KB	
FDDI	4.5 KB	
ESCON		<ul style="list-style-type: none"> • 32 KB for LSA • 20 KB for TCP/IP • 36 KB for MPC+
Parallel Channel		<ul style="list-style-type: none"> • 32 KB for LSA • 20 KB for TCP/IP • 36 KB for MPC+

Channel-Related Publications

ESCON and parallel channel publications that might be useful to you include:

- *IBM ES/9000, IBM ES/3090 Input/Output Configuration Program User's Guide and ESCON Channel to Channel Reference Volume A04*, GC38-0097 (for ESCON and parallel channel-capable processors)
- *IBM ES/9000 Processor Complex Input/Output Configuration Program User's Guide*, SC38-0066 (for non-ESCON-capable processors)
- *IBM System/360, System/370, and System/390 I/O Interface Channel-to-Control Unit Original Equipment Manufacturers' Information*, GA22-6974
- *IBM I/O Configuration Program User's Guide and Reference*, GC28-1027 (for 308x processors)
- *Fiber Optic Link Planning*, GA23-0367
- *Using the IBM Cabling System with Communication Products*, GA27-3620
- *Introducing the 9034 Enterprise Systems Connection Converter*, GA23-0361
- *Planning for the 9034 Enterprise Systems Connection Converter*, GA23-0362
- *3044 Fiber-Optic Channel Extender Link Models C02 and D02*, GA22-7129
- *Maintenance Information for Enterprise Systems Connection Links*, SY27-2597

Publications available for Virtual Telecommunications Access Method (VTAM) Version 4.4:

- *VTAM V4R4 Network Implementation Guide*, SC31-8370
- *VTAM V4R4 Resource Definition Reference*, SC31-8377

Planning for ESCON and Parallel Channel Connections

Publications available for the IBM Transmission Control Protocol/Internet Protocol for VM:

- *IBM TCP/IP V2R4 for VM: Planning and Customization*, SC31-6082
- *IBM TCP/IP V2R2 for VM: Installation and Interoperability*, GG24-3624
- *TCP/IP V3R2 for MVS: Planning and Migration Guide*, SC31-7189-02
- *OS/390 TCP/IP Update Guide*, GC31-8553
- *TCP/IP for VSE/ESA User's Guide*, SC33-6601

For TCP/IP support over MPC, see the *IBM OS/390 TCP/IP OpenEdition Planning & Release Guide*, SSC31-8303

Planning for ISDN

ISDN is supported on the 2216 Model 400 only.

The Multipoint ISDN/PRI Channelized interface provides a scalable solution for customers who require high-capacity dial backup between remote sites or cost-effective consolidation of dozens of leased line connections.

The following sections describe how to plan for ISDN:

- “Planning for ISDN in the 2216 Model 400”
- “Planning for ISDN with your Service Provider” on page 5-36

Planning for ISDN in the 2216 Model 400

The 2216 Model 400 supports up to 8 ISDN PRI or Channelized T1/J1 or E1 interfaces, providing up to 192 or 240 56/64-Kbps connections. Subject to certain rules, the eight ports can be distributed across any combination of 2216 Model 400 ISDN adapters.

Note:

- No more than four 1-port ISDN adapters can be installed.
- No more than one 4-port ISDN adapter can be installed (regardless of the presence or absence of daughter cards FC 2251 and FC 2522).

For a list of adapter plugging rules, see Appendix C, “Adapter Plugging Defaults” on page C-1.

For maximum flexibility, line service on each port can be individually provisioned. In addition, channelized line support enables you to multiplex multiple leased lines into one physical connection.

Determining which adapter to use: The 2216 Model 400 supports several ISDN adapters. Table 5-7 can help you determine which adapter to use.

Table 5-7. Connections per ISDN Adapter

Number of Connections Supported	Adapter	Feature Code
23	1-port ISDN PRI T1/J1	2283
30	1-port ISDN PRI E1	2292
92	4-port ISDN PRI/Channelized T1/J1	2297
120	4-port ISDN PRI/Channelized E1	2298
184	4-port ISDN PRI/Channelized T1/J1 adapter + 4-port ISDN PRI/Channelized T1/J1 daughter card	2297 (adapter) 2251 (daughter card)
240	4-port ISDN PRI/Channelized E1 adapter + 4-port ISDN PRI/Channelized E1 daughter card	2298 (adapter) 2252 (daughter card)

Cabling: One-port adapters require a different set of cables from 4-port adapters. Be sure to select the correct cable for your adapter. More information is available in “Cables” on page 2-20 and Appendix B, “Cable Pin Assignments” on page B-1.

Planning for ISDN with your Service Provider

Contact your telephone company to plan for T1/J1, E1, Channelized, 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

Primary Rate Interface (PRI) 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 2216 Model 400. 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 or Channelized Connections:

Number of lines

You will need one line for each port (To determine how many ports are needed, see Table 5-7 on page 5-35).

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 Connections:

Switch variant

The kind of switch your telco will be using to connect to the 2216 Model 400 ISDN PRI line. The 2216 Model 400 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), and I.431.

Telephone numbers

Assigned by the telco to your channels.

For Channelized Connections:

Timeslots

The number of timeslots that the telephone company has allocated for each circuit. Ask which timeslots correspond to which circuits (timeslot mapping), as well.

For ISDN or Channelized Connections:

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 connectors that terminate your line at the 2216 Model 400. LBO accounts for the distance between the 2216 Model 400 and the telco, the quality of the line, and the intermediate amplification as 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

Whether to enable or disable the E1 CRC4 packet checking mechanism.

Publications

More information about ISDN in the 2216 Model 400 is available in these publications:

- The *2216 Nways Multiaccess Connector Installation and Initial Configuration Guide*, GA27-4106, explains how to install the 2216 Model 400 and its adapters.
- The *Nways Multiprotocol Access Services Software User's Guide*, SC30-3866, provides details about configuring the 2216 Model 400 for use with ISDN/PRI T1/E1 adapters.

Planning for FasTR

FasTR is supported on the 2216 Model 400 only.

Fast Token Ring Encapsulated in ATM (FasTR) increases the media speed between a Token-Ring network and a host from 16 Mbps to 155 Mbps. Figure 5-15 illustrates a FasTR alternative to traditional 16 Mbps Token-Ring connections.

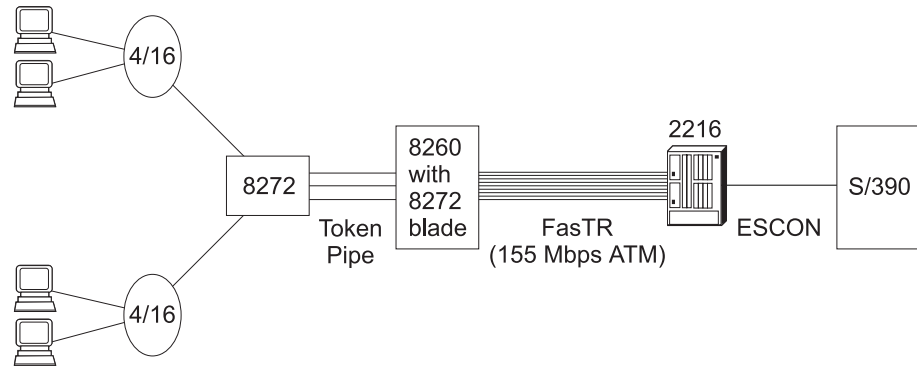


Figure 5-15. Using FasTR

FasTR is designed to enable customers with no working knowledge of ATM to benefit from the speed of ATM without investing in a new network. FasTR can be implemented using any existing 2216 Model 400 ATM adapter (for more information, see “(FC 2284 and 2294) 1-Port ATM 155-Mbps Multimode Fiber Adapter” on page 2-14 and “(FC 2293 and 2295) 1-Port ATM 155-Mbps Single-Mode Fiber Adapter” on page 2-17). These multi-use adapters protect your hardware investments if you are already using ATM and provide a migration path if you are considering a move from Token Ring to ATM.

FasTR supports a variety of media and protocols. For more information, see Table 2-5 on page 2-6.

Redundancy for High-Availability Systems: FasTR can be used to satisfy high-availability requirements for LAN attachment schemes similar to the ones described in “2216 Model 400 and Network Utility Availability and Backup” on page 5-19. The 2216 Model 400 supports up to two simultaneous FasTR attachments (For adapter plugging rules, see page C-1).

Requirements

A FasTR connection requires any two FasTR-capable machines, each carrying the correct adapter. Table 5-8 on page 5-39 lists FasTR-capable platforms and the adapters they require.

Table 5-8. FasTR Requirements

FasTR-capable routers and switches	Adapters that support FasTR	Ordering information
2216 Model 400 Nways Multiaccess Connector	1-port ATM single-mode fiber adapter 1-port ATM multimode fiber adapter	FC 2293, FC 2295 FC 2284, FC 2294
8272 Token-Ring LAN Switch Module for the Nways 8260 Multiprotocol Switching Hub, feature number 6308	MSS Client UFC (single-mode optical fiber) MSS Client UFC (multimode optical fiber)	PN 85H4599 PN 85H4596
8270 Token-Ring LAN Switch, Model 800	MSS Client UFC (single-mode optical fiber) MSS Client UFC (multimode optical fiber)	PN 85H4599 PN 85H4596

Planning for Network Dispatcher

The Network Dispatcher function balances traffic loads among multiple TCP or UDP servers. It also provides backup detection for routing around failed servers. To protect from failure of the Network Dispatcher router itself, Network Dispatcher includes high-availability features such as database synchronization, failure detection, and IP Takeover to redirect traffic to a standby router that is running Network Dispatcher function.

IBM offers the Network Dispatcher feature not only for the 2216 Model 400, but also in the 2210 Nways Multiprotocol Router, in the 2212 Access Utility, and in the Network Utility.

When used for TN3270 server functions, servers must be on a local subnet with the Network Dispatcher machine zero routing hops away. Network Dispatcher can be run in the same 2216 Model 400 or Network Utility with a target TN3270E server function.

For more information about Network Dispatcher, refer to *Multiprotocol Access Services Using and Configuring Features*.

Planning for Web Server Cache

The Web Server Cache function works in conjunction with the Network Dispatcher function to store web pages from one or more web servers for delivery to client browsers, as illustrated in Figure 5-16. The Web Server Cache receives HTTP requests from clients and, if the requested objects are not already cached in memory, retrieves them from a web server and caches them for future use.

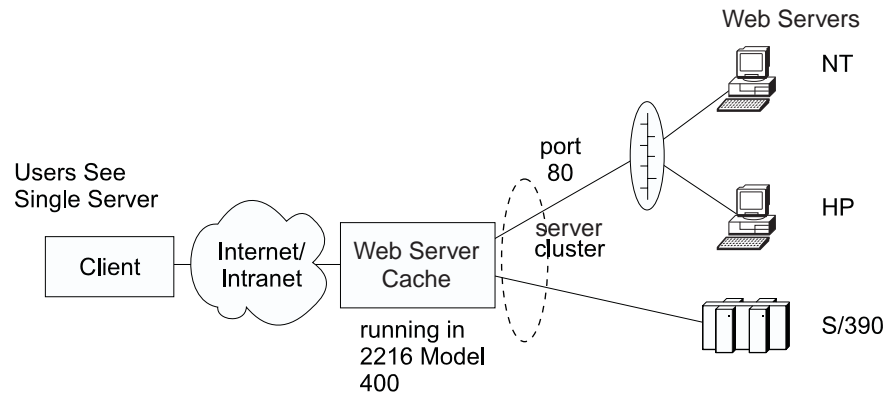


Figure 5-16. Web Server Cache

Web Server Cache is available on the 2216 Model 400. It can be used to cache web objects from any manufacturer's set of web servers. The Web Server Cache operates transparently, requiring no special configuration of the server or client browser. There are no restrictions on the location of web servers and Web Server Caches in the IP network, as long as an IP route is available between them.

The Web Server Cache can be divided into as many as 16 smaller cache partitions, allowing a single 2216 Model 400 to act as a cache for multiple distinct web servers. In addition, a user may define more than one web server as part of the same server cluster. In this case, the Web Server Cache will load balance requests for non-cached pages between the various servers. An IBM-exclusive Network Advisor for HTTP monitors server status to provide the Web Server Cache with feedback designed to enhance network performance and availability.

The Web Server Cache can selectively cache (or exclude from cache) web objects based on the size of an object, the number of objects in a cache partition, and the current size of the partition. A user may also define masks to include or exclude specific web objects by their Uniform Resource Locator (URL). Each cache partition may have a different set of caching policies.

A 2216 Model 400 with the Web Server Cache feature may (optionally) use the IP routing functions of the 2216 Model 400; however, non-IP protocols (for example, APPN, TN3270E, or Data Link Switching) are not available with the Web Server Cache feature. The Network Dispatcher function may be used to balance non-HTTP traffic to target servers.

For a complete overview of the Web Server Cache function, refer to the *MAS Using and Configuring Features*.

Planning for Thin Server

Thin Server is designed to be compatible with other manufacturers' master servers that have Network File System (NFS) support. The Thin Server NFS support has been tested with the following master file servers:

- Windows NT 4 running Network Station Manager V1R3
- AIX 4.3.0.0 running Network Station Manager V1R3

The AS/400 supports the Thin Server's Remote File System (RFS) protocol. The Thin Server RFS support has been tested with the following master file servers:

- OS/400 V3R7 running Network Station Manager V1R2.5
- OS/400 V4R2 running Network Station Manager V1R3
- OS/400 V3R2 running Network Station Manager V1R2.5

However, once the network station is booted and you have logged on to the network, then you can connect to other servers in the network.

Thin Server is also designed to be compatible with other manufacturers' network stations running TFTP or NFS. The Thin Server has been tested with IBM Network Stations.

The number of sessions supported by the Thin Server depends on the network load, the desired performance characteristics of the Network Station, and the protocols being used. If the master file server protocol is NFS then there is no maximum number of Network Stations that can be connected. If the master file server protocol is RFS then no more than 200 Network Stations can be connected at any one time. The desired performance and network load are more dependent on individual network considerations and individual perceptions of acceptable performance. In general, no more than 80 Network Stations should be active at any given time.

Thin Server can be managed using SNMP management tools.

For more information about using IBM Network Stations, see the following web sites and documents:

- The IBM Network Station Home Page:
<http://www.pc.ibm.com/networkstation/station/>
- The IBM Network Station publications:
<http://www.ibm.com/nc/pubs>
- *IBM Network Station Manager Installation and Use*, SC41-0664
- *IBM Network Station Manager for AS/400*, SC41-0632

Appendix A. Charts and Worksheets

This appendix contains planning charts and worksheets that will help you prepare your 2216 Model 400 and Network Utility for use. The worksheets are:

- Initial Configuration Worksheets (page A-2)
- Quick Configuration Worksheets (page A-1)

These charts and worksheets are useful in helping complete the installation. They should be completed by the network planner or network administrator.

Make as many copies of these charts and worksheets as you need to plan your network. Save the blank originals for future copies.

Hardware Configuration Quick Reference for 2216 Model 400

This fanfold card (GX27-3988) is shipped separately with each 2216 Model 400. Part of the setup procedure described in the *Installation and Initial Configuration Guide* is to fill out this card, which when completed will describe how your 2216 Model 400 is configured and cabled.

The *IBM 2216 Hardware Configuration Quick Reference* card is an ongoing record of the connections made to the 2216 Model 400 port receptacles. In addition, the chart records the location of the 2216 Model 400 and the number of the ring or segment to which it attaches. The card is used during installation and cabling of the 2216 Model 400 and while performing problem determination procedures.

Initial Configuration Worksheets

Make one copy of page A-3 or A-4 for each device you will be adding.

You must be at the `Config (only)>` prompt to perform initial configuration on the 2216 Model 400 or Network Utility. You must add each device (port) that you will be using.

The syntax for the **add** command is as follows:

```
Config (only)> Add Device Token-Ring 1 1
```

The example above of the **Add Device** command applies to adding an interface on a multi-port adapter. If you add an interface on a single-port adapter, then you merely provide the slot number. If you add a dial circuit device, then you enter **add device dial-circuit**.

Note: Use the add device commands in this guide for planning purposes. Actual syntax for referring to each interface varies from the names shown here. To begin configuring, see the *Multiprotocol Access Services Software User's Guide*.

Table A-1. Initial Configuration Worksheet, 2216 Model 400

<input type="checkbox"/> Add	<input type="checkbox"/> Device	<input type="checkbox"/> Token-Ring <input type="checkbox"/> Ethernet <input type="checkbox"/> ATM <input type="checkbox"/> FasTR over ATM <input type="checkbox"/> ESCON <input type="checkbox"/> Parallel Channel <input type="checkbox"/> 10/100 Mbps Ethernet <input type="checkbox"/> FDDI <input type="checkbox"/> HSSI <input type="checkbox"/> 1-port ISDN (T1/J1) <input type="checkbox"/> 1-port ISDN (E1) <input type="checkbox"/> 4-port ISDN PRI/Channelized T1/J1 <input type="checkbox"/> 4-port ISDN PRI/Channelized E1 <input type="checkbox"/> X.21 <input type="checkbox"/> V.35/V.36 <input type="checkbox"/> EIA-232E/V.24 <input type="checkbox"/> Dial Circuits	<ul style="list-style-type: none"> • Slot: • Port: • Slot: • Port: • Slot: • Slot: • Slot: • Slot: • Slot: • Slot: • Slot: • Slot: • Slot: • Slot: • Slot: • Slot: • Slot: • Port • Slot • Port: • Slot: • Port: • Slot: • Port: • Slot: • Port:
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Table A-2. Initial Configuration Worksheet, Network Utility

□ Add	□ Device	□ Token-Ring	• Slot:
		□ Ethernet	• Slot:
		□ ATM	• Port:
		□ ESCON	• Slot:
		□ Parallel Channel	• Slot:
		□ 10/100 Mbps Ethernet	• Slot:
		□ FDDI	• Slot:
		□ HSSI	• Slot:
		□ X.21	• Slot:
		□ V.35/V.36	• Port:
		□ EIA-232E/V.24	• Slot:
			• Port:

Bridging

- | | | |
|---|------------------------------|--------------------------------------|
| Configure Bridging ? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Configure SRT Bridging? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Bridge No. (0-F) | <input type="checkbox"/> A † | <input type="checkbox"/> Other _____ |
| Configure Interface ____ (0-xx)? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Configure Source Routing on this interface? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Segment No. (1-FFF) | <input type="checkbox"/> A † | <input type="checkbox"/> Other _____ |
| Save this configuration? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

Protocols

- | | | |
|------------------------------|------------------------------|-----------------------------|
| Configure Protocols ? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
|------------------------------|------------------------------|-----------------------------|

IP

- | | | |
|--|------------------------------|-----------------------------|
| Configure IP? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Configure Interface ____ (0-xx)? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Configure IP on this interface? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| IP address | _____ | Address Mask _____ |
| Enable Dynamic Routing? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Enable OSPF? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Configure community with Write_Read_Trap Access? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Community Name | _____ | |
| Save this configuration? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

IPX

- | | | |
|----------------------------------|------------------------------|-----------------------------|
| Configure IPX ? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Configure Interface ____ (0-xx)? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| Configure IPX on this interface? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

Token Ring encapsulation (*frame*) type?

- TOKEN—RING MSB †
- TOKEN—RING LSB
- TOKEN—RING_SNAP MSB
- TOKEN—RING_SNAP LSB

Ethernet encapsulation (*frame*) type?

- ETHERNET_8022
- ETHERNET_8023
- ETHERNET_II
- ETHERNET_SNAP

FDDI encapsulation (frame) type?

- FDDI
- FDDI_SNAP †

Network No. (1-FFFFFFD) _____

Enable IPXWAN?

- YES
- NO

Host No. for Serial Lines _____

Configure IPXWAN Nodeid?

- YES
- NO
- 1 †
- Other

Nodeid (1-FFFFFFD)

Save this configuration?

- YES
- NO

DNA (DECnet)

Configure **DNA**?

- YES
- NO
- 32 †
- Other

Highest Node No. (1-1023)

Router Level

- Level1 †
- Level2 _____
- DEC Level1
- DEC Level2

Highest Area (1-63)

- 63 †
- Other _____

Node address _____

Configure DNA on Interface ____ ?

- YES
- NO
- 16 †
- Other

Max Routers (1-33)?

Address Mask _____

Save this configuration?

- YES
- NO

Note: † = default

Quick Configuration for Network Utility

Completed by: _____

Date: _____

Network Utility Name: _____

Adapter Type?

Token-Ring

Ethernet

Other

Port (Interface) Number

ATM LAN Emulation

Configure **LAN Emulation**?

YES

NO

Configure LECS to direct clients
requesting unspecified ELAN type to:

Token-Ring

Ethernet

Other

Do you want to add an emulated
Token Ring?

YES

NO

Enter the ELAN Name:

Enter the selector: (2 - FF):

2 †

Other

Do you want to enable Broadcast
Manager for IP?

YES

NO

Do you want to enable Broadcast
Manager for NetBIOS?

YES

NO

Do you want to enable Broadcast
Manager for Source Routing?

YES

NO

Do you want to add an emulated
Ethernet?

YES

NO

Enter the ELAN Name:

Enter the selector: (2 - FF):

3 †

Other

Do you want to enable Broadcast
Manager for IP?

YES

NO

Do you want to enable Broadcast
Manager for NetBIOS?

YES

NO

Bridging

Configure **Bridging**?

YES

NO

Configure SRT Bridging?

YES

NO

Bridge No. (0-F)

A †

Other

Configure Interface ____ (0-xx)?

YES

NO

Configure Source Routing on this
interface?

YES

NO

Segment No. (1-FFF)

A †

Other

Save this configuration?

YES

NO

Protocols

Configure **Protocols**? YES NO

IP

Configure IP? YES NO
Configure Interface ____ (0-xx)? YES NO
Configure IP on this interface? YES NO
IP address _____ Address Mask _____
Enable Dynamic Routing? YES NO
Enable OSPF? YES NO
Configure community with
Write_Read_Trap Access? YES NO
Community Name
_____ _____
Save this configuration? YES NO

Appendix B. Cable Pin Assignments

This appendix describes the signals associated with the pins on the cable connectors for the service port and the WANs supported by the 2216 Model 400 and Network Utility for customer-unique applications. Note that because all adapters are not supported by both the 2216 Model 400 and Network Utility, all cables will not be supported. For more information about which adapters are supported, see "Options" on page 2-12.

LAN and ISDN ports use industry-standard cables. Contact your cable supplier for more information.

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:

Pin No.	Signal	Driven by 2216 Model 400 and Network Utility	Received by 2216 Model 400 and Network Utility
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, supplied with the 2216 Model 400 and Network Utility, is required for attachment to a terminal having a male connector.

Wide Area Networks (WANs)

The cables that IBM ships for the 2216 Model 400 and Network Utility are described in this section.

If you need special cables with specific lengths, use the information in this section to specify the assignment for the pins. 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 2216 Model 400 or Network Utility to the attaching equipment should not exceed 15 m (50 ft).

The wiring of these cables is shown in the following tables.

EIA 232-E/V.24 (FC 2705 and 2706)

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

Signal	Machine End Pin Number	DCE End Pin Number
Protective Ground	1	1
Transmitted Data	2	2
Signal Ground	7	7
Received Data	3	3
Data Set Ready	6	6
DCE Transmitter Signal Element Timing	15	15
Receiver Signal Element Timing	17	17
Clear To Send	5	5
Local Loopback	18	18
Ring Indicate	22	22
Data Terminal Ready	20	20
Request To Send	4	4
Received Line Signal Element	24	8
DTE Transmitter Signal Element Timing	24	24
Data Signal Rate Selector	23	23

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

Signal	Machine End Pin Number	DTE End Pin Number	Signal
Send Data	2	3	Received Data
Signal Ground	7	7	Signal Ground
Received Data	3	2	Transmitted Data
Data Set Ready	6	20	Data Terminal Ready
Transmit Clock	15	24	DTE Transmitter Signal Element Timing
Receive Clock	17	24	Receiver Signal Element Timing
Clear To Send	5	8	Received Line Signal Detect
Data Terminal Ready	20	6	Data Set Ready
Request To Send	4	8	Received Line Signal Detect
Received Line Signal Detect	8	5	Clear to Send
Received Line Signal Detect	8	4	Request to Send
DTE Transmitter Signal Element Timing	24	15 17	DCE Transmitter Signal Element Timing Receiver Signal Element Timing

V.35 (FC 2707 and 2708)

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

Signal	Machine End 25-Pin Connector Pin Number	DCE End Pin Number
Transmitted Data (A)	2	P
Transmitted Data (B)	14	S
Received Data (A)	3	R
Received Data (B)	16	T
Receive Timing (A)	17	V
Receive Timing (B)	9	X
Transmit Timing (A)	15	Y
Transmit Timing (B)	12	AA
Terminal Timing (A)	24	U
Terminal Timing (B)	11	W
Signal Ground	7	B
Request To Send	4	C
Clear to Send	5	D
Receive Line Signal Detect	8	F
Data Terminal Ready	20	H
Data Set Ready	6	E

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

Signal	Machine End 25-Pin Connector Pin Number	Machine End Pin Number	Signal
Transmit Data (A)	2	R	Receive Data (A)
Transmit Data (B)	14	T	Receive Data (B)
Receive Data (A)	3	P	Transmit Data (A)
Receive Data (B)	16	S	Transmit Data (B)
Shield	1	A	Shield
Signal Ground	7	B	Signal Ground
Receive Line Signal Detect	8	C	Request to Send
Receive Line Signal Detect	8	D	Clear to Send
Request to Send	4	F	Receive Line Signal Detect
Clear to Send	5	F	Receive Line Signal Detect
Data Set Ready	6	E	Data Set Ready
Data Terminal Ready	20	E	Data Set Ready
Transmit Clock In (A)	15	U	Terminal Timing (A)
Receive Clock In (A)	15	U	Terminal Timing (A)
Receive Clock In (B)	17	U	Terminal Timing (A)
Transmit Clock In (B)	12	W.	Terminal Timing (B)
Terminal Timing (A)	24	Y	Transmit Clock In (A)
Terminal Timing (A)	24	V	Receive Clock In (A)
Terminal Timing (B)	11	X	Receive Clock In (B)
Terminal Timing (B)	11	AA	Transmit Clock In (B)

V.36 (FC 2709 and 2710)

Table B-6. V.36 Connector Pin Assignments, 37-pin D, Female to Female, Modem-Attach

Signal	Machine End Pin Number	DCE End Pin Number	Signal
Transmit Data (A)	4	6	Receive Data (A)
Transmit Data (B)	22	24	Receive Data (B)
Receive Data (A)	6	4	Transmit Data (A)
Receive Data (B)	24	22	Transmit Data (B)
Transmit Clock out (A)	17	5	Transmit Clock in (A)
		8	Receive Clock in (A)
Transmit Clock out (B)	35	23	Transmit Clock in (B)
		26	Receive Clock in (B)
Transmit Clock in (A)	5	17	Transmit Clock out (A)
Receive Clock in (A)	8		
Transmit Clock in (B)	23	35	Transmit Clock out (B)
Receive Clock in (B)	26		
Data Set Ready	11	11	Data Set Ready
Data Terminal Ready	12		
Receive Line Signal Detect	13	7	Request to Send
		9	Clear to Send
Request to Send	7	13	Receive Line Signal Detect
Clear to Send	9		
Signal Ground	19	19	Signal Ground
DCE Signal Ground	20	37	DTE Signal Ground
DTE Signal Ground	37	20	DCE Signal Ground

Table B-7. V.36 Connector Pin Assignments, 37-pin D, Female to Male, Direct-Attach

Signal	Machine End Pin Number	DTE End Pin Number
Transmit Data (A)	4	4
Transmit Data (B)	22	22
Receive Data (A)	6	6
Receive Data (B)	24	24
Send Timing (A)	5	5
Send Timing (B)	23	23
Receive Timing (A)	8	8
Receive Timing (B)	26	26
Terminal Timing (A)	17	17
Terminal Timing (B)	35	35
Data Set Ready	11	11
Data Terminal Ready	12	12
Receive Line Signal Detect	13	13
Request to Send	7	7
Clear to Send	9	9
Signal Ground	20	20
Signal Ground	19	19
Signal Ground	37	37

X.21 (FC 2711 and 2712)

Table B-8. X.21 Connector Pin Assignments, 15-pin D, Male

Signal	Machine End Pin Number	DCE End Pin Number
Transmit (A)	2	2
Transmit (B)	9	9
Control (A)	3	3
Control (B)	10	10
Indicate (A)	5	5
Indicate (B)	12	12
Signal Element Timing (A)	6	6
Signal Element Timing (B)	13	13
DTE Transmit Signal Element Timing (A)	7	
DTE Transmit Signal Element Timing (B)	14	14
Signal Ground	8	8

Table B-9. X.21 Connector Pin Assignments, 26-pin D, Male to 15-pin Female

Signal	26-pin Connector	15-pin Connector	Signal
Signal Ground	8	8	Signal Ground
Transmit (A)	2	4	Receive (A)
Transmit (B)	9	11	Receive (B)
Receive (A)	4	2	Transmit (A)
Transmit Signal Element Timing (A)	7	6	Signal Element Timing (A)
Transmit Signal Element Timing	14	13	Signal Element Timing
Signal Element Timing	1	1	Shield
Jumper	3,5		
Jumper	10,12		
		3,5	Jumper
	10,12	Jumper	

HSSI

This cable is included with adapter FC 2289.

Table B-10. HSSI Connector Pin Assignments, 50-pin Male, Modem-Attach

Signal	Machine End 25-Pin Connector Pin Number	DCE End Pin Number
SG (signal ground)	1	1
	26	26
RT (receive timing)	2	2
	27	27
CA (DCE available)	3	3
	28	28
RD (receive data)	4	4
	29	29
LC (loopback circuit c)	5	5
	30	30
ST (send timing)	6	6
	31	31
SG (signal ground)	7	7
	32	32
TA (DTE available)	8	8
	33	33
TT (terminal timing)	9	9
	34	34
LA (loopback circuit A)	10	10
	35	35
SD (send data)	11	11
	36	36
LB (loopback circuit B)	12	12
	36	36
SG (signal ground)	13	13
	38	38
Ancillary to DCE	14	14
	39	39
Ancillary to DCE	15	15
	40	40
Ancillary to DCE	16	16
	41	41
Ancillary to DCE	17	17
	42	42
Ancillary to DCE	18	18
	43	43
SG (signal ground)	19	19
	44	44
Ancillary from DCE	20	20
	45	45
Ancillary from DCE	21	21
	46	46
Ancillary from DCE	22	22
	47	47
Ancillary from DCE	23	23
	48	48
Ancillary from DCE	24	24
	49	49
SG (signal ground)	25	25
	50	50

The following cable ships with each HSSI adapter. It is not separately orderable as a feature code.

Table B-11. HSSI, 50-pin Block, Male, Null Modem Cable Pin Assignments

Signal	Machine End 25-Pin Con- nector Pin Number	Machine End Pin Number	Signal
RT (receive timing)	2 27	9 34	TT (terminal timing)
CA (DCE available)	3 28	8 33	TA (DTE available)
RD (receive data)	4 29	11 36	SD (send data)
LC (loopback C)	5 30	10 35	LA (loopback A)
ST (send timing)	6 31	6 31	ST (send timing)
TA (DTE available)	8 33	8 33	CA (DCE available)
TT (terminal timing)	9 34	2 27	RT (receive timing)
LA (loopback A)	10 35	5 30	LC (loopback C)
SD (send data)	11 36	4 29	RD (receive data)
Ground	1 26	1 26	Ground
Ground	13 38	13 38	Ground
Ground	7 32	7 32	Ground
Ground	19 44	19 44	Ground
Ground	25 50	25 50	Ground
loopback (no conn.)	12 37	12 37	Loopback (no conn.)
not used	Any not listed	Any not listed	Not used

1-port ISDN T1 (FC 2714), E1 (FC 2715), J1 (FC 2716)

This set of cables is for use with 1-port ISDN adapters. Information about cables for 4-port ISDN adapters is available beginning on page B-12.

Table B-12. 26-pin Cables for ISDN 1-port T1, E1, and J1

Connection Point	Adapter Media Access	T1 Cable Termination	E1 Cable Termination	J1 Cable Termination
Connector Type	DB26: 26-pin connection	RJ48C: 8-pin connection	Unterminated cable	ISO 10173: 8-pin connection
Transmit +	11	5	N/A	5
Transmit -	13	4	N/A	4
Receive +	15	2	N/A	2
Receive -	17	1	N/A	1
Shield Ground	N/A	3	N/A	N/A
Shield Ground	N/A	6	N/A	N/A

4-port ISDN PRI/Channelized T1 (FC 2717)

This cable is for use with ISDN 4-port adapters. Pinouts for 1-port ISDN adapters are available on page B-11.

Table B-13. 4-port ISDN PRI/Channelized T1 Connector Pin Assignments, 8-pin Male

Signal	RJ45 A Pin	RJ45 B Pin	Signal
Receive Ring	1	1	Receive Ring
Receive Tip	2	2	Receive Tip
Transmit Ring	4	4	Transmit Ring
Transmit Tip	5	5	Transmit Tip

4-port ISDN PRI/Channelized E1 (FC 2718)

This cable is for use with ISDN 4-port adapters. Pinouts for 1-port ISDN adapters are available on page B-11.

Table B-14. 4-port ISDN PRI/Channelized E1 Connector Pin Assignments, 8-pin Male

Signal	RJ45 A Pin	Flying Wire Label
Receive Ring	1	RX+
Receive Tip	2	RX-
Transmit Ring	4	TX+
Transmit Tip	5	TX-

4-port ISDN PRI/Channelized J1 (FC 2719)

This cable is for use with ISDN 4-port adapters. Pinouts for 1-port ISDN adapters are available on page B-11.

Table B-15. 4-port ISDN PRI/Channelized J1 Connector Pin Assignments, Keyed 8-pin Male

Signal	RJ45 A Pin (white over-molding)	RJ45 B Pin (black over-molding)	Signal
Receive Ring 1	1	1	Receive Ring 1
Receive Tip 1	2	2	Receive Tip 1
Transmit Ring	4	3	Transmit Ring
Transmit Tip	5	4	Transmit Tip

Appendix C. Adapter Plugging Defaults

- 2216 Model 400 units assembled at the factory follow the plugging rules that are described in this appendix.
- Network Utility Models TN1 and TX1 have no plugging rules or restrictions.

Model 400 Plugging Sequences

Table C-1 illustrates how the slots are numbered: two rows of four slots, numbered 1 through 8.

Slot 1	Slot 2	Slot 3	Slot 4
Slot 5	Slot 6	Slot 7	Slot 8

Table C-2 and Table C-3 show the default sequence of installation for the various adapters.

- FC 2280 and FC 2281 are installed left to right, beginning with slot 1. A maximum of six can be installed in any single IBM 2216.

first	third	fifth	
second	fourth	sixth	

- Other adapters are installed right-to-left in the first-available slot beginning with slot 8 on the bottom and far right.

eighth	sixth	fourth	third
seventh	fifth	second	first

Model 400 Slots and Adapters

There are two large slots, designated *A* and *B*, on the IBM 2216 Model 400. Slot *A* is unused. Slot *B* is occupied by the system card. In addition, there are eight adapter slots, designated 1 through 8.

- 2280 or 2281 — If **six** Token-Ring (FC 2280) and Ethernet (FC 2281) adapters are installed in any combination, no other adapters can be installed.
- 2280 or 2281 — If a combination of **five** 2280 and 2281 adapters is to be installed, then two other adapters can also be installed.
- The IBM 2216 supports a maximum of:
 - **Four** channel adapters, which can be Parallel Channel Adapters (FC 2299) in any combination with ESCON adapters (FC 2287)
 - **Two** ATM adapters (FC 2284, 2293, 2294, or 2295)

Note: This adapter is also used for fast token-ring (FasTR)

- **One** 4-port ISDN PRI/Channelized (T1/J1 interface) adapter (FC 2297)

One 4-port ISDN PRI/Channelized T1 Daughter card (FC 2251) can be added to the base 4-port ISDN PRI/Channelized T1/J1 adapter (which produces a total of 8 ports on a single adapter).

- **One** 4-port ISDN PRI/Channelized (E1 interface) adapter (FC 2298)

One 4-port ISDN PRI/Channelized E1 Daughter card (FC 2252) can be added to the base 4-port ISDN PRI/Channelized E1 adapter (which produces a total of 8 ports on a single adapter).

- **Four** ISDN adapters (FC 2283 or FC 2292)

A maximum of 8 ISDN interfaces are allowed. Four can be FC 2283 or 2292.

Note: You can configure a 2216 with as many high-speed adapters (FDDI FC 2286, 10/100-Mbps Ethernet FC 2288, and HSSI FC 2289) as desired; however, you may not be able to achieve full media throughput concurrently on all the adapters. When planning for installation, review system performance expectations with an IBM representative.

Adapters can be installed in any of the eight adapter slots with the following restrictions:

1. If the 2-port Token-Ring (FC 2280) or 2-port Ethernet (FC 2281) adapter is plugged into slot 3 and active, then slot 4 cannot be used.
2. If the 2-port Token-Ring (FC 2280) or 2-port Ethernet (FC 2281) is plugged into slot 4 and active, then slot 3 cannot be used.
3. If the 2-port Token-Ring (FC 2280) or 2-port Ethernet (FC 2281) adapter is plugged into slot 7 and active, then slot 8 cannot be used.
4. If the 2-port Token-Ring (FC 2280) or 2-port Ethernet (FC 2281) adapter is plugged into slot 8 and active, then slot 7 cannot be used.

Appendix D. 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 you to multiple-word terms that have the same last word.

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

A

A. Ampere.

ac. Alternating current.

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

Advanced Peer-to-Peer Networking (APPN) network node. A node that offers a broad range of end-user services and that can provide the following:

- Distributed directory services, including registration of its domain resources to a central directory server
- Topology database exchanges with other APPN network nodes, enabling network nodes throughout the network to select optimal routes for LU-LU sessions based on requested classes of service
- Session services for its local LUs and client end nodes
- Intermediate routing services within an APPN network

agent. A system that assumes an agent role.

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

ANSI. American National Standards Institute.

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.

APPN node. Advanced Peer-to-Peer Networking (APPN) node.

asynchronous transfer mode (ATM). A connection-oriented access service to transfer data, voice, and video on broadband networks at very high speeds. These traffic types are mixed together over the available link bandwidth rather than being isolated into dedicated chunks of bandwidth.

The current ATM is for speeds of 155 Mbps and 622 Mbps but it will be capable of speeds in range of gigabits per second.

ATM divides all traffic into fixed-length cells, each containing 48 bytes of user data and five bytes of overhead, and manages the flow of these cells through the network.

ATM. Asynchronous Transfer Mode.

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.

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

Bc. Committed burst size.

Be. Excess burst size.

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.

broadband. A large frequency band allowing different kinds of transmissions, such as coded voice, video, and data, at the same time.

BSC. Binary synchronous communication.

C

CAS. Channel associated signaling.

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.

CCS. (1) common channel signaling (2) change control server.

CDB. Configuration database.

CES. Circuit emulation service.

channelization. The process of breaking the bandwidth on a communication line into a number of channels, possibly of different size. Also called *time division multiplexing* (TDM).

CIR. Committed information rate.

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*.

CMIP. Common Management Information Protocol.

CMIS. Common Management Information Services.

CMOT. CMIP over TCP/IP.

CNM. Communication network management.

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)

CP. Control point.

CRC. Cyclic redundancy check.

CU logical address. The control unit (CU) address defined in the host for the 2216. This value is defined in the host Input/Output Configuration Program (IOCP) by the CUADD statement on the CNTLUNIT macro instruction. The control unit address must be unique for each logical partition defined on the same host.

D

DAS. Dual-attaching system (for FDDI).

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.

dc. Direct current.

DCD. DC distribution (module).

DCE. Data circuit-terminating equipment.

DC48. DC power input type -48V.

dependent LU requester (DLUR). An APPN end node or an APPN network node that owns dependent LUs, but requests that a dependent LU server provide the SSCP services for those dependent LUs.

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

device address. The unit address transmitted on the channel path to select a 2216 device. It is also referred to as subchannel number in S/370 I/O architecture. This value is defined in the host IOCP by the UNITADD statement on the CNTLUNIT macro instruction for the real device.

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

DIMM. Dual inline memory module.

DLCI. Data link connection identifier.

DLSw. Data link switching.

DLUR. Dependent LU requester.

DTE. Data terminal equipment. (A)

DTMF. Dual-tone modulation frequency.

DTR. Data terminal ready.

Dual inline memory module (DIMM). A small circuit board with memory-integrated circuits containing signal and power pins on both sides of the board.

E

E&M. Earth & mark.

EIA. Electronic Industries Association.

EIA unit. A unit of measure, established by the Electronic Industries Association, equal to 44.45 millimeters (1.75 inches).

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.

EMIF. ESCON Multiple Image Facility.

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)*.

ESCD. ESCON Director.

ESCON. Enterprise Systems Connection.

ESF. Extended status flags.

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).

ELS. Event Logging System

F

FANB. Fan box.

FasTR. Fast Token Ring encapsulated in ATM.

FAT. File allocation table.

fax. Hardcopy received from a facsimile machine. Synonymous with *telecopy*.

FDDI. Fiber distributed data interface (100 Mbps fiber optic LAN)

FEP. Front-end processor.

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.

FR. Frame relay.

FRAD. Frame relay access device.

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.

FRFH. Frame relay frame handler.

front-end processor (FEP). A processor, such as the IBM 3745 or 3174, that relieves a main frame from the communication control tasks.

FRTE. Frame relay terminal equipment.

FRU. Field replaceable unit.

FTP. File Transfer Protocol.

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.

Gbps. Gigabits per second (1 000 000 000 bits per second).

GUI. Graphical user interface.

H

HPDT. High Performance Data Transfer

HDLC. High-level data link control.

high-level data link control (HDLC). An access service used over data networks. It uses a non-real-time connection.

HDLC-like data link control, for example:

- Synchronous data link control (SDLC) used with SNA, or
- Link access procedure for D-channel (LAP-D) used with ISDN.

high-performance file system (HPFS). In the OS/2 operating system, an installable file system that uses high-speed buffer storage, known as a cache, to provide fast access to large disk volumes. The file system also supports the coexistence of multiple, active file systems on a single personal computer, with the capability of multiple and different storage devices. File names used with the HPFS can have as many as 254 characters.

high-performance routing (HPR). An addition to the Advanced Peer-to-Peer Networking (APPN) architecture that enhances data routing performance and reliability, especially when using high-speed links.

hot pluggable. Refers to a hardware component that can be installed or removed without disturbing the operation of any other resource that is not connected to, or dependant on, this component.

HPDT. High-Performance Data Transfer.

HPFS. High-performance file system.

HS. High-speed.

HSA. High-speed adapter (module).

HSDS. High-Speed Digital Services.

HSSI. High-speed serial interface.

hub (intelligent). A wiring concentrator, such as the IBM 8260, that provides bridging and routing functions for LANs with different cables and protocols.

I

IDNX. Integrated Digital Network Exchange.

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.

Intermediate Session Routing (ISR). A type of routing function within an APPN network node that provides session-level flow control and outage reporting for all sessions that pass through the node but whose end points are elsewhere.

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. A worldwide network connecting users through autonomous networks in industry, education, government, and research. The Internet network uses Internet Protocol (IP). The major Internet services include electronic mail, FTP, telnet, World Wide Web, and electronic bulletin boards (Usenet). For network interconnection and routing, and Transmission Control Protocol (TCP) for end-to-end control. (A)

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.

ISM. IBM Solution Manager.

ISMD. IBM Software Manufacturing and Delivery.

ISO. International Organization for Standardization.

ISR. Intermediate session routing.

ITU-T. International Telecommunication Union - Telecommunication (replaces CCITT).

K

Kbps. Kilobits per second (1000 bits per second).

kVA. kilovolt amperes.

L

LAN. Local area network.

LAPD. Link access procedure for D-channel.

LCS. Logical channel station.

LED. Light-emitting diode.

LIC. Line interface coupler.

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 Address. For a 2216 with an ESCON Channel Adapter, a port number determined as follows: If one

ESCD is in the communication path, it is the ESCON Director (ESCD) port number that is attached to the host. If two ESCDs are in the path, it is the host-side port number of the ESCD defined with the dynamic connection. When no ESCD is in the communication path, this value must be set to X'01.'

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*.

LMI. Local management interface.

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)*.

logical partition (LP). A subset of the processor hardware that is defined to support the operation of a system control program (SCP). See also *logically partitioned (LPAR) mode*.

logically partitioned (LPAR) mode. A central processor complex (CPC) power-on reset mode that enables use of the PR/SM feature and allows an operator to allocate CPC hardware resources (including central processors, central storage, expanded storage, and channel paths) among logical partitions. In LPAR mode, the ESCON adapter can share a physical fiber connection with multiple host partitions.

LP. Logical partition.

LP number. Logical partition number. This allows multiple logical host partitions (LPs) to share one ESCON fiber. This value is defined in the host Input/Output Configuration Program (IOCP) by the RESOURCE macro instruction. If the host is not using EMIF, use the default of 0 for the LP number.

LPAR. Logically partitioned.

LPAR mode. Logically partitioned mode.

LS. Low-speed.

LSA. Low-speed adapter (module).

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.

MB. Megabyte (1 000 000 bytes).

Mbps. Megabits per second (1 000 000 bits per second).

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.

MLD. Multicast Listener Discovery Protocol.

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.

MOSPF. Multicast Extension to OSPF.

MPC. Multi-Path Channel.

MPC+. High-Performance Data Transfer (HPDT) Multi-Path Channel.

ms. Millisecond (1/1000 second).

N

NDP. Neighbor discovery protocol.

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.

NIC. Network Information Center.

NMS. Network management station.

NNI. Network-to-network interface.

non-return-to-zero change-on-ones recording (NRZ-1). A recording method in which the ones are represented by a change in the condition of magnetization, and zeros are represented by the absence of change. Only the one signals are explicitly recorded. (Previously called *non-return-to-zero inverted*, NRZI, recording.)

NRZ-1. Non-return-to-zero change-on-ones recording.

NSAP. Network service address point.

NSC. Network Support Center.

NVDM. NetView Distribution Manager/6000.

O

OC. Optical carrier.

OSI. Open systems interconnection.

P

packet loss ratio. The probability that a packet will not reach its destination or not reach it within a specified time.

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. (1) (2) Synonymous with *packet mode operation*. See also *circuit switching*.

parallel channel. A channel having a channel-to-control unit I/O interface that uses bus-and-tag cables as a transmission medium. Contrast with ESCON channel.

PCA. Parallel Channel Adapter.

PBX. Private branch exchange.

PCM. Pulse code modulation.

PDH. Plesiochronous digital hierarchy.

permanent virtual circuit (PVC). In X.25 and frame relay communications, a virtual circuit that has a logical channel permanently assigned to it at each data terminal equipment (DTE).

PIM-DM. Protocol-independent multicast-dense mode.

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

PM. Presentation Manager.

PMF. Parameter Management Frame.

PNP. Private numbering plan.

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.

PR/SM. Processor Resource/Systems Manager.

private branch exchange (PBX). A private telephone exchange for transmission of calls to and from the public telephone network.

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.

Processor Resource/Systems Manager (PR/SM). The feature on a 3090 Processor Complex that offers

flexible partitioning of a 3090 processing system into a number of logical partitions. Each partition within a PR/SM environment supports its own MVS or VSE image and VTAM, resulting in a multi-MVS or VSE environment.

PRS. Primary reference source.

PSN. Public switched network.

PSTN. Public switched telephone network.

PTM. Packet transfer mode.

PVC. Permanent virtual circuit.

Q

QoS. Quality of service.

R

rack. A metallic structure, with a standard 19-inch width, that houses Nways Switch hardware elements: logic subrack with modules, fan boxes, and power subrack with power units.

real-time processing. The manipulation of data that are required, or generated, by some process while the process is in operation. Usually the results are used to influence the process, and perhaps related processes, while it is occurring.

RETAIN. Remote Technical Assistance Information Network.

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 refer-

ence 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.

RSC. Remote Support Center.

RSF. Remote Support Facility.

RT. Real time.

S

s. Second.

SDH. Synchronous digital hierarchy.

SDLC. Synchronous Data Link Control.

SDT. Structured data transfer.

Serial Line Internet Protocol (SLIP). A TCP/IP protocol used on a point-to-point connection between two IP hosts over a serial line (for example, an RS/EIA-232 connection into a modem over a telephone line).

In an NBBS network, the SLIP is used over a connection between an Nways Switch administration station (NAS) and an IBM Network Support Center (NSC).

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).

SLA. Serial link architecture.

SLIP. Serial Line Internet Protocol.

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.

SONET. Synchronous optical network.

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.

SRC. System reference code.

STM-1. Synchronous transport module-1.

SW. Switch (module).

SWRD. Switch redrive (module).

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)*.

synchronous optical network (SONET). A US standard for transmitting digital information over optical interfaces. It is closely related to the synchronous digital hierarchy (SDH) recommendation.

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.

TDM. Time division multiplexing.

Telnet. In TCP/IP, an application protocol that allows a user at one site to access a remote system as if the user's display station were locally attached. Telnet uses the Transmission Control Protocol as the underlying protocol.

TFTP. Trivial File Transfer Protocol.

time division multiplexing (TDM). See *channelization*.

TN3270. An informally defined protocol for transmitting 3270 data streams over Telnet.

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.

Transmission Control Protocol/Internet Protocol (TCP/IP). A set of communication 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.

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.

U

UDP. User Datagram Protocol.

UNI. User network interface (protocol).

UTP. Unshielded twisted pair.

V

V ac. Volts alternating current.

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.

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.

virtual connection. In frame relay, the return path of a potential connection.

VPD. Vital product data.

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*.

Index

Numerics

- 2216
 - Network Utility Model TN1 and Model TX1 1-1
 - Nways Multiaccess Connector Model 400 1-1
- 2216 Model 400 2-1
- 2216 Model 400 and Network Utility firmware 4-4

A

- adapter
 - description 2-15, 5-1
 - functions, description 2-15, 5-1
 - Model 400 and Network Utility 2-12
 - planning 5-1
- adapter plugging C-1
- APARs 5-4
- AppleTalk
 - Network Utility and 2216 Model 400 support 2-5
- APPN DLuR
 - with Network Utility 1-4
- APPN LAN/WAN gateway 5-3
- assumptions C-1
- ATM
 - Classical IP 5-4
 - LANE 5-4
 - Network Utility and 2216 Model 400 support 2-5
- availability and backup 5-19

B

- backup
 - configuration example 5-19
 - MPC+ 5-24
 - MPC+ example 5-24
 - TCP/IP environment 5-23
 - TCP/IP environment example 5-23
 - VTAM environment 5-21
 - VTAM environment example 5-21
- Banyan VINES
 - Network Utility and 2216 Model 400 support 2-5

C

- cable pin assignments B-1
- cable requirements 2-22
- cable specifications
 - 1-port ISDN B-11
 - 4-port ISDN B-12
 - EIA 232-E/V.24 B-2
 - HSSI B-9
 - service port B-1
 - V.35 B-4

- cable specifications (*continued*)
 - V.36 B-6, B-7
 - X.21 B-8
 - X.21 direct connect B-8
- channel
 - characteristics, host channel support 5-8
 - distances 5-28
 - functional support
 - ATM Classical IP 5-4
 - ATM LANE 5-4
 - Ethernet 5-4
 - Ethernet V2 5-4
 - Ethernet/802.3 5-4
 - Serial FR, bridged 5-4
 - Serial PPP 5-4
 - Token Ring 5-4
 - network connections 5-6
 - parallel channel cabling considerations 5-28
 - supported 5-7
- command line interface 4-2
- command-line console commands 4-3
- communications supported through LAN/WAN gateway 5-2
- configuration
 - backup example 5-19
 - considerations 5-26
 - network planning 5-26
 - Network Utility typical use configurations 1-10
 - planning activities prior to 5-25
 - rapid 1-10
- configuration and monitoring tools 4-1
- configuration methods 4-1
- Configuration Program
 - hardware and software requirements 3-3
- connections, channel and network 5-6
- corrections, documentation xiv

D

- DECnet V/OSI
 - Network Utility and 2216 Model 400 support 2-5
- dedicated subchannels 5-3
- defining
 - channel attachment 5-25
 - LAN attachment 5-25
- determining system requirements 5-8
- Dial-on-demand and Dial-backup
 - Network Utility and 2216 Model 400 support 2-5
- DLSw
 - with Network Utility 1-4

E

- EIA 232E/V.24 cable specifications B-2
 - EMIF attachment, ES/9000, example 5-12
 - ESA system required 5-4
 - ESCON
 - 2216 Model 400 and Network Utility support 5-1, 5-4
 - adapter planning 5-1
 - channel and configuration examples 5-10
 - features and configuration examples 5-10
 - requirement for ESA system 5-4
 - Ethernet
 - 2216 Model 400 and Network Utility support 5-4
 - 802.3 5-4
 - Network Utility and 2216 Model 400 support 2-5
 - V2 5-4
 - event messages 4-3
 - examples
 - backup configuration 5-19
 - direct attachment, S/390 and 2216 Model 400 or Network Utility 5-10
 - EMIF attachment, ES/9000 processor and 2216 Model 400 or Network Utility 5-12
 - host failure, recovery 5-19
 - LCS and LSA subchannels 5-16
 - MPC+
 - backup 5-24
 - subchannels 5-17
 - single attachment, S/390 and 2216 Model 400 or Network Utility units 5-10
 - system attachment with ESCDs 5-11
 - TCP/IP environment, backup 5-23
 - VTAM environment, backup 5-21
- ## F
- factory plugging defaults C-1
 - FasTR
 - 2216 Model 400 and Network Utility support 5-38
 - adapter support for 5-38
 - requirements 5-38
 - FasTR (Fast Token-Ring)
 - Network Utility and 2216 Model 400 support 2-5
 - FDDI
 - Network Utility and 2216 Model 400 support 2-5
 - fiber optic link planning 2-24
 - firmware
 - 2216 Model 400 and Network Utility 4-4
 - fixes xiv
 - Frame Relay
 - Network Utility and 2216 Model 400 support 2-5
 - frame size 5-32
 - function
 - description 2-15, 5-1
 - support for 2216 Model 400 and Network Utility 5-4

H

- hardware
 - features
 - 2216 Model 400 and Network Utility 2-9
 - requirements 3-2
- help xiv
- host
 - channel support, characteristics 5-8
 - failure, recovery 5-19
 - number of 5-14
 - number of programs supported 5-14
 - planning 5-7
 - programs 5-14
 - dedicated subchannels 5-3
 - interconnect enhancement feature 5-4
 - LAN/WAN gateway 5-2
 - TCP/IP 5-4
 - software 5-14
 - systems, S/370 and S/390 5-8
- HPDT services, MPC+ 5-3
- HSSI cable specifications B-9
- http sites xiv

I

- installation requirements 3-3
- interconnect enhancement feature, required by VTAM 5-4
- Internet resources 5-41
- IPv4
 - Network Utility and 2216 Model 400 support 2-5
- IPv6
 - Network Utility and 2216 Model 400 support 2-5
- IPX
 - Network Utility and 2216 Model 400 support 2-5
- ISDN
 - 2216 Model 400 and Network Utility support 5-35
 - adapter planning 5-35
 - adapter support for 5-35
 - telephone line provisioning 5-36

L

- LAN adapter support 5-4
- LAN attachment 5-25
- LAN Channel Station (LCS)
 - host failure, recovery 5-19
 - subchannels, example 5-16
- LAN/WAN gateway
 - description 5-2
 - number of connections 5-8
 - rules for definitions, LCS and LSA subchannels 5-16
- LCS (LAN Channel Station) 5-16

Link Services Architecture (LSA)
 host failure recovery 5-19
 subchannels, example 5-16
 VTAM, sharing interface 5-14

M

MAS configuration program 4-1
maximum cable distances 5-28
models of the 2216
 Model 400 1-1
models of the Network Utility
 Model TN1 and Model TX1 2-1
monitoring and configuration tools 4-1
monitoring methods 4-2
MPC+ (Multi-Path Channel)
 HPDT services 5-3
 recovery example 5-24
 support, description 5-3
Multi-Path Channel+ (MPC+)
 rules for definitions, subchannels 5-17
MVS/ESA
 2216 Model 400 and Network Utility support 5-4
 APAR for VTAM V3 and ESCON 5-4

N

NetBIOS
 Network Utility and 2216 Model 400 support 2-5
network
 channel connections 5-6
 including 2216 Model 400 or Network Utility in, con-
 siderations 5-26
Network Dispatcher 5-39
 with Network Utility 1-4
network management products 4-3
Network Utility
 Model TN1 and Model TX1 2-1
networks supported 2-3
number of channel-attached hosts and host programs
 supported 5-14
number of host programs supported 5-14

O

operating system
 functional support for 5-4
 MVS 5-4
 required ESA system 5-4
 supported by 2216 Model 400 and Network
 Utility 5-4
 VM 5-4
 VSE/ESA 5-4
optimizing performance 5-32
ordering publications xiii

P

parallel channel
 2216 Model 400 and Network Utility support 5-1
 adapter planning 5-1
 adapter support for 5-1
PCMCIA
 LAN adapter 2-12
performance, optimizing 5-32
physical characteristics of the 2216 Model 400 and
 Network Utility 3-1
physical specifications
 Model 400 3-4
 Network Utility 3-5
pin assignments, cable B-1
planning and preparation
 2216 Model 400 and Network Utility ESCON
 adapter 5-7
 2216 Model 400 and Network Utility Parallel Channel
 adapter 5-7
 2216 Model 400 or Network Utility ESCON
 adapter 5-25
 defining 2216 Model 400 or Network Utility
 channel attachment 5-25
 LAN attachment 5-25
 ESCON adapter 5-1
 frame size 5-32
 host 5-1
 network, including 2216 Model 400 or Network Utility
 in 5-26
 Parallel Channel adapter 5-1, 5-25
 prior to, activities 5-25
 sharing subchannels 5-32
 TCP/IP window size 5-32
 trace function 5-32
 VTAM buffer size 5-32
planning channel attachment 5-25
plugging defaults C-1
plugging sequences C-1
PPP
 Network Utility and 2216 Model 400 support 2-5
prerequisites 5-4
programs, host, interconnect enhancement feature 5-4
protocol, TCP/IP 5-4
protocols supported 2-4
publications
 ordering xiii

R

rack-shelf placement 3-1
recovering from host failures 5-19
replacing adapters 1-10
replacing adapters while 2216 Model 400 is
 operational 1-10

- requirements
 - distances, channel 5-28
 - hardware and software for the Configuration Program 3-3
 - system, determining 5-8
- requirements, installation 3-3

S

- S/390 host
 - direct attachment example 5-10
 - single attachment example 5-10
- SDLC
 - Network Utility and 2216 Model 400 support 2-5
- Serial and ISDN
 - Network Utility and 2216 Model 400 support 2-5
- Serial FR, bridged 5-4
- Serial PPP 5-4
- service port cable specifications B-1
- sharing subchannels 5-32
- slots and adapters C-1
- SNA
 - Network Utility and 2216 Model 400 support 2-5
- SNMP 4-3
- SR/TB
 - Network Utility and 2216 Model 400 support 2-5
- SRB
 - Network Utility and 2216 Model 400 support 2-5
- SRT
 - Network Utility and 2216 Model 400 support 2-5
- standard network management protocol 4-3
- subchannels
 - dedicated 5-3
 - examples
 - LCS and LSA 5-16
 - MPC+ 5-17
 - rules 5-15
 - sharing 5-32
- system
 - operating 5-4
 - requirements, determining 5-8
- system attachment with ESCDs, example 5-11

T

- table-top placement 3-1
- TB
 - Network Utility and 2216 Model 400 support 2-5
- TCP/IP
 - 2216 Model 400 and Network Utility support 5-4
 - LAN/WAN gateway 5-3
 - protocol 5-4
 - recovery example 5-23
 - window size, optimizing performance 5-32
- TCP/IP support 5-4

- Thin Server 5-41
- TN3270E
 - with Network Utility 1-4
- Token Ring 5-4
- Token Ring support 5-4
- Token-Ring
 - Network Utility and 2216 Model 400 support 2-5
- trace function 5-32

U

- updates xiv

V

- V.35 cable specifications B-4
- V.36 cable specifications B-6, B-7
- VM, 2216 Model 400 and Network Utility support 5-4
- VM/ESA, APAR for VTAM V3 and ESCON 5-4
- VTAM 5-4
 - 2216 Model 400 and Network Utility support 5-4
 - buffer size, optimizing performance 5-32
 - environment, 2216 Model 400 or Network Utility backup 5-21
 - HPDT services 5-3
 - Interconnect Enhancement Feature 5-4
 - MPC+ 5-3
 - recovery example 5-21
 - sharing LSA interface 5-14
 - Version 4.1 5-4

W

- Web Server Cache 5-40
- web sites xiv

X

- X.21 cable specifications B-8
- X.25
 - Network Utility and 2216 Model 400 support 2-5

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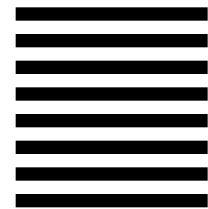
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