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IBM Connectivity Guide

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IBM
International Technical Support Organization
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IBM Connectivity Guide

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Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix B, “Special Notices” on page 329.

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Contents

Preface . . . xi
The Team That Wrote This Redbook . . . xi
Comments Welcome . . . xii

Chapter 1. System/390 Connectivity . . . 1
1.1 Gateways . . . 1
1.1.1 Host Gateway Connectivity . . . 2
1.1.2 Downstream Communication . . . 5
1.2 Open System Adapter (OSA) . . . 6
1.3 3745 and 3746-900 Gateway Function . . . 10
1.3.1 IBM 3746 Multiaccess Enclosure . . . 12
1.4 3172 Gateway Function . . . 14
1.4.1 3172 LAN-to-Host Mode . . . 15
1.4.2 WAN-to-Host Mode . . . 16
1.4.3 3172 Model 3 Characteristics . . . 17
1.4.4 SNA/Communications Program Version 1 Release 1 . . . 18
1.4.5 3172 Model 3 ICP Support . . . 19
1.5 3174 Gateway Function . . . 20
1.6 2216 Nways Multiaccess Connector . . . 22
1.7 RS/6000 Gateway Function . . . 24
1.8 IBM AS/400 as a Remote Gateway . . . 25
1.9 PC Gateway Function . . . 26
1.10 ES/9000 Integrated Communication Adapter . . . 27
1.10.1 Operating System Support . . . 30
1.10.2 ES/9000 Channel and I/O Controller Characteristics . . . 31

Chapter 2. Local Area Network . . . 35
2.1 LAN Interconnection Components . . . 35
2.2 Repeater . . . 36
2.3 Bridges . . . 36
2.4 Routers . . . 43
2.4.1 2210 Nways Multiprotocol Router . . . 44
2.4.2 IBM 2216 Nways Multiaccess Connector . . . 46
2.4.3 IBM 2218 Nways Frame Relay Access Device . . . 48
2.4.4 IBM 6611 Network Processor . . . 50
2.4.5 RouteXpander/2 . . . 53
2.4.6 IBM LAN-to-LAN WAN Program (LTLW) . . . 54
2.4.7 IBM Router Solutions . . . 56
2.5 Switches . . . 57
2.5.1 IBM 2219 Nways Frame Relay Switch . . . 58
2.5.2 IBM 2225 Nways Multiservice Switch . . . 59

2.5.3 IBM 2230 Nways ATM Switch 60
2.5.4 IBM 2220 Nways BroadBand Switch 61
2.5.5 IBM 8210 Nways Multiprotocol Switched Services Server 61
2.5.6 IBM 8270 Nways Token-Ring Switch 61
2.5.7 IBM 8271 Nways Ethernet LAN Switch 62
2.5.8 IBM 8272 Nways Token-Ring LAN Switch 63
2.5.9 IBM 8273 Nways Ethernet RouteSwitch 64
2.5.10 IBM 8274 Nways LAN RouteSwitch 64
2.5.11 IBM 8285 Nways ATM Workgroup Switch 65
2.6 Hubs and Concentrators 66
2.6.1 IBM 6299 Hub for Midrange Systems 66
2.6.2 IBM 8222 Nways Ethernet Workgroup Hub 67
2.6.3 IBM 8223 Fast Ethernet Workgroup Hub 68
2.6.4 IBM 8224 Ethernet Stackable Hub 68
2.6.5 IBM 8225 Fast Ethernet Stackable Hub 68
2.6.6 IBM 8226 Token-Ring RJ45 Multistation Access 69
2.6.7 IBM 8230 Token-Ring Controlled Access Unit 69
2.6.8 IBM 8237 Ethernet Stackable Hub 70
2.6.9 IBM 8238 Nways Token-Ring Stackable Hub 70
2.6.10 IBM 8244 FDDI Workgroup Concentrator 71
2.6.11 IBM 8250 Multiprotocol Intelligent Hub 72
2.6.12 IBM 8260 Nways Multiprotocol Switching Hub 72
2.6.13 IBM 8276 Nways Ethernet RoutePort 73
2.7 Multiplexers 74
2.8 Remote LAN Access 75
2.8.1 8235 Dial In Access to LANs (DIALs) 75
2.8.2 Advanced Radio Communication on Tour (ARTour) 77

Chapter 3. RISC System/6000 79
3.1 RISC System/6000 Connectivity 79
3.1.1 RISC System/6000 Network Support 84
3.2 Communications Server for AIX 85
3.2.1 Communications Server for AIX SNA Gateway 87
3.2.2 SNA Client Access 88
3.3 Connection Program/400 for UNIX Environments 90
3.4 AIX Connections 91
3.5 NetWare for AIX V3.11B 93
3.6 ESCON Channel Connectivity for AIX V1.1 94
3.7 Block Multiplexer Channel Connectivity for AIX V1.1 95
3.8 AIXLink/X.25 V1.1.4 95

Chapter 4. 3174 Establishment Controller 97
4.1 3174 Connectivity Overview 97
4.2 3174 Model Summary 98

4.3 3174 Functional Overview 100
4.3.1 3174 Single Link Multi-Host (SLMH) and Token-Ring 101
4.3.2 3174 Single Link Multi-Host and X.25 101
4.3.3 3174 Single Link Multi-Host and ESCON 101
4.3.4 3174 Channel Attachment and CCA 102
4.3.5 3174 Remote Token-Ring Gateway 102
4.3.6 3174 X.25 Token-Ring Gateway (RPQ 8Q0743) 102
4.4 3174 Configuration Support 103
4.4.1 3174 Peer Communication 105
4.4.2 3174 Advanced Peer-to-Peer Networking (APPN) 107
4.4.3 3174 PU 2.1 Passthru (RPQ 8Q0800) 107
4.4.4 3174 TCP/IP 108
4.4.5 3174 Ethernet and TCP/IP Enhancements (RPQ 8Q1041) 110
4.4.6 3174 ISDN Gateway 110

Chapter 5. AS/400 Connectivity 113
5.1 AS/400 Networking Support 113
5.1.1 AS/400 Communications Hardware 113
5.1.2 AS/400 Adapters and Interfaces 116
5.1.3 Network Architecture Support on Link Protocols 119
5.2 5250 Device Emulation for PC Environments 119
5.3 Remote 5X94 Controllers 120
5.3.1 IBM 5394 Remote Control Unit 121
5.3.2 IBM 5494 Remote Control Unit 121
5.4 AS/400 LAN Features 122
5.4.1 Wireless LAN 123
5.5 AS/400 Communications Applications 124
5.5.1 APPC Applications 124
5.5.2 Client Access for OS/400 Family 125
5.5.3 Client Access for DOS Base 128
5.5.4 Client Access for DOS Extended 129
5.5.5 Client Access for Windows 3.1 131
5.5.6 Client Access for Windows 95/NT 135
5.5.7 Client Access for OS/2 (16-Bit) 137
5.5.8 Client Access for OS/2 Optimized 139
5.5.9 Client Access for UNIX OS 142
5.5.10 IBM RUMBA/400 142
5.5.11 Client Access Console 143
5.5.12 AS/400 to S/390 Applications 144
5.5.13 TCP/IP Support 145
5.5.14 OSI Support 146
5.5.15 NetBIOS Support 147
5.5.16 IPX Support 147
5.5.17 IBM Connection Program/400 for UNIX Environments 147

Chapter 6. IBM Communications Server Products 149
6.1 Communications Server Functions 149
6.1.1 Communications Server Highlights 150
6.2 Communications Server for OS/2 Warp V5.0 154
6.2.1 Communications Server for OS/2 Warp Adapter Support . . . 156
6.2.2 OS/2 Warp Connectivity 162
6.2.3 Communications Manager/2 and Communications Server Comparison 163
6.3 Communications Server for Windows NT 167
6.3.1 Communications Server for Windows NT Communication Adapters 168
6.4 Communications Server for S/390 173
6.5 Communications Server for AIX 174
6.5.1 High Performance Routing 175
6.5.2 Dependant LU Requestor (DLUR) 175
6.5.3 Communications Server for AIX Supported Adapters 175
6.6 IBM eNetwork Host On-Demand Overview 177
6.6.1 Host On-Demand Platforms 179
6.6.2 Host On-Demand Comparison 179

Chapter 7. IBM TCP/IP Products 181
7.1.1 TCP/IP Connectivity 183

Chapter 8. APPN Product Implementation 185
8.1 APPN Product Support Summary 188
8.2 Dependent LU Requester/Server (DLUR/DLUS) 189
8.3 Connection Network 191
8.4 High-Performance Routing (HPR) 191

Chapter 9. Frame Relay 193
9.1 Multiprotocol Interconnect over Frame Relay 195
9.2 Frame Relay Access Devices (FRADs) 195
9.3 Frame Relay to ATM Interworking 196
9.4 ACF/NCP and 3745/6 Frame Relay Support 197
9.4.1 NCP Frame Relay Support 198
9.5 6611 Network Processor Frame Relay 200
9.5.2 Congestion Management 201
9.6 2220 Nways Broadband Switch 202
9.7 IBM 3174 Establishment Controller Frame Relay 204
9.8 IBM 3172 Interconnect Controller Frame Relay 206
9.8.2 Local Management Interface (LMI) 207
9.8.3 Congestion Management 207
9.9 IBM AS/400 Frame Relay 208
9.10 IBM Nways 2219 and IBM Nways 2225 209

9.10.1 IBM Nways 2219 Frame Relay Switch 209
9.10.2 IBM Nways 2225 MultiService Switch Models 400 and 450 . . 209
9.11 2210 Nways Multiprotocol Router and 2216 Nways Multiaccess Connector 211
9.11.1 Local Management Interface (LMI) 211
9.11.2 Congestion Management 212
9.12 Communications Server for OS/2 Warp V4R1 213
9.12.1 SNA over Frame Relay 213
9.12.2 TCP/IP over Frame Relay 213
9.13 IBM 2218 Nways Frame Relay Access Device 214
9.13.1 2218 SNA Support 215
9.13.2 2218 Bisync Support 215
9.13.3 Other 2218 Protocol Support 215
9.13.4 Summary of IBM 2218 Features 215
9.13.5 2218 Frame Relay Node Features 216
9.14 IBM RouteXpander/2 Frame Relay 217

Chapter 10. AnyNet 219
10.1 AnyNet Product Overview 221
10.1.1 Sockets over IPX 221
10.1.2 Sockets over NetBIOS 221
10.1.3 Sockets over SNA 222
10.1.4 SNA over TCP/IP and APPC over TCP/IP 224
10.1.5 IPX over SNA Gateway 227
10.1.6 NetBEUI over SNA 227
10.2 MVS VTAM AnyNet Feature 227
10.3 Communications Server for Windows NT 228
10.4 AIX SNA Server/6000 V2.1.2 and Communications Server for AIX V4.2 228
10.4.1 AIX APPC over TCP/IP and APPC over TCP/IP Gateway . . . 228
10.4.2 AIX Sockets over SNA and Sockets over SNA Gateway . . . 229
10.5 Communications Server for OS/2 230
10.5.1 LAN Gateway 231
10.6 AnyNet/2 V2.0 234
10.6.1 SNA over TCP/IP 235
10.6.2 Sockets over SNA 235
10.6.3 Sockets over NetBIOS 235
10.6.4 Sockets over IPX 236
10.7 AnyNet/2 NetBEUI over SNA 238
10.8 AnyNet IPX over SNA Gateway for OS/2 238
10.9 AnyNet APPC over TCP/IP for Windows 240
10.10 AnyNet Advantages 240
10.10.1 Sockets over SNA Advantages 241
10.10.2 NetBIOS over SNA Advantages 241

10.10.3 SNA over TCP/IP Advantages 242
10.10.4 IPX over SNA Advantages 242

Chapter 11. Mobile Connectivity 243
11.1 eNetwork Wireless Network Integration 243
11.2 The eNetwork Wireless Product Family 243
11.2.1 eNetwork Wireless Mobile Clients 245
11.2.2 eNetwork Wireless Gateway 245
11.2.3 eNetwork Web Express 246
11.2.4 eNetwork Emulator Express 247

Chapter 12. Network Management 251
12.1 Nways Network Manager Family 251
12.1.1 Management Solutions for Small to Medium Networks 253
12.1.2 Management Solutions for Medium to Large Networks (Campus) 257
12.1.3 Management Solutions for Wide Area Networks (WAN) 262
12.2 Management Options of IBM Networking Devices 265

Chapter 13. Internet Connection Secure Servers 271
13.1 IBM Internet Connection Secure Server for AIX, Windows NT, OS/2 Warp, HP-UX, and Solaris 271
13.2 IBM Internet Connection Secure Server for OS/390 273

Chapter 14. Network Station 275
14.1 IBM Network Station Overview 275
14.2 Supported Platforms 277
14.3 Software Requirements 278
14.4 Network Station Manager 279
14.5 Network Station Operations 280

Chapter 15. IBM Personal Communications Family 283
15.1 Personal Communications Overview 283
15.1.1 Personal Communications for OS/2 V4.1 283
15.1.2 Personal Communications for Windows 95 V4.1 284
15.1.3 Personal Communications for Windows V4.1 284
15.1.4 Personal Communications AS/400 and 3270 V4.11 285
15.1.5 eNetwork Personal Communications V4.2 285
15.2 Personal Communications Family Products Comparison 286

Chapter 16. eNetwork 291
16.1 eNetwork - The Current Solution 291
16.2 eNetwork Communications Suite for Windows, Windows 95 and Windows NT V1 292

Chapter 17. Asynchronous Transfer Mode (ATM) 295
17.1 What Is ATM? 295
17.1.1 Terminology 296
17.2 The IBM ATM Family of Products 299
17.3 ATM Workstation Adapters 304
17.3.1 TURBOWAYS 25 Mbps ATM Adapter 305
17.3.2 TURBOWAYS 100 Mbps ATM Adapter 305
17.3.3 TURBOWAYS 155 Mbps ATM Adapter 305
17.3.4 Interphase Adapters 306
17.4 Adapters for Various Operating Systems 306
17.4.1 OS/2 306
17.4.2 Windows NT 307
17.4.3 Windows 95 308
17.4.4 DOS/Windows V3.11 308
17.4.5 AIX 309
17.4.6 Novell NetWare 310
17.5 ATM Solutions 310
17.5.1 Connect Ethernet with ATM 310
17.5.2 Token-Ring with 8272 and ATM 155-Mbps UFC 312
17.5.3 Bridging and Routing over ATM with 8210 MSS Server 313
17.5.4 IBM 8260 Switching Modules with ATM Uplinks 316

Appendix A. Product Number List 317

Appendix B. Special Notices 329

Appendix C. Related Publications 333
C.1 International Technical Support Organization Publications 333
C.2 Redbooks on CD-ROMs 335
C.3 Other Publications 335

How to Get ITSO Redbooks 337
How IBM Employees Can Get ITSO Redbooks 337
How Customers Can Get ITSO Redbooks 338
IBM Redbook Order Form 339

Glossary 341

Index 351

ITSO Redbook Evaluation 353

Preface

This redbook is intended to help the reader understand IBM networking products, their features and how they coexist and compare with each other. It covers a wide range of networking products and architectures giving the reader an overview of current connectivity options. This is an excellent place to start when planning to upgrade or design a network.

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Chapter 1. System/390 Connectivity

In this chapter, we concentrate on controllers that provide gateway functions for mainframes running MVS or VM operating systems. When we refer to local gateways, we mean controllers that are channel-attached to a host processor and provide gateway functions for traffic between the mainframe host and the downstream devices.

Gateways store and forward packets of data between dissimilar networks. The term gateway can be used in a generic sense that applies to any layer of the OSI Model. A data link layer gateway is called a bridge and a router is a gateway at the network layer. However, more commonly, a gateway is used to mean a device that handles interconnection and the transfer of data between entities in layers 4 through 7 of the systems network architecture (SNA) or the open systems interconnection (OSI) reference model. (See Figure 17 on page 36.) Thus, a gateway is required when an entity using one protocol needs to communicate with another entity using a different protocol, when the addressing structure of the two entities is inconsistent, or when connection is required between independent networks.

1.1 Gateways

The following products are channel-attached controllers that provide some level of gateway function to an MVS or VM mainframe host:

- OSA (Open System Adapter)
- 3745 Communication Controller (NCP)
- 3746-900 Expansion Unit for the 3745 (under NCP control)
- 3746-900 Expansion Unit stand-alone (no NCP)
- 3746-950 Nways Controller 950
- 3172 Interconnect Controller Model 3
- 3174 Establishment Controller (local models - xxL)
- 2216 Nways Multiaccess Connector
- RS/6000

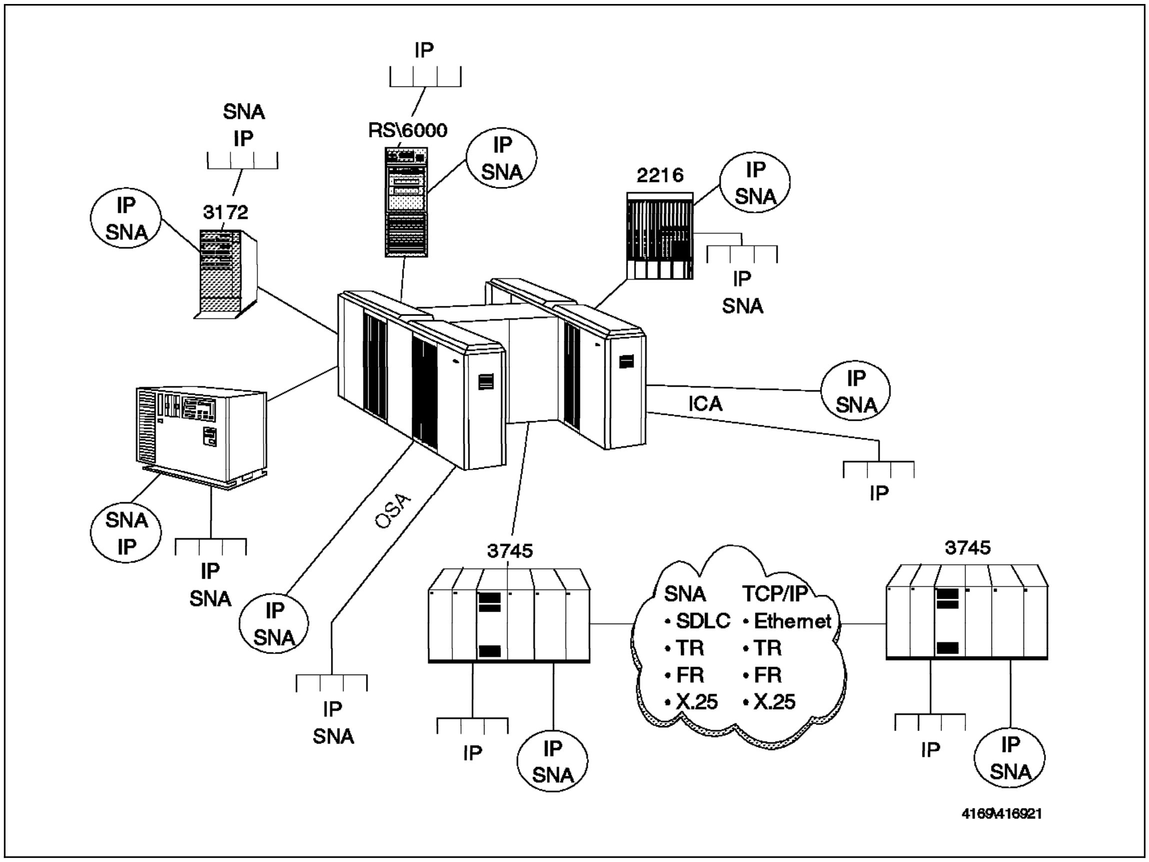


Figure 1. Host Gateway Connections

In this document, when we refer to a remote gateway we mean a device that is not channel-attached to a host S/390, but provides host connection to downstream devices. For example, a remote 3745 can be SDLC or token-ring attached to a local 3745.

1.1.1 Host Gateway Connectivity

The following tables outline different hardware combinations of host gateways to provide SNA and IP data being passed between the host and downstream devices.

1.1.1.1 Host to Gateway SNA/APPN Connectivity

Table 1 on page 3 provides an overview of each local gateway and its ability to pass SNA data between downstream devices and the host.

Table 1. Host Gateway SNA/APPN Connectivity								
Connectivity	**OSA**	**RS/6000 1**	**3172**	**3745**	**3746-900 (NCP)**	**3746-9x0 (stand-alone)**	**3174-xxL**	**2216-400**
Max Parallel Channels	N/A	2	2	16	No	No	1	No
Max ESCON Channels Max LPARs	N/A 8	4 32	1 16	no 2	10 160	10 160	1 8	4 32 3
Max LAN Adapters	5 ports per feature or 80/host	12	4	29	21	20	1	6
Ethernet	5 ports per feature or 80/host	12	4	29	No	No	1	6
Token-Ring	5 ports per feature or 80/host	12	4 4	29	21	20	1	6
FDDI 2	1 port per feature or 16/host	8	1	No	No	No	no	SOD 6
ATM	SOD 6	2	1	No	2	2	No	2
Max SNA DSPU	255/ port 5	9999	255/ port 5	9999	2000/ adapter, 20000 total	500/ adapter, 2000 total	250	1500

Note:

1 The values apply to 9076-308 High-Node.

2 When attached to the 3746 Expansion Unit Model 900, additional capacity and functionality of this unit are offered, including the ESCON channel.

3 The maximum number of LAN adapters can be any combination of these adapters. If an FDDI adapter is present in the 3172, then the following slot may not contain a LAN adapter card of any type. A FDDI card reduces the max. available LAN adapters to 3.

4 The number of LPARs is influenced by several factors. One LSA subchannel is required for each LPAR running VTAM not using MPC+ (Multi Path Channel) and two or more subchannels are required for each MPC+ interface. See *GA27-4193-00* for detailed information.

5 The limit is caused by the VTAM XCA major node.

6 SOD is statement of direction.

1.1.1.2 Host to Gateway IP Connectivity

Table 2 provides an overview of each local gateway and its ability to pass IP data between downstream devices and the host.

Table 2. Host Gateway IP Connectivity

Connectivity	OSA 1	RS/6000 2	3172	3745	3746-900 3	2216-400
Max.Channels	N/A	2	2	16 4 5	No	No
Max ESCON Max LPARs	N/A 1	4 16	1 6 4	No 7	10 160	4 16 8
Max LAN Adapters	5 80/host	12	4	29	21	6
Ethernet	5 80/host	12	4	16	21	6
Token-Ring	5 80/host	12	4	29	21	6
FDDI	1 32/host	8	1	No	No	SOD 10
ATM	SOD	2	1	No	2	2
Max TCP/IP WS	4000(host)	no limit	no limit	no limit	no limit	TCP/IP MVS 5000 9 VM 2000 9

Notes:

1 When integrated in a host/server environment, the OSA adapter provides direct connectivity between programs running on this host and its clients on the LAN.

2 The values apply to 9076-308 High-Node.

3 3745 Models 130 and 170 can have up to 4 parallel channel adapters.

4 3745 Models x10 and x1A can have up to 16 parallel channel adapters.

5 The 3172 Model 3 supports one ESCON adapter if feature code 2800 is installed or two ESCON Single Slot adapters (feature 2801).

6 When attached to the 3746 Expansion Unit Model 900 full additional capacity and functionality of this unit is offered, including the ESCON channel.

7 The 3746-900 supports 10 ESCON adapters (160 hosts). A 3745 with a 3746-900 supports 176 hosts with the x1A Models and 164 with the 17A Model. IP is supported over ESCON only for the 3746 models. IP is not supported downstream for the 3746 models.

8 The number of LPARs is affected by several factors. See *GA27-4193-00* for detailed information.

9 The number of TCP/IP sessions depends on the number of sockets.

10 SOD is statement of direction.

1.1.2 Downstream Communication

Table 3 and Table 4 summarize the downstream capabilities available on OSA, RS/6000, 3174, 3172, 3745, 3746-900, 3746-950, 2216-400. Usually, these functions represent capabilities beyond those of a VTAM token-ring gateway and provide the basis for evaluating these controllers for other unique requirements.

1.1.2.1 Gateway Downstream SNA/APPN Connectivity

Table 3. SNA/APPN Downstream Communications

Downstream Communications	OSA	RS/6000	3174 xxL 1	3172 ICP 3.5 2	3745	3746-900 NCP	3746-9x0 stand alone	2260-400
SDLC		X	X	X	X	X	X	X
ASCII			X		X			
Frame relay				X	X	X		X
X.25		X	RPQ	RFC 1356	NPSI	NPSI		X
X.21		X		Leased	X21SH /MPS	switched		
ISDN			X			SOD 3	SOD 3	X
Bisync					X			
Token-Ring	X	X	X	X	X	X	X	X
FDDI	X	X		X			SOD 3	

Notes:

1 The 3174 requires a CCA adapter to support concurrent channel and SDLC or X.25 communication. AEA is required for ASCII support.

2 The 3172 supports SDLC for SNA traffic to the host and frame relay for TCP/IP and SNA flows to the host. The 3172 supports frame relay for bridging and routing functions supplied by RXR/2.

3 SOD is statement of direction.

1.1.2.2 Gateway Downstream IP Connectivity

Table 4 (Page 1 of 2). IP Downstream Communications

Downstream Communications	OSA	RS/6000	3174 xxL	3172 ICP 3.5	3746-900 (NCP)	3745	3746-9x0 stand-alone	2216-400
PPP		X						
ASCII		SLIP						
Frame relay				X		X		X
X.25		X		X		X		X
X.21								
ISDN							X	
ATM	SOD 1	X						

Table 4 (Page 2 of 2). IP Downstream Communications								
Downstream Communications	**OSA**	**RS/6000**	**3174 xxL**	**3172 ICP 3.5**	**3746-900 (NCP)**	**3745**	**3746-9x0 stand-alone**	**2216-400**
Token-Ring	X	X	X	X		X		X
Ethernet	X	X	X	X		X		X
FDDI	X	X		X		X		
Note: 1 SOD is statement of direction.								

1.2 Open System Adapter (OSA)

There are two types of OSA adapters available for use on the S/390 parallel and transaction servers, as well as for the ES/9000 711- and 511- based models. OSA-1 and OSA-2 adapters provide interfaces to token-ring, Ethernet and FDDI; in addition OSA-2 supports an ATM interface.

The OSA adapters are supported by SNA/APPN, TCP/IP and IPX protocols. In addition to the integrated direct LAN connectivity, OSA performs TCP/IP protocol processing (TCP/IP offload) and supports the LAN Resource Extension and Services/MVS (LANRES/MVS) program product as well as the LAN File Services/ESA (LFS/ESA) program product for NFS clients.

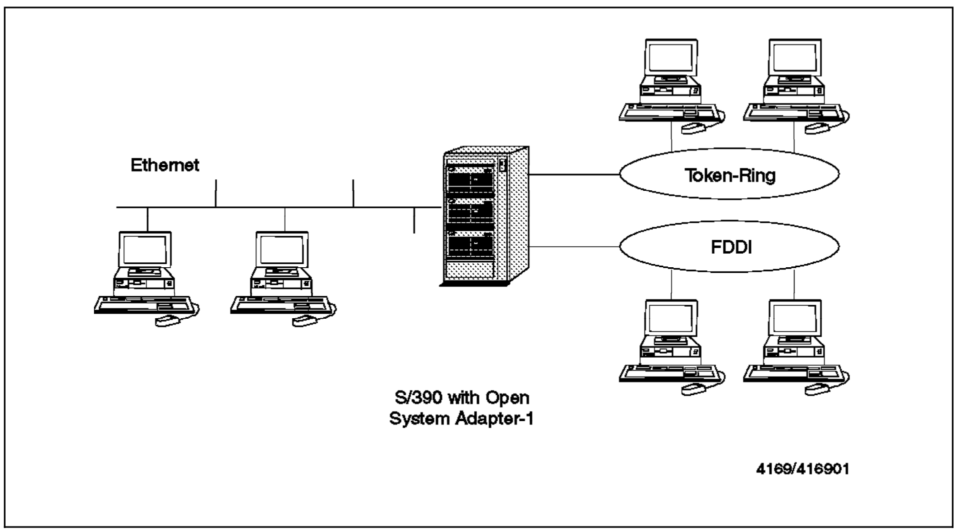


Figure 2. Local Gateway Communication - OSA-1

Table 5 on page 7 shows the maximum number of OSA-1 features that can be installed in the mentioned models.

Table 5. OSA Adapter 1 Communication

					FDDI **1**		Token-Ring or Ethernet **2**	
Models	SEC **3**	Max OSA Cages	Max Card Slots/ OSA Cage	Max Card Slots/CEC	Max. Features	Max Ports	Max Features	Max Ports
9021 711-based	236422	4	8	32	32	32	16	80
9121 511-based	C23956	2	8	16	16	16	8	40
9672 E01-E08, P02, P03	D79759	2	9	9	18	18	8	40
9672 R11-R61, R12-R52,R72,RA2 R53-R83,RX3	D79759 E45548 E45548	1	9	9	9	9	4	20

Notes:

1 Each feature represents one card and provides one port.

2 Each feature represents two cards and provides five ports.

3 SEC is System Engineering Change. The installed level has to be equal or higher than the level mentioned in this table.

The Open Systems Adapter 2 (OSA 2) is an integrated feature that has been implemented in the Models R2 and R3 of the S/390 parallel enterprise server to provide a lower-cost way to access SNA/APPN and TCP/IP applications using Ethernet, token-ring, FDDI or ATM connections.

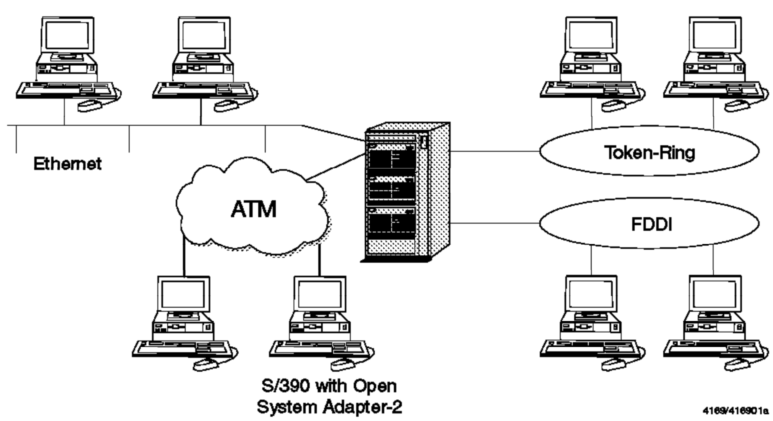


Figure 3. Local Gateway Communication - OSA-2

Table 6 on page 8 shows the maximum number of OSA-2 features that can be installed in the mentioned models.

Model	SEC [1]	max. features	ENTR	FDDI	ATM
9672 R12-R52,R72,RA2 R53-R83,RX3	E45548 E45548	12	12	12	12

Table 6. OSA Adapter 2 Communication

Note:

[1] SEC is System Engineering Change. The installed level has to be equal or higher than the level mentioned in this table.

The OSA-2 has an Ethernet/token-ring (ENTR) feature with two independent ports. The ports can be configured in either half-duplex or full-duplex as two Ethernets, two token-rings or one Ethernet and one token-ring.

The OSA-2 FDDI feature has one port that supports dual-ring or single-ring attachment, as well as attachment to an optical bypass switch. The LAN must conform to either ANSI X3T9.5 or ISO 9314 specification.

The OSA-2 ATM features have one physical port and two logical ports that provide access to token-ring or Ethernet LANs attached to a high-speed ATM network (multi-mode and single-mode). Each logical port is configured independently as token-ring or Ethernet and they support TCP/IP, SNA/APPN or both.

The maximum number of 12 installable adapter cards can all be ENTR or ATM or any mix of these features.

OSA-2 can be configured in several mode combinations depending on system and network requirements:

- TCP/IP Passthru Mode (non-shared port)

  In this mode, an OSA-2 port is capable of transferring TCP/IP-LAN traffic to and from just one TCP/IP host or logical partition.

- TCP/IP Passthru Mode (shared port)

  In this mode, an OSA-2 port is capable of transferring TCP/IP-LAN traffic to and from more than one TCP/IP host within multiple logical partitions.

- SNA Mode (non-shared port)

  In this mode, an OSA-2 port is capable of transferring SNA-LAN traffic to and from just one SNA host or logical partition.

- SNA Mode (shared port)

  In this mode, an OSA-2 port is capable of transferring SNA-LAN traffic to and from multiple SNA hosts in different logical partitions.

- TCP/IP and SNA Mixed Mode (shared port)

In this mode, an OSA-2 port is capable of transferring TCP/IP-LAN and SNA-LAN traffic to and from more than one TCP/IP and SNA logical partition.

- TCP/IP and SNA Mixed Mode for OSA-2 ATM (shared port)

  In this mode, one physical ATM port can be configured into two logical ports. Each logical port may then be configured to support TCP/IP traffic, SNA traffic or both. Each logical port is capable of transferring TCP/IP- and SNA-LAN traffic to and from one or multiple TCP/IP and SNA logical partitions.

OSA is supported by MVS/ESA, VM/ESA and VSE/ESA. The following list shows the minimum level of the supported operating systems:

- MVS/ESA SP Version 4 Release 3
- VM/ESA Version 1 Release 2.2
- VSE/ESA Version 2 Release 2.1

Table 7 references the OSA support in the available operating systems and the applications that can be used with the OSA.

Table 7. OSA Scenarios

	OSA1			OSA2		
Application	**MVS**	**VM**	**VSE**	**MVS**	**VM**	**VSE**
SNA/APPN Passthru	X 1	X 1		X 1	X 1	X
TCP/IP Passthru	X 2	X 3		X 2	X 3	
TCP/IP Offload	X 4			X 4		
LS MVS LFS MVS	X 5					
LANRES	X 6					

Notes:

1 VTAM V4R2 required

2 TCP/IP V2R2.1 required

3 TCP/IP V2R3 required

4 TCP/IP V3R1 required

5 LFS/ESA V1R2.1 required

6 LANRES V1R3 required

SNA Environment: OSA supports the traditional hierarchical subarea environment. In SNA networks the OSA is quite similar to the IBM 3172 Interconnect Controller and is defined as an XCA major node to VTAM.

APPN: OSA does not differentiate between traditional SNA and APPN. The OSA is not an APPN network node; thus, it does not provide dynamic APPN routing, but rather provides static routing to VTAM based on the SAP address and the adapter port.

TCP/IP Passthru: Passthru mode is when the protocol processing of the IP layer and above is done by TCP/IP. In this case there is a higher performance than in the offload mode.

TCP/IP Offload: The TCP/IP protocol processing is performed on the adapter; this reduces the CPU load.

LFS/ESA: OSA enables large scale file serving for TCP/IP NFS clients via the LFS/ESA program; OSA provides caching for NFS requests.

LANRES/MVS: OSA enables large-scale disk serving for NetWare NFS clients via the LANRES/MVS program.

Each LAN port on an open system adapter can be shared across multiple logical partitions (LPARs) when OSA is used for SNA, APPN, TCP/IP Passthru, and LANRES. A LAN port is dedicated to an LPAR when running TCP/IP offload or LFS/ESA modes.

1.3 3745 and 3746-900 Gateway Function

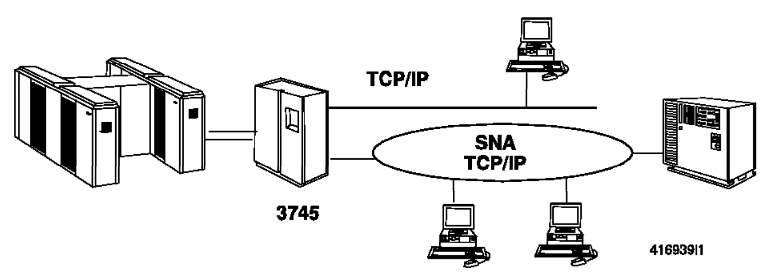


Figure 4. 3745 Local Gateway

The 3745 offers a variety of LAN-to-channel options, providing connectivity for both SNA and TCP/IP through traditional networks. The 3745 can act as a local gateway (channel-attached) or as a remote gateway (remote linked). As a gateway, the 3745 performs the function of routing data through the network rather than relying on an attached mainframe. This capability is provided for SNA, TCP/IP, frame relay, X.25, and X.21.

The individual 3745 models provide various types of connectivity for different network requirements.

Table 8. 3745/3746 Connectivity

	3745-170		**3745-17A + 3746-900**		**3745-X10**		**3745-X1A + 3746-900**		**3746-9x0**	
	Adapters	Ports	Adapters	Ports	Adapters	Ports	Adapters	Ports	Adapters	Ports
Parallel Channel Adapters	4	4	4	4	16	16	16	16		
ESCON Channel Adapters	-	-	10	160	-	-	10	160	10	160
Lines (Low/Medium)	9	96	6+10	96+ 600	32	896	32+ 10	896+ 600	10	240
Lines (T1/E1)	2	2	2+10	2+20	8	8	8+10	8+20	10	20
Token-Ring (TIC1/TIC2)	1	2	1	2	4	8	4	8		
Token-Ring (TIC3)	-	-	10	21	-	-	10	21	10	20
Ethernet	2	4	2	4	8	16	8	16		

Note: T1 lines operate at 1.544 Mbps. E1 lines operate at 2.048 Mbps.

PTF UN84059 is available for MVS TCP/IP Version 3.1 to allow the 3745 to send native IP traffic to TCP/IP over the channel. Without this PTF, IP is encapsulated in an SNA frame using the TCP/IP SNALINK LU0 function. The NCP ROUTED function still requires the SNALINK session.

The 3745 can act as a remote gateway for SNA and TCP/IP from token-ring LANs and TCP/IP from Ethernet LANs to an S/390 by transporting data over the network using the following protocols:

- SDLC (SNA only)
- X.25
- Frame relay
- Token-ring
- Ethernet (TCP/IP only)

The IBM 3746 Model 900 is an expansion unit that provides the IBM 3745 access to ESCON channel adapters and additional communication line and token-ring adapters. The 3746 Model 900 can operate as an APPN network node independently from NCP and as an SNA subarea or composite network node (CNN) controlled by NCP. The IBM 3746 Model 900 is field convertible to the IBM 3746 Nways Controller Model 950.

The 3746-900 under NCP control can act as a remote gateway for SNA on token-ring LANs to an S/390 by transporting data over the network using the following protocols:

- SDLC
- X.25
- Frame relay
- Token-ring

The IBM 3746 Model 950 Nways Multinetwork Controller is a stand-alone APPN network node supporting ESCON channel links, token-rings, and communication line interfaces.

The 3746-900 in stand-alone mode and the 3746-950 can act as remote gateways for SNA on token-ring LANs to an S/390 by transporting data over the network using the following protocols:

- SDLC
- Token-ring

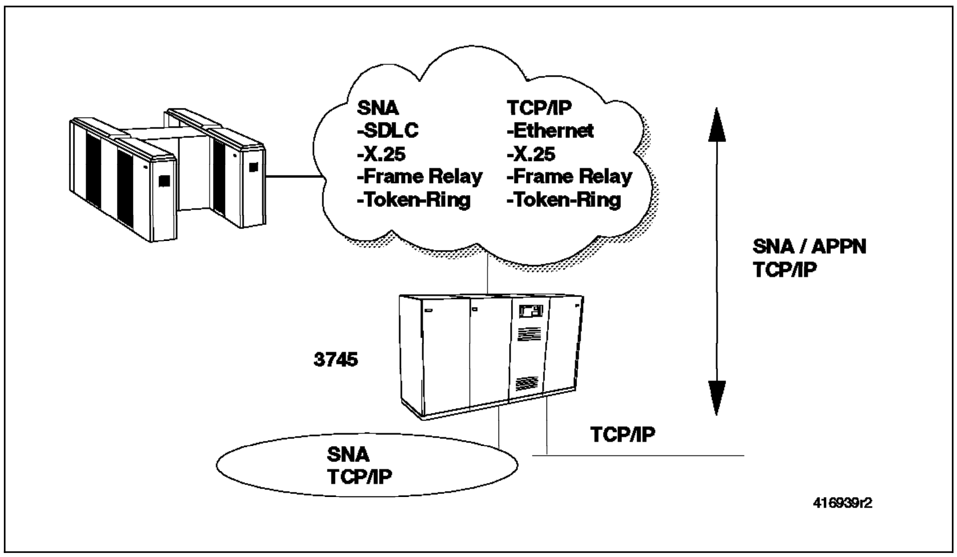


Figure 5. 3745 Remote Gateway

1.3.1 IBM 3746 Multiaccess Enclosure

The IBM 3746 Nways Controller provides a Multiaccess Enclosure using the IBM 2216 technology. It offers additional routing functions primarily oriented to high speed technologies.

The Multiaccess Enclosure offers a wide range of network connectivity options with the routing of multiprotocol traffic. It enables you to interconnect multiple traffic flows, such as SNA/DLUR, TCP/IP, DLSw, APPN and HPR over LAN, leased lines, frame relay, PPP, ISDN, ATM or X.25. It provides the following network connection support:

- ATM 155 Mbps multimode and single-mode adapters for ATM Forum-compliant LANE client (LEC) and Classical IP routing.
- A worldwide ISDN PRI adapter with line speeds of 1.544 Mbps with 23 64 kbps B-channels for data and one 64 kbps D-channel for signaling as well as dial backup and dial on demand. This type of adapter also supports line speeds of 2 Mbps with 30 64 kbps B-channels for data and one 64 kbps D-channel for signaling.
- An ESCON channel adapter that supports SNA passthrough, APPN Intermediate Session Routing (ISR), HPR and TCP/IP routing.
- HPR over the ESCON channel adapter uses the new MPC(+) channel protocol, which brings a reduction in CPU cycles of up to 60% and significant throughput increases depending on the application. Support on the S/390 server is provided by VTAM 4.4.
- Each ESCON channel adapter provides access to multiple hosts or logical partitions (LPARs), up to a maximum of 16 for IP traffic, 16 for HPR traffic or 32 for APPN traffic.
- SNA passthrough and terminated DLSw connections. DLUR and Boundary Access Node (BAN) support to connect downstream SNA devices to VTAM SNA applications.
- DLSw support with VTAM 3.4 (or higher) SNA applications. DLSw allows for local conversion from SDLC to the channel and remote (with a DLSw partner) connectivity to SNA devices on SDLC, LANs and ATM LANE.

The Multiaccess Enclosure requires the Network Node Processor in the IBM 3746 Model 900 or 950 configuration. It must be installed in a Controller Expansion (FC 5023). At the present level, the Multiaccess Enclosure (FC 3000) requires a dedicated 2-port token-ring adapter and two dedicated token-ring couplers type 3 for internal attachment via LAN to the IBM 3746 Nways Controller switch.

For the maximum number of supported adapters in the Multiaccess Enclosure see Table 12 on page 23.

1.4 3172 Gateway Function

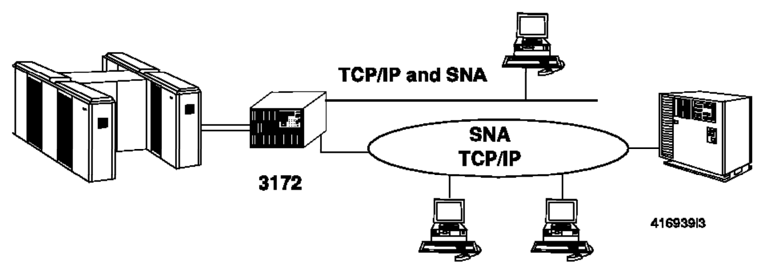


Figure 6. 3172 Local Gateway

The IBM 3172 Model 3 Interconnect Controller is a communications processor that works as a high-speed channel-attached host gateway. The 3172 connects multiple types of LANs and WANs to host processors via parallel or ESCON channel attachment. It has options to support a wide variety of protocols (SNA, TCP/IP, X.25 DECnet, IPX and NetBIOS), topologies and environments including FDDI, frame relay, leased point-to-point and multipoint communications, and dial access.

The 3172 Model 3, depending on the configuration, can function either as a LAN-to-host gateway or a WAN-to-host gateway.

- As a LAN-to-host gateway the 3172 supports FDDI, token-ring or Ethernet connections.
- The WAN-to-host support includes X.21, V.35, RS-232 or RS-442/449 link attachment for SNA/SDLC point-to-point or multipoint links as well as frame relay capabilities.

1.4.1 3172 LAN-to-Host Mode

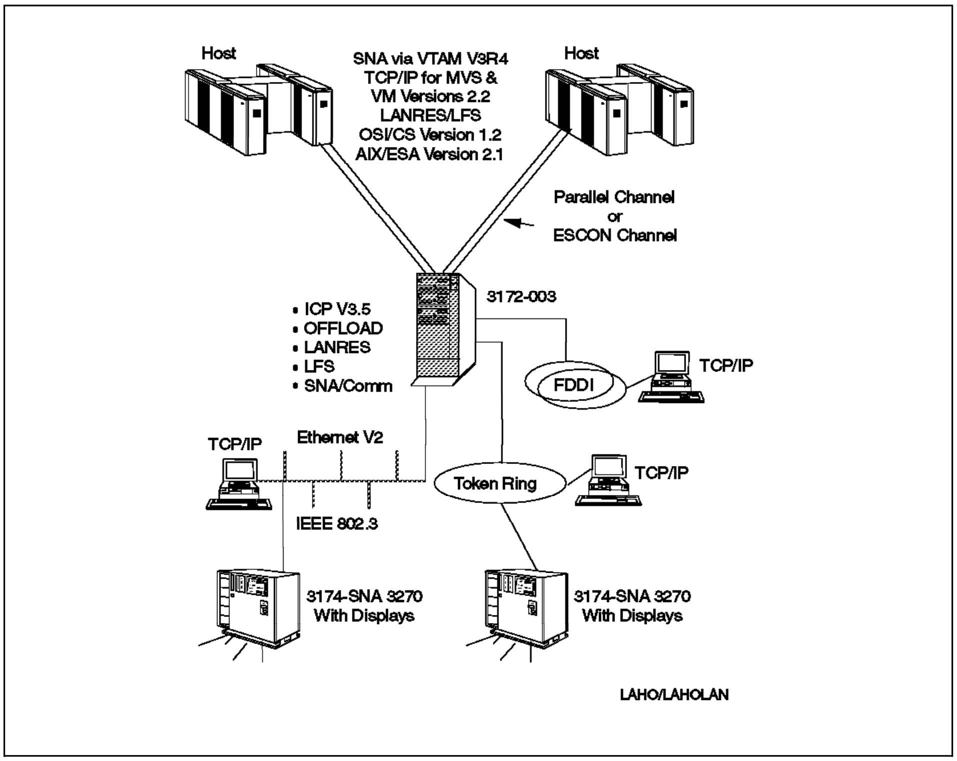


Figure 7. 3172 LAN-to-Host Gateway Functions

In LAN-to-host mode, the 3172 Model 3 may run the following:

- Interconnect Control Program (ICP) Version 3.5 to provide LAN gateway function to token-ring, Ethernet and FDDI LAN-attached stations to access host applications using SNA, TCP/IP (multihost connection) and OSI protocols.
- OS/2 with TCP/IP for OS/2 V2 or higher and the Offload Server with the Offload feature for TCP/IP for MVS or VM to provide LAN gateway function to token-ring, ATM, Ethernet and FDDI LAN-attached stations to access host applications using TCP/IP.
- Novell NetWare Version 3.11 or higher to work with LANRES/VM or LANRES/MVS to provide a server environment on VM or MVS, allowing

LAN-attached (token-ring, Ethernet, or FDDI) NetWare clients access to mainframe resources.

- OS/2 Version 2.0 or higher and OS/2 LAN Server/Advanced V3.0 or OS/2 NFS Offload to work with LAN File Services/ESA LFS/ESA on the host to provide LAN-attached (token-ring, Ethernet, or FDDI) workstations access to mainframe resources.
- SNA Communications Program (SNA/Comm) V1.1 and OS/2 to provide access to VTAM/SNA host applications from token-ring, Ethernet, ATM, and FDDI LANs.
- 3172 IP Channel Communications Program V1 running under OS/2 on the 3172 Interconnect Controller Model 3 provides IP access from LAN-attached IP hosts (token-ring, Ethernet, FDDI, and ATM) to multiple mainframe-based IP hosts.
- HPR Channel Connectivity Program Version 1 and Communications Server for OS/2 Warp Version 4 provide HPR, DLUR, RTP and ANR functions in token-ring, Ethernet, ATM and FDDI attached APPN networks.

1.4.2 WAN-to-Host Mode

Wide area connections are provided through the following platforms:

- SNA Communications Program (SNA/Comm) V1.1 and OS/2 provide access to VTAM/SNA host applications from frame relay and SDLC networks. SNA/Comm supports SNA over frame relay natively and also will support SDLC line concentration in a point-to-point or multipoint network. SNA/Comm is both local and wide area.
- 3172 IP Channel Communications Program Version 1.1 running under OS/2 on the 3172 Model 3, provides TCP/IP connectivity between multiple hosts and workstations over frame relay. (RouteXpander/2 must be installed to support frame relay.)
- HPR Channel Connectivity Program Version 1 and Communications Server for OS/2 Warp 4 provide HPR, DLUR, RTP and ANR functions over X.25, frame relay and SDLC attached APPN networks.

Note: These platforms vary in their support for interfaces and protocols. The interfaces and protocols supported by these platforms can be found in Table 9 on page 17.

1.4.3 3172 Model 3 Characteristics

This section outlines the details that are useful when planning for a 3172.

Table 9. 3172 Model 3 Characteristics

Network	Interface	Maximum Adapters per 3172	Maximum Operational Ports per Adapter	Maximum Speed per Port	Frame Relay	SNA	TCP/IP	ICP	TCP/IP Offload	IP Channel	LFS/LANRES	SNA/Comm	SNA/Comm + Offload	SNA/Comm + IP Channel
802.3														
FC2245	Mini-AUI	4	1	10 Mbps		X	X	X	X	X	X	X	X	X
FC2245	BNC	4	1	10 Mbps		X	X	X	X	X	X	X	X	X
FC2245	RJ45	4	1	20 Mbps [1]		X	X	X	X	X	X	X	X	X
802.5														
FC2235	RJ45	4	1	16 Mbps		X	X	X	X	X	X	X	X	X
WAN														
FC2900	X.21	2	2	2.048 Mbps [2]	X	X	X					X	X	X
FC2940	X.21	4	8	2.048 Mbps [3]	X	X	X					X	X	X
FC2910	V.35	2	2	2.048 Mbps [2]	X	X	X					X	X	X
FC2950	V.35	4	6	2.048 Mbps [3]	X	X	X					X	X	X
FC2922	RS-232	2	2	19.2 Kbps		X	X					X	X	X
FC2930	RS-232	4	8	19.2 Kbps		X	X					X	X	X
FC2920	RS-422/449	2	2	1.544 Mbps [2]	X	X	X					X	X	X
FC2960	RS-422/449	4	6	1.544 Mbps [2]	X	X	X					X	X	X
FDDI														
FC2300	MIC	1	1	100Mbps [2]	X	X	X	X	X	X	X	X	X	X
FC2310	ATM (SC)	1		100 Mbps		X	X		X	X		X	X	X

Notes:

[1] Requires a full-duplex Ethernet connection (such as IBM 8271 EtherStreamer switch) to achieve this speed.

[2] If a WAC is used for frame relay connections, only one of the two ports may be used. If SNA/SDLC traffic is running on the card both ports may be used. If one port is running at 2.048 Mbps the second port may only operate at 64 Kbps.

[3] The speed listed is total per card. Overall port throughput is limited to 64 Kbps simultaneously when all ports are operated at this speed or up to 2.048 Mbps on a single port.

1.4.4 SNA/Communications Program Version 1 Release 1

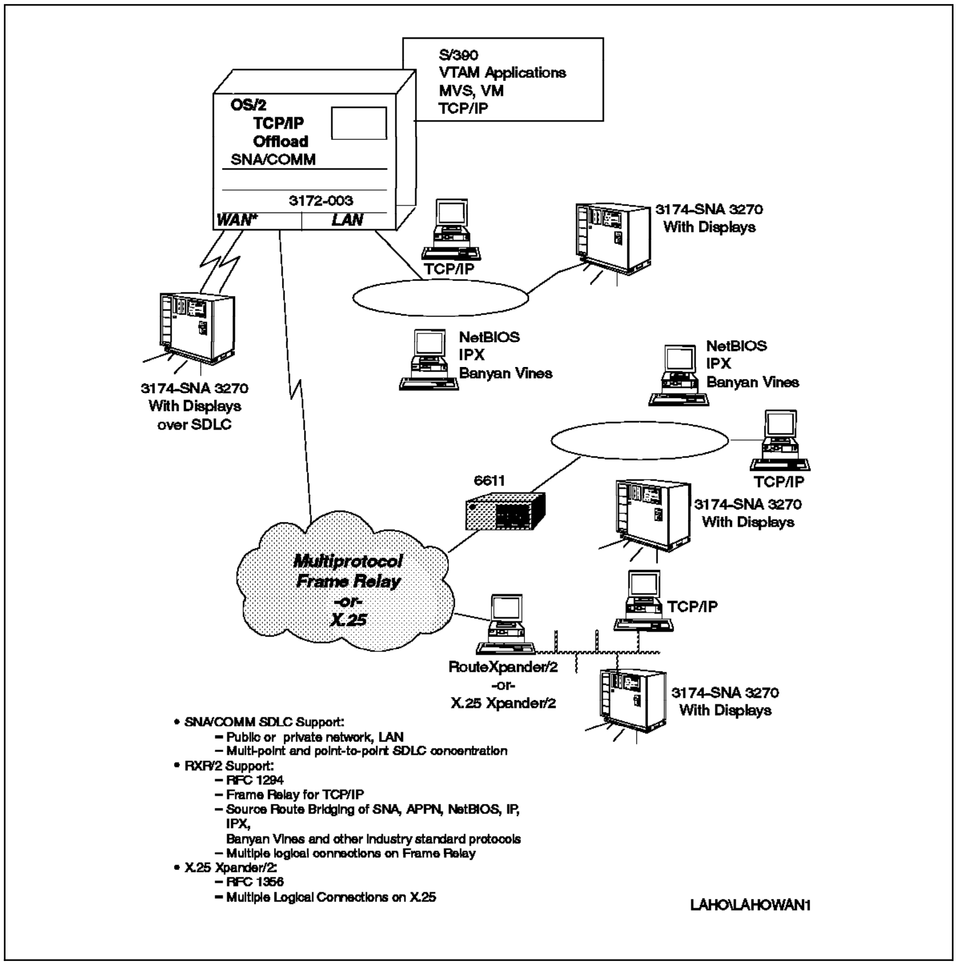


Figure 8. WAN-to-Host Mode Using SNA/Comm

SNA/Comm allows the enterprise to concentrate SNA devices over leased lines or through token-ring, Ethernet or FDDI LAN connections. It contains support for the ESCON Multiple Image Facility (EMIF) that allows connection to multiple hosts (VTAM only).

TCP/IP Offload for MVS or TCP/IP for VM may run concurrently with SNA/Comm over a frame relay connection.

SNA dial support is provided to stations that implement ISO standard 33091. Personal computers with modems running Communications Manager/2 or Personal Communications/3270 implement this asynchronous SDLC support.

If X.25 connectivity is required for SNA traffic, the following combination is required:

- RouteXpander/2 Version2
- X.25 Support/2 feature
- SNA/Comm

Note: This solution is based on RFC 1356 and does not provide QLLC.

The 3172 IP Channel Communications Program can be run with SNA/Comm to enable IP traffic coming into the 3172 to be passed directly to the host.

1.4.5 3172 Model 3 ICP Support

The 3172 Model 3 is supported in the following environments:

Table 10. 3172 ICP Functional Support

LAN Topologies Supported:	WAN Interfaces Supported:	Environment Supported:
Ethernet/IEEE 802.3 CSMA/CD Ethernet/Version2 DIX IBM Token-Ring / IEEE 802.5 FDDI/ANSI X3T9.5 ISO 9314	X.21 V.35 RS-232 RS-422/449	IBM VTAM for MVS, VM and VSE TCP/IP for VM and MVS MVS/ESA, VM/ESA and VSE/ESA

ICP supports the following attachments:

- IBM 3172 Token-Ring Auto LANStreamer MC32 Adapter (FC 2235)
- IBM 3172 Ethernet EtherStreamer MC32 Adapter (FC 2245)
- IBM 3172 FDDI Adapter (FC 2300)
- IBM 3172 Turboways100/155 ATM Adapter (FC 2310/2315)
- IBM 3172 ESCON Adapter (FC 2800 or 2801)
- IBM 3172 System/390 Parallel Channel Adapter (FC 2501)

Valid combinations of the above adapters are shown in the following table:

Table 11 (Page 1 of 2). 3172 ICP Adapter Support

Token-Ring or Ethernet	FDDI	Parallel Channel	ESCON Channel (feature 2800)	ESCON Single Slot (feature 2801)
4	0	2	0	0
4	0	0	1	0
4	0	0	0	2 1
2	1	2	0	0
2	1	0	1	0

Table 11 (Page 2 of 2). 3172 ICP Adapter Support				
Token-Ring or Ethernet	**FDDI**	**Parallel Channel**	**ESCON Channel (feature 2800)**	**ESCON Single Slot (feature 2801)**
2	1	0	0	2 **1**
Note: **1** When using two adapters of this feature, the 3172 must have 16 MB of memory installed.				

1.5 3174 Gateway Function

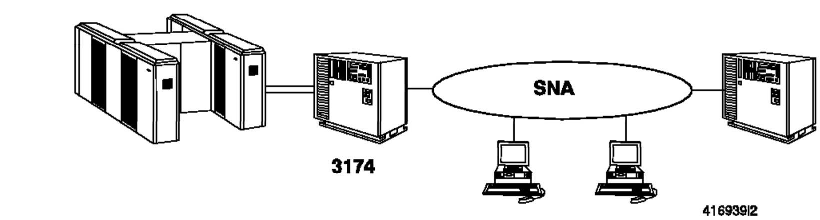


Figure 9. 3174 Local Gateway

The IBM 3174 family of establishment controllers provides a wide range of establishment gateway options. The 3174 family has been the gateway of choice for users migrating from the traditional 3270 workstations to LANs. They provide both local and remote gateway functions between the LAN workstations and the host network. More information about the IBM 3174 connectivity capabilities can be found in Chapter 4, “3174 Establishment Controller” on page 97.

The 3174 xxL models can act as a local gateway for SNA traffic on token-ring LANs to the host by sending data over the channel, or if a CCA is installed, by sending data over an SDLC or X.25 adapter.

The 3174 xxR Models can act as a remote gateway for SNA and TCP/IP on token-ring LANs or TCP/IP on an Ethernet LAN to an S/390 host. The 3174 can have one LAN adapter, either token-ring or Ethernet. TCP/IP traffic coming in from the LAN can only be transported upstream using frame relay. SNA traffic coming in from the LAN can be transported upstream with the following:

- SDLC
- X.25
- Frame relay

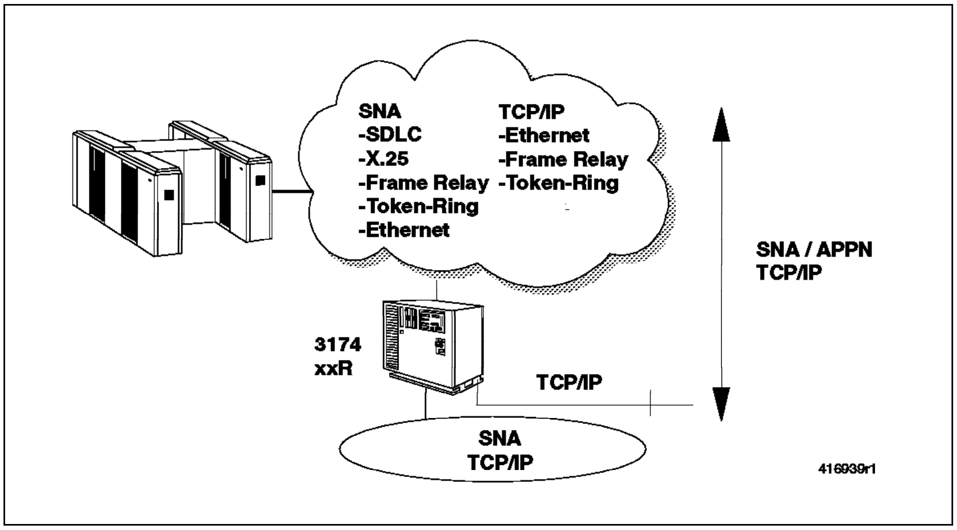


Figure 10. 3174 Remote Gateway

The 3174 can also act as an ISDN gateway with the ISDN adapter.

1.6 2216 Nways Multiaccess Connector

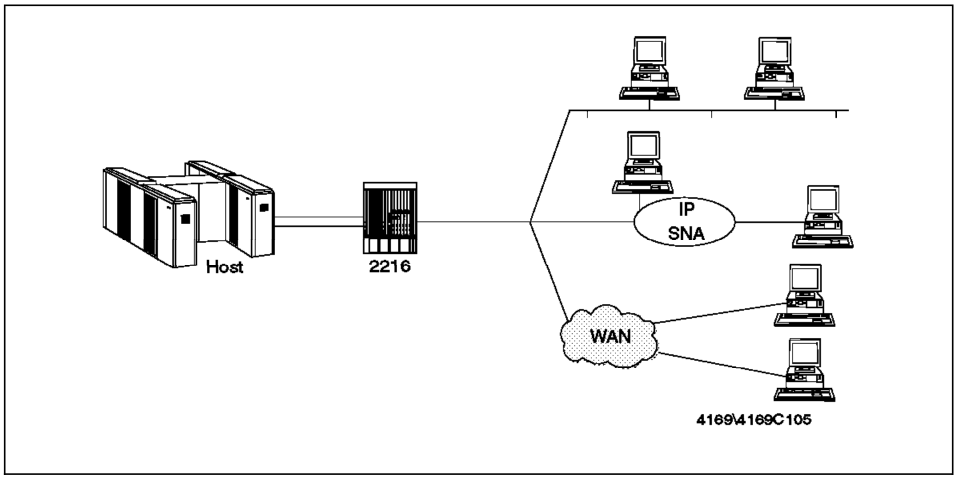


Figure 11. 2216 Local Gateway

The 2216 Nways Multiaccess Connector functions as a high-speed host gateway to TCP/IP and SNA/APPN applications and devices attached to token-ring, Ethernet and other LANs and WANs. The connection to the host processor can only be done by ESCON channel attachment.

The following adapters are supported in the 2216:

- 2-port token-ring
- 2-port Ethernet
- 8-port V.24/EIA-232E
- 8-port V.35/V.36
- 8-port X.21
- 1-port ISDN PRI for T1/J1
- 1-port ISDN PRI for E1
- 1-port 155-Mbps multi-mode Fiber ATM
- 1-port 155-Mbps single-mode Fiber ATM
- 1-port ESCON channel

Table 12. IBM 2216 Maximum Number of Physical Interfaces								
	Token-Ring	**Ethernet**	**V.24/ EIA232**	**V.35/ V.36**	**X.21**	**ISDN PR1**	**ATM 155M**	**ESCON**
Feature	2280	2281	2282	2290	2291	2283 2292	2284 2293	2287
Max # of Cards	6 **1**	6 **1**	8	8	8	4	2	1
Max. # of Ports	12	12	64	48	64	4	2	4

Note:

1 Slots 3+4 and slots 7+8 can only have one token-ring or Ethernet adapter installed.

Depending on the networking environment the 2216-400 equipped with an ESCON adapter provides host applications access to different types of LANs and WANs.

Table 13 shows the functional ESCON support for 2216-400. Any supported combination of host and adapter environment is indicated with an X.

Table 13. 2216 Functional ESCON Support					
Network Interfaces	**TCP/IP 1**	**SNA 2**			
	LCS Gateway	**LSA Gateway**	**APPN/ISR**	**MPC+**	**DLSw**
Token-Ring	x	x	x	x	x
Ethernet V2	x		x	x	x
Ethernet 802.2	x	x	x	x	x
Serial PPP	x		x	x	x
Serial Frame Relay bridged routed	 x		 x x	 x x	 x
SDLC			x		x
X.25	x		x		x
ATM LANE Classical IP	 x x	 x	 x	 x	 x

Notes:

1 TCP/IP V2R2 or higher.

2 To support ESCON, VTAM V3R4 or higher is required, and for MPC+ VTAM V4R4 and APPN HPR are required.

1.7 RS/6000 Gateway Function

The RS/6000 can be used as a gateway for TCP/IP and SNA. Communications Server for AIX V4.2 and SNA Client Access for AIX provide the SNA gateway capability.

SNA Gateway is a separately installable feature of Communications Server for AIX. It provides the ability for multiple downstream workstations to access one or more hosts using one PU definition and one adapter per host. DLUR is supported to make these functions available over an APPN network as well as a subarea network.

SNA Client Access runs on top of Communications Server for AIX. It provides TCP/IP to SNA protocol conversion from an industry-standard TN5250 workstation to an AS/400, or from TN3270 or TN3270E workstations to a mainframe.

SNA Gateway and SNA Client Access provide connectivity over:

- SDLC
- X.25
- FDDI
- Token-ring
- Ethernet
- S/390 channels

More information about RS/6000 connectivity can be found in Chapter 3, "RISC System/6000" on page 79.

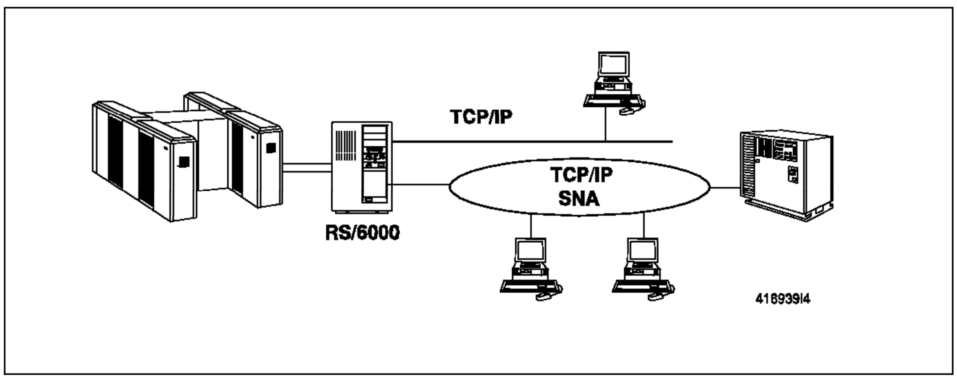


Figure 12. RS/6000 Local Gateway

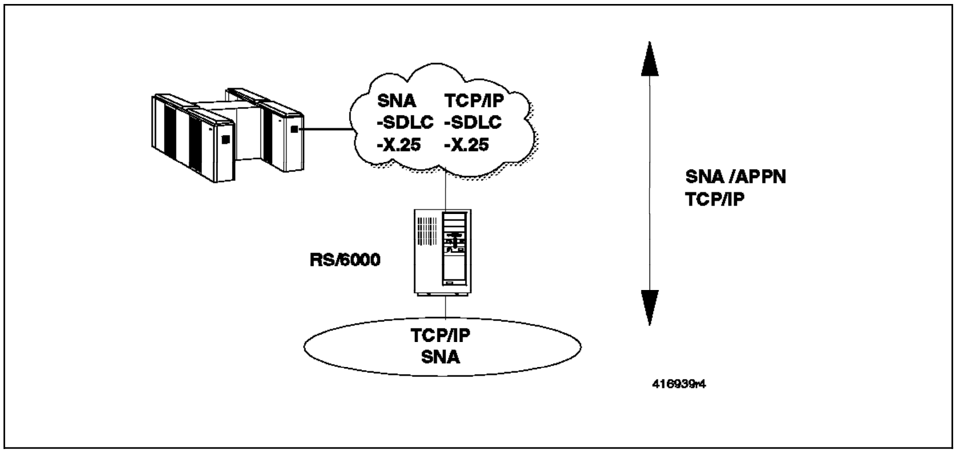


Figure 13. RS/6000 Remote Gateway

1.8 IBM AS/400 as a Remote Gateway

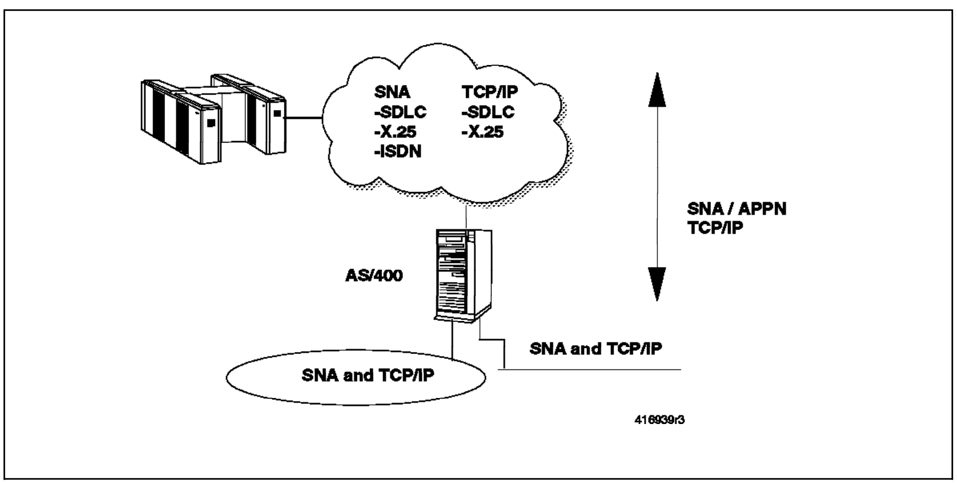


Figure 14. AS/400 Remote Gateway

The AS/400 cannot be used as a local SNA gateway for PU type 2.0 devices. However, the AS/400 can be configured as an APPN network node and supports LU 6.2 sessions. TCP/IP and OSI are supported. More information about AS/400 connectivity can be found in Chapter 5, “AS/400 Connectivity” on page 113.

1.9 PC Gateway Function

PCs can act as a gateway for SNA. This gateway function is provided by IBMs Communications Server family. The Communications Server products are available on different platforms. These gateway functions also include TN3270E, which allows TCP/IP users to access SNA applications in TELNET format.

In order to provide the gateway functions the Communications Server needs a connection to the host system. This connection can be established by:

- AnyNet (SNA over TCP/IP)
- ATM (LAN emulation)
- Coax (for LAN over coaxial cable; LU 6.2)
- Ethernet
- Frame relay
- Token-ring
- SDLC, X.25, and IDLC (synchronous, asynchronous, and AutoSync)
- Twinaxial (for 3270 passthrough)

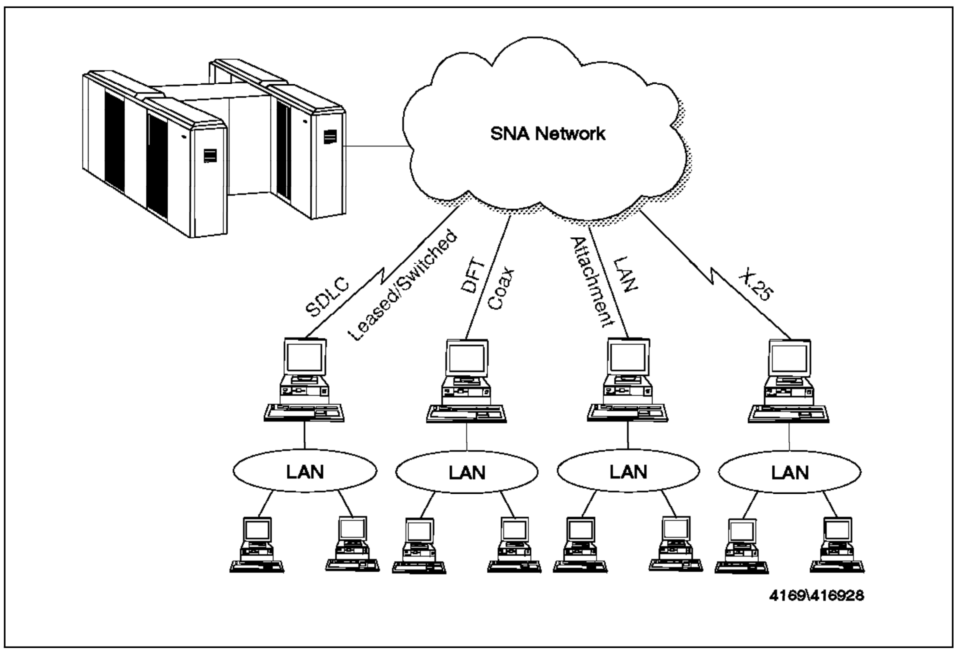


Figure 15. Upstream Communications Protocols to SNA Network

Several products providing these gateway functions for PCs are discussed in Chapter 6, “IBM Communications Server Products” on page 149.

1.10 ES/9000 Integrated Communication Adapter

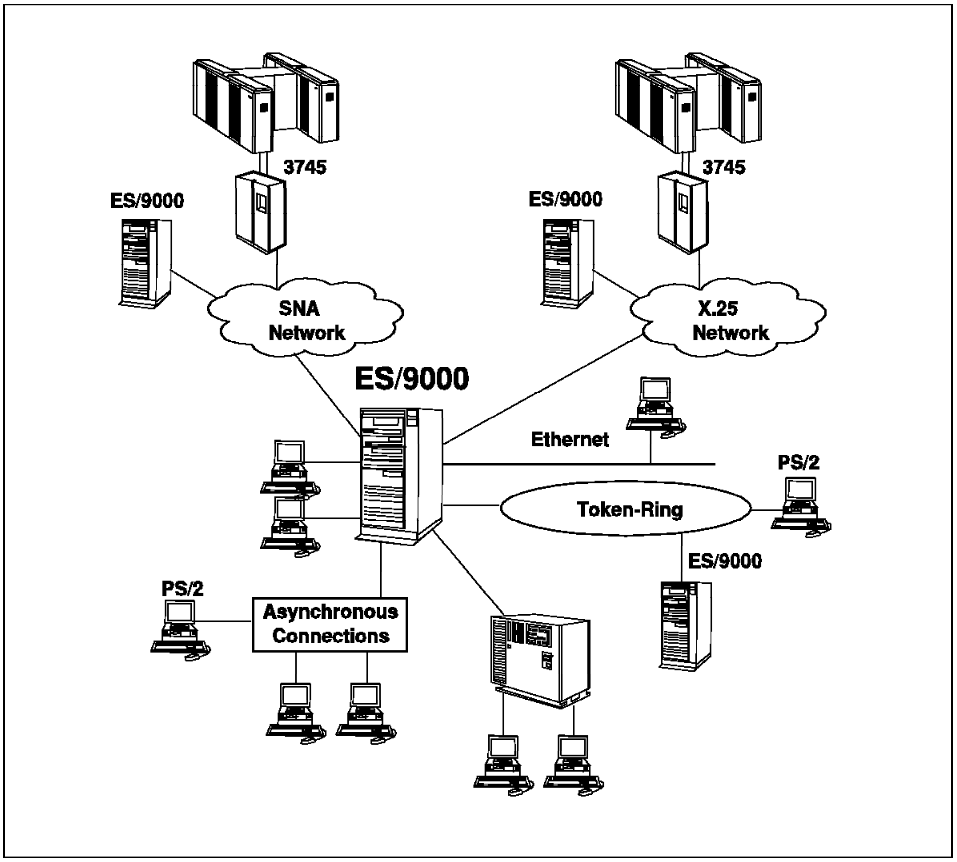


Figure 16. ES/9000 Integrated Communication Adapter

Integrated I/O controller bus and attached I/O controller provide, besides the standard channels, a second type of connection path between the ES/9000 rack-mounted processor and various I/O devices.

I/O controllers are logic cards that act as control units and directly attach I/O devices without separate control units. I/O controllers plus the devices they control are called I/O subsystems.

I/O controllers available on the ES/9000 rack-mounted system are the following:

- S/370 Block Multiplexer Channel (S/370 BMPX)
- DASD/Tape Subsystem Controller
- Workstation Subsystem Controller

- Communication Controllers:
  - Telecommunication Subsystem Controller
  - X.25 TCP/IP Communication Subsystem Controller
  - ASCII Subsystem Controller
  - IBM Token-ring Subsystem Controller
  - IEEE 802.3 LAN Subsystem Controller

You can have up to 16 I/O controllers on an ES/9000 rack-mounted system. You can have multiples of the same I/O controller or of different I/O controllers on one system.

The following tables give you an overview of the integrated communication adapter support of the ES/9000.

Table 14 (Page 1 of 2). ES/9000 Integrated Communication Adapter Software Support				
Subsystem Controller Line	**VM** 4	**VSE**	**MVS**	**DPPX**
Telecommunication	yes	yes	no 2	yes
TTC2 6 Protocol:				
V.24/V.28 (RS-232-C) Interface (300-19,200 bps)				
Point-to-Point Switched Line	VM	BTAM		yes
Point-to-Point Non-Switched Line	VM	BTAM		yes
BSC 1 Protocol:				
V.24/V.28 (RS-232-C) Interface (300-19,200 bps)				
Point-to-Point Switched Line	VM	BTAM		no
Point-to-Point Non-Switched Line	VM,VTAM	BTAM,VTAM		no
Multipoint Non-Switched Line	VTAM	BTAM		no
V.35 Interface (2,400 - 64,000 bps)				
Point-to-Point Non-Switched Line	VM,VTAM	BTAM,VTAM		no
V.11 (RS-422-A) Interface (1,200-64,000 bps)				
Directly Attached System-to-System	VM,VTAM	VSE POWER		no
SDLC Protocol:				
V.24/V.28 (RS-232-C) Interface (300-19,200 bps)				
Point-to-Point Switched Line	VTAM	VTAM		yes
Point-to-Point Switched Line/V.25bis Autocall	VTAM	VTAM		no
Point-to-Point Non-Switched Line	VTAM	VTAM		yes
Multipoint Non-Switched Line	VTAM	VTAM		yes
V.35 Interface (2,400 - 64,000 bps)				
Point-to-Point Non-Switched Line	VTAM	VTAM		yes
X.21 Interface (1,200 - 64,000 bps)				
Point-to-Point Switched Line	no	no		no
Point-to-Point Non-Switched Line	VTAM	VTAM		yes
X.21Bis Interface (1,200 - 19,200 bps)				
Point-to-Point Non-Switched Line	VTAM	VTAM		yes
V.11 (RS-422-A) Interface (1,200-64,000 bps)				
Directly Attached System-to-System	VTAM	VTAM		yes
HDLC LAP-B Protocol:				
V.35 Interface (2,400 - 64,000 bps)				
X.25 Packet Switched Network	VTAM	VTAM		yes
X.21 Interface (1,200 - 64,000 bps)				
X.25 Packet Switched Network	VTAM	VTAM		yes
X.21bis Interface (1,200 - 19,200 bps)				
X.25 Packet Switched Network	VTAM	VTAM		yes
ASCII	yes	yes	yes 5	yes
Start/Stop Protocol:				
V.24/V.28 (RS-232-C) Interface (50-38,400 bps)				
Local or Remote Line	VM	VTAM	MVS	
V.11 (RS-422-A) Interface (50-38,400 bps)				
Local Line	VM	VTAM	MVS	
Mode of Operation				
3270 Emulation Mode	VM,VTAM	VTAM	MVS	
Transparent Mode	VM	no	no	

Table 14 (Page 2 of 2). ES/9000 Integrated Communication Adapter Software Support				
Subsystem Controller Line	**VM [4]**	**VSE**	**MVS**	**DPPX**
X.25 TCP/IP Communication V.35 Interface (2,400 - 64,000 bps) X.25 Packet Switched Network X.21 Interface (1,200 - 64,000 bps) X.25 Packet Switched Network X.21bis Interface (1,200 - 19,200 bps) X.25 Packet Switched Network	yes TCP/IP TCP/IP TCP/IP	no	no	no
IBM token-ring (IEEE 802.5)	VM,TCP/IP VTAM	VTAM	no	yes
IEEE 802.3 LAN [6] (Ethernet)	VM TCP/IP [7]	no	no	no
S/370 Block Multiplexer Channel	yes	yes	yes	yes [3]

Notes:

[1] For BSC transmission, VTAM supports 3270-type devices only.

[2] MVS provides the telecommunication functions through standard channels only.

[3] Limited to the attachment of 3174/3274 Communication Controller and 2440/3422 Tape Subsystem.

[4] For the different VM versions supporting the integrated controller see Table 15 on page 30.

[5] Supported by MVS/ESA, but not by MVS/SP.

[6] Ethernet Version 2 and IEEE 802.3 are supported.

[7] The integrated Ethernet adapter does not support NFS.

1.10.1 Operating System Support

Table 15 shows the operating systems that are supported by ES/9000.

Table 15 (Page 1 of 2). Operating Systems for the ES/9000 Rack-Mounted Systems						
	MVS	**VM [1]**			**VSE**	
	ESA 3.1.0E 4.1.0 4.2.X 4.3.X	ESA 370 R1.0	ESA R1.0 R1.1	HPO R5 R6 XA R2.1	SP 3.2.2 4.1.2	ESA [2] 1.1.0 1.2.X 1.3.X
Communication I/O Controllers:						
Communications S/370 base (SNA, non-SNA) ESA/390		X [3] -	- X [4]		X [5] -	X [5] X [5]
X.25 TCP/IP S/370 base (non-SNA) ESA/390		X -				
ASCII S/370 base (non-SNA) ESA/390	- X [6]	X -	- X [7]		X [5] -	X [5] X [5]
Token-Ring S/370 base (SNA, non-SNA) ESA/390		X [3] -	- X [4] [8]		X [5] -	X [5] X [5]
Ethernet [9] S/370 base (non-SNA) ESA/390		X -	- X [8]		-	

Table 15 (Page 2 of 2). Operating Systems for the ES/9000 Rack-Mounted Systems							
		MVS	**VM [1]**			**VSE**	
Workstation (SNA, non-SNA)	S/370 base	X [5]	X [3]	-		X [5]	X [5]
	ESA/390		-	X [2] [7]		-	X [5]

Notes:

[1] VM/HPO and VM/XA are supported in logical partitions (LPAR) only. They are not supported in basic mode on the 9221.

VM/ESA feature supports channel-attached devices only.
VM/ESA 1.1 supports channel-attached devices and integrated I/O controller.

[2] At system generation time, an S/370 supervisor or an ESA/390 supervisor may be generated.

[3] On VM, SNA mode always requires ACF/VTAM (non-SNA mode is handled by VM). ACF/VTAM must be ordered separately.

Note that ACF/VTAM Version 3 for VM/9370 applies to VM Release 5 and later releases for use on the ES/9370 only. It does not support the ES/9000 rack-mounted system.

[4] VTAM Version 3.4 supports the token-ring and telecommunication subsystem controllers with VM/ESA 1.1.

[5] Requires ACF/VTAM for SNA and non-SNA mode. Note that VSE includes ACF/VTAM as a part of its system package, while for MVS it must be ordered separately.

[6] The ASCII subsystem controller is supported by MVS/ESA in 3270 mode only.

[7] The workstation subsystem controller and the ASCII subsystem controller are supported by VM/ESA 1.1.

[8] TCP/IP supports the token-ring and IEEE 802.3 (Ethernet) controllers in TCP/IP Version 2.2 with VM/ESA 1.1. TSAF also supports the two controllers.

[9] IEEE 802.3 and Ethernet Version 2.

1.10.2 ES/9000 Channel and I/O Controller Characteristics

Table 16 shows the interfaces and the modes supported.

Table 16 (Page 1 of 2). ES/9000 Rack Mounted System Communication Interfaces

Standard Channel I/O Controller	**Interface(s)**	**Modes Supported**
Telecommunication 5 cards maximum: 1 communication processor plus 1 to 4 eight-line adapters, or #6241-6244 1 to 4 two-line adapters #6251-6254	V.24/V.28 (RS-232-C) V.25/V.28 (RS-366-A) V.11 (RS-422-A) V.35 X.21	Modes supported: • SNA • Non-SNA
X.25 TCP/IP Communication #6250 2 cards: 1 communication processor plus 1 multiprotocol adapter	X.21bis V.35 X.21	Modes supported: • Non-SNA
ASCII #6245-6248 5 cards maximum: 1 communication processor plus 1 to 4 eight-line adapters	V.24/V.28 (RS-232-C) V.25/V.28 (RS-366-A) V.11 (RS-422-A)	In 3270 emulation mode: such as 3174 Controller (local, non-SNA) In transparent mode: similar to 7171 CU

Table 16 (Page 2 of 2). ES/9000 Rack Mounted System Communication Interfaces		
Standard Channel I/O Controller	**Interface(s)**	**Modes Supported**
token-ring #6139/6140 2 cards: 1 communication processor plus 1 Token-ring adapter	IEEE 802.5 ISO 8802/5	Similar to 3174, token-ring feature modes supported: • SNA • Non-SNA
Ethernet #6135 2 cards: 1 communication processor plus 1 IEEE 802.3 LAN adapter	IEEE 802.3, Ethernet II (DIX) ISO 8802/3	Modes supported: • Non-SNA
Workstation #6120 1 card maximum	3270-Type: CUT DFT SOEMI	Modes supported: • SNA • Non-SNA

The Table 17 shows the data rates and model numbers.

Table 17 (Page 1 of 2). ES/9000 Communication Interface Data Rates and Model Numbers			
Standard Channel I/O Controller	**Data Rate**	**Maximum Number on ES/9000 Models 120 130 150 170 200**	**Each Controller Attaches a Maximum of**
Telecommunication 5 cards maximum: 1 communication processor plus 1 to 4 eight-line adapters #6241-6244 or 1 to 4 two-line adapters #6251-6244	Maximum line speed: 64 Kbps	12 12 12 12 12	Depends on mix of protocol and line speed.
X.25 TCP/IP Communication #6250 2 cards: 1 communication processor plus 1 multiprotocol adapter	Maximum line speed: 64 Kbps	12 12 12 12 12	1 X.25 Packet Switching Data Network.
ASCII #6245-6248 5 cards maximum: 1 communication processor plus 1 to 4 eight-line adapters	Maximum line speed: 38.4 Kbps	12 12 12 12 12	31 ASCII devices (64 with port sharing).
token-ring #6139/6140 2 cards: 1 communication processor plus 1 token-ring adapter	LAN rate 16 or 4 Mbps #6140 4 Mbps #6139	12 12 12 12 12	1 IBM token-ring.
Ethernet #6135 2 cards: 1 communication processor plus 1 IEEE 802.3 LAN adapter	LAN rate 10 Mbps	12 12 12 12 12	1 IEEE 802.3 or Ethernet Version 2

Table 17 (Page 2 of 2). ES/9000 Communication Interface Data Rates and Model Numbers

Standard Channel I/O Controller	**Data Rate**	**Maximum Number on ES/9000 Models** **120 130 150 170 200**	**Each Controller Attaches a Maximum of**
Workstation #6135 1 card		12 12 12 12 12	32 workstations or OEM devices through 1 or 4 terminal multiplexers
Total Number of Communication Processors (any mix)		12 12 12 12 12	

Chapter 2. Local Area Network

This chapter focuses on the local area network environment and its components.

2.1 LAN Interconnection Components

Intermediate nodes connect two or more networks and allow information exchange between them. Very often they exchange information about network topology, or information that allows network reconfiguration in the event of failure.

The following types of intermediate nodes are available:

- Repeaters - Electrically regenerate, re-time and forward all packets between the networks to which they are attached. Repeaters operate at the physical layer, extending the physical characteristics of the network by regenerating signals so that the optimum performance in terms of signal quality and distance can be achieved.
- Bridges - Tie LANs together to effectively make larger LANs.
- Routers - Selectively forward data between networks.
- Gateways - interconnect networks at higher levels than bridges or routers, ranging from network layer to application layer. A gateway usually supports address mapping between the networks and may also provide transformation of data between the environments to support end-to-end application connectivity.
- Multiplexers - Interleave bits from several devices onto a single physical link.
- Hubs - Act as the central element of a LAN to concentrate the physical cabling, supporting one or several LAN types.
- Switches - Used to segment a LAN, improving performance by reducing contention among users and creating multiple high-speed parallel paths among LAN segments.

Repeaters, bridges, routers and gateways operate on different layers of the OSI Model. These layers determine the functions provided by the mentioned devices. Figure 17 on page 36 shows the OSI Model and the layers to which the interconnection devices refer.

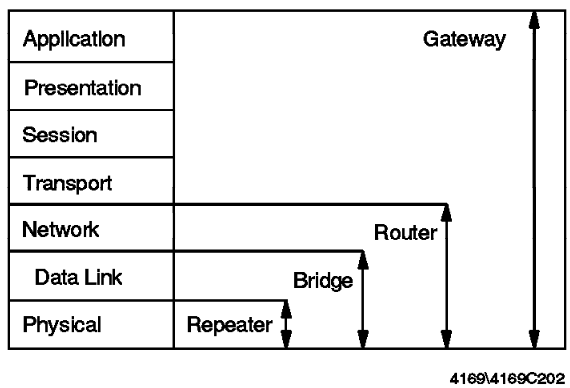


Figure 17. OSI Reference Model

2.2 Repeater

Repeaters are used to regenerate signals within a network to maintain the strength and intensity. They operate on the physical layer of the OSI Model. Most wiring concentrators for Ethernet provide repeater functions to the network.

The following wiring concentrators have repeater capabilities:

- 2480 AS/400 Wireless
- 8222 Ethernet Workgroup Hub
- 8224 Ethernet Stackable Hub
- 8225 Fast Ethernet Stackable Hub
- 8237 Stackable Ethernet Hub

2.3 Bridges

Bridges operate at the media access control (MAC) sublayer of the data link layer (see Figure 17). They are transparent to protocols above the data link layer. They connect two LAN segments and are able to send frames from one endstation to another end station without any knowledge of the protocols used. Bridges can do this because they only care about physical addresses. They are protocol independent. They also have the advantage of supporting multiple protocols concurrently on the same bridge.

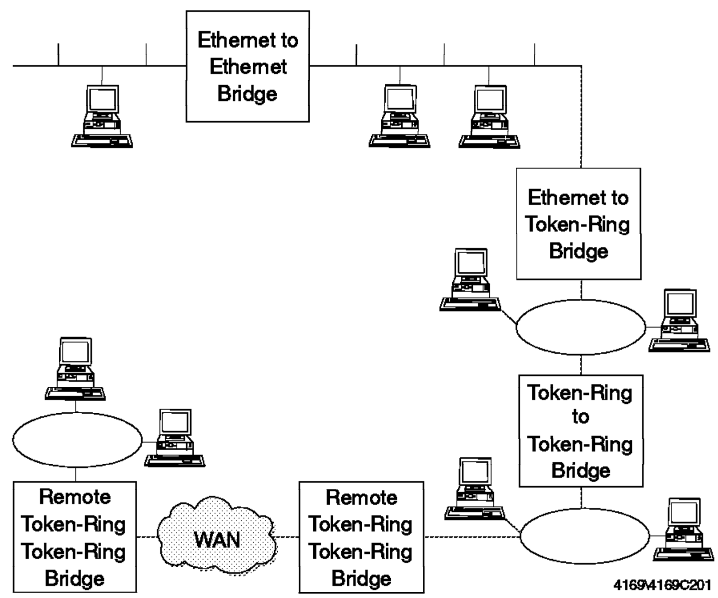


Figure 18. Bridging Environment

There are two primary methods for bridging:

- Transparent bridging
- Source route bridging

Source route bridging is implemented by IBM for use in token-ring LANs. Source-routing requires the sending device to specify the full path to the destination address in each frame being sent to its destination. To acquire the full path, a discovery process is needed to calculate the best path.

Transparent bridging is normally used to connect Ethernet LANs. Transparent bridging is based on the principle that the sending station doesn′t need to know anything about the location of the destination address within the LAN, because in every bridge there is a filtering database that′s dynamically updated and contains information about the stations and their location on the LAN.

Other bridging methods are:

- Source route transparent bridging
- Source route to transparent conversion bridging (or Translational bridging)
- Tunnel bridging

A source route transparent bridge scans all frames for routing information fields. If these fields are present, the bridge acts as a source route bridge. If these fields are not available in the frame, the bridge operates in transparent mode and forwards the frames based on the MAC destination address. The source route transparent bridge is able to handle both kinds of bridging, but it will never translate source route bridge frames into transparent bridge frames or vice versa.

A source route to transparent conversion bridge performs exactly this function. The bridge translates source route frames to transparent frames and vice versa.

A tunnel bridge allows source route frames and transparent frames to cross an IP network. To do this the tunnel bridge encapsulates the frames into IP datagrams, which are then sent to the destination IP address. This destination IP address is another tunnel bridge, which removes the IP disguise and sends the frames to either the source route domain or the transparent domain.

Table 19 on page 42 contains a summary of the IBM bridge products.

Note: Some of the products contained in this summary are actually routers that perform bridging functions. These products are often called *brouters* because they combine bridge and routing functions.

2.3.1.1 IBM 8229 Bridge

The IBM 8229 bridge is the successor of the IBM 8209 bridge; it′s a rack-mountable, modular hardware bridge providing improved performance connection for different kinds of networks. There are three models of IBM 8229 Bridges:

- 8229-001 provides a connection between two local token-ring segments.
- 8229-002 provides a connection between a local token-ring segment and a local Ethernet segment.
- 8229-003 provides a connection between a local token-ring segment and remote token-ring segment using a leased line WAN connection. This model can also be used as the secondary half of the IBM Remote Token-Ring Bridge Program.

To build the mentioned connections, the 8229 has to be equipped with the appropriate attachment modules:

- Feature 4762: Single port token-ring attachment
- Feature 4763: Single port Ethernet attachment
- Feature 4764: Dual port token-ring attachment

- Feature 4765: Single port WAN attachment

Actually each Model 8229 can be converted to another model simply by changing the attachment modules and updating the appropriate software in the flash memory.

Table 18. IBM 8229 Attachment Modules

8229	Alternative	Feature 4762	Feature 4763	Feature 4764	Feature 4765
Mod 001	A	2			
	B		1		
Mod 002		1		1	
Mod 003		1			1

Note: The numbers show the maximum number of features within the different models.

The bridges can either be managed by IBM LAN Network Manager or an SNMP manager such as AIX NetView/6000. For SNMP manager the 8229 works like an agent. Out-of-band management can also be done for SNMP parameters and code updates by using the RS-232-C port of the IBM 8229 Bridge.

2.3.1.2 8250 Hub with Bridge Modules

The IBM 8250 is a family of intelligent hub products with modular hardware composed of a rack-mountable chassis plus a set of feature modules.

They provide the functions of LAN concentration for Ethernet, token-ring, and fiber-distributed data interface (FDDI), LAN and media management, hub management, bridging interconnection for Ethernet and token-ring LANs, and an SNMP agent that includes enterprise-specific extensions.

The 8229 Integrated Bridge Module is a two-port bridge that connects a token-ring segment on the hub backplane (switchable to any of the seven token-ring segments) to either a token-ring segment or an Ethernet segment.

The bridge uses two microprocessors for media-speed bridging (up to 22,000 packets per second for 64-byte frames for token-ring bridging and up to 13,000 packets per second for token-ring to Ethernet bridging). Both source route bridging (SRB) and source route transparent bridging (SRT) are supported for token-ring. Source route to transparent conversion bridging (SRTB) is supported for token-ring to Ethernet bridging. The 8229 Integrated Bridge Module occupies two slots in the 8250. A VT100 terminal or terminal emulator is required for initial configuration.

2.3.1.3 8260 Hub with Bridge Modules

The IBM 8260 is positioned as the high-end member of an Intelligent Hub products family. This platform extends the capabilities of IBM 8250 and can be upgraded to integrate ATM technology. The IBM 8260 fully supports IBM 8250 modules for full forward compatibility. This includes the 8229 Bridge Module. In addition to the 8250 modules, an 8281 ATM LAN bridge-like module is available for the 8260.

2.3.1.4 IBM 6611 Network Processor

The IBM 6611 Network Processor is an Nways multiprotocol router, providing routing and bridging functions to the connected network elements. The hardware platform is based on RISC technology. Depending on the model the 6611 provides 4-7 slots available for several adapters.

Adapters required to provide bridge functions are:

1. Two token-ring ports
2. One token-ring port and one Ethernet port
3. Two Ethernet ports
4. Four SDLC ports and two WAN ports

Using these ports the 6611 can be used as a local bridge, both between like media as well as between disparate media. When used in conjunction with Multiprotocol Network Program Version 1 Release 3′s new source route transparent bridging function, the 6611 is able to provide translational bridging between token-ring and Ethernet LANs for users of SNA, APPN, NetBIOS, IP, IPX and AppleTalk.

IBM 6611 Network Processor can be used for:

- Multiport transparent bridging support of local and remote Ethernet LANs
- Multiport source route bridge support of local and remote token-ring LANs
- Multiport translational bridging for local and remote attached LANs

A fully equipped 6611 can attach up to 14 local token-ring and Ethernet LANs.

2.3.1.5 2210 Nways Multiprotocol Router Bridging Function

The IBM 2210 Nways Multiprotocol Router supports LAN connections via token-ring and Ethernet. For these LANs the following bridging methods are provided by 2210:

- Source route bridging
- Transparent bridging
- Source route transparent bridging

- Source route to transparent conversion bridging

2.3.1.6 2216 Nways Multiaccess Connector Bridging Function

The 2216 Nways Multiaccess Connector has Multiprotocol Access Services (MAS) software which includes bridging functions. There are four supported bridging functions:

- Transparent bridging
- Source route bridging
- Source route to transparent conversion bridging
- Tunnel bridging

If there is a need to transport bridged traffic over a frame relay or X.25, the tunnel bridge function of the 2216 Nways Multiaccess Connector has to be used.

Note: Router devices mentioned in this chapter will be discussed in detail later.

Table 19 is a summary of the bridging functions offered by IBM products.

Table 19. IBM Bridge Summary

Product	Mgmt	Token-Ring Local	Token-Ring Remote	Ethernet Local	Ethernet Remote	Token-Ring to Ethernet	Bridging Type	Max Hop Count
8229 Bridge	LNM SNMP	X	PPP			X	SRB, STB	7
8250/8260 Hub with Ethernet Bridge Module	SNMP			X			STB	
8250/8260 Hub with Token-Ring Bridge Module	LNM SNMP	X					SRB, SRT	7
2210 Nways Multiprotocol Router	LNM SNMP	X	frame relay, PPP	X	frame relay, PPP	X	SRB, STB, SRT, SR-TB	14
2216 Nways Multiaccess Connector	LNM SNMP	X	frame relay, PPP	X	frame relay, PPP	X	SRB, STB, SRT, SR-TB, Tunnel	14
6611 Network Processor	LNM SNMP	X	SDLC, frame relay, X.25, PPP	X	X	X	SRB, STB, SR-TB	7
RXR/2 (on OS/2 PC)	SNMP NetView	X	frame relay, PPP, X.25	X (V1.01)	(V1.01) frame relay, PPP, X.25		SRB, STB	7

Note:

- The 8229 can be configured as the secondary bridge to a Remote Token-Ring Bridge/DOS V1.0.
- The 6611 can act as a remote bridge part with the Remote Token-Ring Bridge/DOS V1.0.
- RXR/2 can also act as a feeder node for the 6611 Network Processor over point-to-point or frame relay lines. X.25 support is provided by RXR/2 V2 with the X.25 Support/2 program. RXR/2 V2 does not offer translational bridge support.
- PPP is point-to-point protocol.
- Bridging types:
  - Source route bridging (SRB)
  - Transparent bridging (STB)
  - Source route transparent bridging (SRT)
  - Source route to transparent conversion bridging (SR-TB)
- Hop count is used to determine the number of token-ring bridges between the source and destination node. This is used to limit the number of bridges data can cross.

2.4 Routers

Routers operate at the network layer (see Figure 17 on page 36) and they interconnect different networks. Routers participate as normal devices on each network they are connected to. Unlike bridges that are usually restricted to connecting LANs within one network, routers have the capability of connecting networks of different types, including point-to-point, multiaccess non-broadcast and multiaccess broadcast. They do this by determining the optimal path for a frame of data to traverse, through an interconnected series of networks to reach its destination.

A router has the additional capability of exchanging information with other routers and with end nodes on remote networks as long as they support the same network layer protocol.

Routers forward frames based on information in the network layer headers of frames received from the attached networks. Network layer headers contain address information (typically consisting of a network identifier and a host identifier) and associated control to allow the frames to be routed to their correct destination. Frames that have no network layer header or that have a network layer header for a protocol not supported by a particular router are discarded.

Routers, unlike bridges, are protocol dependent. They must specifically support each protocol. Bridges operate at the data link layer and are protocol independent.

There are a number of network layer protocols, each of which has its own network layer header format for addressing and control. Some protocols are vendor proprietary, while others are open protocols or standard-based.

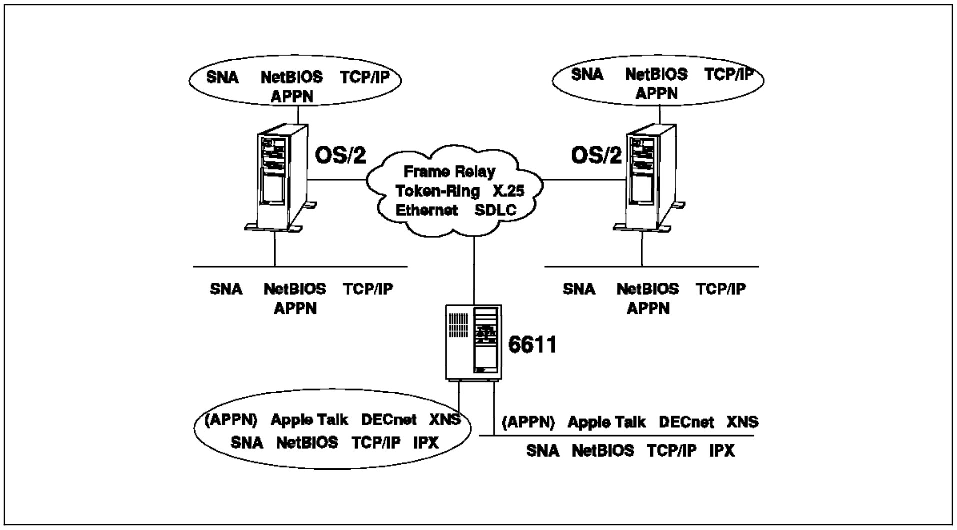


Figure 19. Router Environment

2.4.1 2210 Nways Multiprotocol Router

The IBM 2210 is available in several models, based on the type of networks you want to support. Table 20 shows the different models available.

The differences between some of the models are the amount of flash memory and DRAM. Flash memory is used to store a compressed version of the router's software while DRAM memory provides the working memory for the router programs and the router network tables.

Table 20 (Page 1 of 2). 2210 Model Matrix

Models	LAN TR	LAN ETH	WAN Port 1	ISDN BR1 Port	Flash Memory (Base/Max)	DRAM (Base/Max)	Adapter Slot 2
1S4	0	1	13	13	2 Mb/2 Mb	4/4	No
1U4	0	1	13	13	4/4	8/8	No
1S8	0	1	1 3	1 3	2/2	4/4	No
1U8	0	1	1 3	1 3	4/4	8/8	No
12T	1	0	2	0	4/4	4/16	No
12E	0	1	2	0	4/4	4/16	No
127	1	0	2	1	4/4	4/16	No
128	0	1	2	1	4/4	4/16	No
14T	1	0	4	opt	4/12	4/32	Yes
24T	2	0	4	opt	4/12	4/32	Yes
24E	0	2	4	opt	4/12	4/32	Yes

Table 20 (Page 2 of 2). 2210 Model Matrix							
Models	LAN		WAN Port 1	ISDN BR1 Port	Flash Memory (Base/Max)	DRAM (Base/Max)	Adapter Slot 2
	TR	ETH					
24M	1	1	4	opt	4/12	4/32	Yes

Notes:

1 Standard WAN ports will support any of these interfaces:

- EIA RS232 - D1/V.24
- V.35
- V.36
- X.21

2 Will support optional network interfaces such as ISDN/BR1 in future releases.

3 Only one of these ports can be configured/used at a given time.

Networks Supported by the IBM 2210: The IBM 2210 supports the following LAN connections:

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

Every IBM 2210 supports the following serial connections:

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

Note: RS449 is also supported, using the V.36 cable available for the IBM 2210.

In addition to these serial connections, you can order optional support for ISDN.

Nways Multiprotocol Routing Services: Nways Multiprotocol Routing Services (MRS) is the software that runs on the IBM 2210. It is available in a Base Suite package, plus four packages that can be ordered separately. It extends the functions of IBM 2210 Nways Multiprotocol Network Services (MRNS) Version 1 Release 3 Enhanced.

In addition to current MRNS Version 1 Release 3 Enhanced the new MRS provides:

- APPN NN/HPR/DLUR support
- ISDN BIR and PRI adapter and worldwide ISDN switch support
- ATM support including LAN emulation client and classical IP
- Broad range of LAN, WAN and ATM network connectivity options
- Compatibility between products supported by the multiprotocol service software

- Other protocol enhancements
- Easy configuration, installation and maintenance

MRS Base Suite: The Base Suite contains the following functional capabilities:

- TCP/IP, including OSPF
- Bridging (SR, TB, SRT, SR-TB)
- MAC Filtering
- Data Link Controls (PPP, FR, X.25 and SDLC)
- NetBIOS name caching/filtering
- SDLC primary and secondary support
- SDLC relay
- APPN/HPR/DLUR
- V.25bis
- Bandwidth Reservation System
- WAN Reroute
- Specific device drivers where appropriate, for example to support ISDN PRI/BRI and ATM

The Base and the Additional Routing Suite include the following additional protocols available in specific package options noted below:

- IPX
- AppleTalk Phase 2
- Banyan VINES
- DECnet IV
- DECnet V/OSI
- BGP-4

Note: LAN Network Manager support is *not* in this package.

There are a set of identical loads that include the ISDN BRI support for 2210 Models 127 and 128, as well as a set for the new 2210 models, for a total of 15 distinct loads. An additional five loads will be necessary to support the ISDN BRI adapter on the 2210 Models 14T, 1SX, 1UX, 24T, 24E, and 24M when available.

2.4.2 IBM 2216 Nways Multiaccess Connector

With the 2216 Nways Multiaccess Connector, network access solutions for regional router concentration, remote SNA concentration and high-performance campus and data centers are available. The 2216 provides WAN access, network optimization, device attachment and concentration.

The 2216 also features 2210 and 8210/MSS compatibility with multiprotocol services. Full routing and bridging functions supporting all widely used protocols are available. The highlights of 2216 Nways Multiaccess Connector are:

- Access to SNA and TCP/IP host applications from LANs, WANs and ATM
- MPC+ support for HPR
- APPN ISR routing
- APPN and IP routing over any other 2216 interface
- APPN DLUR
- APPN BAN and BNN frame relay support to provide connectivity between downstream FRADs and VTAM SNA applications
- IP route selection and filtering
- DLSw for VTAM SNA applications to provide connectivity to SNA devices on SDLC, LANs and ATM LAN emulation
- ESCON channel to LAN connectivity for token-ring, Ethernet and ATM LAN emulation
- Compatibility with 2210 and 8210

Nways Multiprotocol Access Services (MAS) is the software that supports the IBM 2216. The function of this code is almost the same as MRNS/MRS, which is used for the IBM 2210. Due to different hardware and interfaces of these devices the code is not interchangeable. The Nways MAS has two components:

- The code that provides the routing, bridging, data link switching, and some monitoring systems that allows you to perform network management, problem determination and configuration.
- The configuration program, which offers a graphical user interface that allows you to configure the 2216 from a workstation.

For MAS, all routing protocols in the following table are included in a single package with the option to choose a code load with or without APPN/HPR/DLUR support. 'Y' means that the protocol is supported for the specified DLC.

Table 21 (Page 1 of 2). Protocols or Functions Supported on DLCs

	PPP	FR	X.25	SDLC	Token-Ring	Ethernet	ATM/1483	ATM/LEC
TCP/IP	Y	Y	Y	N	Y	Y	Y	Y
IPX	Y	Y	Y	N	Y	Y	Y	Y
AppleTalk 2	Y	Y	N	N	Y	Y	N	Y
DECnet IV	Y	Y	Y	N	Y	Y	N	Y
DECnet V/OS1	Y	Y	N	N	Y	Y	N	Y

Table 21 (Page 2 of 2). Protocols or Functions Supported on DLCs								
	PPP	**FR**	**X.25**	**SDLC**	**Token-Ring**	**Ethernet**	**ATM/1483**	**ATM/LEC**
Banyan VINES	Y	Y	Y	N	Y	Y	N	Y
Bandwidth Reservation (BRS)	Y	Y	N	N	N	N	N	N
FR BAN SNA End System	Y	Y	N	Y	Y	Y	N	Y
DLSw SNA End System	Y	Y	N	Y	Y	Y	N	Y
DLSw NetBIOS End System	Y	Y	N	N	Y	Y	N	Y
APPN ISR	Y	Y	N	Y	Y	Y	N	Y
APPN HPR	Y	Y	N	N	Y	Y	N	Y
APPN DLUR	N	Y	N	Y	Y	Y	N	Y
Bridging	Y	Y	N	N	Y	Y	N	Y
WAN Restoral	Y	N	N	N	N	N	N	N
WAN Reroute	Y	Y	N	N	N	N	N	N
Dial On Demand	Y	Y	N	N	N	N	N	N

2.4.3 IBM 2218 Nways Frame Relay Access Device

The 2218 Nways Frame Relay Access Device (FRAD) allows multipoint, leased-line and LAN-based protocols to take advantage of frame relay networks. The 2218 Nways FRAD is fully compliant with RFC1490 and can interact with many IBM products including the 3745/46, 2210 and 2216.

The 2218 Nways FRAD integrates and supports traditional equipment and their serial protocols such as SDLC, X.25 QLLC, BSC, Async and SNA DSPUs. In addition, the IBM 2218 Nways FRAD concentrates up to 120 LAN and serial link attached devices onto a single, high-speed frame relay circuit. It can be managed by either NetView or any industry-standard SNMP manager.

All available models can either be run as conversion nodes or frame relay nodes. The choice for either mode is made by microcode features; all models of 2218 Nways FRAD are shipped with pre-installed microcode:

- Models 0xx are shipped with 2218 Microcode Release 2.1.
- Models 1xx are shipped with 2218 Microcode Release 2.0, Release 2.1 is available on a diskette.

- Models 3xx are shipped with 2218 Microcode Release 2.0, Release 2.1 is available on a diskette.

Microcode Functions:

- Release 2.0 Functions for conversion nodes (all models)
  - Support for SDLC or BSC hosts
  - Support for SDLC, BSC or Async terminal units
  - SDLC/BSC to LLC2 conversion
  - SNA/SDLC BNN
  - NetView/390 Service Point
  - SNMP Agent
- Release 2.0 Functions for frame relay nodes (all models)
  - Single LAN protocol
  - SDLC/BSC point-to-point or multidrop with primary and secondary emulation
  - Transparent multipoint async
  - LLC2 to frame relay
  - SNA/SDLC BNN
  - Anex D and LMI
  - RFC1490 BNN and BAN
  - PDQ/PDT priority control
  - CIR conformance
  - NetView/390 Service Point
  - SNMP Agent
- Release 2.1 Functions for conversion nodes (all models)
  - BSC RJE
- Release 2.1 Functions for conversion nodes (Models 0xx/3xx)
  - X.25 QLLC
- Release 2.1 Functions for frame relay nodes (Models 0xx/3xx)
  - BSC RJE
  - Auto LLC
  - Annex A
  - X.25 Pass-Through
  - X.25 QLLC
  - X.25 WAN

Table 22 (Page 1 of 2). 2218 Model Matrix

Models	LAN Interface		Number of Serial Base Ports	Number of Supported Devices	DRAM Flash (Base/Max)
	Token-Ring	Ethernet			
02T	1	0	2	30	4 MB/8 MB/2 MB
02E	0	1	2	30	4 MB/8 MB/2 MB
02X	0	0	2	30	4 MB/8 MB/2 MB
18T	1	0	8	16	2 MB/2 MB/2 MB

Table 22 (Page 2 of 2). 2218 Model Matrix					
18E	0	1	8	16	2 MB/2 MB/2 MB
18X	0	0	8	16	2 MB/2 MB/2 MB
32T	1	0	2	120	4 MB/8 MB/2 MB
32E	0	1	2	120	4 MB/8 MB/2 MB
34T	1	0	4	120	4 MB/8 MB/2 MB
34E	0	1	4	120	4 MB/8 MB/2 MB
38T	1	0	8	120	4 MB/8 MB/2 MB
38E	0	1	8	120	4 MB/8 MB/2 MB

Notes:

- Models 0xx also support one or two integrated DSU/CSU adapters, one ISDN BR1 adapter and one 2-port synchronous adapter.
- Six WAN ports can be ordered for Models 0xx. Only four ports can be utilized at any given time.
  - Two EIA-232 ports or standard, two universal serial ports are optional.
- BSC is only supported on EIA-232 ports.

2.4.4 IBM 6611 Network Processor

The 6611 uses bridging, routing and data link switching functions to receive and transmit multiple protocols from one LAN to another.

The Multiprotocol Network Program (MPNP) provides the necessary configuration functions to support each protocol. The 6611 is not a gateway and therefore requires the endstations that want to communicate with each other to use the same protocol. The data link switching function encapsulates SNA and NetBIOS frames into an IP datagram for transport over a WAN.

With all other protocols it uses the packet or frame format prescribed by that protocol to route or bridge the protocol. The 6611 is available in Models 120, 125, 145 and 175. The following is a list of all types of adapters that are available for any 6611 model:

- Four-port multi-interface serial adapter
- Two-port token-ring network 16/4 adapter
- Two-port Ethernet adapter
- Multi-interface serial/token-ring combination adapter
- Multi-interface serial/Ethernet combination adapter
- Two-port multi interface serial adapter
- One-port token-ring network 16/4 adapter
- One-port Ethernet adapter
- Four-port SDLC adapter
- X.25 adapter

Note: Model 120 is only available with fixed configurations.

The 6611 provides routing of the network layer protocols used by the following protocol suites:

- TCP/IP (including encapsulated SNA, SDLC, and NetBIOS)
- HPR ANR/RTP/ARB
- IPX
- XNS
- DECnet Phase IV
- AppleTalk Phase 2
- Banyan VINES
- APPN Network Node
- Frame relay
- ITU-T LMI
- DLSw V1

2.4.4.1 Communication Adapter Features Supported

The communication adapter features supported for each of the protocols that can be routed by the 6611 Network Processor are summarized in Table 23.

Table 23 (Page 1 of 2). IBM 6611 Adapter Ports and Supported Protocols

Adapter Ports:	**Ethernet 1**			**Token-Ring**		**Serial**			**SDLC**	**X.25**
Standard:	**Version 2**	**IEEE 802.3**		**IEEE 802.5**						**CCITT X.25**
Framing → Protocols ↓	**Type**	**LLC**	**SNAP**	**LLC**	**SNAP**	**PPP**	**Frame Relay**	**TR Bridge Pgm**	**SDLC**	**X.25**
IP	X		X		X	X	X	X		X
XNS	X	X	X	X	X	X	X	X		
IPX 1	X	X	X	X	X	X	X	X		X
AppleTalk			X		X	X	X	X		
DECnet	X				X	X	X	X		
Banyan VINES	X		X	X	X	X	X	X		
SNA 3	X		X	X		X	X	X	X	X
APPN 2	X		X	X		X	X	X		X
NetBIOS 3	X		X	X		X	X	X		X
Source route bridging				X	X	X	X	X		
Transparent bridging	X	X	X			X	X			

Table 23 (Page 2 of 2). IBM 6611 Adapter Ports and Supported Protocols

Adapter Ports:	Ethernet 1			Token-Ring		Serial			SDLC	X.25
Standard:	Version 2	IEEE 802.3		IEEE 802.5						CCITT X.25
Framing → Protocols ↓	Type	LLC	SNAP	LLC	SNAP	PPP	Frame Relay	TR Bridge Pgm	SDLC	X.25
Translational bridging	X	X	X	X	X	X	X	X		

Notes:

1 Also supports native Novell 802.3 for IPX.

2 To run APPN, DLSw must be configured. APPN also requires that DLSw or IP be configured for APPN network nodes to communicate across a WAN.

3 For local DLSw of SNA, the configuration of IP is not required. For remote DLSw of SNA and NetBIOS, IP must be configured on the link between DLSw session partners.

The communication adapter features supported for the TCP/IP protocol suite can also be used to support the transfer of information that originates from nodes that use either the SNA or the NetBIOS protocol suites. This is achieved using the 6611 Network Processor data link switching function, which encapsulates the SNA or NetBIOS protocols inside the TCP protocol.

2.4.5 RouteXpander/2

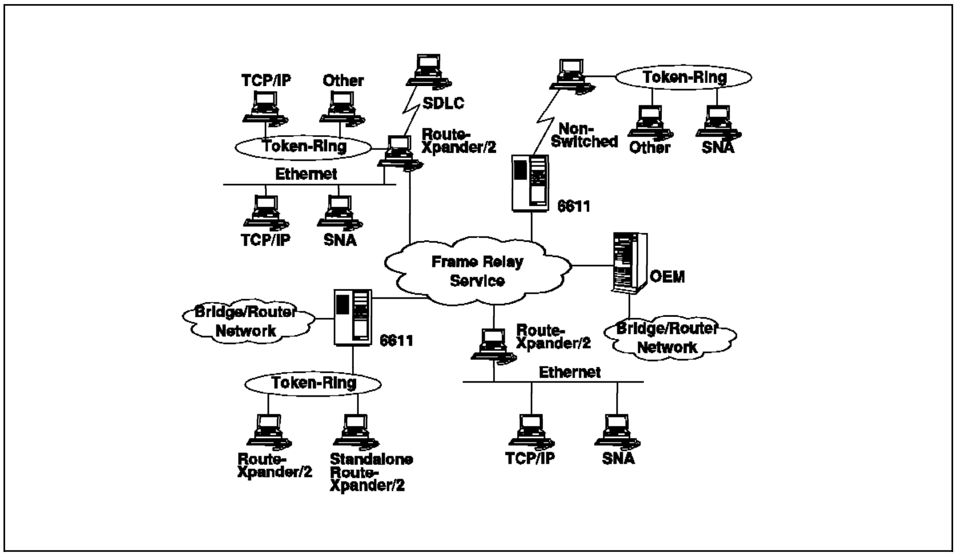


Figure 20. RouteXpander/2 and Wide Area Connector

RouteXpander/2 brings the multiprotocol router, bridging, and frame relay technologies to OS/2 workstations. Among the benefits of frame relay support is its ability to multiplex multiple protocols on a single link. The RouteXpander/2 source-route bridge and multiprotocol routing facilities transport multiple protocols, including TCP/IP, SNA/APPN and NetBIOS over a single link, using either frame relay or point-to-point connections.

In order for routing to occur, the protocol stack must exist on the OS/2 workstation with RouteXpander/2. RouteXpander/2 contains a source route bridge to handle situations where routing is not possible. For example, in the case of NetBIOS which cannot be routed, the source route bridge is used. The bridge can connect two LANs. Because the frame relay device driver is configured as a token-ring LAN, traffic can be bridged from a LAN to a WAN. Because it is a source route bridge, only token-ring LANs are supported for bridging; Ethernet LANs are not supported for bridging.

For bridging, RouteXpander/2 interoperates with another RouteXpander/2 and with the native bridge support of the 6611 Network Processor over a frame relay network using a point-to-point connection.

By acting as a feeder node, RouteXpander/2 offers applications access to frame relay and router networks, without requiring a dedicated processor for the connection. RouteXpander/2 communicates with another

RouteXpander/2 over a non-switched, point-to-point link, offering direct LAN-to-LAN multiprotocol communication.

RouteXpander/2 is designed to communicate with devices that comply with the frame relay specifications and conform to multiprotocol operation as documented in RFC 1294.

Detailed information about the hardware and software requirements can be found in the announcement letter for RouteXpander/2.

2.4.6 IBM LAN-to-LAN WAN Program (LTLW)

The LAN-to-LAN Wide Area Network Program Version 1.0.6 (LTLW) interconnects remote local area networks (LANs) across a wide area network (WAN). Applications written to the IEEE 802.2 interface that use the IBM NetBIOS frame protocol will be able to communicate with remote LANs using the wide area network as a transport medium. The LTLW program provides the interface between the LAN and the WAN, and communication will be via the LU 6.2 facilities provided by OS/2 Communications Manager.

LTLW and LTLW Entry are software-based router products that are designed to link geographically separate LANs together to carry NetBIOS, IPX and IP traffic between them. The IBM LAN-to-LAN Wide Area Network Program does the following:

- Allows existing LAN-attached stations to communicate via a WAN.
- Is able to use an SNA backbone (SNA subarea or an APPN network or an X.25 Packet Switched Data Network (PSDN)) as a WAN.
- Runs on a PC or PS/2 machine under OS/2 V2.0 or higher.
- Supports any WAN adapters supported by the hardware.
- Uses the OS/2 Extended Edition Communications Manager Advanced Peer-to-Peer Communication (APPC) LU 6.2 interface to send and receive traffic between NetBIOS switches.
- Provides a graphical and text-based operator interface for planning, configuring, installing, monitoring, error detection and recovery.

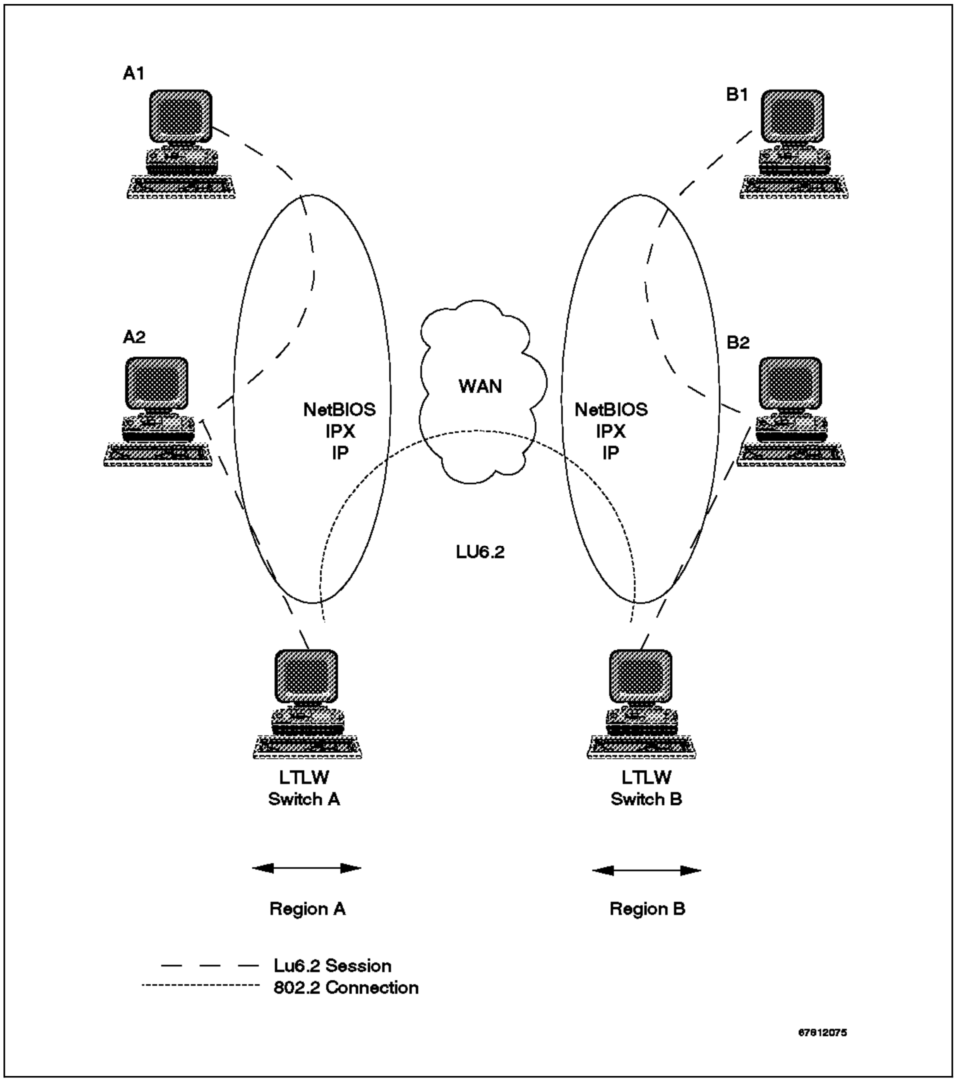


Figure 21. Connections of LANs via WAN Using LTLW

In Figure 21, a NetBIOS application in station A1 is communicating with station B1. Station A1 might be a DOS LAN Requester accessing a file server in station B1. At the same time, station A2, perhaps a print server, is being accessed by station B2. Both connections are multiplexed onto an APPN LU 6.2 SNA session between two NetBIOS switches.

2.4.7 IBM Router Solutions

The following table describes the IBM router hardware and software.

Table 24. IBM Router Solutions

Solution	Interconnection
2210 Nways Multiprotocol Router	Remote LAN to Token-Ring Remote LAN to Ethernet
2216 Nways Multiaccess Connector	Local/Remote LAN to Token-Ring Local/Remote LAN to Ethernet
2218 Nways Frame Relay Access Device	Local/Remote LAN to token-ring Local/Remote LAN to Ethernet
6611 Network Processor	Local/Remote LAN to Token-Ring Local/Remote LAN to Ethernet
IBM RouteXpander/2	Local/Remote LAN to Token-Ring Local/Remote LAN to Ethernet
IBM LAN-to-LAN WAN Program	LAN-to-LAN over WAN
IBM 973x IDNX LWX	LAN to WAN

2.5 Switches

Traditional LANs were typically small with few concerns about the number of attached stations and bandwidth. Within the last few years LANs have grown in scale, speed and importance, and have experienced an increasing number of congestions and lower performance, depending on the network traffic. Figure 22 shows a traditional LAN to connect the stations to a host system and different servers.

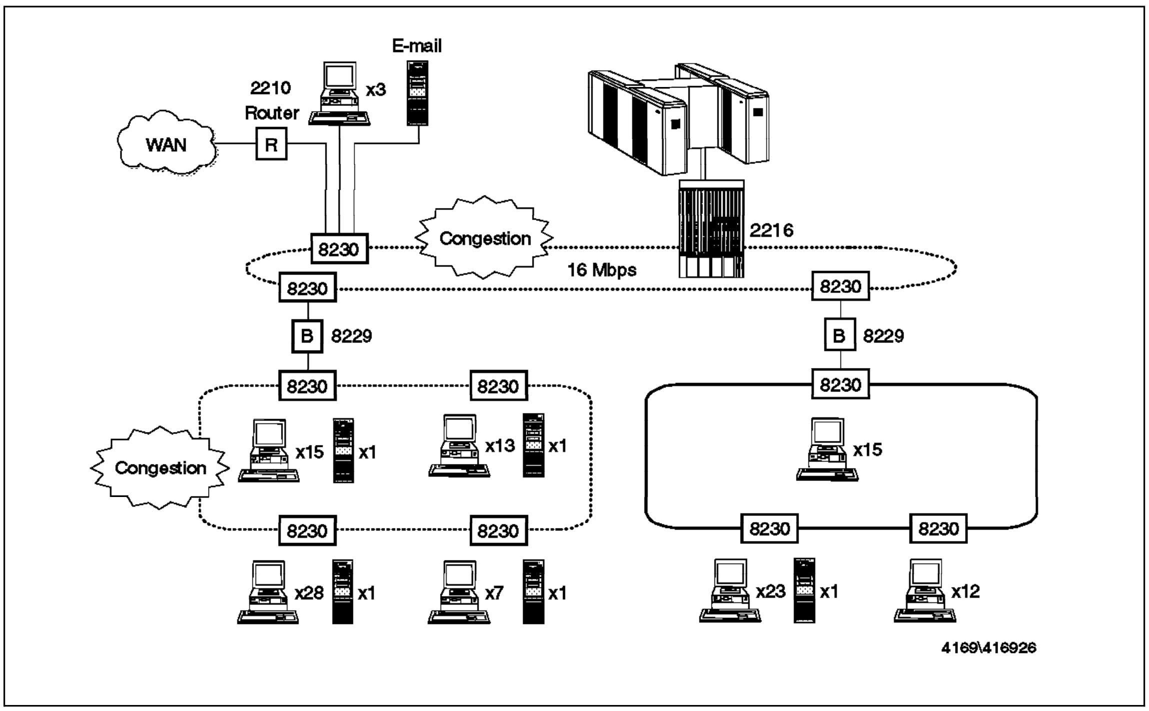


Figure 22. Traditional Token-Ring LAN

To cope with congestion and performance problems the use of switches and switch-attached servers is recommended. Figure 23 on page 58 shows a switch solution for the above network. Smaller numbers of stations per port and direct-attached speed-dependent applications provide better performance and fewer congestion situations.

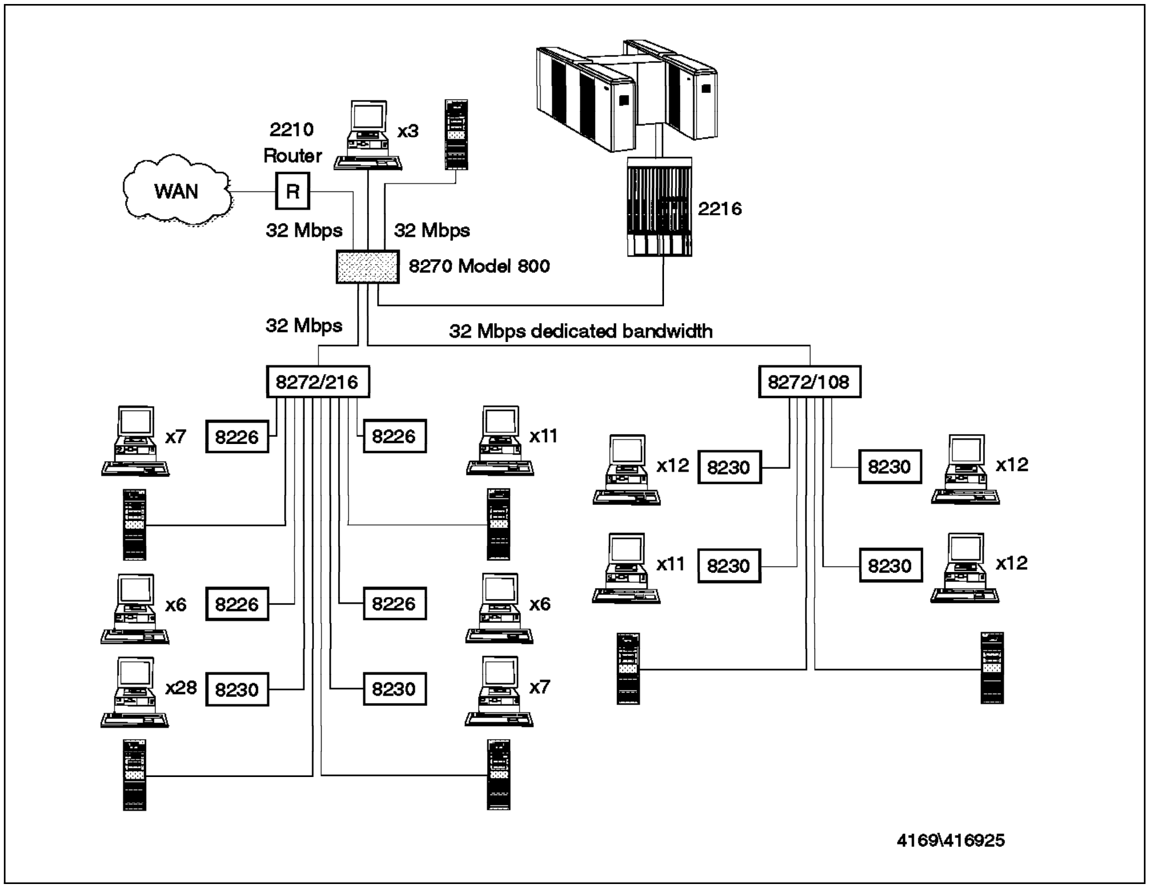


Figure 23. Switched Token-Ring LAN

2.5.1 IBM 2219 Nways Frame Relay Switch

The IBM Nways Frame Relay Switch provides a high-performance platform for frame relay networks. It is a six-slot, modular frame relay switch with different interface modules to fit the network requirements. One of the slots is used to hold the Packet i960 RISC processor to allow high-performance packet switching, so there are only five slots available for I/O modules. The 2219 and its I/O modules offer a wide range of supported interfaces:

- 1-port E1/T1 Channelized
- 6-port V.25/X.21
- 8-port V.24/X.21
- 18-port V.24/X.21

Note: A maximum of 60 lines can be active at a time.

Frame Relay Support: The Nways Frame Relay Switch I/O modules can act as DTE or DCE at transmission rates of 2.4 Kbps to 4.096 Mbps, providing comprehensive frame relay Permanent Virtual Circuit (PVC) functions such as:

- Frame relay feeder interface (UNI-DTE)
- Frame relay switch interface (UNI-DCE)
- Frame relay network-to-network interface (NNI)
- Leased line trunk
- Interswitch trunk over a frame relay service

If the incoming traffic is other than the frame relay protocol, such as SNA/ SDLC or X.25, the Nways Frame Relay Switch will encapsulate the data links into the frame relay format. The Nways Frame Relay Switch microcode provides translation that converts protocols such as PPP (Point-to-Point Protocol) and encapsulated protocols (IP, IPX, and transparent bridging) to frame relay standards, based on the Frame Relay Forum′s implementation agreement for multiprotocol encapsulation over frame relay (RFC 1490). The encapsulation format and translation format provide consolidation of all WAN traffic carried on a single broadband packet backbone.

The Nways Frame Relay Switch microcode delivers standard-based capabilities for managing and controlling WANs.

2.5.2 IBM 2225 Nways Multiservice Switch

The IBM 2225 Nways Multiservice Switch provides a flexible multiservice WAN platform, based on ATM cell switching for interworking among frame relay, SMDS and ISDN. By providing all three broadband packet services, the Nways Multiservice Switch products give users the flexibility of choosing the service that suits the particular need of their networked applications. There are two models to meet the different needs.

Table 25. 2225 Model Matrix

2225 Models	Maximum Number of Slots	Maximum Number of I/O Slots	Throughput
400	8	6	1.2 Gbps
450	16	14	1.2 Gbps

There are two types of I/O modules, an IOM-plus and an IOM-16. The IOM-16s have more memory and, in some cases, an upgraded HD processor on the I/O processing card. The IBM 2225 Nways Multiservice Switch models support the following interfaces:

- V.35, V.36, X.21, RS449
- E1/T1 channelized and unchannelized
- HSSI

- T3-DS3/E3 ATM UNI
- DSX-1
- T1/ISDN PRI
- E1/ISDN PRI
- OC3/STM-1 ATM UNI
- DS3 channelized

The following table shows the supported broadband packet services.

Table 26. Supported I/O Modules on 2225

I/O Module	Port Speed	ATM	SMDS	Frame Relay
Universal I/O V.35, X.21	Up to 8 Mbps	Y	Y	Y
Unchannelized T1/E1	1.54 - 2.05 Mbps	Y (DX1)	Y	Y
Channelized T1/E1	24 or 36, 56/64 Kbps Channels	Y	Y	Y
ISDN T1/E1	24 or 36, 56/64 Kbps Channels	Y	Y	Y
HSSI	Up to 45 Mbps	Y (DX1)	Y	Y
DSX-1	1.54 Mbps	Y (DX1)	Y	Y
ATM UNI T3/E3 IWU	45/34 Mbps	Y	N	N
Channelized DS3	28 x T1	N	N	Y
ATM UNI OC3/ STM1 CS/IWU	155 Mbps	Y	N	N
ATM UNI T3 CS/IWU	45 Mbps	Y	N	N

2.5.3 IBM 2230 Nways ATM Switch

The IBM 2230 Nways ATM Switch and all its models are scalable switches designed for Quality of Service (QoS) and high performance across all ATM operations with an internal switch port speed of 640 Mbps. This switch supports mixed data, video, and voice traffic. There are two models available:

Table 27. 2230 Model Matrix

2230 Models	Maximum Number of Slots	Maximum Number of I/O Slots	Throughput
600	8	6	2.5 Gbps
650	16	14	5.0 Gbps

For 2230 Nways ATM Switches the following ATM interfaces are supported:

- DS3/E3
- OC3c/STM-1 SMF
- OC3c/STM-1 MMF

2.5.4 IBM 2220 Nways BroadBand Switch

The IBM 2220 Nways BroadBand Switch is a fast-packet and ATM cell switch based on IBM′s Networking BroadBand Services (NBBS) architecture. It offers 3.7 Gbps switch aggregate bit throughput (or an I/O rate of 7.4 Gbps) and connects to high-bandwidth carrier offerings through standard trunk interfaces. This architecture was designed specifically to meet the challenges of broadband, multi-service transport networks.

Table 28. 2220 Model Matrix

2220 Models	# of Slots	LIC511 Support	Maximum # of Lines V.74/X.71/V.35
300	6	2	170
500	8	4	240
501	14	10	600
Note: Model 501 is an extension of Model 500 providing six additional adapter slots.			

The IBM 2220 Nways BroadBand Switch can be managed by any standard SNMP management program.

2.5.5 IBM 8210 Nways Multiprotocol Switched Services Server

With the IBM 8210 Nways Multiprotocol Switched Services (MSS) Server attached to a campus asynchronous transfer mode (ATM) switch, a high-performance multiprotocol backbone can be formed. This maximizes the effectiveness of existing networks, while positioning your network to use high-speed, low-delay applications. The 8210 Nways Multiprotocol Switched Services provide the following benefits:

- ATM Forum LAN Emulation
- ELAN and VLAN
- Standard-based routing for IP and IPX over ATM
- Standard-based transparent and source route bridging for ELANs
- Super VLAN for ATM LAN Emulation
- FDDI Routing for connection of FDDI to ATM
- Ability to specify QoS
- Next Hop Routing Protocol support (NHRP)
- AppleTalk Routing support
- Redundant ARP Server support

2.5.6 IBM 8270 Nways Token-Ring Switch

The IBM 8270 Nways LAN Switch Model 800 is a configurable token-ring switch. It supports a set of features and functions comparable to those available on the IBM 8272. Unlike the other members of IBM′s LAN switch family (the IBM 8271 and the IBM 8272), the IBM 8270 Model 800 has no fixed LAN ports but has eight slots available for Universal Feature Cards (UFCs). The following UFCs are avialable:

- 4-Port Token-Ring/Enhanced UTP/STP UFC
- 2-Port Token-Ring/Enhanced Fiber UFC
- ATM 155 Mbps Multi-Mode Fiber/Token-Ring UFC
- MSS Client
- MSS Domain Client
- RMON

The IBM 8270 Model 800 complement of the IBM 8272 Nways Token-Ring LAN Switch provides significantly more configuration flexibility than is available with the 8272. The IBM 8270 Model 800 supports a maximum of 31 physical token-ring ports. Toward this maximum, the ATM 155 Mbps multi-mode fiber/token-ring UFC counts as one physical port.

The 8270 Nways Token-Ring Switch can be managed by SNMP.

2.5.7 IBM 8271 Nways Ethernet LAN Switch

The IBM 8271 Nways Ethernet LAN Switch is a device used for Ethernet LAN segmenting and increasing network bandwidth. The IBM 8271 creates multiple, concurrent paths among the connected Ethernet segments, each supporting the full 10 Mbps Ethernet bandwidth. The IBM 8271 Switch provides high-speed forwarding of Ethernet frames among the shared or dedicated Ethernet segments attached to each Ethernet port.

The IBM 8271 supports full-duplex (bidirectional) communication with devices on dedicated segments such as other IBM 8271s or workstations that are equipped with full-duplex Ethernet adapters. Full-duplex Ethernet connections provide up to twice the bandwidth of standard half-duplex connections and up to 20 Mbps on each of the switch ports.

The 8271 is available in six models with different capabilities:

Table 29 (Page 1 of 2). 8271 Model Matrix

8271 Models	# of 10Base-T Ports	# of 100Base-TX Ports	Duplex Capability	Additional Ports/Modules
108	8		Yes	1 Universal Feature Slot
216	16		Yes	2 Universal Feature Slots
524	24	1 (uplink)	Yes (on uplink)	optional plug-in feature module **2**, optional transceiver module
612	12	1 (uplink)	Yes (on uplink)	optional plug-in feature module **2**, optional transceiver module
624	24	1 (uplink)	Yes (on uplink)	optional plug-in feature module **2**, optional transceiver module

Table 29 (Page 2 of 2). 8271 Model Matrix				
8271 Models	# of 10Base-T Ports	# of 100Base-TX Ports	Duplex Capability	Additional Ports/Modules
712	12 **1**	12 **1**	Yes	optional plug-in feature module **2**

Notes:

1. The Model 712 has 12 10Base-T/100Base-TX autosensing ports.
2. Optional modules include:
   - 100Base-FX module with SC connectors
   - 100Base-TX module with RJ-45 connector
   - 155Mbps ATM OC-3c module

The following adapters are available for the universal feature slot:

- Feature 6988: ATM 155 Mbps Multi-Mode Fiber/Ethernet
- Feature 6995: 100Base-TX UFC
- Feature 7000: 100Base-FX UFC
- Feature 7020: 3-Port 10Base-FL UFC
- Feature 8470, 8475, 8480: FDDI UFC
- Feature 9195: 4-Port 10Base-T UFC

2.5.8 IBM 8272 Nways Token-Ring LAN Switch

The IBM 8272 Nways Token-Ring LAN Switch is, like IBM 8271, used to increase bandwidth and segmentation within LANs, but IBM 8272 is used for token-ring LANs.

IBM 8272 supports full 16 Mbps bandwidth for each attached token-ring segment. It supports full-duplex (bidirectional) communication with devices on dedicated segments such as IBM 8272s or workstations that are equipped with full-duplex token-ring adapters. Full-duplex token-ring connections provide up to twice the bandwidth of standard half-duplex connections and up to 32 Mbps on each of switch ports.

The IBM 8272 is available in two different models:

Table 30. 8272 Model Matrix			
8272 Models	Token-Ring Ports	Duplex Capability	Additional Ports
108	8	Yes	1
216	16	Yes	2

Notes:

- All models can be SNMP managed.
- The maximum number of stations per port is 1700.
- The maximum number of stations per 8271 is 10000.

For the additional feature slot the following adapters are available:

- Feature 5060: RMON/token-ring card
- Feature 5076: ATM 155 Mbps multi-mode fiber/token-ring card
- Feature 8470, 8475, 8480: FDDI cards
- Feature 9196: 4-Port token-ring UTP/STP card

2.5.9 IBM 8273 Nways Ethernet RouteSwitch

The IBM 8273 Ethernet RouteSwitch is used to provide high-speed switching between a fixed number of Ethernet ports and two uplink slots for backbone access. These hardware prerequisites and the available Nways RouteSwitch Software Program allow you to provide high-speed switching between Ethernet segments and to increase performance for ATM, FDDI and Fast Ethernet uplinks. The IBM 8273 Nways Ethernet RouteSwitch is available in three different models:

Table 31. 8273 Model Matrix

8273 Models	# of 10Base-T Ports	# of Sub-Module Ports	# of Universal Ports	Memory DRAM/Flash	
100	12	2	0	8 Mb	2 Mb
10E	12	2	0	16 Mb	4 Mb
10U	Any mix adapter board 1	2	8	8 Mb	2 Mb

Note: 1 Any of the following features can be installed: 7114 - 7119.

For the sub-module ports there are features available to provide each model with the following uplink options:

- To servers: 100Base-TX, CDDI, ATM OC3
- To backbones: 100Base-FX, FDDI, ATM OC3
- To WANs: Frame relay, ATM DS3 or E3

The controlling software for the IBM 8273 is Nways RouteSwitch Software Program (NRSP) V2R1.0, which is available for all 8273 models.

2.5.10 IBM 8274 Nways LAN RouteSwitch

The 8274 is a device for a broad range of switching module options that support Ethernet, token-ring, FDDI, CDDI, Fast Ethernet and ATM on twisted-pair, coaxial and optical fiber cabling at wire speed with automatic any-to-any translation.

The 3 models of the 8274 that are available. are alike in many ways. They each provide policy-based VLANs, IP and IPX routing, FDDI trunk, ATM private and switched virtual circuits, ATM LAN Emulation, Multiprotocol Encapsulation over ATM, Classical IP over ATM and graphical network management on a broad set of standard management platforms.

The Model W33 differs from the other 2 models in that an integrated, optional, redundant power supply is not supported and cell and frame switching are not supported in the same chassis.

Table 32. 8274 Model Matrix

8274 Models	# of Slots Max/Available		13.2 Gbps Route Cell Matrix
W33	3	2	Yes
W53	5	4	Yes
W93	9	8	Yes
Note: The management processor module is required and takes one slot.			

An 8274 at maximum extension is able to provide the following connections:

- 16 OC3 ports
- 256 Ethernet ports
- 48 token-ring ports
- 64 Fast Ethernet wire ports
- 16 Fast Ethernet optical fiber ports
- 64 CDDI ports
- 16 FDDI ports
- 16 ATM DS3 or E3 ports
- 64 frame relay WAN ports

2.5.11 IBM 8285 Nways ATM Workgroup Switch

The IBM 8285 Nways ATM Workgroup Switch is a 25 Mbps switch and adapter providing a lower-cost alternative migration to an ATM network. The 8285 is available in two models: 00B and 00P. Both models consist of a box that provides 12 ATM ports at 25.5 Mbps and a feature slot.

For this feature slot there are two I/O cards available to support a high-speed ATM interface at 155 Mbps: single-mode and multi-mode fibers are available.

The difference between Model 00B and 00P shows up at ordering time. For Model 00P you have to choose between 12 ISA or 12 PCI TURBOWAYS adapters.

The IBM Nways ATM Workgroup Switch can be managed by SNMP network management for Nways Campus Manager.

2.6 Hubs and Concentrators

Hubs are the central elements of LANs where the physical cabling infrastructure is concentrated, hence the name hub or concentrator. Hubs can support one or different kinds of LAN types such as Ethernet, token-ring, FDDI, ATM, and the newer 100Base-T and 100VG-AnyLAN technologies.

Intelligent hubs provide network management information, allowing operators to monitor and control every port on the hub from a single network control center. This is a significant advantage over older non-intelligent hubs.

The two major categories for hubs are multiprotocol hubs and workgroup hubs.

Multiprotocol Hubs: Multiprotocol hubs usually accommodate extra features such as built-in fault tolerance, internal bridging and routing support, power management, and sophisticated management features. These hubs are usually more expensive on a cost-per-port basis than workgroup hubs.

Workgroup Hubs: Workgroup hubs, on the other hand, usually provide single-protocol support for a smaller number of users. They are also easier to set up and support.

However, workgroup hubs do not necessarily have fewer capabilities than multiprotocol hubs. Many of the hubs perform error detection and recovery and provide flexible configuration options. In addition, most hub products support the SNMP standard, originally designed to support TCP/IP networks, which allows them to be controlled by an SNMP central network management system.

Table 36 on page 73 compares IBM′s hubs with each other to position them in a network environment.

2.6.1 IBM 6299 Hub for Midrange Systems

The 6299 Hub for Midrange Systems is a complete line of networking hubs for connecting 5250-type devices (such as personal computers (PCs) with 5250 emulation adapters, twinax-attached printers, and InfoWindow displays) to AS/400, System/36, and System/38 hosts using low-cost, unshielded twisted-pair (UTP) wiring. The 6299 also has a unique Host Port Multiplexer feature that connects the host to remote sites using a single UTP, twinax, or fiber optical cable. The IBM 6299 Hub for Midrange Systems converts a midrange twinax cabling topology from daisy chain to a highly flexible, expandable star topology. Once the initial cabling is installed, any future device movement, addition and deletion of UTP-attached devices is much easier than twinax-attached devices.

The 6299 Hub for Midrange Systems family consists of a single-, dual- and nine-slot chassis and supports three different installable modules:

- Device Communication Module
  - One UTP host port
  - Seven UTP device ports
  - Repeater function included
  - Enhanced diagnostics
- Host Port Multiplexer
  - Multiplexes up to eight host ports onto a single UTP, twinax, or duplex fiber optic link.
  - Connects midrange hosts to remote sites using minimal cabling.
- UTP Distribution Block
  - Converts up to eight host ports on a single DB25 cable to eight separate UTP host ports.
  - Can be installed in 6299 Models 200 and 900 only.

2.6.2 IBM 8222 Nways Ethernet Workgroup Hub

The 8222 Nways Ethernet Workgroup Hub is an unmanaged IEEE 802.3 (Ethernet) low-end, low-cost concentrator. It is intended for installations that do not require SNMP network management. This hub is available in three models:

- 8222-008, containing 8 10Base-T ports
- 8222-016, containing 16 10Base-T ports
- 8222-308, is a networking kit with 8222-008 and 3 Etherjet 10Base-T ISA adapters

The primary function of the Nways hubs is to provide an economical means for devices to be connected over unshielded twisted pair cabling and to communicate with one another over an Ethernet local area network. They are also used to extend the range of Ethernet networks. These hubs can be joined by cascading over a variety of media (10Base-T, 10Base-2 thin coax, 10Base-5 thick coax or optical fiber) to allow additional devices to connect to an Ethernet network segment.

The IBM Nways 8222 hubs fully comply with the IEEE 802.3 repeater specification including the repeater, segment partition and jabber lockup functions.

2.6.3 IBM 8223 Fast Ethernet Workgroup Hub

The 8223 Fast Ethernet Workgroup Hub is a stand-alone IEEE 802.3 100Base-TX unmanaged workgroup hub. It includes an advanced network monitoring LED display that provides utilization and collision rates as well as per port status. It offers a high-performance, low-cost alternative method for interconnection.

The 8223 Fast Ethernet Workgroup Hub Model 008 contains eight 100Base-T ports. The eighth port supports both MIDI (Medium-Dependent Interface) and MDI-X (Medium-Dependent Interface-Crossed) wiring configurations, allowing connection to workstations or other Class II hubs with standard straight-through UTP cables.

2.6.4 IBM 8224 Ethernet Stackable Hub

The 8224 Ethernet Stackable Hub allows you to create a flexible Ethernet environment that grows as networking needs grow. It is available in two models. Each 8224 provides up to 17 ports of Ethernet connectivity: 16 10Base-T ports and one optional media expansion port for connectivity to an existing 10Base-2, 10Base-5, or fiber Ethernet network.

In addition, the 8224 can be placed in a stack of up to 10 units, set on a desktop or rack-mounted. The 8224 supports segmentation, cascading through its media expansion ports or 10Base-T ports, provides centralized management of remote sites and branch offices through its out-of-band management support via the SLIP protocol.

2.6.5 IBM 8225 Fast Ethernet Stackable Hub

The 8225 Fast Ethernet Stackable Hub provides a simple, high-performance, cost-effective solution to the bandwidth bottleneck of small and medium-size legacy LANs. The 8225 is available in three models, allowing users to start small and upgrade seamlessly. It conforms to the IEEE 802.3 Ethernet standard for Class 1 repeaters, which ensures interoperability with other 100Base-TX compatible products, including network interface adapters switches, routers and other internetworking equipment.

The 8225 Fast Ethernet Stackable Hub is available in three different models. Each model has 13 ports: 12 100Base-TX and one port for an optional extender module. There are also differences in management:

- Model 001 can be managed by Model 002 or Model 003
- Model 002 basic managed unit (SNMP)
- Model 003 advanced managed Unit (RMON)

2.6.6 IBM 8226 Token-Ring RJ45 Multistation Access

The 8226 Token-Ring RJ45 Multistation Access is a multistation access unit. It offers a splitter function that exceeds the capabilities of the IBM 8228. While offering increased function, the IBM 8226 will not be a replacement for the IBM 8228, but an addition to the product line. The 8226 supports Unshielded Twisted Pair (UTP), Shielded Twisted Pair (STP), and Foiled Twisted Pair (FTP) cabling for both lobe and main ring paths. The other major functions are that the 8226 is powered by an integrated auto-ranging power supply, it does not require a setup or initialization tool, and it can coexist with all other IBM token-ring concentrators and hubs.

The 8226 Token-Ring RJ45 Multistation Access provides 8-port attachment for three different network installations:

- Main Ring (stand-alone) - providing a single ring of up to eight attached workstations
- Main Ring (cascaded) - up to 10 IBM 8226 Model 001s can be cabled together via the RI/RO ports (maximum of 80 workstations)
- Splitter - when connected to a port of another hub (or concentrator/access unit), it provides the ability to connect up to eight workstations to a hub port.

2.6.7 IBM 8230 Token-Ring Controlled Access Unit

The IBM 8230 is an intelligent token-ring network wiring concentrator, providing enhanced levels of control and reliability over passive token-ring network wiring concentrators, such as the IBM 8228.

The 8230 is a rack-mountable device with the following functions:

- Supports ring operation at 4 and 16 Mbps
- Is able to function as a repeater in both ring directions (on main and backup path)
- Has pluggable ring-in and ring-out modules to support copper and fiber cable
- Has token-ring MAC appearances on both the main and backup ring path
- May have its microcode loaded from the IBM LAN Network Manager or from a diagnostic utility, which is provided

One IBM 8230 attaches up to 96 workstations to the token-ring local area network (IEEE 802.5).

Table 33. 8230 Model Matrix				
Models	max. number of stations	Dual Ring Redundancy	LAMs/RLAMs	Management
003	80	No	remote active, passive, LIU	CMOL/SNMP
013	80	No	remote active, passive LIU	CMOL/SNMP
04A	16 active	No	No	CMOL/SNMP
04P	16 passive	No	No	CMOL/SNMP
213	92	Yes	all local and remote	CMOL/SNMP

2.6.8 IBM 8237 Ethernet Stackable Hub

The 8237 Ethernet Stackable Hub is a single segment 10Base-T repeater hub. Each port of the repeater provides many features to keep the network from failing. The hub is a single-segment hub but it can be attached to one of three backplane segments. A stack can be composed of up to 10 repeater hubs.

8237 Ethernet Stackable Hub is available in three different models. Each model provides an expansion slot on the front of the display panel, which can be connected to various network extenders. Each of the optional media extender modules supports one of the following standard types of Ethernet transmission protocols:

- AUI/10Base-2
- 10Base-FL/FOIRL
- 10Base-T/100Base-TX
- 100Base-FX

These expansion modules allow extended connectivity to switches, routers, Fast Ethernet networks and Ethernet networks.

The 8237 models have different management capabilities:

- Model 001 is unmanaged. It can be implemented as an unmanaged unit, or it can be managed by a Model 002 or Model 003.
- Model 002 provides basic SNMP management.
- Model 003 provides advanced RMON management (9 groups).

2.6.9 IBM 8238 Nways Token-Ring Stackable Hub

The 8238 Nways Token-Ring Stackable Hub brings many functions of the large, chassis-based hubs to a cost-effective, stackable unit. The 8238 Nways Token-Ring Stackable Hub allows you to install only the number of local area network (LAN) ports needed, and allows you to easily increase capacity as required, from a minimum of 16 to a maximum of 128 active or passive ports. Each hub unit supports 16 ports. This capability makes the 8238 perfect for workgroups and remote sites.

The 8238 stack consists of a management base and up to seven expansion units. These units are connected with IntraStack cables, giving the stack a single-system appearance. Simple Network Management Protocol (SNMP) is used to manage the network.

The product highlights are:

- Ideal product for small work groups or remote locations
- Stackable design
- 16 to 128 active or passive ports
- Three levels of SNMP management with full remote monitoring
- RS232 port for out-of-band management
- Optional ring-in/ring-out module

The 8238 Nways Token-Ring Stackable Hub is available in six different models, providing a passive as well as an active base and three different levels of SNMP manageability.

2.6.10 IBM 8244 FDDI Workgroup Concentrator

The 8244 FDDI Workgroup Concentrator is the primary attachment to the FDDI dual ring for attaching workstations to the backbone. The 8244 FDDI concentrator allows attaching up to 12 devices to 100 Mbps networks. These devices may be connected via multi-mode optical fiber, IBM Cabling System′s shielded twisted pair (STP), copper cable, or unshielded twisted pair (UTP-5) copper cable. The 8244 can provide connection for FDDI devices that are based on the ANSI and ISO standards. SNMP management is supported.

Table 34. 8244 Model Matrix

Models	Max. Number of Ports	Max. Number of Ring Ports	Max. Number of Workstation Ports	Type of Ring Ports	Type of Workstation Ports
06F	6	2	4	Fiber	Fiber
06S	6	2	4	Fiber	STP
06U	6	2	4	Fiber	UTP5
12F	12	2	10	Fiber	Fiber
12S	12	2	10	Fiber	STP
12S	12	2	10	Fiber	UTP5

2.6.11 IBM 8250 Multiprotocol Intelligent Hub

The 8250 Multiprotocol Intelligent Hub is a family of products designed to provide the platform to build LANs meeting the requirements of customers using various types of cabling systems (such as STP, UTP, fiber and coax) and different types of LANs (such as token-ring, Ethernet, and FDDI).

The 8250 family consists of several models of rack-mountable chassis, each offering an advanced backplane architecture, which allows the concurrent operation of several LANs using various LAN protocols. A range of media and management modules are also provided to allow the design of networks addressing the individual needs of each organization.

8250 modules can be added, removed or reconfigured while the 8250 is in operation. This allows changes to the configuration of the network without affecting the operation of the other users on the network.

Port switching allows individual ports on a module to be assigned to different networks on the backplane. This feature, which is available on certain Ethernet modules only, will provide you with the ability to design cost effective networks and allow you to easily handle configuration changes arising from user relocations or component failures.

2.6.12 IBM 8260 Nways Multiprotocol Switching Hub

The 8260 Nways Multiprotocol Switching Hub is an intelligent hub which provides the platform to build LANs using different kinds of cabling systems and different types of LAN protocols such as token-ring, Ethernet and FDDI. Additionally the 8260 Nways Multiprotocol Switching Hub provides a platform for high-speed networks based in Asynchronous Transfer Mode (ATM) technology.

There are seven different models available, providing numerous capabilities to meet different network requirements.

Table 35. 8260 Model Matrix

Models	Max. Number of slots	Max. Number of Hub CNTL. Modules	Packet Channel	ATM	Token -Ring	Ethernet	FDDI
017	17	2	Yes	No	Yes	Yes	Yes
A17	17	2	No	Yes	Yes	Yes	Yes
010	10	2	No	No	Yes	Yes	Yes
A10	10	2	No	Yes	Yes	Yes	Yes
P10	10	2	Yes	No	Yes	Yes	Yes
P17	17	2	Yes	No	Yes	Yes	Yes
G17	17	2	Yes	Yes	Yes	Yes	Yes

With more than 70 modules available (including 8250 modules), the 8260 Nways Multiprotocol Switching Hub combines the functions of a shared-media, modular, intelligent hub with LAN and ATM switches in a single unit. The 8260 Nways Multiprotocol Switching Hub provides resources for future network requirements. The 8260 accepts a wide range of Ethernet, token-ring, FDDI, ATM and unique features such as MPEG-2 video. A bigger hub, the IBM 8265 Nways Campus Hub, is being developed. It will provide more slots than the 8260. All modules for the 8260 will be available for eht 8265.

2.6.13 IBM 8276 Nways Ethernet RoutePort

The 8276 Nways Ethernet RoutePort complements the 8274 Nways LAN RouteSwitch, 8273 Nways Ethernet RouteSwitch and 8271 Nways Ethernet LAN Switch. Used in combination with one of these switches, the 8276 Nways Ethernet RoutePort extends the benefits of switching. To take advantage of switching, LAN segmentation, virtual LANs, routing, and increased bandwidth, the 8276 Nways Ethernet RoutePort should be considered.

8276 Nways Ethernet RoutePort is available in six different models supporting up to 36 10Base-T ports, two single-mode ports and two muliti-mode ports.

Table 36 (Page 1 of 2). Comparison of IBM's Hubs and Switches

Model	Token-Ring	Ethernet	FDDI	ATM	Min. Lobe Ports	Max. Lobe Ports	Unmanaged	SNMP Mgmt.	CMOL Mgmt.
8222-008		X			6	7	X		
8222-016		X			16	18	X		
8223		X			8	8	X		
8224-001		X			16	17	X 1		
8224-002		X			16	17		X	
8225		Fast			12	13		X	
8226	X				8	8	X		
8230-003/ 013	X				0	80		X	X
8237-001		X			16	17	X 1		
8237-002/ 003		X			16	17			
8238	X				16	126		X	
8244-06F 06S/06U			X		6	12		X	
8244-12F 12S/12U			X		12	12		X	
8271-108		X		Uplink	8	12		X	
8271-216		X		Uplink	16	24		X	
8271-524		X		Uplink	25	26		X	

Model	Token-Ring	Ethernet	FDDI	ATM	Min. Lobe Ports	Max. Lobe Ports	Unmanaged	SNMP Mgmt.	CMOL Mgmt.
8271-612		X		Uplink	13	14		X	
8271-624		X		Uplink	25	26		X	
8271-712		X		Uplink	12	12		X	
8272-108	X			Uplink	8	12		X	
8272-216				X	8	12		X	
8276-360- 365		X			34	36		X	
8250	X	X	X		2	384		X	
8260	X	X	X	X	2	600		X	

Table 36 (Page 2 of 2). Comparison of IBM's Hubs and Switches

Note: See Chapter 12, "Network Management" on page 251 for information on network management for these devices.

2.7 Multiplexers

Multiplexers operate at the physical layer, taking data bits from several devices, and interleaving this data onto a single physical link. Such methods as time division multiplexing (TDM) or frequency division multiplexing (FDM) may be used to maximize the number of devices that can share a single transmission facility. Multiplexers manage the bandwidth; hence they are often called *bandwidth managers*.

The Integrated Digital Network eXchange (IDNX), IBM product number 973x, is a family of bandwidth managers that allow organizations to implement, manage and optimize private networks consisting of diverse transmission facilities. The 973x supports voice, video and applications by combining multiplexing, routing, switching and integral network management.

The 973x LAN/WAN eXchange (LWX) provides routing between geographically disperse LANs via various routing protocols.

The 973x Frame Relay eXchange (FRX) provides the interface for frame relay networks.

The following are the three models of the 973x available:

- 9733 IDNX Micro 20
- 9738-090 IDNX Model 70 with Model 90 upgrade package
- 9739 IDNX Model 90

2.8 Remote LAN Access

In this section, we discuss the remote LAN products and the environments in which they reside.

2.8.1 8235 Dial In Access to LANs (DIALs)

The 8235 Dial In Access to LANs (DIALs) family is a dedicated multiport, multiprotocol remote access hardware server for token-ring and Ethernet LANs with routing and bridging support for multiple protocols. It is used to extend the office LAN to remote users. Supporting dial-in, dial-out and LAN-to-LAN connections, the 8235 Dial In Access to LANs (DIALs) will help your remote access users connect easily, quickly, reliably and securely from wherever they are working.

The 8235 Dial In Access to LANs (DIALs) provides a flexible platform for the various application requirements of your remote access users. Multiple users are supported via simultaneous operation of all ports, compression techniques and transmission speeds up to 128 Kbps with ISDN. Protocols supported include:

- NetBIOS for LAN servers
- IPX for NetWare
- 802.2 LLC for 3270 and 5250
- IP for TCP/IP applications
- X.25
- AppleTalk on Ethernet

The 8235 comes with IBM DIALs client software that supports dial-in, dial-out and LAN-to-LAN connections for OS/2, DOS and Windows. Other clients supported include Apple Macintosh, Windows 95, Windows NT 3.5, UNIX clients and SLIP clients.

The following table shows a list of available 8235 Dial In Access to LANs (DIALs) models:

Table 37 (Page 1 of 2). 8235 Model Matrix

Models	Token-Ring LAN	Ethernet LAN	RS-232-D Ports	RJ-11 Ports	RJ-45 Ports	Transmission
001	Yes	No	8	0	0	57.6 Kbps
002	No	Yes	8	0	0	57.6 Kbps
021	Yes	No	8	0	0	115.2 Kbps
022	No	Yes	8	0	0	115.2 Kbps

Table 37 (Page 2 of 2). 8235 Model Matrix

Models	Token-Ring LAN	Ethernet LAN	RS-232-D Ports	RJ-11 Ports	RJ-45 Ports	Transmission
031	Yes	No	0-8(DB-9)	0-8	0-4	V.34/V.42Bis/BRI
032	No	Yes	0-8(DB-9)	0-8	0-4	V.34/V.42Bis/BRI
051	Yes	No	2	0	0	115.2 Kbps
052	No	Yes	2	0	0	115.2 Kbps
I40	by feature	by feature	2	0-4	0-4	115.2 Kbps

The 8235 DIALs Server includes Windows (or Win-OS/2) software that lets you configure, monitor and upgrade any number of 8235s from a single local or remote workstation using IP or IPX.

You can also manage your 8235s using an SNMP manager. You can keep an activity log that records each incoming call from beginning to end, as well as any error conditions that exist. The activity log can be easily exported to another application for more detailed analysis. The management software also provides complete status information on all 8235s on your network.

Additional management options include support for Nways Manager for Windows and AIX or management from a command shell using Telnet or an ASCII terminal as a management console.

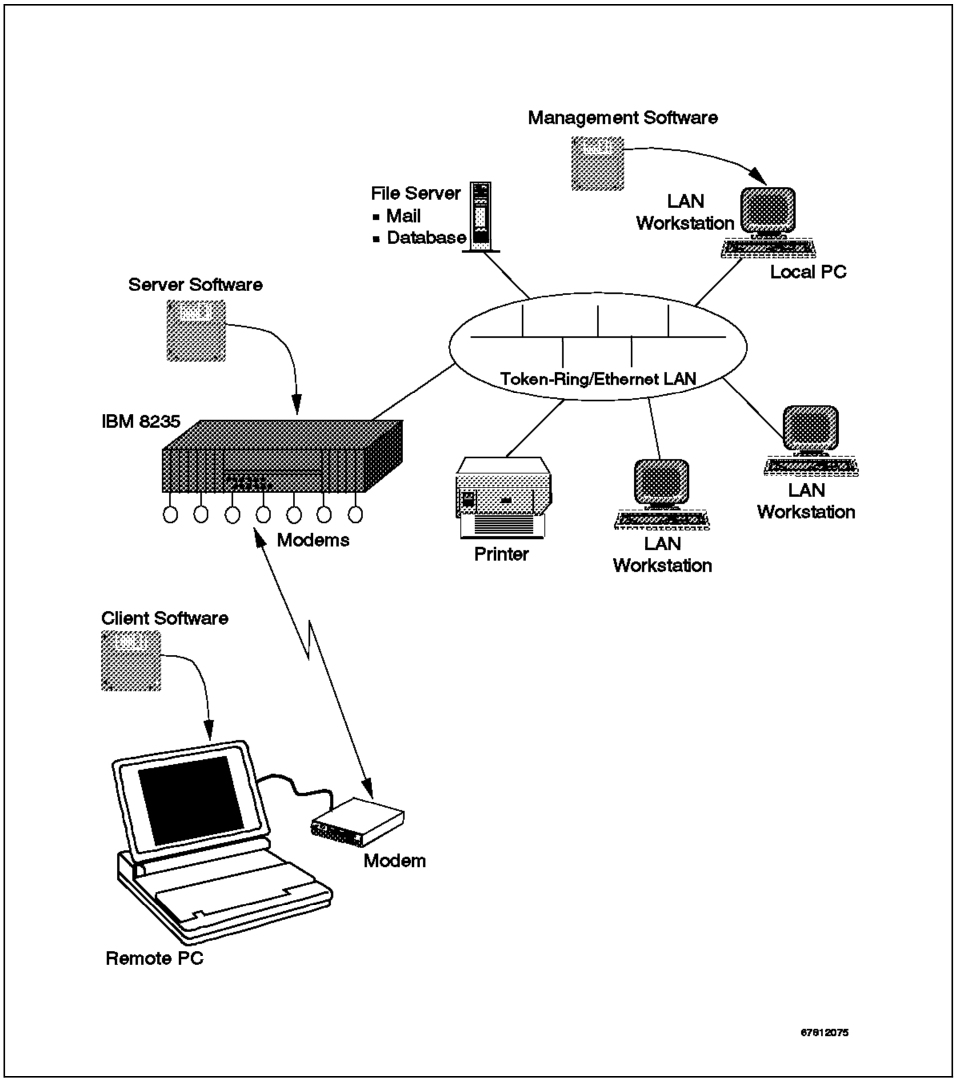


Figure 24. 8235 Connectivity Options

2.8.2 Advanced Radio Communication on Tour (ARTour)

The ARTour family of products enable immediate and optimized mobile communications for customers, allowing them to use their existing applications unchanged across wireless and wired networks. In addition, ARTour enables new mobile applications to be developed to industry standards (application programming interfaces and protocols) for mobile environments.

The ARTour family of products includes the ARTour Gateway and Mobile Client, which enable existing TCP/IP applications to have access to wireless networks and two application enablement offerings that optimize 3270 emulation and Web-based applications:

- ARTour Emulator Express
- ARTour Web Express

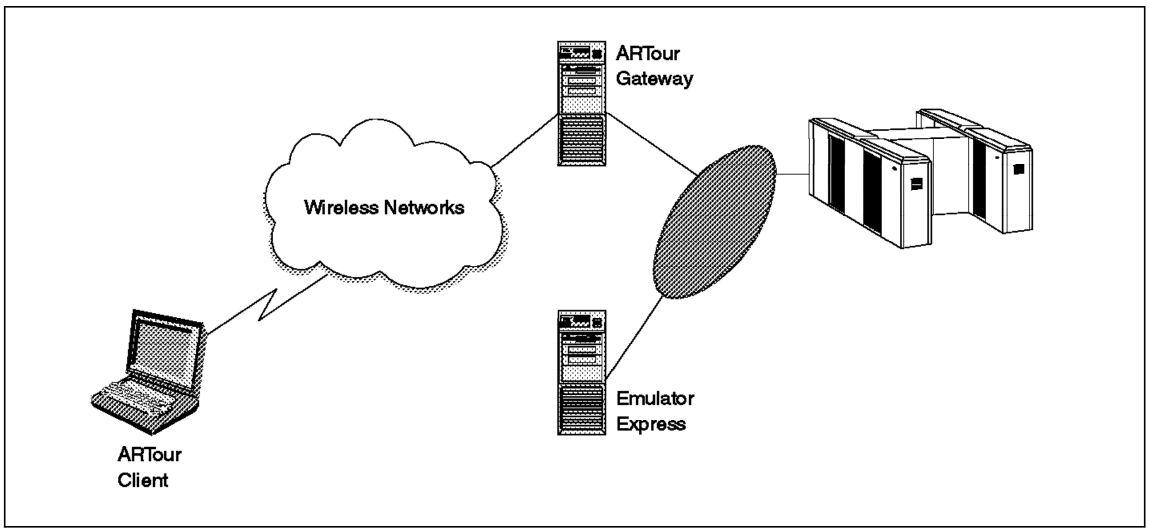


Figure 25. ARTour Connection

For more information see Chapter 11, “Mobile Connectivity” on page 243.

Chapter 3. RISC System/6000

This chapter provides information on how the IBM RISC System/6000 interoperates with other RS/6000s, other UNIX-based systems and also with other machines such as OS/2 workstations and S/390 systems.

3.1 RISC System/6000 Connectivity

IBM AIX for RISC System/6000 provides TCP/IP network capability. The addition of Communications Server for AIX adds SNA capability to the RISC System/6000. The SNA Client Access for AIX function on top of Communications Server for AIX provides TCP/IP and Internet users with access to IBM mainframes. AIX Connections can be used with AIX V4 to provide networking server functions on token-ring, Ethernet, or FDDI LANs as well as in X.25 or SDLC networks. The following are current AIX products providing connectivity:

- Operating systems (includes TCP/IP)
  - AIX V4.1.5
  - AIX V4.2
  - AIX V4.2.1 (repackaging of AIX 4.1.5 and AIX 4.2)
  - AIX V4.3
- Communications Server for AIX V4.2 for SNA connectivity including:
  - Subarea network capability
  - APPN network capability
  - SNA Gateway
  - AnyNet: Sockets over SNA Access Node and Gateway
  - AnyNet: APPC over TCP/IP Access Node and Gateway
  - Application Programming Interfaces (APIs)
  - XSNA
  - APPC Application Suite for AIX
  - ESCON channel connectivity (SNA Channel feature)
  - Block Mux channel connectivity (SNA Channel feature)
  - 3270 single session host connection emulation
- SNA Client Access for AIX V1.2
- IBM eNetwork Host On-Demand
  - SNA host session access to Web browsers
- 3270 Host Connection Program for AIX
  - 327x display emulation support
- AIX Connections V4.1 option
  - File and Print server functions on token-ring and Ethernet LANs for
    - Novell NetWare
    - Microsoft's LAN Manager
    - Windows NT Server

- OS/2 LAN Server
- Apple Filing Protocol (AFP)

– IPX/SPX, NetBIOS, TCP/IP, RFC 1001/1002, and AppleTalk protocol support
– Gateway for NetWare, Server Message Block (SMB) and DCE-DFS file systems
– Proxy authentication for NetWare, NT Domain Server and OS/2 Domain Controller

- ESCON Channel Connectivity for AIX V1.1
- Block Mux Channel Connectivity for AIX V1.1

The following table summarizes the communication adapters support in AIX V4. It also points to required software and device drivers and to TCP/IP and/or SNA protocol support.

Table 38 (Page 1 of 4). AIX V4 Supported Adapters

Adapter Name	**Feature Code**	**MCA/ISA/ PCI/PCMCIA**	**Supported on AIX 4.1**	**Supported on AIX 4.2**	**TCP/IP support (by AIX itself)**	**SNA support (by Comm. Server)**	**Additional software required**
Asynchronous Adapters							
8-port Async Adapter	2930	MCA	Yes	Yes	X	-	-
8-port Async Adapter	2931 8207	ISA	Yes	Yes	X	-	-
16-port Async Adapter	2955 2956	MCA	Yes	Yes	X	-	-
64-port Async Adapter	6400	MCA	Yes	Yes	X	-	-
128-port Async Adapter	8128 8127	MCA	Yes	Yes	X	-	-
128-port Async Adapter	2933	ISA	Yes	Yes	X	-	-
8-port Async Adapter	2940	MCA	Yes	Yes	X	-	-
8-port Async Adapter	2932	ISA	Yes	Yes	X	-	-
16-port Async Adapter	2957	MCA	Yes	Yes	X	-	-
Token-Ring Adapters							
Token-Ring High-Performance	2970 9970	MCA	Yes	Yes	X	X	-
Token-Ring LANstreamer	2972	MCA	Yes	Yes	X	X	-
Token-Ring (short)	2971 2973 8209	ISA	Yes	Yes	X	X	-

Table 38 (Page 2 of 4). AIX V4 Supported Adapters							
Adapter Name	**Feature Code**	**MCA/ISA/ PCI/PCMCIA**	**Supported on AIX 4.1**	**Supported on AIX 4.2**	**TCP/IP support (by AIX itself)**	**SNA support (by Comm. Server)**	**Additional software required**
Token-Ring LANstreamer	2979	PCI	Yes	Yes	X	X	-
Token-Ring 3Com	8246	PCI	Yes	Yes	X	X	-
Token-Ring Credit card	7092	PCM CIA	No	No	X	X	-
Token-Ring	8042 8043 8044	PCM CIA	Yes	Yes	X	X	-
FDDI Adapters							
FDDI - Single Ring	2720	MCA	Yes	No	X	X	-
FDDI - Dual Ring	2722	MCA	Yes	No	X	X	-
FDDI - Single Ring	2724	MCA	Yes	Yes	X	X	-
FDDI - Dual Ring	2723	MCA	Yes	Yes	X	X	-
FDDI - Single Ring	2725	MCA	Yes	Yes	X	X	-
FDDI - Dual Ring	2726	MCA	Yes	Yes	X	X	-
Ethernet Adapters							
Ethernet	2980 9980	MCA	Yes	Yes	X	X	-
Ethernet (integrated)	4221 9000	integr.	Yes	Yes	X	X	-
Ethernet (integrated)	4222 9001	integr.	Yes	Yes	X	X	-
Ethernet	2992	MCA	Yes	Yes	X	X	-
Ethernet	2993	MCA	Yes	Yes	X	X	-
Ethernet	2987	PCI	Yes	Yes	X	X	-
Ethernet	2985	PCI	Yes	Yes	X	X	-
Ethernet 10/100 OEM	8242	PCI	Yes	Yes	X	X	-
Ethernet short	2981 2982 8210	ISA	Yes	Yes	X	X	-
Ethernet OEM	8241	ISA	Yes	Yes	X	X	-
Ethernet	8022 8023 8024 8032 8033 8034	PCM CIA	Yes	Yes	X	X	-
Network Terminal Accelerator Adapters and Serial Communications Network Servers Support							

Table 38 (Page 3 of 4). AIX V4 Supported Adapters							
Adapter Name	**Feature Code**	**MCA/ISA/ PCI/PCMCIA**	**Supported on AIX 4.1**	**Supported on AIX 4.2**	**TCP/IP support (by AIX itself)**	**SNA support (by Comm. Server)**	**Additional software required**
Network Accelerator Terminal /256 sessions	2402 2406	MCA	Yes 1	Yes	X	X	-
Network Accelerator Terminal /2048 sessions	2403 2407	MCA	Yes 1	Yes	X	X	-
Serial Communications Network Server 7318 2	Mod. P10	Eth.	Yes	Yes	X	-	-
Serial Communications Network Server 7318 2	Mod. S20	Eth.	Yes	Yes	X	-	-
X.25 Adapters Support							
X.25 Interface Co-Processor/2	2960	MCA	Yes	Yes	X	X	AIXLink X.25 (5696-926)
X.25 Interface Co-Processor/2	2961 2962 8211	ISA	Yes	Yes	X	X	AIXLink X.25 (5696-926)
ARTIC: Portmaster 1Mo	7006	MCA	Yes	Yes	X	X	AIXLink X.25 (5696-926)
ARTIC: Portmaster 2Mo	7008	MCA	Yes	Yes	X	X	AIXLink X.25 (5696-926)
ARTIC 960: 1 Mo	2921	MCA	Yes	Yes	X	X	AIXLink X.25 V1.1.3 (5696-926)
ARTIC 960: 2 Mo	2924	MCA	Yes	Yes	X	X	AIXLink X.25 V1.1.3 (5696-926)
ARTIC 960: 8 Mo	2928	MCA	Yes	Yes	X	X	AIXLink X.25 V1.1.3 (5696-926)
2-port Multiprotocol	2962	PCI	Yes	Yes	-	X	AIXLink X.25 V1.1.4 (5696-926)
Synchronous Adapter Support							
1-port Multiprotocol	2959	MCA	Yes	Yes	-	X	-
2-port Multiprotocol	2962	PCI	Yes	Yes	-	X	-
4-port Multiprotocol	2700	MCA	Yes	Yes	-	X	-
4-port Multiprotocol	2701	ISA	Yes	Yes	-	X	-
Host Adapters Support							
3270 Connection (WorldWide/USA)	2990 2991	MCA	Yes	Yes	-	-	3270 HCON V2.1

Table 38 (Page 4 of 4). AIX V4 Supported Adapters							
Adapter Name	**Feature Code**	**MCA/ISA/ PCI/PCMCIA**	**Supported on AIX 4.1**	**Supported on AIX 4.2**	**TCP/IP support (by AIX itself)**	**SNA support (by Comm. Server)**	**Additional software required**
S/370 Channel Emulator	2759	MCA	Yes	No	X	-	PRPQ 5799-QDA or AIX Print Service Facility
S/390 ESCON Control Unit	2756	MCA	Yes	Yes	X	X	ESCON Channel Connectivity for AIX V1.1
S/390 ESCON Emulator	2754	MCA	Yes	No	X	X	Device Driver PRPQ #8A1016
Block Multiplex Channel	2755	MCA	Yes	Yes	X	X	Block Multiplex Connectivity for AIX V1.1
Fiber Channel Adapters Support							
Fiber Channel/266	1906	MCA	No	No	X	-	-
Fiber Channel/1063	1904 + 1902	MCA	Yes	Yes	X	-	-
ATM Adapters Support							
Turboways 100 ATM	2984	MCA	Yes	Yes	X	-	-
Turboways 155 ATM	2989	MCA	Yes	Yes	X	-	-
HIPPI Adapter Support							
HIPPI Adapter	2735	MCA	Yes	Yes	X	-	HIPPI Driver Group (5765-551)
SOCC Adapter Support							
SOCC	2860	MCA	No	No	X	-	

Note:
1 Support starts from AIX V4.1.5
2 Support for Serial Communications Network Server (Machine type 7318, Models P10 and S20) is provided in AIX V4.1 and AIX V4.2, no additional drivers or software required.

3.1.1 RISC System/6000 Network Support

Table 39 shows an overview of software support for RS/6000 network connectivity.

Table 39 (Page 1 of 2). Communication between RS/6000 Systems

Network or Connection Type	RS/6000 Software Offerings	RS/6000 Hardware Offerings
Ethernet Version 2 or IEEE 802.3 LAN	TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – NFS in AIX – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX – NCS in AIX – Enhanced X-Windows in AIX windows Environment/6000 licensed program. – AFS distributed file system from Transarc Corporation • Communications Server for AIX V4.2	• Ethernet High-Performance LAN Adapter • Network Terminal Accelerator Adapter • Integrated Ethernet adapters for Models M20, 200 Series, 300 Series, and 550L.
Token-Ring LAN	• TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – NFS in AIX – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX – NCS in AIX – Enhanced X-Windows in AIX windows Environment/6000 licensed program – AFS distributed file system from Transarc Corporation • Communications Server for AIX V4.2	Token-Ring High-Performance Network Adapter
HIPPI Network	• TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – NFS in AIX – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX – NCS in AIX – Enhanced X-Windows in AIXwindows Environment/6000 licensed program • IPI-3 master slave protocols supplied with the HIPPI driver group offering can be used for performing memory-to-memory transfers, message passing, or device emulation.	High-Performance Parallel Interface (HIPPI) Micro Channel Packaged on 3 type-5 Micro Channel Architecture (MCA) cards • Intel i960 based controller MCA card • Feature Code # 2735
X.25 WAN	TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX • SNA LU 6.2/QLLC in: – Communications Server for AIX V4.2 • X.25 API and the X.25 facilities in AIX • AIXlink/X.25	• X.25 Interface Co-Processor/2 • X.25 Interface Co-Processor ISA version
SDLC WAN	• Communications Server for AIX V4.2	4-Port Multiprotocol Communication Controller with the 4-port Multiprotocol Cable Assembly

Table 39 (Page 2 of 2). Communication between RS/6000 Systems

Network or Connection Type	RS/6000 Software Offerings	RS/6000 Hardware Offerings
Asynchronous Connection	• TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX • ATE in AIX • SLIP in AIX – Mail facilities in AIX	• Two standard EIA-232D ports in the RS/6000 system unit • 8-Port Async Adapter-EIA-232 with the IBM Multiport Interface Cable • 8-Port Async Adapter-EIA-422A with the IBM Multiport Interface Cable • 8-Port Async Adapter-MIL-STD 188 with the IBM Multiport Interface Cable • 16-Port Async Adapter-EIA-232 with the IBM 16-Port Interface Cable -EIA-232 • 16-Port Async Adapter-EIA-422A with the IBM 16-Port Interface Cable -EIA-422A • 128-Port ASYNC Controller with IBM Remote Async Nodes • IBM 7318 Serial Communications Network Servers, Model P10 and Model S20
FDDI LAN	• TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – NFS in AIX – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX • Communications Server for AIX V4.2	• IBM FDDI Adapter
ISDN WAN	• TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX • SNA LU 6.2/SDLC and SNA LU 6.2/QLLC in: – Communications Server for AIX V4.2 • X.25 API and X.25 facilities in AIX	• X.25 Interface Co-processor/2 in conjunction with IBM 7820 ISDN terminal adapter • 4-port Multiprotocol Communication Controller with 4-Port Multiprotocol Cable Assembly in conjunction with IBM 7820 Terminal Adapter.
Serial Optical Channel Converter	• TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – NFS in AIX – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX	• IBM Serial Optical Channel Converter
Fiber Channel	• TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – NFS in AIX – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX	• IBM Fiber Channel Adapter/266
Asynchronous Transfer Mode	• TCP/IP protocols in AIX. The following programs can be used with TCP/IP: – NFS in AIX – TCP/IP applications in AIX – BNU in AIX – Mail facilities in AIX – NCS in AIX – Enhanced X-Windows in AIXwindows Environment/6000 licensed program	• Turboways 100 ATM Adapter

Note:
1 IEEE 802.3 only.

3.2 Communications Server for AIX

Communications Server for AIX provides the RS/6000 with SNA connectivity. It provides the following functions:

- APPN network nodes and end nodes

- LEN nodes either connected to an APPN network or in a network using independent LU 6.2 for peer communication
- HPR ANR functions when configured as a network node
- Dependent communication with a host in a subarea network using dependent LU types
- SNA gateway connectivity through an AIX workstation
- AnyNet Sockets over SNA access node and gateway functions
- AnyNet APPC over TCP/IP access node and gateway functions

Communications Server for AIX provides support for the following link-level protocols:

- SDLC
- Token-ring
- Standard Ethernet
- IEEE 802.3 Ethernet
- X.25
- FDDI
- ESCON and block multiplexer channel

3.2.1 Communications Server for AIX SNA Gateway

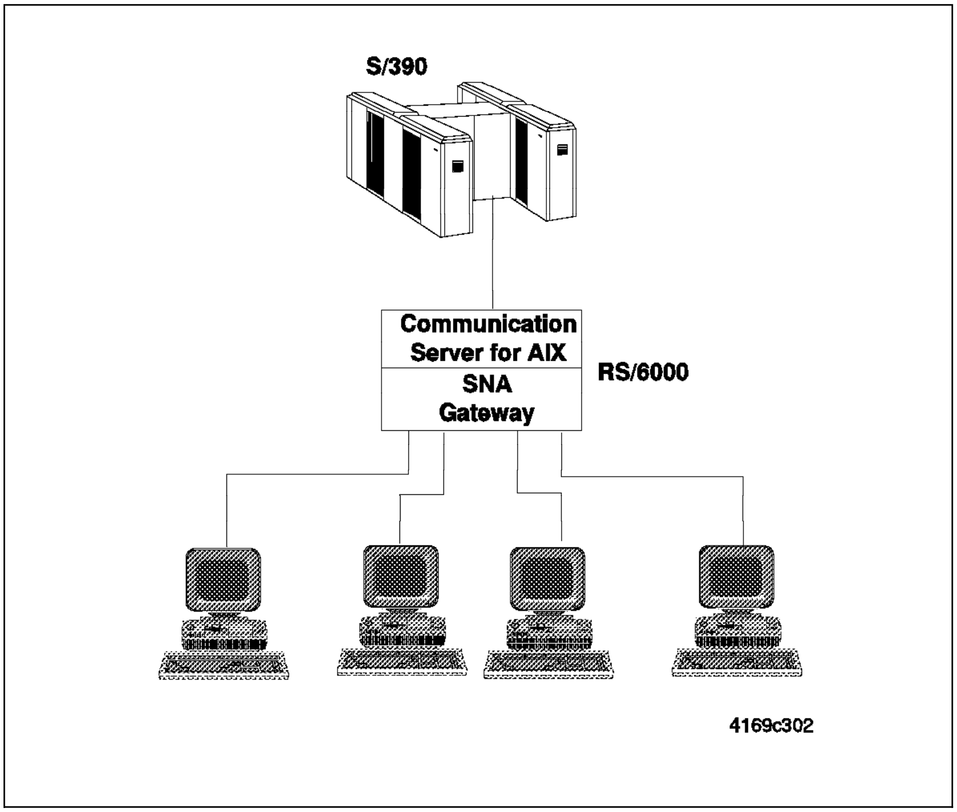


Figure 26. SNA Gateway

SNA Gateway supports communication between one or more host physical units (PUs) and one or more downstream workstations. It can be used in conjunction with DLUR to allow session traffic from dependent LUs on downstream workstations to be carried over APPN networks between the SNA Gateway and the host.

SNA Gateway provides the following benefits:

- Downstream workstations can access multiple hosts through a single link to the gateway.
- A single host PU and adapter can communicate with multiple downstream workstations through the gateway.
- All downstream workstations can use nearly identical configurations.
- Downstream workstations can access alternative host connections in the event of a link outage.

- Several downstream workstations can share the same group of host definitions.

3.2.2 SNA Client Access

SNA Client Access is an optional licensed program that runs on the SNA Server for AIX or Communications Server for AIX platforms. The program provides access to SNA networks to users of programmable workstations or personal computers that are attached to TCP/IP networks. SNA Client Access functions as a TCP/IP Telnet server, providing SNA network access service to client applications running anywhere in the TCP/IP network.

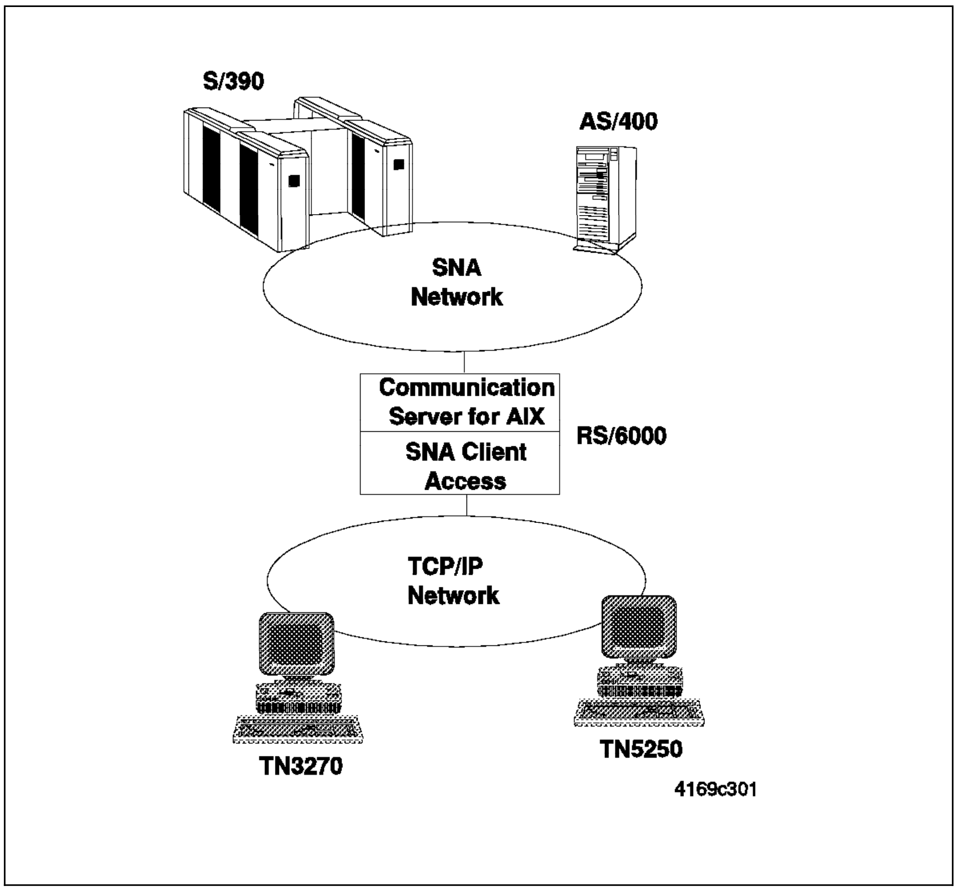


Figure 27. SNA Client Access

SNA Client Access enhances the networking capabilities of the AIX operating system by extending gateway functions to industry-standard protocols and clients. You can connect your TCP/IP clients on OS/2, DOS, AIX, Windows, Windows NT, HP, and Sun operating systems to your SNA network.

SNA Client Access for AIX V1.2 provides the following functions:

- Provides TCP/IP and Internet users with easy access to IBM mainframes.
- Supports a wide range of multivendor TCP/IP clients.
- Functions as a TN3270E/5250 Server.
- Supports new industry-standard TN3270E clients.
- Enhanced print support to TCP/IP users (enables locally attached printer services).
- Supports load balancing across multiple servers using IBM Loadleveler and maintains operation during server failures (fault resilience).
- Exploits IBM AIX 4.1 and SMP hardware as well as IBM AIX 3.2.5 operating systems.
- Provides end-to-end response time monitoring for TN3270E clients.
- Provides increased security and usability through enhanced configuration capabilities.

3.2.2.1 SNA Connectivity

SNA Client Access has access to all of the communication protocol support that is part of Communications Server for AIX and supports SNA logical units (LU) types 0, 1, 2, 3, and APPC.

SNA Client Access supports many connectivity capabilities of the SNA Server, whether you want to connect networks over WAN, using SDLC or X.25, LAN, using token-ring, Ethernet or FDDI, or direct-attached channel.

3.2.2.2 Load Balancing

SNA Client Access for AIX offers a robust solution for controlling and balancing the workload across gateways. Clients are routed to a machine, based on mainframe LU availability, link speed, client/mainframe connection load, overall system load, and machine processor speed. In addition to optimizing the load conditions of the servers, load balancing maintains the operation during server failures by automatically rerouting clients to an available server.

3.2.2.3 Telnet 3270E Print Support

SNA Client Access also provides Telnet 3270E server functions. The standard extensions allow users to print from mainframe applications to printers attached to their workstations or to printers in their TCP/IP network. TN3270E support is compliant with industry-standard Request for Comment (RFC) 1646 and the recently published RFC 1647. SNA Client Access can also pass responses on printing that allows end-to-end printer confirmation.

SNA Client Access for AIX supports the following clients:

- IBM AIX 3270 Host Connection Program
- IBM AIX TCP/IP
- IBM AIX x3270
- IBM Connection Program/400 for UNIX Environment
- IBM Personal Communications/3270
- IBM TCP/IP for DOS
- IBM TCP/IP for OS/2
- Brixton Brx3270 Open Client
- Brixton Brx5250 Open Client
- Brixton BrxTN3270 Client
- Brixton BrxLU6.2
- Plus any industry-standard Telnet 3270 and Telnet 5250 emulator

SNA Client Access for AIX supports any network adapter that is supported by Communications Server for AIX.

3.3 Connection Program/400 for UNIX Environments

IBM Connection Program/400 provides common AS/400 system access capability across a heterogeneous network of RS/6000 and other supported UNIX workstations (Sun SPARCstation and Hewlett-Packard 9000 Series 700). Here are the key features and functions of this program:

- *5250 emulation* (x5250 and e5250)
  Existing functions include dynamic font selection, keystroke record/playback, cut and paste, enhanced user interface 5250 data stream support, color customization, screen print control, xButtons, mouse support, command line options, keyboard customization, and text assist. This function is supported in SNA and TCP/IP networks.

- *File Transfer* using SQL-like commands
  This function is supported in SNA networks only. In a TCP/IP environment, the file transfer function is supported by the TCP/IP protocol itself (TFTP, FTP, and RCP applications).

  Remote Printer support
  It allows you to print AS/400 SCS output on any workstation-attached printer in the network. Users can print where it is most convenient and printers can be shared between UNIX users and applications and between AS/400 users and applications. This function is supported in SNA and TCP/IP networks.

- *Remote Command Execution* from AS/400 system to control multiple workstations from a single AS/400 system

This function is supported in SNA networks only. In a TCP/IP environment, the remote command execution function is supported by the TCP/IP protocol itself (REXEC, RSH applications).

- *Database and Application access*
  It opens AS/400 databases and provides application access to RS/6000, Sun and HP workstations. Remote access to the AS/400 system data can easily be achieved using SQL APIs. This function is supported in SNA and TCP/IP networks.
- *National Language support*

Connection Program/400 supports two communication protocol suites:

- TCP/IP over token-ring, Ethernet, X.25 (for communications between the AS/400 system and RS/6000, Sun SPARCstation, and HP 9000 Series 7000 workstations). The following software is required from the AS/400 side: Operating System/400 Version 2 Release 2 (5738-SS1) and later and TCP/IP Connectivity Utilities/400 Version 2 Release 2 (5738-TC1).
- SNA (including APPC LU 6.2) over token-ring, Ethernet, X.25, or SDLC (for communications between the AS/400 system and the RS/6000). Communication Server for AIX (or SNA Server for AIX) is required to run in an SNA environment. The following software is required from the AS/400 side: Operating System/400 Version 2 Release 2 (5738-SS1) and later and PC Support/400 for Version 2 Release 2 (5738-PC1).

Hardware Considerations

Connection Program/400 requires one of the following adapters on the RS/6000:

- Any LAN adapter that allows you to connect to a TCP/IP LAN (for example, Ethernet, token-ring and so forth)
- X.25 Interface Co-Processor/2 (#2960, #2961) or Artic Portmaster Adapter/A (#7006, #7008)
- Single-port, Multiprotocol Adapter/A (#2959) (for SNA network only)
- 4-Port Multiprotocol Communications Controller (#2700, #2701) (for SNA network only)

3.4 AIX Connections

AIX Connections, a feature of AIX V4, provides a workgroup solution for a network of PC systems. This server software package works with clients running popular operating systems including OS/2, Microsoft Windows, Microsoft Windows 95, Microsoft Windows NT Workstation, and Apple Macintosh.

AIX Connections provides the ability to connect PC clients to UNIX data and applications. You can integrate UNIX servers into existing PC client environments without purchasing extra hardware or software.

AIX Connections provides PC-to-UNIX connectivity. This enables it to operate with other AIX applications, such as databases, communication gateways, and network file systems. AIX Connections also provides the infrastructure for file and printer sharing services between AIX servers and attached PC clients. AIX Connections is a base for server applications because it provides a set of functions for concurrent processing required by:

- Graphical workstation support
- PC file and print servers
- Network File System (NFS)/Distributed File System (DFS) data servers
- Client/server applications, such as Online Transaction Processing (OLTP) and database applications
- Data collection systems
- Name servers
- Gateway and router systems

The asynchronous Point-to-Point Protocol (PPP) is one of the key benefits of AIX Connections. PPP enables remote communications with very fast modem and data compression capabilities. This makes it easier for mobile clients to access data and applications on their home servers as if they were in the work area.

AIX Connections uses a network communications protocol (DHCP) that dynamically configures network clients. This protocol offers the security protection required for dynamically executing network updates and configuration.

AIX Connection supports the Windows Internet Naming Service (WINS) protocol. This helps to avoid IP broadcast storms for NetBIOS name resolution in a bridged environment. It removes the requirement to have Microsoft WINS reachable in typical Intranets.

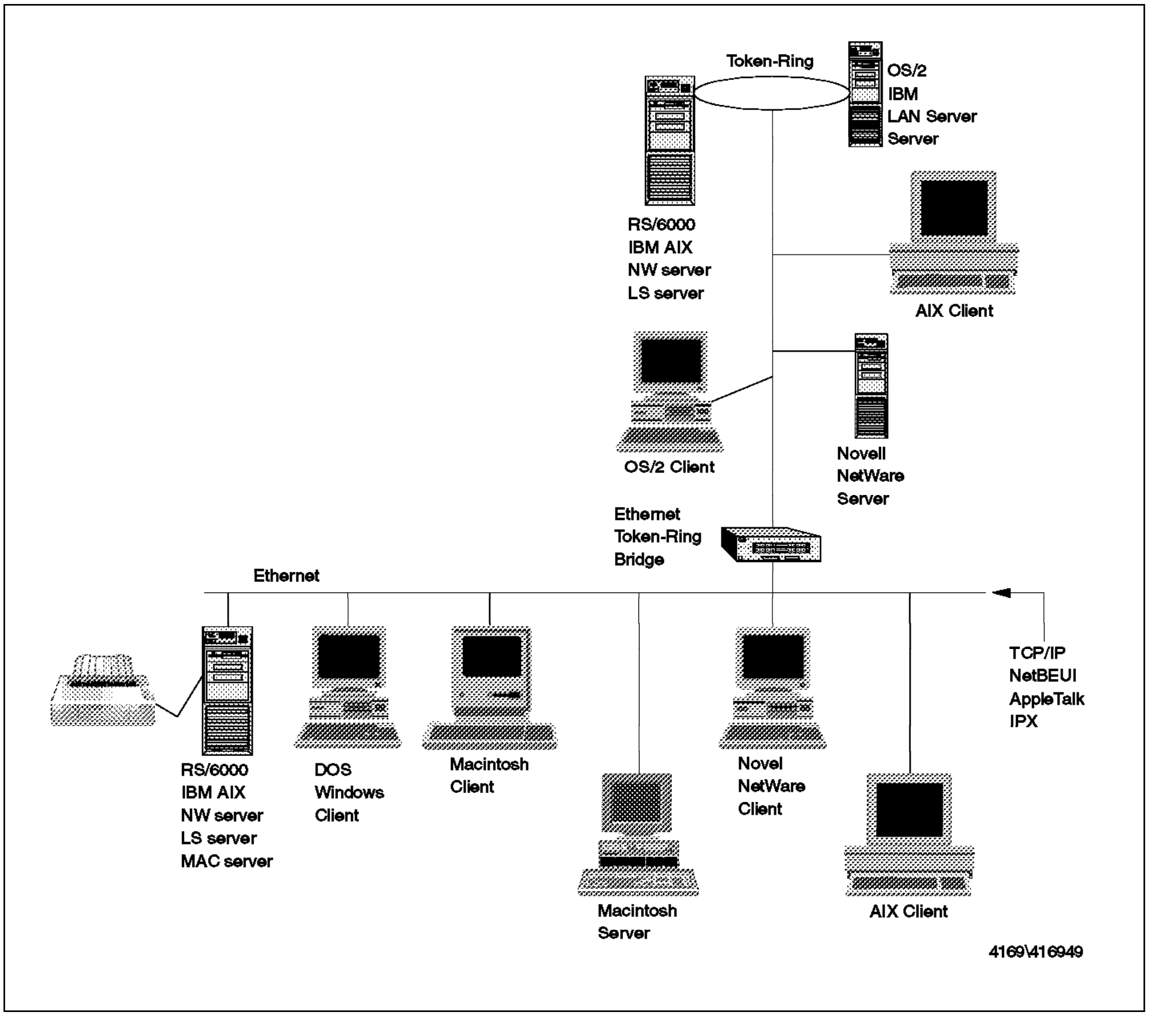


Figure 28. AIX Connections Overview

3.5 NetWare for AIX V3.11B

IBM NetWare for AIX, Version 3.11B allows RS/6000 workstations with AIX Version 4.1 and Version 4.2 to act as servers for products running Novell's NetWare on Local Area Networks (NetWare LANs). Based on Novell NetWare for UNIX Version 3.11B, IBM NetWare Version 3.11B brings the resources and applications of the full-function, multipurpose AIX operating system to PC LAN users. Here are the key features and functions of this program:

- Allows a single RISC System/6000 to perform a dual role as an AIX network system and a Novell NetWare server.
- File and print sharing among DOS, OS/2, Windows, and AIX users is transparent to existing NetWare clients. NetWare Version 3.11B is compatible with other implementations of Novell's Intel-based NetWare products such as Novell's Intel-based NetWare 3.12 or Novell's Intel-based NetWare 2.2. OS/2 users can manipulate long file names with extended attributes (as with local files). In addition, NFS files can be shared by AIX, DOS, OS/2, and Windows users. The personal computer and AIX users can share the same print queues and system printers.
- Support for IPX/SPX protocols in AIX.
- Personal Computer access to AIX applications via Novell Virtual Terminal (NVT2). NVT2 capability works with off-the-shelf personal computer terminal emulation software to provide login and access to the AIX operating system. With NVT2, DOS and DOS/Windows users gain access to the many AIX multiuser applications available in this environment.
- Support for NetWare application programming interfaces (APIs) such as Sequenced Packet Exchange (SPX), Internet Packet Exchange (IPX), and NetWare.

3.6 ESCON Channel Connectivity for AIX V1.1

The ESCON Channel Connectivity for AIX V1.1 program extends the networking/connectivity capabilities to host systems over the ESCON channels. Support is included for SNA and TCP/IP protocols and for the Client Input Output/Sockets (CLIO/S) licensed program (5648-129 V2.1).

ESCON Channel Connectivity for AIX V1.1 is compatible with Client Input Output/Sockets (CLIO/S) 5648-129 with PTF# 74395.

ESCON Channel Connectivity for AIX Version 1.1 requires the following:

- TCP/IP Environments: AIX Version 4.1.2 or later
- SNA Environments: SNA Server for AIX Version 3.1 (5765-582) (or Communications Server for AIX, Version 4) and the SNA Channel Attachment feature (feature #0705)

ESCON Channel Connectivity for AIX V1.1 requires ESCON Control Unit Adapter (#2756) plus ESCON fiber-optic cabling and connectors, and ESCON optional cooling fan is required for a type 7013 RS/6000.

3.7 Block Multiplexer Channel Connectivity for AIX V1.1

This channel connectivity program extends the networking/connectivity capabilities to host systems over the block multiplexer channels. Support is included for SNA and TCP/IP protocols and for the Client Input Output/Sockets (CLIO/S) licensed program (5648-129 V2.1).

Block Multiplexer Channel Connectivity for AIX V1.1 is compatible with Client Input Output/Sockets (CLIO/S) 5648-129 with PTF #74395.

Block Multiplexer Channel Connectivity for AIX Version 1.1 requires the following:

- TCP/IP Environments: AIX Version 4.1.2 or later
- SNA Environments: SNA Server for AIX Version 3.1 (5765-582) (or Communications Server for AIX, Version 4) and SNA Channel Attachment Feature (feature #0705)

Block Multiplexer Channel Connectivity for AIX V1.1 requires the Block Multiplexer Channel Adapter (#2756) plus a Block Multiplexer Adapter Cable, Block Multiplexer Interface Assembly, and a BUS and TAG cable of appropriate length.

3.8 AIXLink/X.25 V1.1.4

AIXlink/X.25 Version 1.1.4 provides advanced X.25 function on systems running AIX Version 4. It supports the following RS/6000 adapters:

- 2-Port Multiprotocol PCI Adapter (FC 2962)
- X.25 Interface Co-Processor/2 (FC 2960), a single port synchronous adapter (V.24, V.35, X.21).
- ARTIC Portmaster Adapter/A (FC 7006, 7008) with any of the following EIBs:
  - 6-port V.35 (FC 7046) supporting link access speeds of up to 56 kbps.
  - 6-port X.21 (FC 7048) supporting link access speeds of up to 64 kbps.
  - 8-port V.24 (FC 7042) supporting link access speeds of up to 19.2 kbps.

AIXlink/X.25 supports up to 8 adapters in any combination in a single RS/6000 system up to the limit of each type adapter supported by the system.

In addition, AIXLink/X.25 provides X.3, X.28, and X.29 Packet Assembler/Disassembler (PAD) support attachment of asynchronous terminals. The following are a few highlights:

- Supports ITU-T 1980/1984/1988 recommendations (run-time selectable)
- Full-terminal and host-Packet Assembler/Disassembler (PAD) support (X.3, X.28, X.29)
- Supports Transmission Control Protocol/Internet Protocol (TCP/IP) higher-layer protocols
- Dedicated or switched (X.32, V.25 bis) network access
- Automatic or user-defined point-to-point Data Terminal Equipment/Data Circuit-Terminating Equipment (DTE/DCE) configuration
- Flexible adapter support
- Up to 512 virtual circuits per line
- Extensive line trace and statistics facilities
- Simple Network Management Protocol (SNMP) proxy agent and Management Information Base (MIB) support for X.25 and LAP-B statistics
- New streams-based application program interfaces (APIs) to packet and frame layers
- Preserves application program interface (API) compatibility with the X.25 support included with AIX Version 3 for RS/6000 for existing application migration

Chapter 4. 3174 Establishment Controller

This chapter provides information on the 3174 Establishment Controller.

The 3174 Establishment Controller is the most fundamental component of the 3270 family of products, which includes display stations, printers and control units. It connects and controls a cluster of user terminals to a host computer. It can play a key part in SNA, SDLC, BSC, X.25, ISDN, TCP/IP, APPN, frame relay, token-ring, Ethernet, and ASCII networks.

4.1 3174 Connectivity Overview

Table 40. 3174 Connectivity

Models	Attachment	Cluster	TR DSPU	TR GW	ENET GW
Floor standing units					
11L	Parallel Channel	STD	X	X	X
12L	ESCON Channel	STD	X	X	X
11R	V.24/V.28, V.35 Option	STD	X	X	X
12R	X.21	STD	X	X	X
13R	Token-Ring 16/4 Mbps	STD	STD	X	X
19″ Rack models					
21L	Parallel Channel	STD	X	X	X
21H	Parallel Channel (ES/9000 IP-Prod.)	STD	X	X	X
22L	ESCON Channel	STD	X	X	X
21R	V.24/V.28, V.35 Option	STD	X	X	X
22R	X.21	STD	X	X	X
23R	Token-Ring 16/4 Mbps	STD	STD	X	X
Desktop models					
61R	V.24/V.28, V.35 Option	STD	X	X	X
62R	X.21	STD	X	X	X
63R	Token-Ring 16/4 Mbps	STD	STD	X	X
Desktop entry models					
91R	V.24/V.28, V.35 Option	STD			
92R	X.21	STD			
95R	V.24/V.28, V.35 Option	STD			

Note:

X denotes optional.

4.2 3174 Model Summary

Table 41 (Page 1 of 3). 3174 Basic Features

Models	01L 01R 02R 03R	11L 12L 11R 12R 13R	21L 21R 22L 23R	51R 53R	52R	61R 62R 63R	91R 92R	95R
Memory								
Basic memory (MB)	1	2	2	1	1	2	2	4
-Maximum memory (MB)	4	6 **1**	6 **1**	3	1.5	6 **1**	2	NA
-Memory, 1 MB	X	X	X	X	X	X	NA	NA
-Memory, 2 MB	X	X	X	X	X	X	NA	NA
-Memory, 4 MB	NA	NA	X	NA	NA	X	NA	NA
Diskette drive								
Base diskette drive (MB) w/o CS-B	1.2	2.4 **2**	NA	1.2	1.2	2.4	2.4	2.4
-Base diskette drive (MB) w CS-B	1.2	2.4	2.4	1.2	NA	2.4	2.4	NA
-DASD, additional attachments	3	3	1	1	1	1	NA	NA
2nd diskette drive	1.2	NA	NA	1.2	1.2	NA	NA	NA
2nd diskette drive w/CS-B	2.4	2.4	2.4	2.4	NA	2.4	NA	NA
2nd diskette drive w/o CS-B	2.4	2.4 **2**	NA	2.4	NA	2.4	NA	NA
-20 MB fixed disk drive	2	2	1	1	1	1	NA	NA
3270 terminal ports								
Base 3270 terminal attachment ports	4	4	4	9	9	9	4	4
3270 terminal attachment ports (max.)	32	64	64	16	16	32	8	32
-TMA (under covers), 8 ports each, w/o #3100	1-4	1-4	1-4	NA	NA	NA	NA	NA
-3299 Models 002 and 003, 8 ports each w/o #3100	1-4	1-4	1-4	1-2	1-2	1-2	1	4
-3299 Models 032 32 ports w/o #3100	1	1-2	1	NA	NA	NA	NA	1
-TMA (under covers), 8 ports each, w/ #3100	NA	1-8	1-4	NA	NA	NA	NA	NA
-3299 Models 002 and 003, 8 ports each w/ #3100	NA	1-8	1-4	NA	NA	NA	NA	NA
-3299 Models 032 32 ports w/o #3100	NA	1-2	1-2	NA	NA	NA	NA	NA
ASCII terminal support								
Maximum number of ASCII ports	24	24	24	8 **4**	8	8	NA	NA
Maximum number of ASCII adapters	3	3	3	1 **4**	1	1		
IBM 3270 terminal support-Downstream Load (DSL) devices								
DSL for IBM 3179/92G, 3472G	X	X	X	X	X	X	NA	NA
DSL for IBM 3193	X	X	X	X	X	X	NA	NA
DSL for IBM 3290	X	X	X	X	X	X	NA	NA
Base host attachment features								
ESCON Channel (SNA/non-SNA)	NA	X **5**	X **5**	NA	NA	NA	NA	NA
S/370, S/390 Channel (SNA/non-SNA)	X **6**	X **6**	X **6**	NA	NA	NA	NA	NA
EIA 232D, V.24/V.28 to 19.2Kbps	X **7**	X **7**	X **7**	X **7**	NA	X **7**	X **7**	X **7**
V.35 to 64 Kbps	X **7**	X **7**	X **7**	X **7**	NA	X **7**	X **7**	X **7**
X.21 to 64 Kbps	X **8**	X **8**	NA	NA	X **8**	X **8**	X **8**	NA
Token-Ring 16/4 Mbps	X **9**	X **9**	X **9**	X **9**	NA	X **9**	NA	NA
4-wire SNBU	X **10**	X **10**	X **10**	X **10**	NA	X **10**	X **10**	NA
2-wire SNBU	X **10**	NA	NA	X **11**	NA	NA	NA	NA
Alternate host attachment								
EIA 232D, V.24/V.28 to 19.2 Kbps	X **12**	X **12**	X **13**	NA	NA	NA	NA	NA
V.35 to 64 Kbps	X **12**	X **12**	X **13**	NA	NA	NA	NA	NA
X.21 to 256 Kbps	X **14**	X **14**	NA	NA	NA	NA	NA	NA
Token-Ring 16/4 Mbps	X **15**	X **15**	X **15**	X **15**	X	X **15**	NA	NA

Table 41 (Page 2 of 3). 3174 Basic Features								
Models	**01L 01R 02R 03R**	**11L 12L 11R 12R 13R**	**21L 21R 22L 23R**	**51R 53R**	**52R**	**61R 62R 63R**	**91R 92R**	**95R**
Secondary host attachment (CS-B or -C req′d)								
Maximum number of CCA features	2	2	2	1 **16**	NA	2 **17**	NA	NA
EIA 232D, V.24/V.28	2	2	2	1 **16**	NA	2 **17**	NA	NA
V.35	2	2	2	1 **16**	NA	2 **17**	NA	NA
X.21	2	2	2	1 **16**	NA	2 **17**	NA	NA
Token-Ring								
Token-Ring Gateway 16/4 Mbps, CS-B required	X **18**	X **18**	X **18**	X **18**	NA	X **18**	NA	NA
Token-Ring Gateway 16/4 Mbps, uses CS-S	X **20**	X **20**	NA	X **20**	X	X **20**	NA	NA
Licensed Internal Code								
Config. Support-C (#6010)	X	X	X	NA	NA	NA	NA	NA
Config. Support-C (#6060)	NA	NA	NA	X	NA	X	NA	NA
Config. Support-C upgrade (#6015) **2**	X	X	X	NA	NA	NA	NA	NA
Config. Support-C upgrade (#6065) **2**	NA	NA	NA	X	NA	X	NA	NA
Config. Support-B (#5010)	X	X	X	NA	NA	NA	NA	NA
Config. Support-B (#5060)	NA	NA	NA	X	NA	X	NA	NA
Config. Support-B (#5090)	NA	NA	NA	NA	NA	NA	X	NA
Config. Support-A5 (#9010)	X	X **22**	NA	X	X	X	X	NA
Config. Support-N	NA	NA	NA	NA	NA	NA	NA	X
APPN								
APPN LIC Feature (#7010)	X	X **23**	X **23**	NA	NA	NA	NA	NA
APPN LIC Feature (#7060)	NA	NA	NA	X	NA	X	NA	NA
Peer Communication								
Peer Comm. LIC Feature (#8010) **24**	X	X	X	NA	NA	NA	NA	NA
Peer Comm. LIC Feature (#8060) **24**	NA	NA	NA	X	NA	X	NA	NA
RPQ (8Q718) Prereq.#5010/5080/5090 and #3026/3044	X	X	X	X	NA	X	NA	NA
ISDN								

Table 41 (Page 3 of 3). 3174 Basic Features								
Models	**01L 01R 02R 03R**	**11L 12L 11R 12R 13R**	**21L 21R 22L 23R**	**51R 53R**	**52R**	**61R 62R 63R**	**91R 92R**	**95R**
ISDN BRI Adapter (#3055)	X 25	X 25	X 25	NA	NA	X 25	NA	NA

Notes:

X denotes yes
NA denotes not applicable

1 Only when using Configuration Support-B (CS-B), otherwise 4 MB

2 Early machine shipments may have 1.2 MB diskette drives, excluding Model 12L

3 Maximum of 6 when 3299 Model 032 is used as 8-port multiplexer

4 Excluding Model 53R

5 Models 12L and 22L only

6 Models 01L, 11L and 12L only

7 Models 01R, 21R, 51R, 61R, 81R,90R and 91R only

8 Models 02R, 12R, 52R, 62R, 82R, and 91R only

9 Models 03R, 13R, 23R, 53R, and 63R only

10 Models 01R, 21R, 51R, 61R, 81R,90R and 91R only

11 Models 01R, 51R and 81R only

12 Models 01L, 03R, 12L and 13R only

13 Alternate hosts capability provided as standard feature on Models 22L and 23R

14 Models 01L, 03R, 11L, 12L and 13R only

15 Models 01L, 01R, 02R, 11L, 11R, 12L, 12R, 21L, 21R, 22L, 51R,52R, 61R and 62R only

16 Model 51R only

17 Maximum of one for Model 63R

18 Except Models 03R, 13R, 23R, 53R and 63R

19 Gateway adapters standard

20 Except Models 03R, 12R, 23R, 53R and 63R

21 Feature 6015 and 6065 may be ordered by customers who have previously licensed Configuration Support-B, Feature 5010 or 5060 respectively

22 Except Model 12L

23 Except Models 12L and 22L

24 Requires token-ring adapters (#3026, #3030, #3031, #3044)

25 Except Models 03R, 13R, 23R and 63R

4.3 3174 Functional Overview

The 3174 is one of the most fundamental components of 3270 products. It provides a wide variety of functions and supported protocols:

- Single Link Multi-Host (SLMH) support enables a 3174 attached by token-ring LAN, X.25, or ESCON director, to access concurrently up to eight 3270 hosts
- Multiple Logical Terminal (MLT) to enable IBM 3270 CUT terminals to maintain up to five 3270 sessions

- X.25 support is provided on V.24, V.35, X.21 Interfaces
- Token-ring gateway 3174-90R, provides SNA remote token-ring LAN gateway, except for X.25, MLT, and MH/token-ring LAN gateway support
- X.25 token-ring gateway provided by RPQ
- ISDN gateway with Configuration Support-C 1.0
- APPN network node with Configuration Support-C 1.0
- Concurrent Communication Adapter (CCA)
- Peer communication with Configuration Support-C
- TCP/IP
- Ethernet
- Frame relay
- Asynchronous Emulation Adapter (AEA) support

4.3.1 3174 Single Link Multi-Host (SLMH) and Token-Ring

The Single Link Multiple-Host is a function that allows terminals attached to 3174 Models 03R, 13R, 53R and 63R (token-ring attached controllers) to concurrently access up to eight hosts that are attached to the same token-ring network as the 3174. The token-ring attachment can be either a Type 3 token-ring adapter (4 Mbps) or a Type 3A Dual Speed (16/4 Mbps) communication adapter.

The SLMH token-ring code provides a multiple SNA PU 2.0 appearance, so that terminals attached to the same physical 3174 can communicate with multiple hosts that are also connected to the same token-ring network. Up to five concurrent sessions are supported for each attached terminal and these sessions can be distributed between eight hosts.

4.3.2 3174 Single Link Multi-Host and X.25

Configuration Support-B Release 3 expands the connectivity of a 3174 to 16 SNA hosts on X.25 links. The primary adapter supports up to eight SNA X.25 hosts and each CCA feature supports up to four SNA X.25 hosts. Using the MLT function, each user can access up to 5 of the 16 hosts. Each host connection uses an X.25 virtual circuit. SLMH is applicable to AEA device users.

4.3.3 3174 Single Link Multi-Host and ESCON

The ESCON director allows dynamic communication between the 3174 and up to eight hosts with one physical ESCON connection to the 3174. The 3174 can be three kilometers away from the host and still be locally attached. Using two ESCON directors, the distance can be multiplied to a maximum of 43 kilometers.

The multiple host support is provided by virtual controllers and physical controllers. The virtual controller (VCU) is functionally a 3174 connected to one host, but using the ESCON director you can dynamically connect and disconnect to the hosts as required. There can be up to eight VCUs inside the 3174, which means there can be eight logically connected hosts at one time. The physical controller is the 3174 itself, as well as the microcode that controls all the functions.

By using the MLT support a user attached to one of the 3174 ports can jump between any five of the eight possible host connections.

4.3.4 3174 Channel Attachment and CCA

The multi-host connectivity provided by Configuration Support-B Release 1 or higher and the Concurrent Communication Adapter (CCA) feature provides flexible and concurrent access to multiple 3270 host applications resident in more than one host from a terminal. Each CCA feature provides access to a single host for synchronous teleprocessing communication over a TP link at speeds up to 64 kbps using SNA/SDLC and X.25 protocols and up to 19.2 kbps using BSC protocols. The primary attachment can be either channel, TP or token-ring.

4.3.5 3174 Remote Token-Ring Gateway

The 3174 remote gateway can be attached to the host via a leased full-duplex (CS-B3 or later) or half-duplex SDLC line. Switched SDLC and X.21 connections are not supported. X.25 switched virtual circuits and permanent virtual circuits can be supported when using RPQ 8Q0743, X.25 token-ring gateway. Frame relay communication can be supported with Configuration Support-C Release 5.

VTAM and NCP view the downstream PUs as stations on a multipoint SDLC link.

4.3.6 3174 X.25 Token-Ring Gateway (RPQ 8Q0743)

The X.25 token-ring gateway RPQ combines the functions provided by the token-ring network and X.25 support: a 3174 token-ring gateway that connects to the X.25 network, using X.25 Single Link Multi-Host and allowing other 3174s and workstations as DSPUs to access up to 16 host systems.

With the RPQ the 3174 acts as a gateway to allow other 3174s and workstations on the token-ring to access multiple hosts via the X.25 network or up to three different X.25 networks. In this environment the 3174 acts as a QLLC secondary station, with the exception that it is also a gateway. Hence, it is referred to as a QLLC secondary gateway.

The RPQ also allows the 3174 to act as a gateway to allow PU 2.0 devices in the X.25 network, such as other 3174s and workstations, to access hosts on the token-ring. In this environment the 3174 acts as a QLLC primary station as well as a gateway to the hosts on the token-ring. Hence, it is referred to as a QLLC primary gateway.

To use the RPQ, you need the following in the 3174 gateway:

- Type 3A Dual Speed (16/4) Communication Adapter (the token-ring adapter card).
- Configuration Support-B Release 3 and later or Configuration Support-C Release 2.1 and later Licensed Internal Code.
- At least 3 MB of controller storage.
- 3174 Models 01L, 11L, 21L, and 22L require the installation of a Concurrent Communication Adapter (CCA) or alternate host attachment to allow connection to an X.25 network. In the case of alternate host attachment the 3174 must be customized as an x1R or x2R model.

The following should be considered when planning to use the RPQ:

- X.25 SVCs and X.25 PVCs are supported.
- The number of virtual circuits supported depends on the 3174 model, its configuration and on the X.25 window size. The maximum number of X.25 gateway connections is 200.
- If the 3174′s primary link support is customized for APPN or ISDN, X.25 token-ring gateway support can only be customized for a secondary (CCA) link.
- For Configuration Support-B, this RPQ is mutually exclusive with the Port Expansion Feature (FC 3100).
- The 51R and 90R models are only supported by Configuration Support-B.

4.4 3174 Configuration Support

Table 42 (Page 1 of 3). 3174 Configuration Support/Level

Function	C6	B4	S5	A5	N
Networking and Connectivity					
4 Mbps token-ring	X	X	X	X	NA
16 Mbps token-ring	X	X	X	X	NA
ESCON fiber-optic channel (SNA/non-SNA)	X	X	NA	NA	NA
S/370&S/390 parallel channel (SNA/non-SNA)	X	X	X	X	NA
EIA 232D, V.24/V.28 at speeds up to 19.2 kbps	X	X	X	X	NA
V.35 at speeds up to 64 kbps	X	X	X	X	X
X.21 at speeds up to 64 kbps	X	X	X	NA	NA
X.21/X.25 switched autocall/autodisconnect	X	X	NA	NA	NA

Table 42 (Page 2 of 3). 3174 Configuration Support/Level					
Function	**C6**	**B4**	**S5**	**A5**	**N**
ASCII emulation adapter	X	X	NA	X	NA
3270 terminal emulation	X	X	NA	X	NA
ASCII terminal emulation	X	X	NA	X	NA
ASCII Passthru	X	X	NA	X	NA
User-defined translate tables	X	X	NA	NA	NA
MLT sessions available on 3270 hosts	X	X	NA	NA	NA
Enhanced ASCII security	X	X	NA	NA	NA
Concurrent Communication Adapter	X	X	NA	NA	NA
Single Link Multi-Host	X	X	NA	NA	NA
Token-ring	X	X	NA	NA	NA
ESCON	X	X	NA	NA	NA
X.25	X	NA	NA	NA	NA
Frame relay	X	NA	NA	NA	NA
Token-ring gateway with up to 250 DSPUs **1**	X	X	X **2**	NA	NA
Group poll	X	X	NA	NA	NA
Duplex multipoint	X	X	NA	NA	NA
Multi-host token-ring gateway	X	X	NA	NA	NA
Advanced Peer-to-Peer Networking (APPN)	X	NA	NA	NA	NA
Token-ring	X	NA	NA	NA	NA
Ethernet	X	NA	NA	NA	NA
SDLC links	X	NA	NA	NA	NA
Parallel channel	X	NA	NA	NA	NA
ESCON channel	X	NA	NA	NA	NA
Frame relay	X	NA	NA	NA	NA
X.25	X	NA	NA	NA	NA
Dependent LU Requester (DLUR)	X	NA	NA	NA	X
Frame relay support	X	NA	NA	NA	NA
Peer communication **3**	X	X	NA	NA	NA
PU Type 2.1 passthru RPQ (8Q0800)	NA	X	NA	NA	NA
ISDN BRI adapter (#3055)	X	NA	NA	NA	NA
Datastreaming	X	X	NA	NA	NA
4-wire SNBU	X	X	X	X	X
IP-routing over frame relay	X	NA	NA	NA	NA
Telnet client for CUT/ASCII	X	NA	NA	NA	NA
TN3270 client	X	NA	NA	NA	NA
MVS host	X	NA	NA	NA	NA
CICS/6000	X	NA	NA	NA	NA
Print server for telnet (LPD)	X	NA	NA	NA	NA
X.25 token-ring gateway RPQ 8Q0743	X	X	NA	NA	NA
SVC	X	X	NA	NA	NA
PVC	X	NA	NA	NA	NA
X.25 IP-routing	X	NA	NA	NA	NA
256 kbps over frame relay and SDLC	X	NA	NA	NA	X
Remote SRB support over token-ring	X	NA	NA	NA	NA
Intermediate session routing	X	NA	NA	NA	NA
Network management					
Central Site Management (CSCM)	X	X	X	X	X
Central Site Customization Utility (CSCU)	X	X	X	X	X
Central Site Control Facility (CSCF)	X	X	NA	NA	X
Remote diagnostic	X	X	NA	NA	X
Remote IML	X	X	NA	NA	X
SNA alerts	X	X	X	X	X
Network asset management	X	X	X	X	X
Vital Product Data (VPD)	X	X	X	X	X
User-defined product data	X	X	NA	NA	NA
Extended Vital Product Data (IBM 3472)	X	X	NA	NA	NA
Response Time Monitor (RTM)	X	X	X	X	X

Table 42 (Page 3 of 3). 3174 Configuration Support/Level					
Function	**C6**	**B4**	**S5**	**A5**	**N**
Enhanced trace facility	X	X	NA	NA	X
NetView focalpoint communication	X	NA	NA	NA	NA
SNMP agent (MIB II)	X	NA	NA	NA	NA
End-user productivity					
Multiple Logical Terminal (MLT) support for up to 5 sessions	X	X	X	X	X
FTTERM (File Transfer and Terminal Emulator Program) support	X	X	X	X	X
Keyboard definition utility	X	X	X	X	X
Type-ahead	X	X	NA	NA	X
Enhanced null/blank processing	X	X	NA	NA	X
Entry assist	X	X	X	X	X
Fast typematic (IBM 3472)	X	X	X	X	X
Local format storage	X	X	4	4	X
GDDM/ASCII graphics for specific ASCII devices	X	X	NA	NA	NA
Split-screen RPQ (8Q0801)	NA	X	NA	NA	X
Copy session-to-session RPQ (8Q0877)	NA	X	NA	NA	X
Device attachment					
RG-62A/U coaxial cable	X	X	X	X	X
IBM Cabling System (Types1, 2 and 9)	X	X	X	X	X
Telephone twisted-pair wire (ICS Type 3) TTP terminal multiplexer adapter (RPQ 8Q0806) Dual-purpose connector to twisted-pair (DPC-T3) adapter-PN 83X9758	X X X	X X X	X NA X	X X X	NA NA NA
Fiber-optic media (62.5/125, 100/140, and 50/125 micron) via the IBM 3299-032	X	X	NA	X	NA
3299 Model 002/003	X	X	X	X	X
3299 Model 032	X	X	NA	X	X

Notes:

X denotes yes.
NA denotes not applicable.

1 Not with #3025 or Model 90R.

2 Maximum of 140 DSPUs with Configuration Support-S.

3 Via RPQ 8Q0718.

4 Via RPQ 8X0024.

4.4.1 3174 Peer Communication

The 3174 Peer Communication feature provides the ability to have LAN communications between the following:

- Programmable workstations coax-attached to the same 3174 controller
- Programmable workstations coax-attached to different 3174 token-ring attached controllers
- Programmable workstations coax-attached to a 3174 and any host system or PUs accessible to the 3174 via the token-ring

This support is in addition to the host communication that has been traditionally available to programmable workstations. Peer communications can be used in conjunction with the 3174 PU 2.1 Passthru token-ring gateway (RPQ 8Q0800) or with 3174 APPN to further extend the capabilities of 3174 coax-attached workstations.

When two programmable workstations attached to the same 3174 establish communications, the 3174 Peer Communication feature provides a LAN function to route the traffic between the two workstations. When a programmable workstation establishes communications with another programmable workstation on a different token-ring attached 3174 or with a DOS or OS/2-based programmable workstation attached directly to the token-ring, perhaps as file or prin t server, the 3174 Peer Communication feature provides a bridge function between the 3174 and the token-ring.

Where communication is desired between programmable workstations connected to two different 3174s that are token-ring connected, this could really be a sequence of bridged rings. In addition to 3174 token-ring gateways, any supported token-ring gateway (for example, 3745 or 3172) could be used to provide the host communication path for the 3174.

3174 peer programmable workstations may be mixed with non-peer terminals (for example, fixed-function 3270s) on a port-by-port basis on the same controller. All terminals, including the 3174 peer programmable workstations continue to have S/370 host communication.

All 3174 models are supported except the small 8-port models. All supported 3174 configurations must have a 16/4 dual speed token-ring adapter. (The 4 Mbps token-ring adapter is not supported.) While the token-ring attached programmable workstations can be equipped with the 4 Mbps token-ring adapter, and the token-ring LAN configured to run 4 Mbps, only the 3174 need be equipped with the 16/4 dual speed token-ring adapter.

Peer communication is supported on the following models:

- Models 01L, 01R, 02R, 12L, 21H, 22L, 51R (with FC 3026, 3030 or 3044
- Models 11L, 11R, 12R, 61R, 62R (with FC 3026 or 3044)
- Models 21L, 21R, 12R, 22R (with FC 3026 or 3044)
- Models 03R, 53R (with FC 3030)
- Models 13R, 23R and 63R

In a coax-connected programmable workstation configured to run the peer communication function, the following software is also supported:

- TCP/IP for DOS Version 2.1
- TCP/IP for OS/2 Version 2.1

- IBM Personal Communications/3270
- IBM 3270 Workstation Program
- Extended Edition Version 1.3
- Extended Services Version 1.0
- Communications Manager/2
- APPC/PC
- IBM PC LAN Program
- DOS LAN Requester (included with the OS/2 LAN Server)
- OS/2 LAN Requester (included with the OS/2 LAN Server)
- Novell NetWare
- AS/400 PC Support

4.4.2 3174 Advanced Peer-to-Peer Networking (APPN)

The APPN LIC feature provides the functions of an APPN network node on the 3174, and allows application programs that use Advanced Program-to-Program Communication (APPC) running on either a workstation or host to communicate with a partner program anywhere else in the APPN network. There is an overview of APPN in Chapter 8, "APPN Product Implementation" on page 185.

Support for APPC applications under the APPC LIC feature and LAN applications under the Peer Communication LIC is provided on the same controller with support for S/370 and S/390 host applications.

Configuration Support-C Release 3 builds on the APPN and peer communication (LAN over coax) capabilities of Release 2.

APPN support includes the following:

- 3174 APPN network node (NN) compatibility in environments where the host is a low entry networking (LEN) node, APPN end node (EN), APPN network node (NN), migration data host (MDH) or an interchange node (ICN).
- Support of multiple links into a LEN subarea from an APPN network comprised of 3174s and other APPN nodes.
- Support for the transfer of 3270 and APPN downstream across a single SDLC or token-ring link between a 3174 and an AS/400 running OS/400 Version 2R2.

4.4.3 3174 PU 2.1 Passthru (RPQ 8Q0800)

This RPQ extends the 3174 token-ring gateway support to allow LAN-attached devices to establish PU 2.1 and PU 2.0 sessions with channel and TP-attached hosts.

The PU 2.1 gateway function parallels the existing PU 2.0 support. That is, a logical connection is provided to a LAN PU 2.1 node which gives the appearance that the node is directly attached to the host. The gateway serves to map either the device subchannel addresses or SDLC poll addresses to LAN MAC addresses and vice versa.

The passthru function has been expanded to handle XID3 transfer between the host and LAN devices. Upon successful completion of the XID3 sequence the gateway opens the link station and enters a passthru mode for the data transfer between the host and devices.

Link termination for PU 2.1 devices is dependent on the protocol of the upstream link (SDLC or channel). Termination can occur as a result of a host request, device request or a link failure.

The RPQ requires the following:

- Type 3A dual-speed (16/4 Mbps) communication adapter.
- Configuration Support (LIC) B.
- Models 01L, 01R, 02R, 51R may require additional storage.
- For 3174 remote models: VTAM V3R2 or higher.
- For 3174 channel models with a VM host: VTAM V3R3 or higher is required.
- For 3174 channel models with an MVS host: VTAM V3R4 or higher is required.
- NCP V4R3 is required for 3725.
- NCP V5R2 or higher is required for 3745.

Keep the following in mind when planning to use the RPQ.

- The RPQ will only operate for link connections made via the primary communication link (TP or channel).
- The RPQ is only supported on SNA channel or SNA SDLC connections.

4.4.4 3174 TCP/IP

To support TCP/IP on an IBM 3174 a minimum level of RPQ 8Q0935 and Configuration Support-C Release 2 or Configuration Support-C Release 3 is required. Telnet support was originally offered by RPQ 8Q0935. This support was then included in Configuration Support-C Release 3.

4.4.4.1 RPQ 8Q0935 and C3 Base Implementation

This RPQ provides a TCP/IP Telnet client function for the IBM 3174 controller. 3270 devices (3270 CUT, ASCII and DFT-E) attached to an IBM 3174 communicate directly with TCP/IP servers via the 3174′s interface to a token-ring. The TCP/IP server may be attached directly to the token-ring, or it may exist anywhere in the network reachable via that token-ring, or any bridges or routers.

Coax-attached displays operating in CUT mode are supported as VT100, VT220, IBM 3101 or DG210 devices and can access full-screen (24 X 80) Telnet applications. ASCII displays are supported via the AEA feature in the IBM 3174. Note when accessing TCP/IP on an IBM S/390 host (TCP/IP for MVS or VM), only line-by-line mode is supported.

The following displays can be used to access TCP/IP applications:

- Coax-attached (CUT) dependent displays (up to five sessions via MLT).
- Intelligent workstations operating in CUT mode (up to five sessions via MLT). (Intelligent workstations on 3174 coax ports may also have TCP/IP sessions when operating under 3174 peer communication. For more information see 4.4.1, "3174 Peer Communication" on page 105.)
- DFT-E displays operating in ASCII host session mode (one session).
- ASCII displays (up to five sessions via AEA MLT).

The following are the supported TCP/IP protocols:

- IP - Internet Protocol
- ICMP - Internet Control Message Protocol
- ARP - Address Resolution Protocol (resolver client only)
- TCP - Transmission Control Protocol
- UDP - User Datagram Protocol
- TELNET - Teletypewriter Network (client only)
- PING - Packet Internet Groper (ICMP)
- DNS - Domain Name Server (stub resolver)
- SNMP - Simple Network Management Protocol (MIB-1 agent only)

Prerequisites:

- 3174 hardware required:
  - The 3174 requires a token-ring adapter. This adapter is standard on the 03R, 13R, 23R and 63R models.
  - 3174 Models 01L, 01R, 02R, 11L, 11R, 12L, 12R, 21H, 21L, 21R, 22L, 22R, 51R, 61R and 62R require an IBM token-ring adapter (FC 3026, 3030 or 3044).
  - An AEA adapter (FC 3020) is only required when ASCII terminals are to be connected to the 3174.
- Microcode required:
  - 3174 Configuration-Support C, Release 2 (FC 6010, 6015, 6060 or 6065) and TCP/IP for 3174 (RPQ 8Q0935).

4.4.4.2 Configuration Support-C Release 6 TCP/IP Enhancements

Configuration Support-C 6 enhanced the 3174 TCP/IP support by adding:

- IP routing of datagrams through the 3174
- TN3270 support
- Printer support
- SNMP extension to support MIB-II variables

4.4.5 3174 Ethernet and TCP/IP Enhancements (RPQ 8Q1041)

Most 3174 models include an Ethernet adapter in the base machine. Attached dependent terminals (both CUT and ASCII) may access SNA and TCP/IP hosts via an Ethernet LAN. These terminals, attached to one of these controllers, can access upstream Ethernet LAN-attached hosts in a manner similar to the token-ring DSPU configurations.

Using the Ethernet adapter feature, the 3174 controller can be configured as an Ethernet gateway to SNA hosts. Devices attached downstream from the 3174 on an Ethernet LAN can access SNA hosts upstream from the 3174 Ethernet gateway. Existing MLT support makes it possible for each dependent terminal to have up to five sessions.

RPQ 8Q1041 TCP/IP Enhancements provides TCP/IP TN3270 support, TCP/IP host printer and SNMP MIB-II support.

4.4.5.1 3174 TCP/IP Enhancements RPQ 8Q1041

The following were made available with RPQ 8Q1041 and are be applicable to both Configuration Support-C Release 3.0 and 4.0:

- TN3270 support makes it possible for client terminals to use TCP/IP protocol for mainframe access to 2170 applications in full-screen mode.
- TCP/IP printer support allows printers attached to a 3174 to accept and print jobs from TCP/IP hosts.
- SNMP MIB-II support enhances the level of network management offered by the 3174.

4.4.6 3174 ISDN Gateway

The IBM 3174 Integrated Services Digital Network (ISDN) Basic Rate Interface (BRI) adapter provides downstream communication to PS/2 devices with the ISDN Interface Co-Processor/2 Model 2 and ISDN Co-Processor Support Program Version 1.1 installed at speeds up to 64 kbps. The 3174 ISDN BRI adapter provides four ports, each providing two independent 64 kbps data channels, in addition to one 16 kbps signalling channel, enabling support for up to eight remote PS/2 ISDN workstations with no contention.

Each ISDN Basic Rate port is comprised of three separate channels. One channel establishes the connection between the calling and called devices. This channel operates at 16 kbps. The two other channels provide the transport of the actual data being sent from one device to the other. These channels operate at 64 kbps.

Each 3174 ISDN BRI adapter and Configuration Support-C may be installed in one of the following 3174 Controller models: 01L, 01R, 02R, 11L, 11R, 12L, 12R, 21H, 21L, 21R, 22L, 61R and 62R.

The maximum number of 3174 ISDN BRI adapters that may be installed is as follows:

- Four for the Models 11L, 11R, 12L, 12R, 21L, 21R and 22L
- Three for the Models 01L, 01R and 02R
- Two for the Models 61R and 62R

Chapter 5. AS/400 Connectivity

The aim of this chapter is to provide information for the networking and router specialist not familiar with the AS/400. We concentrate on the AS/400′s capabilities in terms of communications and networking. It is not a detailed presentation so for greater depth on any particular subject, the reader should refer to the AS/400 communications manuals and appropriate redbooks. An additional information source on AS/400 connectivity is the AS/400 home page at http://www.as400.ibm.com.

5.1 AS/400 Networking Support

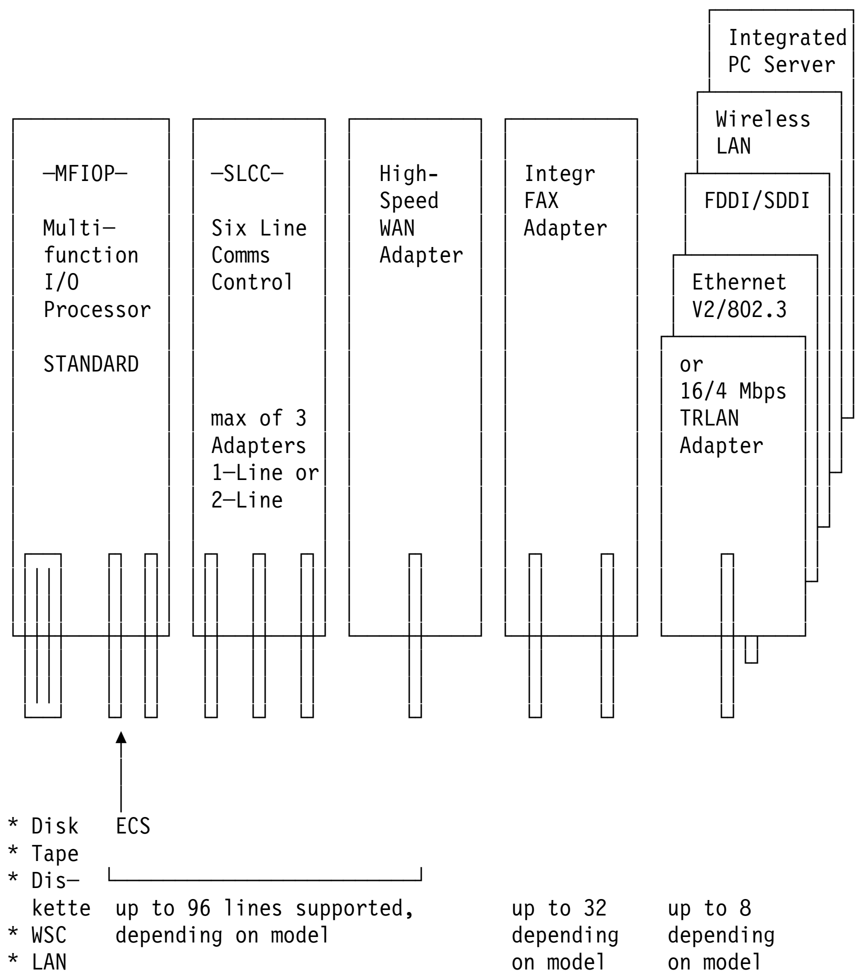
The AS/400, although traditionally a node found in APPN networks and a T2.1 node in SNA subarea networks, also supports TCP/IP, IPX/SPX and OSI networking protocols. The AS/400 is increasingly found in mixed IBM and non-IBM network environments.

SNA, IPX/SPX, and TCP/IP are part of the base support provided by OS/400. OSI is a separately licensed program product. NetBIOS is also supported as part of the LAN Server/400 licensed program product. The link protocol support is also provided by the base OS/400 code.

An overview of the communications support, hardware and software provided on the AS/400 is given in the following sections. The number of lines and adapters supported depends on the Model of the AS/400, which goes from the low-end Model 200 (supporting up to 280 twinax-attached devices) to the high-end Model 530 (supporting up to 7000 twinax devices), plus the server models, and the AS/400 entry level models that are portable.

5.1.1 AS/400 Communications Hardware

The Advanced Systems and Advanced Servers support the following communications controllers and adapters.



ECS   Electronic Customer Support — first line with ECS is standard on AS/400.

LocalTalk adapter can be attached to the MFIOP or to the SLCC

Figure 29. Adapters Supported on the AS/400

The Multi-Function I/O Processor (MFIOP) is a standard feature on the AS/400. It can be used to support either disk, tape, diskette or workstation controller attachments. It also supports two communications lines. The first communications line is supplied as standard via a V.24 supplied adapter. A second adapter can be ordered for the second line, which can be either V.24, V.35, X.21, or a LocalTalk workstation adapter. LAN adapters are also supported.

The Six-Line Communications Controller (SLCC) is an optional feature that can support up to six communication lines via three adapter slots. These adapters can be a mixture of one and two line V.24 adapters, one and two line X.21 adapters, one line V.35 adapters, ISDN Basic Rate Interface adapter or a LocalTalk workstation adapter.

5.1.1.1 Integrated PC Server (IPCS)

Integrated PC Server is the new name for File Server I/O Processor (FSIOP). It provides, along with supporting AS/400 software, a high-performance client-centered system. The Integrated PC server provides file system access to clients such as OS/2, DOS and Windows, that are attached to token-ring and Ethernet LANs. The file system can also be accessed by AS/400 host applications and provide LAN communications to AS/400 applications using TCP/IP, IPX and APPN.

The Integrated PC Server cannot be installed on B models or the 9402-D02/E02/F02. The IPCS requires at least one memory feature (either #2861 or #2862), one LAN feature (either #6149/#9249 token-ring or #6181/#9381 Ethernet) and OS/400 V3R7 (with cumulative PTF package C7029370, or later) or V3R2.

The Integrated PC server uses AS/400 disk for storage space. This storage space uses disk in the System ASP. Up to 8 GB of disk can be specified per storage space with a maximum of 16 storage spaces per Integrated PC Server. The maximum file size is 2 GB.

The Integrated PC Server is hardware. It is an I/O processor that you attach to the AS/400.

These Integrated PC Servers, combined with a high-performance LAN adapter, make the AS/400 performance comparable to PC-based serving.

An Integrated PC Server can be used as a LAN adapter or as a processor and LAN adapter to run applications such as:

- Novell NetWare
- Lotus Domino 4.5
- FlowMark V2.3

The following Integrated PC Server types are supported:

- 6506 - consists of an Intel 66 Megahertz 486 processor
- 2850 - consists of an Intel Pentium 133 Megahertz processor
- 6616 - consists of an Intel Pentium 166 Megahertz processor

Two versions of the 6506 Integrated PC Server hardware are available, a one-port and a two-port version. Each version can have 16 MB, 32 MB, 48 MB, or 64 MB of memory.

The two-port version can run one token-ring and one Ethernet network, two token-ring networks, or two Ethernet networks. If you use a two-port version, you can connect one port and keep the remaining port available for future use. However, do not connect more than one cable to a single port.

The I/O adapter serves as a communications adapter, which requires token-ring or Ethernet line descriptions.

The Integrated PC Servers do not support ring error monitor (REM) or configuration report server (CRS) on token-ring networks.

5.1.2 AS/400 Adapters and Interfaces

Communication controllers are integrated into the AS/400 System Unit.

Comms Ctrl	Adpt Intf	ASYNC	BSC	SDLC	X.25	Frame Relay	Protocols running concurrently
		Link Protocols					
MFIOP	V.24	19.2	19.2	19.2	19.2	–	SDLC, ASYNC, BSC,
	X.21	–	–	64	19.2	–	X.25 and X.21 SHM
	V.35	–	64	64	64	–	concurrently
SLCC	V.24	19.2	19.2	19.2	19.2	–	ASYNC, BSC, SDLC,
	X.21	–	–	64	64	–	X.25 and X.21 SHM
	V.35	–	64	640	64	–	concurrently
	ISDN	two 64 Kbps links (2B+D)					IDLC, X.25
High-Speed WAN	V.35	–	–	2 M	–	2 M	SDLC and
	V.36	–	–	2 M	–	2 M	frame relay
	X.21	–	–	2 M	–	2 M	not concurrently
TRLAN		Protocol is IEEE 802.2/.5 at 4 or 16 Mbps					SNA, TCP/IP, IPX
CSMA/CD		Protocol is IEEE 802.2/.3 and Ethernet V2, at 10 Mbps					SNA, TCP/IP, IPX
SDDI/FDDI		At 100 Mbps					SNA, TCP/IP
Local Talk		Allows attachment of Apple Macintoshs via the LocalTalk adapter					–
WLAN		Spread Spectrum radio, operating in the 2.4 to 2.4835 GHz band					SNA, TCP/IP
IPCS		IEEE 802.2/.3 and Ethernet V2 or Token-Ring 802.2/.5					SNA, TCP/IP, IPX, NetBIOS
FAX		Group 3 fax					–

Figure 30. Link Protocols Supported on AS/400 Adapters

The maximum number of communication adapters is dictated by the total number of communication lines supported by model as follows:

Table 43. AS/400 Model Support for Communications Lines							
Model	**Total Comm Lines**	**Total High Speed Lines**	**Max T1/E1/J1 Lines < or =**			**Max SLCC + High Speed Comm Adapter**	**Max other High Speed Lines**
			384 kbps	**512 kbps**	**640 kbps**		
300	33	8	8	8	4	4	8
310	64	24	24	16	8	8	24
320	96	24	24	16	8	8	24
400	20	6	6	4	2	2	6
436-SSP	8	1	0	0	0	0	1
436-OS4	20	6	6	4	2	2	6
500	33	8	8	8	4	4	8
510	96	24	24	16	8	8	24
530	200	48	48	32	16	16	48
40S	20	6	6	4	2	2	6
50S	96	24	24	16	8	8	24
53S	200	48	48	32	16	16	48

Notes:

1. The last column (Max other High Speed Lines) consists of X.21, V.35, and ISDN lines that support BSC, X.25, IDLC and SDLC at speeds greater than 19.2 kbps up through 64 kbps. An ISDN adapter attaches one communication line with two high-speed ISDN user channels to an ISDN network. It is counted as two lines when determining the number of lines supported.

2. The Six-Line Communications Controller (SLCC) supports up to three V.35 SDLC data lines for attachment to T1/E1/J1 facilities through appropriate data communications equipment (DCE). Support per controller is as follows:

   - One V.35 SDLC data line operating at speeds up to 640 kbps
   - Two V.35 SDLC data lines operating at speeds up to 512 kbps
   - Three V.35 SDLC data lines operating at speeds up to 384 kbps

5.1.3 Network Architecture Support on Link Protocols

	SNA	TCP/IP	OSI	IPX
SDLC	X			
X.25	X	X	X	X
IDLC (ISDN)	X			
Frame relay	X	X		X
SDDI/FDDI	X	X		X
Token-ring	X	X		X
Ethernet	X	X		X
Wireless	X	X		

5.2 5250 Device Emulation for PC Environments

The AS/400 workstation data stream is 5250. The AS/400 supports locally and remotely attached 5250 devices or intelligent workstations running 5250 emulation. The following products provide various levels of 5250 emulation support:

- 5250 Express Program V4.0

  An entry level 5250 display and printer emulation program that runs on many PC platforms including Windows 95, DOS, and OS/2. It is designed to use the 5250 Express Adapter and 5250 Emulation adapters.

- AS/400 Client Access

  The AS/400 Client Access family provides an overall AS/400 solution for connecting PCs to the AS/400. It is the recommended solution for users of OS/400 V3.1 or higher.

- Personal Communications

  Personal Communications is a solution for users at lower levels than OS/400 V3.1 or for situations that require both AS/400 and S/390 access. OS/2 users that need native TCP/IP support should choose Personal Communications. Client Access provides native TCP/IP support for Windows 95/NT users.

See 5.5.2, “Client Access for OS/400 Family” on page 125 for supported networking functions and features of Client Access/400 products.

See Chapter 6, “IBM Communications Server Products” on page 149 for functions provided in Communications Server family of products regarding AS/400 connectivity.

See Chapter 15, “IBM Personal Communications Family” on page 283 for more information on Personal Communications.

5.3 Remote 5X94 Controllers

Remote controllers are supported for the remote attachment of workstations and printers. This includes the 5394 remote workstation controller and the 5494 remote workstation controller. The 5394 provides a WAN (SDLC or X.25) link to the AS/400 and supports twinax-attached 5250 devices. The 5494 supports either a WAN (SDLC, X.25 or frame relay) or LAN link to the AS/400. The single 5494 LAN adapter (token-ring or Ethernet) can either be used for the AS/400 connection or for LAN-attached 5250 devices. 5250 devices can also be twinax-attached to the 5494. The 5494 is an APPN low entry networking (LEN) node.

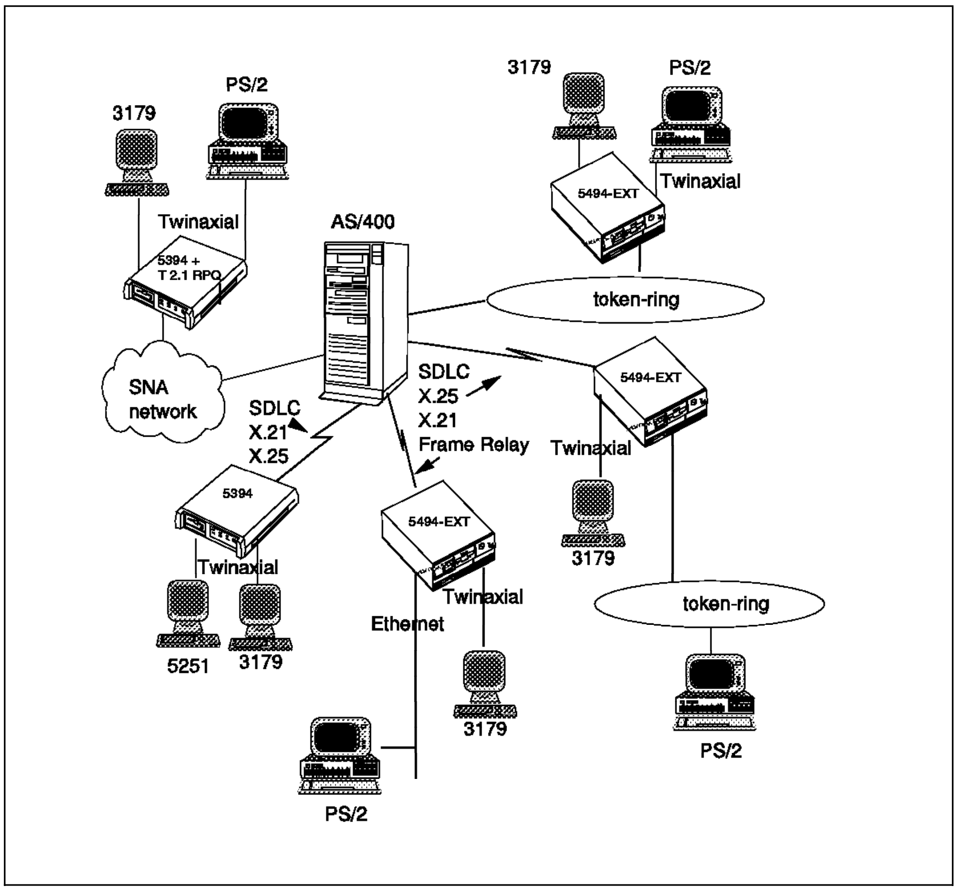


Figure 31. IBM 5394 and 5494 Remote Control Units

5.3.1 IBM 5394 Remote Control Unit

The 5394 Remote Control Unit attaches up to sixteen 5250 type displays, printers, IBM Personal Computers and Personal System/2, and Personal System/55 (AP only) to an AS/400 via a communications link. The function provided will be similar to that provided to the local workstations via the local twinaxial workstation controllers.

RPQ 8Q0775 allows an IBM 5394 to connect to an AS/400 as a LEN node using LU 6.2 and type 2.1 node architectures or to communicate with an AS/400 through an SNA subarea network.

The following table summarizes the 5394 remote control units.

Table 44. 5394 Remote Control Units

Control Unit	Model	Number of Terminals	Interface	speed max. Kbps	Protocol	Text/Edit	CA/400
5394	01A 01B	4 16	V.24	19.2	SNA/SDLC or SNA/X.25	yes	yes
5394	02A 02B	4 16	X.21	64	SNA/SDLC or SNA/X.25	yes	yes
5394	01Z 01W	4 16	V.35	64	SNA/SDLC or SNA/X.25	yes	yes

Notes::

1. Hardware feature, reduces max. number of terminals to 6, limits IBM 5294 to X.25 usage
2. Hardware feature
3. Hardware feature

5.3.2 IBM 5494 Remote Control Unit

The 5494 Remote Control Unit manages the operation of workstations and workstation communications to the AS/400. The IBM 5494-EXT replaces the IBM 5494-001 and the IBM 5494-002. The 5494 now has only one model, to which features are added, thus customizing the 5494 for operational needs.

The 5494-EXT supports the attachment of up to 28 twinaxial devices. With the 5494 Twinaxial Expansion Kit installed, up to 56 twinaxial devices can communicate with the AS/400 through a Type 2.1 connection.

Table 45. 5494 Remote Workstation Controller

Model	Number of Devices	Comm. Interface	Supported Networks	LAN Adapter
001 or EXT.	56, Twinax att.	V.24 V.35 or X.21	SDLC, X.25 SDLC, X.25, Frame Relay SDLC, X.25, Frame Relay	no
002 or EXT.	80, max. of these 56 Twinax, 80 Token-Ring or Ethernet•	V.24 V.35 or X.21	SDLC, X.25 SDLC, X.25, Frame Relay SDLC, X.25, Frame Relay	one 16/4 Mbps or one Ethernet

Note:

1. Ethernet adapter can be put into 5494-001/002 as well 5494-001/002 with microcode R3 get EXT. model.

It can communicate with an AS/400 system over a token-ring network while supporting up to 28 twinaxial devices, or can support token-ring attached devices while communicating with an AS/400 over an SDLC, X.21, X.25, or frame relay connection. In this configuration, the 5494 supports up to 80 devices of which up to 56 could be twinaxial-attached and the rest token-ring attached.

5.3.2.1 5494 EXT Remote Control Unit Expansion Features

Table 46. IBM 5494-EXT Expansion Features

5494 Configuration	Link between 5494 to AS/400	Max. Twinax Devices	Max. LAN Devices	Max. Total Devices
Base - no expansion units	SDLC, X.25, Frame Relay	28	0	28
Base + twinax expansion	SDLC, X.25, Frame Relay	56	0	56
Base + token-ring expansion	TRN SDLC, X.25, Frame Relay	28	80	80
Base + token-ring + twinax expansions	TRN SDLC, X.25, Frame Relay	56	80	80
Base + Ethernet expansion	ETH SDLC, X.25, Frame Relay	28	80	80
Base + Twinax + Ethernet expansion	ETH, SDLC, X.25, Frame Relay	56	80	80

Notes::

1. Ethernet is V2 or IEEE 802.3 using 10Base-2, 10Base-5, or 10Base-T.
2. Token-Ring adapter is 16/4 Mbps.

5.4 AS/400 LAN Features

This section focuses on the LAN features that are available with the AS/400. The following are the LAN adapters available on the AS/400:

- Ethernet/IEEE 802.3 Network Adapter/HP
- Fiber Distributed Data Interface Adapter
- 16/4 Mbps Token-Ring Network Adapter/HP
- 16/4 Mbps Token-Ring Network Adapter/A
- I/O Attachment Processor (base for 2668)
- Shielded Twisted-Pair Distributed Data Interface Adapter
- AS/400 Wireless LAN Adapter

5.4.1 Wireless LAN

The AS/400 Wireless LAN Adapter provides wireless connectivity from AS/400 systems to workstations or other systems connected to a wireless LAN network. Support is provided for portable and stationary PCs, for specialized hand-held devices used for data collection, and for connections between AS/400 systems. In addition to the AS/400 Wireless LAN Adapter, the following AS/400 wireless LAN networking devices are available from IBM:

- PCMCIA Type II, Micro Channel and PC AT (ISA) wireless LAN adapters to enable PCs to participate in the AS/400 Wireless LAN network.
- Lightweight, compact RS-485 and Ethernet wireless LAN Access Points.
- A variety of wireless bar-code scanning data collection devices called Portable Transaction Computers (PTCs).

The AS/400 Wireless LAN Adapter uses an advanced technology, direct sequence, spread-spectrum radio operating in the 2.4 to 2.4835 GHz band. The operating band may be different in some countries to meet country regulations. Spread spectrum provides excellent resistance to interference from other radio frequency (RF) sources. Availability of this feature in any particular country is dependent on current country radio frequency regulations and certification for use by the country.

The AS/400 Wireless LAN Adapter comes with an antenna and a cable for connecting the antenna to the adapter. The area of coverage may be extended beyond the coverage provided by the antenna attached to the adapter by adding AS/400 Wireless LAN Access Points to the network via an unshielded twisted-pair wired backbone. In addition, access points may be connected without wires, acting as wireless repeaters. Each adapter or access point generates one cell of coverage area. Networks are designed to create overlapping cells to ensure consistent coverage of the area desired. The AS/400 Wireless LAN Adapter allows transparent seamless movement from cell to cell while maintaining a continuous host session.

The AS/400 Wireless LAN Adapter operates with existing application software interfaces. Existing 5250 and LAN-oriented applications can use the AS/400 Wireless LAN Adapter without change. When used with the Portable Transaction Computers, application changes, to address the smaller screen size of these devices, may be desired.

The raw bit rate for the AS/400 Wireless LAN Adapter is 2 Mbps, shared by all active devices in the network. The range covered by one cell in most office environments is from 100 to 300 feet in all directions, depending on the building structure, antenna type and antenna placement. Outdoors, with a clear line-of-sight between yagi antennas, a range of up to three miles may be achieved. The yagi antenna is available as a feature of the 2480 Access Points.

The 2480 AS/400 Wireless Access Points are compact, lightweight devices that act as either wireless LAN bridges or wireless LAN repeaters that support transparent roaming through a multi-cell network. The following two models of the AS/400 Wireless Access Point are supported:

- 2480 Model RS0, AS/400 Wireless RS-485 LAN Access Point. This device is used with the AS/400 Wireless LAN Adapter to create a multi-cell wireless network. These access points may connect to the AS/400 Wireless LAN Adapter through an RS-485 twisted-pair wired backbone or without wire using the RF network. The 2480 Model RS0 is supported on AS/400 Advanced Systems with an AS/400 Wireless LAN Adapter (#2668)
- 2480 Model E00, AS/400 Wireless Ethernet LAN Access Point. This device serves as a bridge from an Ethernet 10Base-2, 10Base-5 or 10Base-T wired LAN to the AS/400 Wireless LAN network. Multiple units can be used to create a multi-cell network. The 2480 Model E00 is supported on AS/400 Advanced Systems with an Ethernet adapter.

5.5 AS/400 Communications Applications

The AS/400 provides applications for communicating in an APPN network, for communicating to an S/390 SNA host, for communicating in a TCP/IP network and an OSI network. We describe some of these applications briefly in this section.

5.5.1 APPC Applications

The AS/400 is primarily an APPC host. APPC is the communications method of using the SNA LU Session Type 6.2 protocol. APPC stands for Advanced Program-to-Program Communications. APPN (Advanced Peer-to-Peer Networking), which the AS/400 also supports, allows data communications to route data between two or more APPC hosts in a network that are not directly attached.

Applications that use SNA LU 6.2 sessions include the following:

- OfficeVision/400 (OV/400) for the distribution of documents and messages.
- System Management Tool (SMT) for distributing objects and libraries to one or multiple AS/400s.
- APPC User Program to provide individual program-to-program communication, allowing cooperative processing.
- File Transfer Support for transferring files and library members.

- Object Distribution Facility (ODF) for the distribution of programs, files, spool files, etc.
- NetView FTP/400 for transferring files with MVS NetView FTP and AS/400.
- Multiple System Software (MSS) to maintain synchronized copies of predefined databases on separate AS/400s.
- 5250 Passthru is a communications function that allows a user to sign on to one system (AS/400 or S/36) from another system and use the remote system′s programs and data interactively.
- SNA Distribution Services (SNADS) is a store and forward application that sends, receives and routes electronic mail, documents and files in APPN and SNA subarea networks.
- Distributed Relational Database Access (DRDA) is an LU 6.2 application that provides a set of advanced SQL protocols to provide access to distributed relational databases. DRDA can be used to issue remote units of work to access data on a remote database in the following environments: AS/400 DB2/400, OS/2 DB2, DB2 (MVS) and SQL/DS (VM).
- Distributed Data Management (DDM) is a function that allows an application program or user on one system to use data files stored on a remote system (that also supports DDM). To the user it appears as if the data is local.
- Client Access/400 provides a method of connecting personal computers to the AS/400 system.

5.5.2 Client Access for OS/400 Family

The Client Access for OS/400 server code sits on the AS/400 and provides Database Server, File Server, Print Server and Electronic Mail Server support to the PCs.

The AS/400 Client Access products are:

- AS/400 Client Access Family including:
  - Optimized OS/2 client (32-bit)
  - Windows 3.1 client
  - OS/2 client (16-bit)
  - DOS Extended Memory client
  - DOS client
- AS/400 Client Access for Windows including:
  - Windows 95/NT client
  - Enhanced for Windows 3.1 client

For further information about Client Access/400 products, fixes, and related information, visit the Client Access/400 Web site on the World Wide Web at http://www.as400/client/cahome.htm.

Table 47 (Page 1 of 3). Client Access/400 Functions						
	Windows 95/NT	OS/2 Optimized 32-bit	Windows 3.1	OS/2 16-bit Original	DOS Extended 16-bit Original	DOS Base 16-bit Original
5250 Emulation Display and Print						
Rumba (SBCS/DBCS)		X **1**	X **1**	X	X	
PC5250 (SBCS/DBCS)	X **2**	X **1**	X **1**			
WSF (SBCS)					X	X
Application Command-Level APIs						
Data Queues	X	X	X	X	X	
Submit Remote Command	X	X	X	X	X	X
Distributed Program Call	X	X	X			
Client Management						
Installable on PC Server	X	X	X			
Installable from PC Server	X	X	X			
Run from PC Server	X					
SNMP Client Management		X				
Desktop Management		X				
PC Update	X	X	X	X	X	X
System Information Agent (SIA)		X				
Central Administration Function	X	X **3**	X **3**	X	X	X
Migration Utility	X		X			
Node Operation Facility	X		X			
Command-Level APIs on AS/400						
Start PC Command (STRPCCMD)			X	X	X	X
Run RMT CMD (RUNRMTCM)	X	X				
Copy to PC Document (CPYTOPCD)	X	X	X	X	X	X
Copy from PC Document (CPYFRPCD)	X	X	X	X	X	X
Send Message				X	X	X
Communications Programs						

Table 47 (Page 2 of 3). Client Access/400 Functions						
	Windows 95/NT	**OS/2 Optimized 32-bit**	**Windows 3.1**	**OS/2 16-bit Original**	**DOS Extended 16-bit Original**	**DOS Base 16-bit Original**
SNA/APPC Router	X	X	X	X	X	X
Native TCP/IP Router	X					
TCP/IP via AnyNet		X	X			
Communications Support Programs						
Windows 95 SNA Driver	X 4					
LAN Support Program			X 5		X	X
NTS/2		X 5		X		
TCP/IP Stack	X 4	X 5, 6	X 5, 6			
Client Access Console						
AS/400 PC Console - PC5250		X 1	X 1, 9			
AS/400 PC Console - RUMBA		X 1	X 1, 9			
SNA Networks						
EHNAPPC APIs	X	X	X	X	X	X
CPI-C APIs	X	X	X	X		
Sockets APIs	X 13	X	X 13			
Twinaxial	X	X	X	X	X	X
Asynchronous	X	X	X	X 12	X	X
Asynchronous over SDLC		X	X			
X.25		X 12	X	X 12	X 7	
SDLC	X	X	X	X	X	X
Token-ring	X	X	X	X	X	X
Ethernet	X	X	X	X	X	X
ISDN		X 12		X 12		
TCP/IP Networks						
EHNAPPC APIs		X	X			
CPI-C APIs		X	X			

Table 47 (Page 3 of 3). Client Access/400 Functions	Windows 95/NT	OS/2 Optimized 32-bit	Windows 3.1	OS/2 16-bit Original	DOS Extended 16-bit Original	DOS Base 16-bit Original
Sockets APIs	X 14	X	X 15			
Token-ring	X 16	X	X			
Ethernet	X 16	X	X			
SLIP	X 14		X			

Notes:
1 DBCS is Japanese only.
2 SBCS support only.
3 Provides the ability to make install diskettes.
4 Function provided using MSDLC available from Microsoft.
6 Provides communications stack. Applications (TELNET, FTP) are not provided. Supports English-only SBCS (DBCS data transmission supported).
7 Function provided with V3R1M1 and later.
8 Version 1 Level 2 support.
9 Asynchronous only.
10 Windows 3.1 (16-bit) version with Windows 95 product.
12 Stand-alone Communications Manager/2 can provide this connectivity. Client Access can also be used in combination with CM/2.
13 Microsoft WinSock compliant.
14 Function provided with Windows 95 product.
15 Applications written to the MS WinSock interface are supported.
16 Function provided with MS 32-bit DLC.

5.5.3 Client Access for DOS Base

Client Access/400 for DOS is used with the Intel 8088/86 level of PC hardware that does not have extended memory (such as PC and PC XT), as it runs entirely in DOS conventional memory.

Client Access/400 for DOS provides the following:

- The DOS Router communications program which supports the APPC protocol. This was previously packaged with PC Support/400
- Workstation Function (WSF), which provides 5250 display and print support for up to five sessions (single-byte character set (SBCS) support only)

The IBM LAN Support Program (LSP), which provides device drivers and associated program interfaces for workstations on a LAN, is available for use with Client Access/400 for DOS.

The following list shows communications software that was tested to work with or in a Client Access for DOS environment:

- IBM Workstation Feature (WSF) for DOS (SBCS only) (see also 5.5.4.2, "IBM Workstation Function for DOS" on page 130)
- IBM Router for DOS (see also 5.5.4.1, "Router for DOS" on page 130)
- IBM LAN Support Program V1.38

5.5.4 Client Access for DOS Extended

Client Access/400 for DOS with Extended Memory should be used if you are planning to run DOS as the primary workstation operating system and if your PC has an Intel 80286 or greater processor. This Client Access/400 product has been specifically written to utilize extended memory. Many Client Access/400 for DOS configurations need less than 50 KB of DOS conventional memory, which makes over 500 KB available for running business applications.

Client Access/400 for DOS with Extended Memory provides the following:

- The communications program, the DOS Router (previously packaged with PC Support/400), which supports APPC protocol.
- Workstation Function (WSF) provides the 5250 emulation for the DOS environment. It is also written to use extended memory, if available.
- Windows Real Mode can be used with Client Access/400 for DOS with Extended Memory but it does not exploit Windows functions such as its memory manager. RUMBA/400 can be used with this package, and all previous APIs continue to be supported.
- The IBM RUMBA/400 5250 display/printer emulation program, which provides graphical user interfaces for AS/400 functions, allows multiple concurrent display or printer sessions.
- Ultimedia System Facilities, which includes both a GUI interface and enablers, allows PC applications to integrate multimedia capabilities such as video, image, and graphics.

The IBM LAN Support Program (LSP), which provides device drivers and associated program interfaces for workstations on a LAN, is available for use with Client Access/400 for DOS with Extended Memory.

The following list shows communications software that was tested to work with or in a Client Access for DOS environment:

- IBM Workstation Feature (WSF) for DOS (SBCS only) (see also 5.5.4.2, “IBM Workstation Function for DOS” on page 130)
- IBM RUMBA/400 for Windows (only if run in a Windows environment) (see also 5.5.10, “IBM RUMBA/400” on page 142)
- IBM Router for DOS which supports the following networks (see also 5.5.4.1, “Router for DOS”):
  - Token-ring (direct and via 5494 Remote Controller)
  - Ethernet
  - Twinaxial (local, 5394 and 5494 Remote Controllers)
  - SDLC
  - Asynchronous (directly attached, through IBM or ROLM CVX, and remote dialup)
  - X.25 (SBCS only)
- IBM LAN Support Program V1.38
- IBM LAN Distance Remote Workstation V1.1
- Novell NetWare for SAA
- Novell NetWare V3.12, V4.10
- Novell/IBM NetWare for SAA: AS/400 edition (see also 5.5.5.2, “Compatibility with NetWare for SAA” on page 134)

5.5.4.1 Router for DOS

Client Access for DOS provides DOS Router as the communication program that supports the APPC protocol.

For LAN connectivity, the IBM LAN Support Program (LSP) can be used. This program is supplied in the PC Tools folder (QIWSTOOLS) and is available as a separately orderable feature of Client Access.

The following physical communications are supported:

- Token-ring (direct and 5494 Remote Controller)
- Twinaxial (local, 5394 and 5494 Remote Controllers)
- Asynchronous (directly attached, through IBM or ROLM CBX, and remote dialup)
- SDLC
- Ethernet
- 3174 Establishment Controller APPN, Peer Communications LIC, and Configuration Support-C

Note: Only twinaxial, token-ring, Ethernet, and SDLC connections are available for DOS (DBCS).

5.5.4.2 IBM Workstation Function for DOS

Workstation Function (WSF) for DOS users is used in an SNA network to emulate AS/400 workstations, printers, or graphics workstations. WSF supports single-byte character set (SBCS) only. The following functions are available:

- Up to five display sessions or printer sessions can be active concurrently.
- The full 27-row and 132-column capability of the large screen hardware, such as an IBM 8507, 8514, or 8515 display attached to an IBM 8514/A adapter. It emulates the graphics capability of a 5292 Model 2 display station and attached plotter.
- Printer emulation supports a variety of PC printers that can be used as system printers.
- A session manager function allows multiple display and printer sessions to be viewed concurrently. Each session window can be dynamically sized, maximized, and moved with either a mouse or the keyboard.
- Keyboard emulation provides the combination of both traditional 5250 keyboard functions and PC keyboard functions. Some examples are World Trade Special Character Set (Layer 100), and support for Arabic, Hebrew, Greek, and Turkish languages. Default keyboard profiles allow a PC to function as another keyboard (such as Personal Computer AT, Enhanced Keyboard, 5250 Keyboard, 5140 PC Convertible).
- Functions are available to create custom keyboard profiles, generate playback sequences and customize the assignment of each keyboard key in the base, shift, Alt and Alt graphics states. A function is provided to print, copy, or display a template from the keyboard profile information.
- PC text-assist function is available for OfficeVision for OS/400 users.

5.5.5 Client Access for Windows 3.1

Client Access/400 for Windows 3.1 can be used with Microsoft Windows 3.1 and Microsoft Windows for Workgroups 3.11 PC operating systems. Client Access/400 for Windows 3.1 runs in Windows enhanced mode.

This client was written to minimize the use of terminate-and-stay-resident (TSR) programs (except for the device drivers). As an example, using the PC Support/400 DOS Extended client on a twinax connection might require 60-90 KB of DOS conventional memory. In a similar scenario, this Windows client would use no DOS conventional memory. The Windows client runs entirely under the control of Windows memory management.

Communications are installed from within Windows, too. To connect to an AS/400 system is as easy as clicking a mouse versus having to exit to DOS when you want to manage connectivity. This client is also well integrated with Windows utilities, such as Program Manager, File Manager, Control Panel, and Printer Manager. You have access to any network resource without having to leave the Windows environment.

A migration utility allows existing PC Support/400 and Client Access/400 DOS Extended clients to migrate their configurations and to install the new Client Access/400 for Windows 3.1 client without PC diskettes. This utility is available as a PTF to the QIWSTOOL folder of 5763-XA1. For V3R1, the PTF is SF21265 which was in Cum C5094310. For V3R6, the PTF is SF29441.

Subsets of the IBM Networking Services/Windows (NS/Windows) and IBM AnyNet/Windows programs make up the communications layer. The AnyNet/Windows communications layer utilizes the Multiprotocol Transport Networking (MPTN) architecture, which allows desktop PCs to run on either SNA or TCP/IP networks with similar capability.

Communications support includes the following:

- APPC and common programming interface communications (CPI-C) protocol interface.
- SNA communications for token-ring, Ethernet, twinax, and asynchronous connectivity.
- Asynchronous communication supports many async modems, many popular adapters, and provides high-speed async connectivity.
- Desktop PCs appear to the network as APPN nodes or subarea nodes, thus eliminating the need for protocol converters or gateways.
- A Node Operator Facility (NOF) that provides the APIs to do the following:
  - Connect and disconnect a link
  - Activate and deactivate logical units
  - Change configuration information after the router is started
- These functions are all done under program control without end user involvement.
- TCP/IP communications for token-ring and Ethernet LANs.

There is a communication feature that can be ordered. For V3R2, the feature number is 8540 and for V3R7 the feature number is 8524. This feature contains the following programs on diskette:

- LAN Support Program, Version 1.38: The LAN Support Program can be used with Windows 3.1, DOS Extended, or DOS clients in an SNA/APPC network. The workstation must be installed with Version 1.35 or later. The English version of the LAN Support Program can be dowloaded at http://www.raleigh.ibm.com/nes/neslant.htm.
- IBM TCP/IP Stack: The IBM TCP/IP stack can be used with Windows 3.1 (Client Access/400 V3R1M1) in a TCP/IP network. The TCP/IP stack is a subset of the IBM TCP/IP for DOS/Windows product. For example, it does not contain FTP or TN5250 functions since file transfers, 5250 emulation, remote printing, etc, are already provided by Client Access.

- IBM NTS/2 (LAPS): The IBM NTS/2 Program can be used with the OS/2 (16-bit) client in an SNA/APPC network.

Notes:

1. The IBM TCP/IP for DOS stack is provided on an ″as-is″ basis.
2. Non-IBM TCP/IP stack support responsibility resides with the stack provider.

Client Access/400 integrates the PC workplace with the AS/400 environment. For the desktop user, Client Access/400 5250 emulators provide graphical interfaces for existing AS/400 applications. 5250 emulation provides easy access and sign-on to any AS/400 system in the network. Other functions include a movable iconic tool bar and a 3-D status look and feel.

Client Access/400 provides graphical 5250 emulation products, PC5250 and RUMBA/400, which support graphical user environments such as Windows and OS/2. Both programs run in the PC operating system environment, provide multiple concurrent display or printer sessions, support cut and paste plus many other high productivity functions.

Workstation function (WSF) 5250 emulation is recommended for use on PCs with DOS-only installed. WSF supports as many as five display or printer sessions and also has a windowing function that allows users to cut and paste data between sessions.

The following list shows communications software that was tested to work with or in a Client Access for Windows 3.1 environment:

- IBM Router for Windows 3.1 (see also 5.5.5.1, “Router for Windows”)
- IBM LAN Support Program V1.38
- IBM LAN Server/400
- IBM LAN Client 2.0, 2.1 (IEEE 802.2 only)
- Novell LAN WorkPlace for DOS V5
- IBM 8235 DIALS V4.0
- IBM LAN Distance Remote Workstation V1.1

5.5.5.1 Router for Windows

Subsets of the IBM Networking Services/Windows (NS/Windows) and IBM AnyNet APPC over TCP/IP for Windows programs make up the communications layer. The AnyNet APPC over TCP/IP for Windows communications layer implements the Multiprotocol Transport Networking (MPTN) architecture, which allows desktop PCs to run on either SNA or TCP/IP networks with similar capability.

Communications support includes the following:

- APPC and CPI-C protocol interface.
- Desktop PCs appear to the network as APPN nodes or subarea nodes, thus eliminating the need for protocol converters or gateways.
- A Node Operator Facility (NOF) that provides the APIs to do the following:
  - Connect and disconnect a link
  - Activate and deactivate logical units
  - Change configuration information after the router is started

These functions are all done under program control without end user involvement.

The IBM LAN Support Program (LSP) (needed for LAN connection on SNA/APPC networks), associated program interfaces for workstations on a LAN, and the TCP/IP for DOS Stack Kit (needed for LAN connection on TCP/IP networks) are available by using a diskette media feature.

The following TCP/IP stacks are supported:

- IBM TCP/IP for DOS, Version 2.1.1, with CSD UB10718
- Walker Richer Quinn (WRQ) TCP Connection for Windows, Version 4.02
- FTP PC/TCP OnNet 1.1 for DOS/Windows (Windows VxD Kernel)
- NetManage Chameleon TCP/IP for Windows, Version 4.5.1
- Novell LAN WorkPlace for DOS, Version 5.0
- Microsoft TCP/IP-32 3.11a for Windows for Workgroups Version 3.11 (VxD)

The following physical communications are supported:

- SNA networks:
  - Token-ring (direct and through 5494 Remote Controller)
  - Twinaxial (local, through 5394 and 5494 Remote Controllers)
  - SDLC
  - Ethernet
  - Asynchronous
  - X.25
- TCP/IP networks:
  - Token-ring (direct and through 5494 Remote Controller)
  - Ethernet
  - SLIP

5.5.5.2 Compatibility with NetWare for SAA

Using Client Access for Windows 3.1 with Novell NetWare for SAA requires NetWare for SAA Version 2.0.

When you use Client Access for Windows 3.1 and NetWare for SAA, consider the following:

- When you install and configure Client Access for Windows 3.1 to run on NetWare for SAA, select for Connection type None from the Common Options of the Client Access for Windows 3.1 System Configuration.
- When you run in a NetWare for SAA environment, ensure that the NS/Router is started before you install, configure, or use any Client Access for Windows 3.1 functions. Failure to do this may cause a Windows Dynalink error, which will require you to end the Client Access function and start the NS/Router before you retry the function.
- When you use Client Access for Windows 3.1 Setup to install functions, it is recommended that you not install the Client Access Network Driver. Install the Novell Network Driver instead.

5.5.6 Client Access for Windows 95/NT

Client Access for Windows 95 is closely integrated with the Windows 95 operating system. Client Access is built as an extension of both the Windows 95 operating system and the AS/400 server. For example, Client Access configuration and password management are integrated into the Windows 95 Control Panel. Network drives to the AS/400 (previously called shared folder drives) are integrated into the Windows 95 Explorer. Network printers to the AS/400 (previously called virtual printers) are integrated into the Windows 95 Add Printer wizard. These AS/400 server resources are viewed and accessed seamlessly as client resources.

The Windows 95 client exploits the capabilities of Windows 95 by:

- Incorporating Windows 95 shell extensions and tool tips
- Integrating with Windows 95 Network Neighborhood
- Providing OLE automation objects and custom controls
- Providing communications to the AS/400 using the Windows 95 WinSock interface

The Windows 95 client supports both the Windows 95 security features and OS/400 security:

- OS/400 security verifies the user ID and password on the AS/400 at connect time and provides the user with a screen interface to request a new password or user ID at connect time. APIs are available to retrieve information about the user ID as well.
- Windows 95 security - users can use Windows 95 functions to change passwords or grant access to others for folders or printers.

In either case the password is encrypted when sent on the network.

All functions of the Windows 95 client are written to standard Client Access application programming interfaces (APIs), such as Distributed Program Call, Data Queues, Remote Command, etc., and can run over any network connection supported by the Windows 95 client. Any customer PC application can also be written to these Client Access APIs and can then run transparently over any supported network connection. The following communications networks are currently supported:

- TCP/IP network support

  The Windows 95 client uses the TCP/IP programs shipped with Windows 95; thus, all connections, drivers, adapters that are supported by Windows 95 can be used.

- SNA networking support

  This includes NetSoft NS/Router 2.00, Microsoft SNA Server 2.11, and NetWare for SAA 2.0 (via the NetSoft router).

Users of the Windows 95 client can print their PC documents on AS/400-type printers. To get the full function available on AS/400 IPDS/AFP printers (such as overlays and page segments) the Advanced Function Print (AFP) driver is included. For AS/400 SCS printers (text only), the SCS printer driver is included. These drivers enable PC applications (such as desktop publishers, PC word processors, or spreadsheets) to print documents on AS/400 high-function, high-speed printers.

The printing capability is integrated under control of the Windows 95 Network Neighborhood features, which makes it easy to install and use.

PC users can easily and transparently store and access PC data on AS/400 systems by using the built-in PC file serving capabilities of Client Access. The Windows 95 client supports the OS/400 Integrated File System. The Integrated File System integrates many file systems into a single file structure and provides a common interface to any data stored on the AS/400. File types, such as stream files, database files, documents, CD-ROM files, and legacy shared folders are supported by the Integrated File System. Although all the data is stored in a single file structure, users can use unique file system commands that they are familiar with (such as Change Directory and Remove Directory) to work with the data.

The Windows 95 client integrates this Integrated File System view with the Windows 95 Explorer, Network Neighborhood, and other Windows 95 functions. Client Access also integrates the support of long file names provided by both Integrated File System and Windows 95. This well-integrated support further extends the Windows 95 drag-and-drop functions between the desktop and applications. For example, when a user drags a document object to a printer or fax object, the AS/400 can handle the printing or faxing of that document directly. Or, a user could use the Windows 95 Explorer to list documents stored on the AS/400 and then drag a document object from the listing to a word processor to automatically open it for editing.

The following list shows communications software that was tested to work with or in a Client Access for Windows 95/NT environment:

- IBM PC5250 for Windows 95
- IBM PC5250 Console for Windows 95
- SNA Networking Software
  - NetSoft NS/Router V1.15
    - Token-ring
    - Ethernet
    - Asychronous
    - Twinaxial
    - SDLC
  - Microsoft 32-bit DLC (MSDLC)
- TCP/IP Networking Software
  - IPX/SPX (shipped with Windows 95)
  - MS Windows 95 32-bit TCP/IP stack (WinSock 1.1)
- Networking/Connection Software
  - IBM Personal Communications for AS/400
  - Novell NetWare Client for Windows 95
  - Novell NetWare V3.12, 4.10
  - MS SNA Server V2.11
  - IBM Communications Server for NT
  - Novell/IBM NWSAA: AS/400 edition
  - WinAPPC Compatible (32-bit)

5.5.7 Client Access for OS/2 (16-Bit)

Client Access/400 for OS/2 supports 16-bit architecture of OS/2 and can be used with IBM OS/2, IBM OS/2 for Windows, and IBM OS/2 Warp operating systems. Client Access/400 for OS/2 provides functions and attributes similar to those found in PC Support/400.

Additional functions include:

- RUMBA/400, which is provided as the graphical user interface for AS/400 functions and runs under the control of OS/2 Presentation Manager. It allows multiple display or printer concurrent sessions, cut and paste, and print support. (RUMBA/400 requires OS/2 2.1 or later on the PC desktop.) In Version 3 Release 0.5, the communications layer uses Communications Manager/400 and supports APPC communications.

- In Version 3 Release 1, the communications layer uses portions of IBM Communications Manager/2 Version 1.1 and supports APPC and APPN. Functions included in this version are SNA data compression at the session level (which can significantly increase performance), additional First Failure Support Technology (FFST) architecture probes for problem notification, and enhancements to the Trace Facility. The common programming interface communications (CPI-C) interface is also provided.
- The OS/400 Graphical Operations interface, which allows users to handle some AS/400 tasks by using icons instead of typing commands.
- Ultimedia System Facilities for OS/2, which is a set of APIs that enable applications for multimedia operations.

The IBM NTS/2 Program (IBM LAN Adapter and Protocol Support (LAPS)), which provides device drivers and associated program interfaces for workstations on a LAN, is available for use with Client Access/400 for OS/2.

The following list shows communications software that was tested to work with or in a Client Access for O/2 environment:

- IBM RUMBA/400 for OS/2 (see also 5.5.10, "IBM RUMBA/400" on page 142)
- IBM Router for OS/2 which supports the following networks (see also 5.5.8.1, "Router for OS/2" on page 140):
  - Token-ring (direct and via 5494 Remote Controller)
  - Ethernet
  - Twinaxial (local, via 5394 and 5494 Remote Controllers)
  - SDLC
  - Asynchronous (with CM/2 or Comm. Server/2 support)
  - X.25 (with CM/2 or Comm. Server/2 support)
  - ISDN (with CM/2 or Comm. Server/2 support)
- IBM Communications Manager/400
- IBM NTS/2 V2.20.5 WR07045

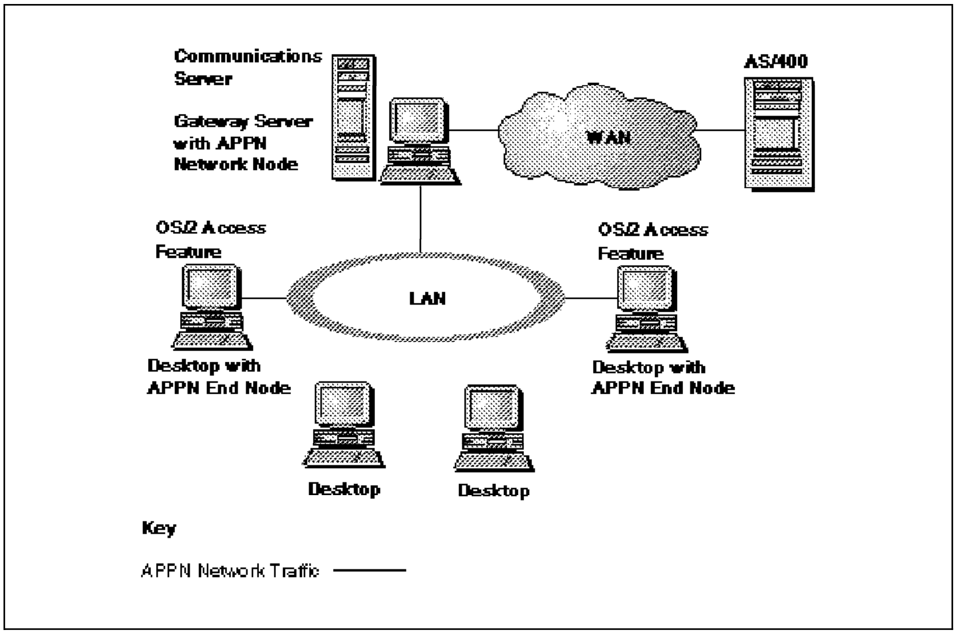


Figure 32. Client Access for OS/2

5.5.8 Client Access for OS/2 Optimized

Client Access/400 Optimized for OS/2 can be used with IBM OS/2, IBM OS/2 for Windows, or IBM OS/2 Warp operating systems. This 32-bit client offering of Client Access/400 was written by using object-oriented programming techniques. These object-oriented attributes provide you with a client that has automated and easy-to-use configuration and installation support, better client management, recoverability, and improved serviceability. For example, Client Access/400 Optimized for OS/2 clients can use the Simple Network Management Protocol (SNMP) to report client problems to AS/400. This improves the serviceability of the entire network of systems.

The following list shows communications software that was tested to work with or in a Client Access for O/2 environment:

- IBM PC5250 for OS/2 (see also Chapter 15, “IBM Personal Communications Family” on page 283)
- IBM RUMBA/400 for OS/2 (see also 5.5.10, “IBM RUMBA/400” on page 142)
- IBM Communications Manager for OS/2 V1.11 or Communications Server for OS/2 V4:
  - Token-ring (direct and via 5494 Remote Controller)

  - Ethernet
  - Twinaxial (local, via 5394 and 5494 Remote Controllers)
  - SDLC
  - Asynchronous
  - Asynchronous over SDLC
  - X.25
  - ISDN
- IBM AnyNet/2 V2.01.0 (Sockets over SNA)
- Communications Manager/2 V1.11
- IBM DIALS V4.0
- IBM TCP/IP for OS/2 V2, V3
- Novell NetWare for OS/2
- OS/2 Internet Access Kit
- IBM Personal Communications for AS/400
- IBM PC5250 PC Console for OS/2 (see also 5.5.11, "Client Access Console" on page 143)

5.5.8.1 Router for OS/2

In Client Access/400 Version 3 Release 1, the communications layer uses portions of IBM Communications Manager/2 and supports APPC and APPN.

The Client Access for OS/2 client uses the IBM NTS/2 Program (IBM LAN Adapter and Protocol Support (LAPS)) for connectivity. This program is supplied in the PC Tools folder (QIWSTOOLS) and is available as a separately orderable feature of Client Access.

The following physical communications are supported:

- Token-ring (direct and via 5494 Remote Controller)
- Twinaxial (local, via 5394 and 5494 Remote Controllers)
- X.25 (CM/2)
- SDLC
- Ethernet

5.5.8.2 Client Access/400 and OS/2 Warp Compatibility

The OS/2 optimized V3R1M1 client is supported running on OS/2 Warp Version 4 with the following limitations:

- If you are installing the Optimized client on OS/2 Warp Version 4, you must apply a PTF prior to installing the client. Either apply PTF SF37615 or ftp the latest fix and follow the instructions in the cover letter.

  Note: This fix only applies to new installations of Client Access/400 Optimized on OS/2 Warp Version 4. These fixes are not required if you already have Client Access installed and are upgrading to OS/2 Warp Version 4.

- You cannot run the PCOMM Entry (5250 emulation) that is supplied with Warp Version 4 and Client Access PC5250 on the same PC.
- The client management functions, such as SNMP and Problem Log do not work. IBM is working to resolve the problems and will update information APAR II09210 as more information becomes available.
- On some PCs the VPD.INI file may be corrupted, which will prevent Client Access from installing. See the VPD.INI File Corruption section in Informational APAR II09210 for recovery instructions.
- Make sure to read the following Informational APARs for additional information regarding Client Access that is not specific to OS/2 Warp Version 4:
  II09210 - Installation Information
  II09213 - Known Problems
- Client Access/400 Optimized for OS/2 V3R1M0 is not supported on OS/2 Warp Version 4. You must use V3R1M1, which provides more function than V3R1M0. The V3R1M1 client code is available at no additional charge.
- Testing has not yet been completed for Ultimedia on OS/2 Warp Version 4.
- Client Access/400 Optimized for OS/2 has not been tested and is not supported on the DBCS GBK version of OS/2 Warp Version 4.0.

OS/2 Warp Version 4 ships several functions that replace Client Access/400 functions. Among these functions are the Systems Management Client, which replaces the System Information Agent shipped with Client Access and the Desktop Management Interface (DMI). The Client Access installation program does not correctly detect the presence of these two functions.

If you selected to install the Systems Management Client when you installed OS/2 Warp Version 4, then the installation program for the OS/2 Optimized client will not complete successfully.

If you did not select to install the Systems Management Client when you installed OS/2 Warp V4, then the Client Access/400 installation will complete successfully. However, the installation program will install the DMI version from Client Access, which corrupts the DMI database shipped with Warp V4.

A fix is available by applying PTF SF37615 or from the IBM FTP Software site: `ftp.software.ibm.com` in the following directory:

  as400/products/clientaccess/os2opt/v3r1m1/ptfs/sf37615.

If you intend to install the PC5250 component of Client Access, you must delete any PCOMM Entry session objects that you have created. The existence of these objects will prevent the Client Access PC5250 component from installing. If you decide to remove PC5250, the Personal Communication folder from PCOMM Entry will also be removed. To recover this folder, run the INSTALL.EXE program that is in the \TCPIP\PCOMOS2 directory. This will re-create the Personal Communications folder on the desktop.

5.5.9 Client Access for UNIX OS

IBM and StarQuest jointly developed the Client Access for UNIX OS application. It provides 5250 terminal emulation, bi-directional file transfer, remote command execution and user connection management. Client Access for UNIX OS is a solution for UNIX system users who need access to AS/400 data and applications. For a detailed product description visit StarQuest at their Web site http://www.starquest.com.

Client Access for UNIX OS provides a standard UNIX user interface allowing access to AS/400 systems. You can choose X/Motif or character terminals. Multiple windows allow concurrent access to multiple applications and multiple AS/400 systems. By using standard AS/400 and UNIX facilities, users can directly print screen output from their AS/400 to their UNIX-based printer. In graphical environments, text may be copied from AS/400 applications and pasted into UNIX applications.

Client Access for UNIX OS provides the following features:

- 5250 terminal emulation
- Wide screen support
- Extended attributes
- Print screen
- Multiple sessions
- Copy and paste AS/400-to-UNIX applications
- Text assist
- Keyboard mapping
- Pass-through support
- National language support
- Multi-byte character set support

5.5.10 IBM RUMBA/400

RUMBA/400 provides 5250 display and print emulation for the Windows 3.1 and OS/2 operating systems. It provides PC desktop users a graphical user interface and movable iconic tool bar. You can easily and transparently interact with existing AS/400 data and applications. RUMBA/400 functions include:

- Support for as many as 32 concurrent display and printer sessions.

- Can be used with any print driver that is provided by Microsoft Windows 3.1 including 3812 standard character string (SCS).
- Ability to cut and paste data between Windows applications. Each window could be running a separate AS/400 or PC application.
- Hot link support - A link created to the AS/400 system that will constantly and automatically bring updated data from host screens to other Windows applications, such as spreadsheets.
- Hot spots - The ability to select and click on system-provided function keys, menu items, or end-user selected words or phrases. The user can assign either system-provided macros or their own macros to user-defined hot spots.
- Customized macro capability - Allows a series of keystrokes or screen comparisons to be recorded and saved, and then later performed with a macro. RUMBA/400 comes with system-defined macros. In addition, you can define your own. You can assign both system and user-defined macros to hot spots or quick-step pads. PC applications can be started with RUMBA/400 user-defined macros.
- Quick-step pad - A pad of between 6 and 192 buttons to which you can assign system-provided macros or user-defined macros. An associated macro function is performed by clicking on a given button. As many as eight quick-step pads can be active at once. You can create, size, position, and change the color of the quick-step pads.
- Screen color and keyboard remapping - Allows you to customize screen colors and keyboard mapping for each emulation session.
- Emulator high-level language application programming interface, dynamic data exchange (DDE), run-time support, and, enhanced nonprogrammable terminal user interface 5250 data stream enhancements. All these interfaces enable AS/400 green screen applications to have a PC GUI front end.
- Interactive, file transfer interface that allows PC files and AS/400 database files to be retrieved or stored.
- PC text-assist function for OfficeVision for OS/400 users.

5.5.11 Client Access Console

The Client Access Console is a separately orderable feature of Client Access and is available for AS/400 Advanced Series systems. The Client Access Console feature enables an IBM-compatible personal computer (PC) to function as the AS/400 console. The Client Access Console eliminates the need for a dedicated dependent workstation for the console. The Client Access Console feature also takes the place of a twinaxial or ASCII workstation processor that is used to connect the dependent workstation to the AS/400 system.

The PC that is used as the console is attached to the AS/400 with a special console cable (feature code 9026 or 9027). This cable connects the serial port on the PC to a 2609 or 2612 input/output adapter (IOA) that is installed in the AS/400. Only one PC that is attached to an AS/400 can use the Client Access Console support at a given time.

The PC that is used as the AS/400 console must be running a PC5250 or RUMBA/400 application to emulate a locally attached 5250 display station. The Client Access Console does not support a console printer.

The PC can also have a LAN connection to the AS/400. This connection allows the PC to function as a Client Access workstation.

5.5.12 AS/400 to S/390 Applications

The following examples are of applications that allow the AS/400 to communicate with S/390 mainframe hosts: SNA 3270 emulation, SNA Primary LU Support (SPLS), VM/MVS Bridge, and RJE (Remote Job Entry).

SNA 3270 emulation allows the AS/400 user to remotely log on to a host system. The AS/400 appears as a PU Type 2 Control Unit to the host. 3270 display emulation converts the 3270 data stream, intended for a 3278 device, into a 5250 data stream that can be recognized by a display station attached to the AS/400. 3270 printer emulation converts the 3270 data stream, intended for a 328x printer, into a data stream that can be recognized by an AS/400-attached printer. 3270 emulation is part of OS/400.

SPLS allows 3270 displays and printers, attached to an S/390 host, to communicate with the AS/400 as if they were 5250 devices directly attached to the AS/400. SPLS support is part of OS/400.

The VM/MVS bridge is a function provided by the AS/400 licensed program product Communications Utilities, which provides distribution services between a SNADS network on the AS/400 and VM/RSCS, and between SNADS and MVS/JES. The AS/400 emulates an NJE node. This allows the AS/400 to send and receive electronic mail, documents, print output and files to and from the host.

RJE is also a function provided by the AS/400 licensed program product Communications Utilities. RJE allows the AS/400 to submit jobs/data that require processing to a host, utilizing the processing power of the host while maintaining the application and data locally. It does not provide a sign-on panel to the host and requires host/JCL knowledge.

The AS/400 can be connected as a node type 2 or node type 2.1 to VTAM/NCP. An AS/400 connected as a type 2 PU supports only SSCP dependent sessions. An AS/400 connected as a type 2.1 PU will support LU 6.2 sessions in a subarea or APPN network and APPN sessions within an APPN network.

Table 48. SNA Host Functions

Function	From AS/400 to:			To AS/400 from:		
	VSE	MVS	VM	VSE	MVS	VM
Interactive access	3270DE	3270DE	3270DE	SPLS	SPLS	
Print output transfer	X 2	X 2	X 2	SPLS	SPLS	X 3
File transfer	 RJE Pgm-Pgm DSX	VM/MVS Bridge RJE Pgm-Pgm N/DM	VM/MVS Bridge N/DM	 RJE Pgm-Pgm DSX	VM/MVS Bridge RJE Pgm-Pgm N/DM	VM/MVS Bridge N/DM
Pgm-Pgm, LU 6.2 LU 0	CICS CICS	CICS IMS 1 CICS IMS	APPC/VM	CICS	CICS CICS IMS	APPC/VM
DDM	CICS	CICS				
Document/message distribution		Office Vision	VM/MVS Bridge		Office Vision	VM/MVS Bridge
Distributions of applications	DSX	N/DM	N/DM	DSX	N/DM	N/DM
NetView	NetView	NetView				

Notes:

SPLS is SNA primary LU support.
1 With LU 6.2 protocol, program calls only from AS/400 to IMS.
2 As data or RJE reader file from AS/400 to /390.
3 RSCS supports LU 1 SCS printer, 3270DE on AS/400.

5.5.13 TCP/IP Support

The AS/400 has native TCP/IP support. This support allows the AS/400 to communicate with a great variety of non-IBM systems that support TCP/IP rather than APPC. The TCP/IP applications that the AS/400 supports include Telnet, FTP, LPD/LPR, electronic mail via SMTP, and network management via SNMP. TCP/IP support is part of OS/400 V3R2, V3R7, and V4R1. The protocols are supported in the base OS/400 code. The program product TCP/IP Connectivity Utilities, which is shipped free, provides the applications. There is also a licensed program product called File Server Support/400.

The following is a brief overview of the TCP/IP applications supported:

Telnet - The AS/400 provides both client and server support to allow AS/400 users to log in remotely to Telnet hosts and to allow remote users on Telnet clients to log in to the AS/400.

File Transfer Protocol (FTP) - The AS/400 provides both client and server support for FTP. This allows files to be sent and received between the AS/400 and other FTP systems.

Line Print Daemon/Line Print Requester (LPD/LPR) - The AS/400 provides LPR support to allow the AS/400 client to send spool files to a remote LPD server system. It also provides LPD support to allow it to receive print output from remote LPR systems.

Simple Mail Transport Protocol (SMTP) - The AS/400 allows users on the AS/400 to send and receive electronic mail and documents over a TCP/IP network via SMTP. The user interface to this protocol is through the OfficeVision/400 licensed program product on the AS/400.

Simple Network Management Protocol (SNMP) - The AS/400 functions as an SNMP agent in an SNMP managed network. It provides, for example, MIB II and APPN MIB databases for management via an SNMP manager.

File Server Support/400 (FSS/400) - This application is a server implementation of the Sun Network File System (NFS). It allows remote NFS clients to access data on the AS/400 as if it were local to the user.

5.5.14 OSI Support

The AS/400 supports the networking protocol OSI. OSI was developed as a standard by the International Organization for Standardization (ISO). This allows the AS/400 to interoperate with a variety of non-IBM systems, which support this open networking architecture. The AS/400 supports the following OSI standards: X.400, FTAM, X.500 and Network Management. The AS/400 implements OSI with three licensed programs: OSI Communications Subsystem, OSI Message Services/400 and OSI File Services/400.

OSI Communications Subsystem provides configuration functions, network management support and directory services (X.500). It also provides the lower layer support to allow the AS/400 to establish a connection via X.25 to another OSI host.

OSI Message Services/400 provides X.400 services for the sending and receiving of electronic mail and documents. It implements the 1984 level of X.400. The user interface to X.400 is via the licensed program product OfficeVision/400 for electronic mail, and via the SNADS commands

SNDNETF, SNDNETMSG and SNDNETSPLF to allow users to transfer files, messages and spool files.

OSI File Services/400 provides File Transfer Access and Management (FTAM) services. It allows file transfer and file management. A menu-driven user interface is supplied allowing you to interactively transfer and manage files.

5.5.15 NetBIOS Support

NetBIOS is supported on the AS/400 by the LAN Server/400 product. LAN Server/400 software supports the file server I/O processor (FSIOP) providing high-performance file serving to a PC running LAN Requester.

5.5.16 IPX Support

Native IPX support is now available on the AS/400. This allows the AS/400 to transparently route IPX. IPX packets can be transported from one IPX network into another, either LAN-to-LAN or LAN-to-WAN, via the AS/400. The AS/400 implements RIP and NLSP for routing in an IPX network. Applications can be written to IPX sockets. IPX is also added to AnyNet/400, which will allow AS/400 users to transport native APPC application data over an IPX backbone.

NetWare application server support is available via the Integrated PC server (IPCS), that is, Novell NetWare 4.1 can be installed on the IPCS.

5.5.17 IBM Connection Program/400 for UNIX Environments

Connectivity to an AS/400 from the RS/6000 is provided by the IBM Connection Program/400 for UNIX environments. It also supports the Sun SPARCstation and HP 9000 Series 700. It provides 5250 emulation, file transfer, remote command, remote database access via SQL APIs, national language support, and remote printer support.

In a TCP/IP environment Connection Program/400 for UNIX Environments for OS/400 V3.1 supports full 5250 functionality. Version 2 Release 1 and above of AS/400 TCP/IP includes the 5250 data stream protocol in the Telnet server. However, without Connection Program/400 for UNIX Environments for OS/400 V3.1, the supported workstations to be used as AS/400 terminals are still limited to the 3270 data stream protocol or VT100 full-screen support, and text assist is not available. Connection Program/400 for UNIX Environments for OS/400 V3.1 provides 5250 emulation in an AIXwindows environment (x5250) as well as for ASCII workstations (e5250).

In an SNA environment, Connection Program/400 for UNIX Environments for OS/400 V3.1 provides SNA connection to a RISC System/6000 over token-ring, Ethernet, X.25 or SDLC. It provides 5250 emulation in an AIXwindows environment (x5250) and for ASCII workstations (e5250), file transfer, database access via SQL APIs, printer support, and remote command capabilities.

IBM Connection Program/400 is supported on the Sun and HP workstations over TCP/IP and on the RISC System/6000 over TCP/IP and SNA. TCP/IP is supported over token-ring, Ethernet, or X.25. 5250 SNA is supported over token-ring, Ethernet, X.25, or SDLC.

Chapter 6. IBM Communications Server Products

This chapter provides information on IBM′s family of Communications Server products.

IBM′s Communications Server family of products provides a multifunction gateway function for any product that uses the standard 3270 display and printer protocols. It also has the capability to integrate SNA and TCP/IP networks, enabling SNA and sockets applications on any platform and from any vendor to be transported across connected SNA and TCP/IP networks. NetBIOS and IPX LANs can also be integrated into either SNA or TCP/IP network environments. The TN3270E server function provides SNA 3270 access to host systems for TCP/IP users with TN3270 emulators.

The Communications Server family includes solutions for OS/2, AIX, Windows NT, OS/390 and NetWare server environments, and is fully interoperable with OS/400 networks.

6.1 Communications Server Functions

The following table summarizes the key functions of the various IBM Communications Server products. The information is based on the IBM Communications Server Web site at http://www.networking.ibm.com/cms/cmsabt.html.

Table 49 (Page 1 of 2). Communications Server Technology Highlights

Function	Comm. Server for OS/2	Comm. Server for NT	Comm. Server for AIX	Comm. Server for MVS - OS/390	OS/400	NetWare for SAA V2.2
3270 SNA Gateway	X	X	X			X
APPN End Node and Network Node function	X	X	X	X	X	
High Performance Routing - Intermediate node routing - HPR connection endpoint	 X X	 X X	 X	 X X	 X	
3270 support over APPN (DLUS/DLUR)	X	X	X	X		
TN3270E Server	X	X	X			X
Sockets over SNA access node	X	X	X	X	X	
APPC over TCP/IP access node	X	X	X		X	
SNA over TCP/IP access node	X	X		X		
Sockets over SNA gateway	X	X	X			X

Table 49 (Page 2 of 2). Communications Server Technology Highlights						
Function	**Comm. Server for OS/2**	**Comm. Server for NT**	**Comm. Server for AIX**	**Comm. Server for MVS - OS/390**	**OS/400**	**NetWare for SAA V2.2**
APPC over TCP/IP gateway	X		X		X	
SNA over TCP/IP gateway	X	X		X		
IPX over SNA gateway	X					X
IPX over TCP/IP gateway	X					
NetBIOS over SNA gateway	X					
NetBIOS over TCP/IP gateway	X					
NetWare Directory Services integration						X

6.1.1 Communications Server Highlights

6.1.1.1 SNA Gateway

SNA gateway support allows multiple LAN-attached workstations to access one or more System/370, System/390, or AS/400 host systems through one or more physical connections. The gateway acts as an intermediary between the workstation and the host system and reduces the cost of host connections per workstation. From the host perspective, the gateway appears as an SNA PU2.0 node, supporting one or more LUs per workstation, with all LUs belonging to the gateway PU. To the supported workstations, the gateway appears like an SNA PU4 communications controller and forwards such host requests as BIND and UNBIND. The workstation′s LUs are not aware of the SNA gateway, but the gateway is aware of all LUs at the workstation.

SNA gateway capabilities include:

- LU types 0, 1, 2, 3, and dependent LU6.2.
- Any type of downstream workstations that support standard IBM SNA connectivity protocols.
- Support for LUs 0, 1, 2, and 3 to an AS/400 host system using SNA passthrough. The AS/400 host passes the data through to a System/390 host.
- Support for the forwarding of network management vector transports (NMVTs) between the workstations and the host system.
- LU pooling, a condition where the LUs defined in the gateway can be grouped together in a *pool* for multiple workstations providing benefits such as reduced configuration, and load balancing/backup.
- Multiple LU pools, each pool associated with a specific application.
- Common pools associated with multiple hosts.

• Up to 254 LUs per PU, with no limit on the number of PUs.

The following figure shows Communications Server for NT as an SNA gateway.

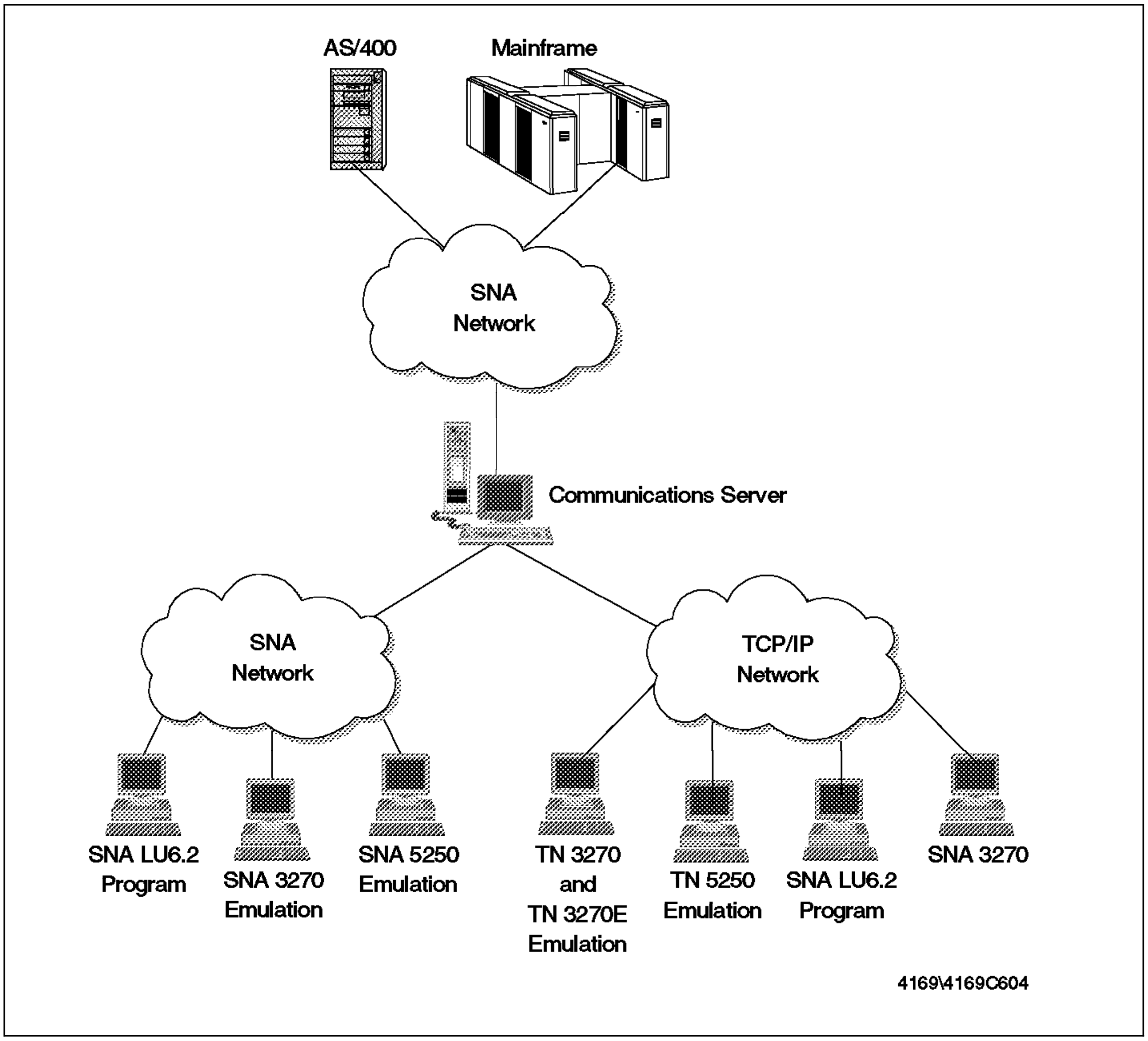


Figure 33. Communications Server as an SNA Gateway

6.1.1.2 High Performance Routing

High Performance Routing (HPR) is an end-to-end, connection-oriented protocol that allows you to optimize communications across the network. These capabilities include:

- Improved network availability through end-to-end connections, alternate route calculations, and transmission resumption if an intermediate link or node fails.
- Improved network performance by only performing error recovery at the endpoints of the network and by selectively retransmitting only lost or erroneous packets.
- Improved SNA congestion control by constantly monitoring and adjusting the amount of data flowing between the endpoints, ensuring they do not overload.

HPR automatic network routing (ANR) nodes provide a transport path between two rapid transport protocol (RTP) nodes. HPR is discussed in 8.4, "High-Performance Routing (HPR)" on page 191.

6.1.1.3 Dependent LU Requestor (DLUR)

DLUR lets you transport dependent LU traffic through an APPN network. A DLUR is an APPN end node or network node that uses dependent LUs but requests that a Dependent LU Server (DLUS) provide the system service control point (SSCP) for those dependent LUs through an APPN network. A DLUS controls conversion from a subarea environment to an APPN environment, allowing central management control of remote dependent LUs to be maintained while benefiting from an APPN network.

DLUR and VTAM′s DLUS function enables dependent LUs (0,1, 2, 3, and dependent LU6.2) to operate unchanged in an APPN network without changing applications. It supports dynamic and multiple paths through the network and eliminates the need for dependent LUs (or their gateway) to be adjacent to the VTAM host.

DLUR is discussed in more detail in 8.2, "Dependent LU Requester/Server (DLUR/DLUS)" on page 189.

6.1.1.4 TN3270E Server

TN3270E Server provides a method, based on standards, that allows TCP/IP clients easy access to the large number of existing legacy applications residing on IBM host systems without changing the application programs.

The TN3270E Server is compliant with the industry-standard Request for Comments (RFCs) 1576, 1646 and 1647. This capability provides 3270 terminal and printer emulation to TCP/IP users in an open, standard environment. TN3270E defines a new Telnet option and subnegotations that allow a client or server to negotiate exactly which terminal type and features are supported. Clients and servers supporting TN3270E can now negotiate to pass SNA responses to guarantee end-to-end printer confirmation.

TN3270E Server supports any downstream TN3270 or TN3270E client that adheres to the RFCs stated above. However, the TN3270E server must be specifically configured to support downstream TN3270 clients.

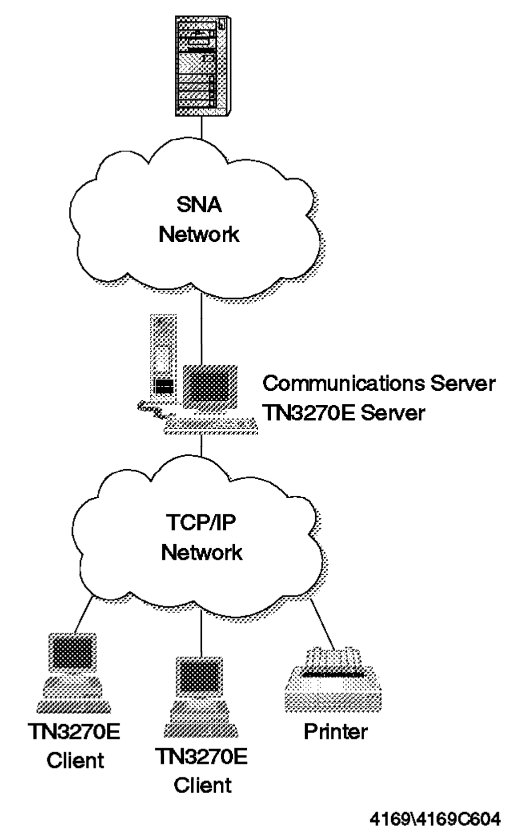


Figure 34. TN3270E Server

6.1.1.5 AnyNet Sockets over SNA (Access Node and Gateway)

The Sockets over SNA and Sockets over SNA gateway functions enable sockets applications in SNA and TCP/IP networks to communicate. Sockets over SNA gateways are often used to connect isolated TCP/IP networks using an SNA backbone network.

The AnyNet Sockets over SNA Gateway function connects SNA and TCP/IP networks to allow sockets application data to flow freely across both environments. Workstations and hosts in SNA networks can run sockets applications and appear to be directly connected to the TCP/IP network. In addition, dual gateways can be used to connect TCP/IP networks across an

SNA network. All of the connections are to be made with no changes to the sockets applications, TCP/IP network, or SNA network. This capability provides the benefits of the SNA network to the TCP/IP applications and eliminates the need for parallel networks.

Sockets over SNA is discussed in 10.1.3, “Sockets over SNA” on page 222.

6.1.1.6 AnyNet SNA over TCP/IP (Access Node and Gateway)

The AnyNet SNA over TCP/IP function allows SNA applications to communicate over interconnected TCP/IP and SNA networks. The SNA over TCP/IP access node allows SNA applications to communicate between workstations or a host to a workstation across a TCP/IP network. This function supports independent LU 6.2 and dependent LU 0, 1, 2, 3, or 6.2. In addition, the SNA over TCP/IP access node can be used with SNA gateway to enable SNA gateway sessions over a TCP/IP network.

The SNA over TCP/IP gateway function extends the reach of SNA applications by allowing these applications in an SNA network to communicate with SNA applications in an IP network. This gateway supports independent LU 6.2 sessions.

APPC over TCP/IP support includes LU 6.2 communication only.

SNA over TCP/IP and APPC over TCP/IP support are discussed in 10.1.4, “SNA over TCP/IP and APPC over TCP/IP” on page 224.

6.2 Communications Server for OS/2 Warp V5.0

Communications Server V5.0 for OS/2 Warp is packaged with the Access Features for OS/2, Windows 3.1, Windows NT and Windows 95. provide the following:

- IBM Communications Server for OS/2 Warp, Version 5.0
  - Multiprotocol gateway support
    - TN3270E Server
    - LAN Gateway to enable IPX and NetBIOS applications to communicate across TCP/IP and SNA
    - SNA over TCP/IP
    - Sockets over SNA
    - SNA Gateway
  - Frame Relay support for SNA and TCP/IP at the DLC level
  - Integrated Host On-Demand
  - Remote Web-based administration
  - APPN network, end node and low entry networking (LEN) node support with these functions:

  - HPR with Automatic Network Routing (ANR) and Rapid Transport Protocol (RTP)
  - HPR over WAN
  - HPR Multi-link transmission group (MLTG) support
  - Branch extender (an APPN border node subset)
  - DLUR/DLUS-Server LU Registration
  - Multiple PU support
  - APPC full-duplex
- Installation and configuration support
- Local and wide area connectivity support
- Multiprotocol Transport Services (MPTS)
- SNA network support and systems management
- APPN backup link support
- 32-bit OS/2 APIs
- CPI-C support for Windows applications on OS/2
- User control of unlocked shared storage limit
- IBM Personal Communications AS/400 and 3270 APPC/LUA Entry Level (Entry-Level Emulator)

• Windows NT and Windows 95 Access Feature

  - API support including CPI-C, APPC, RUI and LUA, and CSV
  - TN62 API to enable LU 6.2 applications to be used over a TCP/IP network
  - APPN end node
  - HPR
  - DLUR
  - AnyNet SNA over TCP/IP
  - AnyNet Sockets over SNA

• Access Features for OS/2 and Windows
  - The OS/2 Access Features for OS/2 2.11 and OS/2 Warp

    These Access Features provide 32-bit OS/2 API support and enable applications written to the Sockets, APPC, CPI Communications, and LUA APIs to run unchanged over either SNA or TCP/IP local and wide area networks.

    The Access Feature for OS/2 Warp is based on IBM Communications Server for OS/2 Warp, Version 4.1. It runs on OS/2 Warp, or later. It is also referred to as OS/2 Access Feature Version 4.1. This Access Feature provides:
    - Multiprotocol access node support for the desktop with Sockets over SNA and SNA over TCP/IP
    - Frame relay support

- DLUR/DLUS-Server LU registration
- Backup link support
- APPN end node
- HPR with RTP support
- Local and wide area connectivity support
- SNA network support and systems management
- 32-bit OS/2 APIs
- CPI-C support for Windows applications on OS/2
- User control of unlocked shared storage limit
- Installation and configuration support
- Smaller footprint (as low as 5 MB)
- MPTS

The Access Feature for OS/2 2.11 is the same Access Feature included in IBM Communications Server for OS/2 Warp, Version 4. It runs on OS/2 2.11, or later. It is also referred to as OS/2 Access Feature Version 4.0.

– Windows Access Feature Version 4.1 (Windows Access Feature)

The Windows Access Feature is a bundle of two existing products that provide APPC programming support and enable APPC applications to run unchanged over either SNA or TCP/IP local and wide area networks. The products are:

- IBM APPC Networking Services for Windows (NS/Windows) Version 1.0.2 (Software Announcement 294-562, dated September 20, 1994).
- IBM AnyNet APPC over TCP/IP Version 1.0 for Windows (Software Announcement 295-110, dated March 21, 1995).

The Windows Access Feature also includes the LAN Support Program.

6.2.1 Communications Server for OS/2 Warp Adapter Support

Communications Server for OS/2 Warp V5.0 supports a wide variety of communication adapters in a LAN or a wide area network (WAN) environment. The following tables list IBM communication adapters that are supported. There are also many adapters of many other vendors that are supported.

Communications Server for OS/2 is compatible with the following IBM LAN adapters. Each adapter is shown with its information about these categories:

Name The name of the adapter card

Bus Type One of the following:

- Industry Standard Architecture/Extended Industry Standard Architecture (ISA/EISA or AT),
- Micro Channel Architecture (MCA)
- Peripheral Component Interconnect (PCI)
- Personal Computer Memory Card Interface Association (PCMCIA)

Protocols The Data Link Control communications protocols supported by the adapter

Driver Supplied Whether or not driver software is shipped with Communications Server

Note: Many other vendors ship drivers with their adapter cards. Also, IBM ships drivers within the Communication Server package for many OEM adapters.

Table 50 (Page 1 of 3). Communications Server for OS/2 Warp Supported PC Adapters

Adapter Name	Bus Type				Protocols						Driver Supplied
	AT /ISA /EISA	MCA	PCI	PCMCIA	Token -Ring	Ethernet	FDDI	3174 Peer	ATM	PC Network	
16/4 Busmaster EISA Adapter	X				X						X
16/4 Busmaster Server Adapter/A		X			X						X
Ethernet Adapter/A		X				X					X
Ethernet Twisted Pair Adapter/A		X				X					X
ATM (LAN Emulation)	X	X							X		X
Auto LANStreamer MC32 Adapter		X			X						X
Dual EtherStreamer MC32 Adapter		X				X					X
Dual LANStreamer MC32 Adapter		X			X						X
Ethernet Credit Card Adapter (10Base2)				X							X
Ethernet Credit Card Adapter II (10BaseT)				X		X					X
EtherStreamer MC32 Adapter		X				X					X
FDDI Copper Base EISA Adapter	X						X				X
FDDI Copper Base ISA Adapter	X						X				X
FDDI Copper Base MC Adapter		X					X				X

Table 50 (Page 2 of 3). Communications Server for OS/2 Warp Supported PC Adapters											
Adapter Name	**Bus Type**				**Protocols**						**Driver Supplied**
	AT /ISA /EISA	**MCA**	**PCI**	**PCMCIA**	**Token -Ring**	**Ethernet**	**FDDI**	**3174 Peer**	**ATM**	**PC Network**	
FDDI Copper Extender EISA/ISA Adapter	X						X				X
FDDI Copper Extender MC Adapter		X					X				X
FDDI Fiber Base EISA Adapter	X						X				X
FDDI Fiber Base ISA Adapter	X						X				X
FDDI Fiber Base MC Adapter		X					X				X
FDDI Fiber Extender EISA/ISA Adapter	X						X				X
FDDI Fiber Extender MC Adapter		X					X				X
Home and Away Credit Card Adapter				X							X
LAN Adapter/A for Ethernet		X				X					X
LAN Adapter for Ethernet	X					X					X
LAN Adapter for Ethernet CX	X					X					X
LAN Adapter for Ethernet TP	X					X					X
LAN Streamer MC 16 Adapter		X			X						X
LAN Streamer MC 32 Adapter		X			X						X
PC Network Adapter II Frequency 2	X									X	X
PC Network Adapter II Frequency 3	X									X	X
PC Network Adapter II/A Frequency 2		X								X	X
PC Network Adapter II/A Frequency 3		X								X	X
PC Network Baseband Adapter	X									X	X
PC Network Baseband Adapter/A		X								X	X
PC Network Broadband Adapter II	X									X	X
PC Network Broadband Adapter II/A		X								X	X
PCMCIA Adapter for Ethernet				X		X					X
Token-Ring 16/4 Credit Card Adapter II				X	X						X
Token-Ring Network 16/4 ISA-16 Adapter	X				X						X
Token-Ring Network 16/4 Adapter	X				X						X
Token-Ring Network 16/4 Adapter II	X				X						X
Token-Ring Network 16/4 Adapter/A		X			X						X
Token-Ring Network 16/4 PCMCIA				X	X						X

Table 50 (Page 3 of 3). Communications Server for OS/2 Warp Supported PC Adapters											
Adapter Name	**Bus Type**				**Protocols**						**Driver Supplied**
	AT /ISA /EISA	**MCA**	**PCI**	**PCMCIA**	**Token -Ring**	**Ethernet**	**FDDI**	**3174 Peer**	**ATM**	**PC Network**	
Token-Ring Network 16/4 Trace and Performance Adapter	X				X						X
Token-Ring Network 16/4 Trace and Performance Adapter/A		X			X						X
Token-Ring Network Adapter	X				X						X
Token-Ring Network Adapter II	X				X						X
Token-Ring Network Adapter/A		X			X						X
Token-Ring Network Trace and Performance Adapter II	X				X						X
Token-Ring Network Trace and Performance Adapter II/A		X			X						X
Turboways ATM Adapters (LAN Emulation)	X	X									X

Communications Server and OS/2 Access Feature are compatible with the following wide area communications adapters. Each adapter is shown with information pertaining to these categories:

Adapter Name The name of the adapter card

 # Adapters The maximum number of adapters supported by Communications Server for OS/2 Warp V4.1 or OS/2 Access Feature on a given PC.

Bus Type Is one of the following:

- Industry Standard Architecture/Extended Industry Standard Architecture (ISA/EISA or AT)
- Micro Channel Architecture (MCA)
- Peripheral Component Interconnect (PCI)
- Personal Computer Memory Card Interface Association (PCMCIA)

Network Type Is either Systems Network Architecture (SNA) or Internet Protocol (IP).

Connection Type Can be leased, switched or ISDN (a *B* indicates ISDN B channel support only).

DLC API Communications Server supports non-programmable *shallow* and programmable *deep* adapters for ISA, MCA and PCI-bus PCs using a set of open APIs. These APIs allow IBM and other OEMs to provide connectivity for a variety of DLCs (SDLC, X.25, Frame relay, IDLC, etc.) over a variety of connection types (leased, switched, ISDN, etc.). Communications Server for OS/2 Warp V4.1 provides an externalized Advanced NDIS (ANDIS) interface to support shallow adapters for Micro Channel, ISA, and EISA bus attachment.

Electrical Interface The electrical interface to which the adapter conforms and which is supported by Communications Server.

Table 51 (Page 1 of 2). Communications Server for OS/2 Warp Supported WAN Adapters

Adapter Name	# Adapters	Bus Type				Net-work Type		DLC Type	Connection Type			DLC API			Electrical Interface					
		AT /ISA /EISA	MCA	PCI	PCMCIA	SNA	IP		Leased	Switched	ISDN	Shallow	Deep	NDIS	RS232	V.25	V.35	X.21	RS422	RS530
ARTIC 960				X		X		SDLC	X	X		X			X	X	X	X		
						X		X.25	X	X		X			X	X	X	X		
						X	X	Frame Relay	X					X			X	X		
ISDN Interface CoProcessor Card	4	X	X			X		SDLC			X	X								
						X		X.25			X	X								
						X		IDLC			X	X								
WaveRunner Digital Modem	3	X	X		X	X		SDLC			B	X								
						X		X.25			B	X								
						X		IDLC			B	X								

Table 51 (Page 2 of 2). Communications Server for OS/2 Warp Supported WAN Adapters																					
Adapter Name	# Adapters	Bus Type				Net-work Type		DLC Type	Connection Type			DLC API			Electrical Interface					
		AT /ISA /EISA	MCA	PCI	PCMCIA	SNA	IP		Leased	Switched	ISDN	Shallow	Deep	NDIS	RS232	V.25	V.35	X.21	RS422	RS530
Wide Area Connector	1	X	X			X		SDLC	X	X		X			X	X	X	X	X	
						X	2	X.25	X	X		X			X	X	X	X	X	
						X	X	Frame Relay	X					X			X	X	X	
Multiprotocol Communications Adapter	1	X				X		SDLC	X	X		X			X	X				
	2		X			X		SDLC	X	X		X			X	X				
Realtime Interface Co-Processor Multiport Model 2	1	X				X		SDLC	X	X		X			X	X	X		X	
						X		ASYNC	X	X		X			X	X	X		X	
Realtime Interface Co-Processor Portmaster/2	1		X			X		SDLC	X	X		X			X	X	X			
						X		ASYNC	X	X		X			X	X	X			
X.25 Co-Processor	8	X	X	X		X	2	X.25	X						X	X	X	X		
SDLC Communications Adapter	1	X				X		SDLC	X			X			X					

Notes:

- 1 The number of adapters that are supported depends on the hardware configuration of the PC.
- 2 Prerequisite of this support is the IBM Extended Networking Kit.

Note that the above table only shows IBM adapters. Communications Server for OS/2 also supports a variety of OEM adapters that, due to space limitations, cannot all be listed here.

Communications Server for OS/2 supports the following types of modems:

- Asynchronous modems (both 14.4 and 28.8 kbps)
  - Modems that are 100% compatible with the Hayes AT command set
  - IBM modems that conform to the ITU-T (CCITT) V24/V.28 (EIA RS232-D) and V.35 interface standard
  - Non-IBM asynchronous modems that conform to the above regulations

  - Modems that conform to the RS232D standard DTE-to-DCE interface
- Synchronous modems and CSU/DSU units that support the V.25bis command set
- Modems which are 100% compatible with the Hayes AutoSync protocol
- Cellular modems
- PCMCIA modems

Note: X.25 users require a synchronous connection to the Link Access Protocol Balanced (LAPB) link.

6.2.2 OS/2 Warp Connectivity

The following products are the major IBM workstation operating systems and connectivity products available on OS/2:

- OS/2 Warp V3 and OS/2 Warp V3 with WIN-OS2

  Both operating systems are shipped with a bonus pack that includes IBM Internet Connection for OS/2. This package provides easy access to the Internet and includes UltiMail Lite, Gopher Client, TelnetPM, PMANT, and FTPPM. In addition, the following communication products can be installed:
  - Communications Server for OS/2 Warp V4.0
  - Personal Communications AS/400 and 3270 V4.1 for OS/2
  - Personal Communications AS/400 V4.1 for OS/2
- Warp Connect V3 and Warp Connect with WIN-OS/2 V3

  Warp Connect V3 and Warp Connect with WIN-OS/2 V3 target small businesses with a mid-range product solution for connectivity. These products provide a set of LAN products including the following:
  - IBM Peer for OS/2 V1.1
  - OS/2 LAN Server 4.0 Requester (including NetBIOS over TCP/IP)
  - IBM LAN Distance Remote V2.2
  - IBM TCP/IP for OS/2 V3.0 (including Internet Connection for OS/2 features and IBM WebExplorer)
  - NetWare Client for OS/2 V2.11

  In addition you could install the following:
  - IBM TCP/IP for OS/2 V2.0 Kits
  - Communications Server for OS/2 Warp V4.0
  - Personal Communications AS/400 and 3270 V4.1 for OS/2
  - Personal Communications AS/400 V4.1 for OS/2
- OS/2 Warp Server V4.0 and OS/2 Warp Server Advanced V4.0

  OS/2 Warp Server V4 includes the following:
  - NetWare Client for OS/2
  - Remote Access Services for remote client support
  - TCP/IP and Dynamic IP

In addition you can install the following:

- Communications Server for OS/2 Warp V4.0
- Personal Communications AS/400 and 3270 V4.1 for OS/2
- Personal Communications AS/400 V4.1 for OS/2

6.2.3 Communications Manager/2 and Communications Server Comparison

The following figure shows where various functions of older IBM products are integrated in the recently announced IBM eNetwork product family, such as Communications Server and Personal Communications.

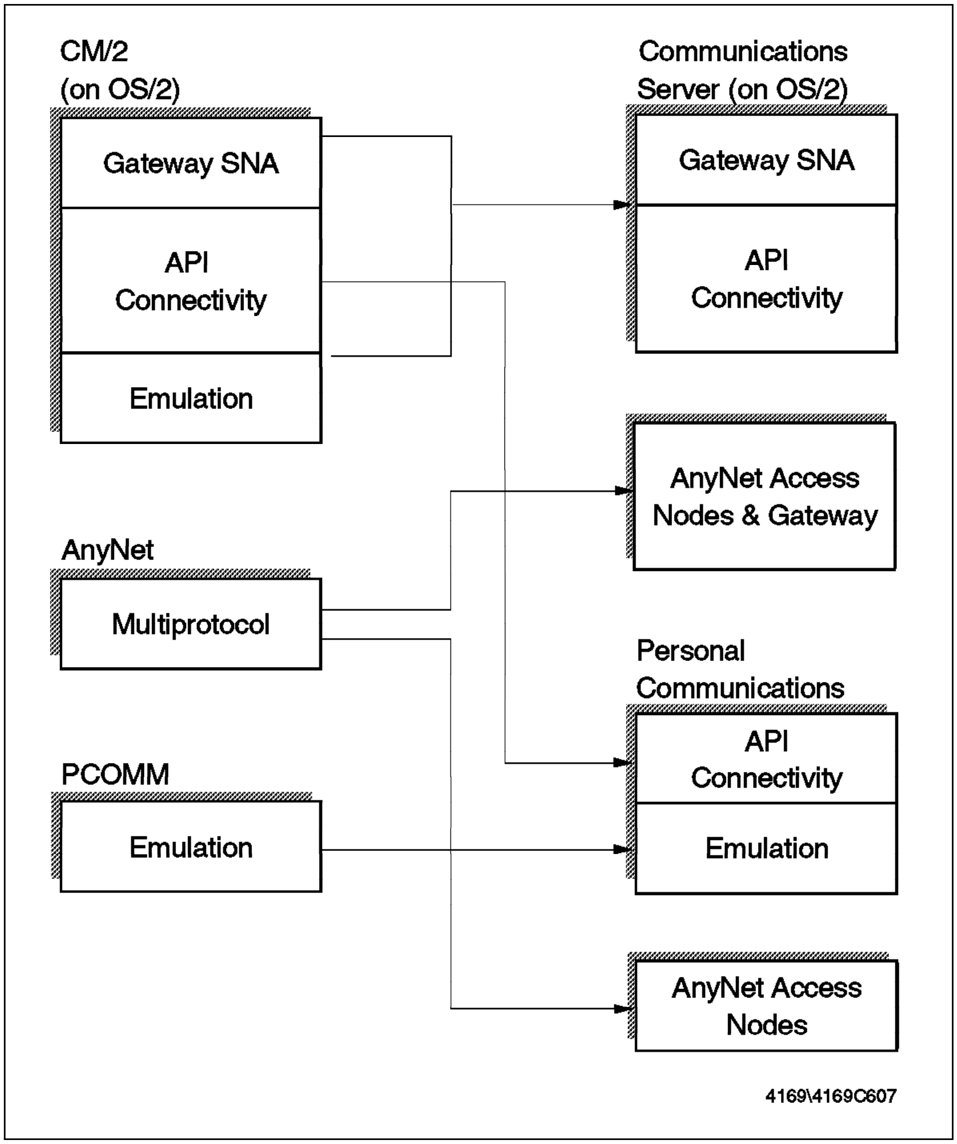


Figure 35. Communications Server Product Function Transition

The next table shows a comparison between Communications Manager/2 (CM/2) and Communications Server functions. In the table below, use the center column to confirm the presence of a CM/2 function or feature in Communications Server, and use the last column to help you understand all the additional capabilities included in Communications Server for OS/2 Warp, Windows NT, and AIX.

Table 52. CM/2 and Communications Server Comparison		
Function	**Common to CM/2 and Communications Server**	**Communications Server for OS/2, Windows NT, and AIX Additions**
SNA Support		
SNA gateway	• APPN End Node and Network Node function	• High Performance Routing (HPR) • 3270 support over APPN or dependent logical unit server/requester (DLUS/R)
Internetworking		
Multiprotocol support	• None	• Host On-Demand • TN3270E • TN5250 (AIX with SNA Client Access) • Sockets over SNA accees node and gateway • SNA over TCP/IP access node and gateway • IPX over SNA or TCP/IP (OS/2) • NetBIOS over SNA or TCP/IP (OS/2)
WAN Connectivity and Communication		
Line speeds for WAN	• Switched - 9.6 kbps • Leased up to 19.2 kbps • Asynchronous - 57.6 kbps	• Leased up to 2 Mbps
Additional support	• ISDN	• Channel (Windows NT and AIX) • ATM • SDLC full-duplex • 16 SDLC lines (OS/2) • Frame relay (OS/2 and Windows NT) • OEM cards
Communication API Support		
Application Programmming Interface (API) support	• 16-bit – LUA – APPC – ACDI – CPI-C – X.25	• 32-bit – LUA (OS/2 and Windows NT) – APPC – ACDI (OS/2) – CPI-C – X.25 (OS/2)

In the table below, use the center column to confirm the presence of a CM/2 function or feature in PCOMM, and use the last column to help you understand all the additional capabilities included in PCOMM.

Table 53 (Page 1 of 2). CM/2 and Personal Communications Comparison		
Function	**Common to CM/2 and Personal Communications**	**Personal Communications Additions**
	Emulators	
Terminal emulation types	• 3270 • 5250	• TN3270 • TN5250 • CUT
Emulator user functions	• Menu bar • Pop-up keypad • Hotspots • Color remapping • Keyboard remapping • Automatic font sizing • Clipboard editing • File transfer • Online help • Host graphics • Integrated mouse support	• Auto-start of Web browser • Macro function including record/playback • Iconic tool bar, including tool bar customization and tool bar pop-up description • Enhanced clipboard editing • Shared folders (AS/400) • Data transfer (AS/400) • Keyboard remap layout by language • Printer setup for form feed option • TCP/IP host print (RFC1646 - RFC1647) • Column separator customization support
	Communication APIs	
Application Programmming Interface (API) Support	• EHLLAPI • SRPI • Kernel API (PCSAPI) • CPI-C • APPC • APPC3270 • LUA	• 32-bit • DDE • PCSAPI
	Connection and Protocol Support	
Connection types and communications protocol support	• Coaxial • Twinaxial • Leased lines • Switched lines • Token-ring • Ethernet • SNA over asynchronous • Hayes AutoSync • PCMCIA adapters • SDLC • IEEE 802.2 • 3174 PEER communication • FDDI • ISDN • X.25	• SDLC through AS/400 • Non-SNA DFT • Home terminal (including Turbo file transfer) • Asynchronous for IBM Global Network (IGN) • IPX/SPX • TCP/IP
Additional support	• Session-level encryption (SLE) for OS/2 • Data compression	• Response time monitor • IGN data security with DES
Communication line speeds for WAN	• Switched - 19.2 kbps • Leased up to 2 Mbps • Asynchronous - 57.6 kbps	

Table 53 (Page 2 of 2). CM/2 and Personal Communications Comparison		
Function	**Common to CM/2 and Personal Communications**	**Personal Communications Additions**
Major enhancements	• APPN End Node • APPN LEN Node • DLUR	• High-Performance Routing

6.3 Communications Server for Windows NT

Another member of IBM's family of Communications Servers is Communications Server for Windows NT V5.01. Communications Server for NT runs on Windows NT Version 3.51 or Version 4.0 and a minimum 100 MHz Intel Pentium processor PC with a minimum of 32 MB of RAM. It gives you local and wide area network connectivity and extensive APPN support. It allows TCP/IP clients to access SNA APIs without using the SNA protocol between client and server.

Communications Server for Windows NT V5.01 provides the following features:

- SNA capability
  - PU 2.0
  - LU 0, 1, 2, 3, 6.2
  - PU gateway
  - APPN end node
  - APPN network node
  - High Performance Routing (HPR)
  - Dependent LU Requestor (DLUR)
- Multiprotocol networking
  - SNA over TCP/IP
  - TCP/IP over SNA
  - Connects SNA and TCP/IP
- Client APIs supported
  - APPC
  - CPI-C
  - ENHAPPC - Windows 3.11, Windows 95, and Windows NT only
  - LUA RUI
  - LUA SLI
  - Emulator applet
- Client protocols
  - TCP/IP
  - IPX/SPX
- Connectivity
  - Token-ring
  - Ethernet

- Twinax
- Async
- SDLC
- ISDN (via OEM adapter)
- Frame relay (via OEM adapter)
- Channel (via OEM adapter)

• Server capability
  - Load balancing **1**
  - Fault tolerance
  - Hot backup
  - LU pooling
  - Remote install, config, admin
  - Host On-Demand
  - Discovery

• Client operating systems
  - OS/2
  - Windows 3.1
  - Windows 95
  - Windows NT

Note:
1 Communications Server for Windows NT load balances across links using LU pooling.

Communications Server for NT has local and remote configuration and administrative support. Within the product package you also get an entry-level terminal emulation for 3270 and 5250.

6.3.1 Communications Server for Windows NT Communication Adapters

IBM Communications Server for Windows NT supports the following PC communications adapters. For up-to-date information, see the Web site at http://www.networking.ibm.com/cms/csnchn.html.

Table 54 (Page 1 of 2). Communications Server for Windows NT V5.0.1 Supported PC Communication Adapters																						
Adapter Name			**Bus Type**				**Net-work Type**		**DLC Type**	**Connection Type**			**DLC API**			**Electrical Interface**						
	# Adapters	**# Ports**	**AT /ISA /EISA**	**MCA**	**PCI**	**PCMCIA**	**SNA**	**MS/IP**		**Leased**	**Switched**	**ISDN**	**Shallow**	**Deep**	**NDIS**	**RS232**	**V.24**	**V.35**	**X.21**	**RS422**	**RS530**
IBM Adapters																					
Multi Protocol Communications Adapter	2	1	X	X			X		SDLC	X	X		X			X	X				
Wide Area Communications Adapter	8	2		X			X		SDLC	X	X		X			X	X	X	X	X	
				X			X		X.25	X	X		X			X	X	X	X	X	
Wide Area Communications Adapter	14	2	X				X		SDLC	X	X		X			X	X	X	X	X	
			X				X		X.25	X	X		X			X	X	X	X	X	
Wide Area Communications Adapter					X		X	X	SDLC	X	X			X		X	X	X	X		
					X		X		X.25	X	X			X		X	X	X	X		
Com Port/Async Modem			X	X	X	X	X		SDLC	X	X		X								
Com Port/AutoSync Modem			X	X	X	X	X		X.25	X	X		X								
EICON Technology Adapters																					
EICONCard C20			X				X	X	Frame Relay	X	X				X		X		X		
EICONCard C21			X				X	X	Frame Relay	X	X	X			X		X		X		
EICONCard DPNA			X				X	X	Frame Relay	X	X				X	X	X	X	X		
EICONCard EC/PC			X				X	X	Frame Relay	X	X				X	X	X	X	X		
EICONCard EC/MC				X			X	X	Frame Relay	X	X				X	X	X	X	X		
EICONCard HSI/PC			X				X	X	Frame Relay	X	X				X	X	X	X	X		
EICONCard HSI/MC				X			X	X	Frame Relay	X	X				X	X	X	X	X		

Table 54 (Page 2 of 2). Communications Server for Windows NT V5.0.1 Supported PC Communication Adapters

Adapter Name	# Adapters	# Ports	Bus Type				Network Type		DLC Type	Connection Type			DLC API			Electrical Interface					
			AT /ISA /EISA	MCA	PCI	PCMCIA	SNA	MS/IP		Leased	Switched	ISDN	Shallow	Deep	NDIS	RS232	V.24	V.35	X.21	RS422	RS530
EICONCard MPNA				X			X	X	Frame Relay	X	X				X	X	X	X	X		
EICONCard S50			X				X	X	Frame Relay	X	X				X	X	X	X	X		X
EICONCard S51			X				X	X	Frame Relay	X	X	X			X	X	X	X	X		X
EICONCard S52			X				X	X	Frame Relay	X	X				X	X	X	X	X		X
EICONCard S94			X	X			X	X	Frame Relay	X	X	X		X	X	X	X	X	X		X
EICONCard S94			X				X		SDLC	X	X	X		X							
Microgate Adapters																					
Digital Services Adapter	2	1		X			X		SDLC	X	X		X			X	X	X			
Quadron Adapters																					
ARTIC POLARLINK (MCA)		1		X					Frame Relay	X	X			X	X	X		X			
ARTIC POLARLINK (PCI)		1			X				Frame Relay	X	X			X	X	X		X			
ARTIC POLARLINK (ISA)		1	X						Frame Relay	X	X			X	X	X		X			
Synaptel Interphase Adapters																					
SynCard Series Adapters			X	X	X		X	X	DLSw	X	X	X		X	X	X	X	X	X		
SynCard Series Adapters			X	X	X		X	X	SDLC	X	X	X		X		X	X	X	X		
SynCard Series Adapters			X	X	X		X		X.25	X	X	X				X	X	X	X		

6.3.1.1 Discovery of Service Providers

Discovery is a LAN address resolution protocol that can be used by a node on the LAN to find another node that matches specific search criteria. By specifying the search parameters, a node can search for APPN network nodes that provide SNA boundary function, AS/400s, SNA gateways, or user-defined classes of server. Discovery support further simplifies configuration by automatically finding network nodes for the end nodes. A Communications Server for Windows NT server can respond to requests from clients as a network node server, PU2.0 gateway, or as a user-defined class of server.

6.3.1.2 SNA API Client Support

The SNA API client support allows TCP/IP-attached or IPX-attached clients to access SNA APIs without requiring SNA protocols to flow between the clients and the server. This remote API allows most SNA configurations to take place at the central server. The SNA clients provide support for CPI-C, EHNAPPC, LUA RUI, LUA SLI, APPC, and limited support for NOF, MS, and Common Services interfaces, while providing the actual SNA processing at the server. These clients are delivered as part of the server but are actually installed and configured at the client.

A Communications Server Software Developers Toolkit (which can be separately installed from the Communications Server for Windows NT CD-ROM) is also available for application developers to use. The toolkit contains samples, header files, library files, and online manuals for each of the APIs. Communications Server for Windows NT supports SNA API clients on Windows 95, Windows NT, Windows 3.x, and OS/2 platforms.

6.3.1.3 32-Bit APIs

Communications Server for Windows NT supports a wide range of 32-bit APIs on the server for the application program developer. These APIs provide convenient ways for application programs to access Communications Server functions and allow applications to address the communication needs of connections to both IBM and other computers. In addition, the interfaces provided support SNA protocols so standardization is ensured.

API support includes:

- Advanced Program-to-Program Communications (APPC)
- Common Programming Interface for Communications (CPI-C)
- Conventional LU Application Interface (LUA) RUI and SLI
- WinSock
- Network Operator Facility
- Management Services

- Common Services

6.3.1.4 Local and Remote Configuration and Administration

A configuration GUI provides a user interface for entering configuration data. Local configuration is supported at both the client and server level. The Node Operations application allows users to remotely or locally stop, start, and monitor resources in the network. The Node Operations application is also supported from any Windows NT client.

6.3.1.5 Web-Based Server Administration

Communications Server for Windows NT includes a new Web-based tool that provides remote integrated cross-server administration capability. IBM takes Web-based server administration to a new dimension. A simple GUI provides a convenient, at-a-glance status of Communications Server while the consistent user interface preserves a common look and feel across server platforms.

6.3.1.6 Host On-Demand

Continuing to advance our strategy of providing network computing solutions, Communications Server for Windows NT provides Host On-Demand, designed to provide fast and easy access to host information from intranets and the Internet. Host On-Demand is a Java-based solution that incorporates industry-standard Telnet 3270 protocols. It provides a high-performance, low-cost solution for intranet and Web users who need occasional access to their central computer applications or databases from any Java-enabled user platform. The license for Communications Server for Windows NT, V5.01 includes the use of the product Host On-Demand. Host On-Demand can be used to support as many concurrent users/clients as allowed by the terms of the associated Communications Server for Windows NT license.

6.3.1.7 Entry Level Emulator

Communications Server for Windows NT includes an entry-level version of the Personal Communications 3270 and 5250 emulators for administrative purposes.

This emulator provides basic 5250 and 3270 support and provides a subset of the features and functions in the full-function IBM Personal Communications family of emulators. The emulator is authorized to run on the server only.

The entry-level emulator functions include:

- Color mapping
- Command line transfer (3270 only)

- Full font set
- Various screen sizes (Models 2 through 5)
- Two sessions

6.3.1.8 Data Security

Communications Server for Windows NT provides basic and enhanced security support at the session and conversation levels. Security features limit which Windows NT users may access SNA resources through the SNA API clients. Conversation security includes support for password substitution. Enhanced LU-LU security is also provided.

6.4 Communications Server for S/390

Communications Server for S/390 is available through two packages:

- Communications Server for OS/390 Release 3
- Communications Server R2 for MVS/ESA

Communications Servers for S/390 comprise the following program products:

- VTAM Version 4.4 (includes integrated AnyNet function)
- TCP/IP Version 3.2

Communications Server for MVS/ESA provides a communications gateway by combining SNA and TCP/IP networking technologies into a single product offering. Communications Server for MVS/ESA includes all functions and features of IBM′s VTAM and TCP/IP products. It operates on any IBM System/370 (308x, 3090 or 43xx), System/390, or ES/9000 processor that supports MVS/ESA SP Versions 4.3 or later.

The following list shows some of the applications, services, and functions which Communications Server for MVS/ESA on multiprotocol networks provides:

- High Performance Native Sockets (HPNS) is a new function for key TCP/IP application program interfaces (APIs) that directly exploits the MVS/ESA architecture. HPNS is the base for TCP/IP performance and RAS improvements because it avoids the invocation of the IUCV/VMCF path. Pathlength and CPU cycles are significantly reduced in the S/390 host.
- Enhancements to RouteD (the dynamic route update server) and support for virtual addresses provide fault-tolerant IP network attachment.
- High performance routing (HPR) improves network availability and throughput by routing around failures in the network and reducing the storage and cycles required in intermediate nodes.

- CMIP services and topology agent provides dynamic topology management, to help monitor the status of resources owned by VTAM. (CMIP stands for Common Management Information Protocol, the Open Systems Interconnection (OSI) X.700 standard for network management.)
- AnyNet/MVS provides OE DCE RPC socket application simultaneous communication to endpoints across APPN, SNA and TCP/IP networks.
- Other SNA functions include APPN host-to-host channel dynamics, APPN systems management functions such as an APING command, reduced VTAM definition in a sysplex environment and the APPC Application Suite.

6.5 Communications Server for AIX

Communications Server for AIX V4.2 provides SNA connectivity to RISC/6000 customers. It supports connectivity over wide area networks (WANs) using SDLC or X.25 connections, or over local area networks (LANs) using token-ring, Ethernet or FDDI protocols. It fully supports the AIX operating system including the uniprocessor (UP) and symmetric multiprocessing (SMP) hardware systems, exploiting the parallel processing capabilities of this new technology to significantly improve system performance. It further supports direct, high-speed, channel connections from a RISC System/6000 to an IBM host system. Support includes the ESCON and BlockMultiplexer environments.

IBM Communications Server for AIX, Version 4, is the successor to IBM's SNA Server for AIX, Version 3.1.

Enhancements include:

- Integrated SNA gateway function
- SNA channel connectivity feature for ESCON and Block Multiplexer channels
- Integration of the AnyNet APPC over TCP/IP and Sockets over SNA access mode and gateway functions
- Host On-Demand, Web-based access to 3270 applications
- Advanced SNA functions, including:
  - Support for High Performance Routing (HPR) as an intermediate node (with ANR)
  - Dependent LU requester (DLUR), enabling dependent LUs (including 3270 and 3270-based applications) to operate within an APPN network
  - Support for non-blocking APPC calls
  - Inclusion of the HCON 3270 emulator (single session license)
- AnyNet Sockets over SNA gateway function
- AnyNet APPC over TCP/IP gateway function

- Single user 3270 and 5250 emulation

In addition to LAN and SDLC connections, it also supports direct channel attachment from a mainframe to an RS/6000 or SP2 system. This connection can be a Block Multiplexer or an ESCON channel.

The Communications Server for AIX also provides TN3270E and TN5250 Server support. A prerequisite of this function is the IBM SNA Client Access program.

6.5.1 High Performance Routing

Communications Server for AIX V4.2 provides HPR base support function, also known as Automatic Network Routing (ANR) over the token-ring, Ethernet, FDDI, X.25 and SDLC physical data transports.

HPR is supported on the following versions of AIX when the associated APARs are installed:

- AIX Version 4.1.2, 4.1.3, or 4.1.4 with APAR IX60351
- AIX Version 4.1.5 -- No APAR required
- AIX Version 4.2 with APAR IX60672

6.5.2 Dependant LU Requestor (DLUR)

DLUR, in conjunction with VTAM′s dependent LU server (DLUS) function, enables dependent LUs (LU0, 1, 2, 3, and dependent LU 6.2) to operate unchanged in an APPN network, without changing applications. The DLUS establishes an LU 6.2 session with, and provides SSCP services to the DLUR node. Any number of dedicated physical units (PUs) can be defined on the LU 6.2 sessions. The gateway function of Communications Server for AIX can be used to provide services to the downstream dependent LUs.

The following functions are supported in this release:

- Local LUs
- Downstream LUs by using SNA Gateway
- SSCP takeover
- Multisubnet
- DLUS Backup - If a DLUS becomes unavailable, LUs are automatically reconnected to a pre-configured backup DLUS.

6.5.3 Communications Server for AIX Supported Adapters

Communications Server for AIX V4 supports the following IBM RS/6000 communications adapters:

- Token-Ring:
  - Token-Ring High Performance Network Adapter (#2970)

- IBM 16/4 PowerPC Token-Ring Adapter (#2971)
- Auto Token-Ring LAN Streamer 32 MC Adapter (#2972)
- PCI AutoLANStreamer Token-Ring Adapter (#2979)

- Ethernet:
  - High-Performance LAN Adapter (#2980)
  - IBM ISA Ethernet Adapter (#2981)
  - IBM PCI Ethernet BNC/RJ-45 Adapter (#2985)
  - IBM PCI Ethernet AUI/RJ-45 Adapter (2987)
  - Ethernet/FDX 10 Mbps TP/AUI MC Adapter (#2992)
  - Ethernet/FDX 10 Mbps BNC/AUI MC Adapter (#2993)
  - Integrated Ethernet Adapters
- SDLC:
  - 4-Port Multiprotocol Communications Controller (#2700)
  - ISA MPQP Adapter (#2701)
  - Single port, Multiprotocol Adapter/A (#2959)
- X.25:
  - X.25 Interface Co-Processor/2 (#2960)
  - X.25 Interface Co-Processor -- ISA (#2961)
  - Portmaster(R) Adapter/A -- 1MB (#7006)
  - Portmaster Adapter/A -- 2MB (#7008)
  - Multiport Model 2 -- ISA (#2701)
  - ARTIC960 Co-Processor -- 4MB (#2924)
  - ARTIC960 Co-Processor -- 8MB (#2928)
- IBM Fiber Distributed Data Interface (FDDI) Adapters plus appropriate cables for an attachment to a FDDI network:
  - FDDI Single-Ring Adapter (#2720)
  - Fiber Single-Ring Adapter (#2724)
  - FDDI Dual-Ring Upgrade (#2722)
  - Fiber Dual-Ring Adapter (#2723)
  - STP Single-Ring Adapter (#2725)
  - STP Dual-Ring Upgrade (#2726)
- ESCON(R) Channel Adapter (#2756)
- Block Multiplexer Channel Adapter (#2755)

6.5.3.1 Communications Server for AIX Version 4 Compatibility

Communications Server for AIX V4.2 runs on AIX V4.1.2 or later, including AIX 4.2 and AIX 4.3.

Communications Server for AIX Version 4 is not compatible with AIX Version 3.2.X.

Communications Server for AIX Version 4 is compatible with:

- ESCON Channel Connectivity for AIX Version 1.1 (5765-603)
- Block Multiplexer Channel Connectivity for AIX Version 1.1 (5765-604)

6.5.3.2 Communications Server for AIX Version 4 Limitations

The common installation procedures for all software servers for AIX require AIX Version 4.1.4, and later. The normal product installation procedures for SNA Server for AIX Version 3.1 are used for AIX Version 4.1.2 and 4.1.3 systems.

6.6 IBM eNetwork Host On-Demand Overview

IBM eNetwork Host On-Demand is a small TN3270 emulator application that operates as a Java applet on a Web browser. Host On-Demand allows a user to use a Web browser to access a host 3270 application through the Web.

Host On-Demand provides:

- Customized 3270 windows
- Multiple sessions
- Persistant connections
- Platform flexibility
- Security

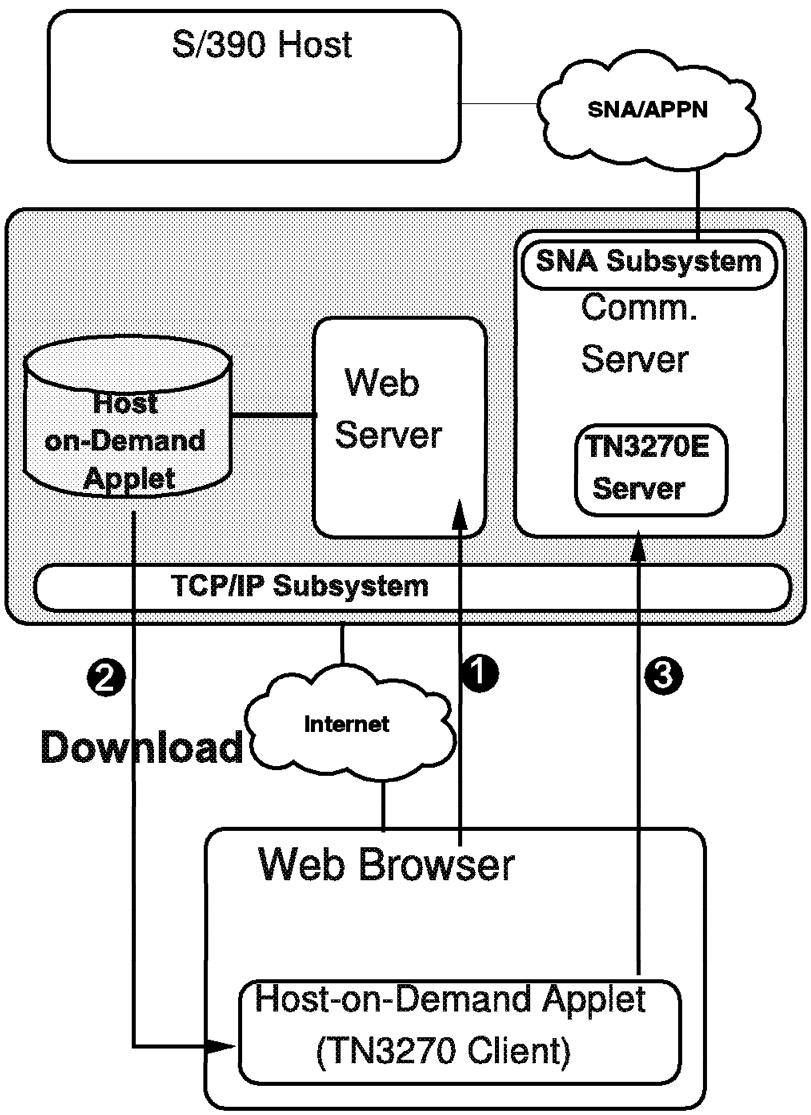


Figure 36. Host On-Demand Overview

The diagram in Figure 36 shows the basic flow of a Host On-Demand session.

1. The user connects to a Web server. Depending on how this Internet server is configured, the user either gets the Host On-Demand application by default, or requests it specifically by entering a specific URL such as http://servername/he3270en.htm.

2. The server then downloads a Java applet to the browser, which is a small standard Telnet 3270 application.

3. This application then contacts the same server and connects into the TN3270E server of Communications Server.

Additional information on Host On-Demand can be found on the Web at http://www.networking.ibm.com/eNetwork/OnDemand/hod.html.

6.6.1 Host On-Demand Platforms

Host On-Demand is available for the following products:

- IBM Communication Server for OS/2 Warp V4.1 and V5.0
- IBM Communication Server for AIX, Version 4 Release 2
- NetWare for SAA, Version 2 Release 2
- IBM Communications Server for Windows NT
- IBM Communications Server for MVS/ESA
- IBM TCP/IP Version 3 Release 2 for MVS/ESA
- OS/390 Release 3

6.6.2 Host On-Demand Comparison

A quick look at Host On-Demand compared with IBM Personal Communications is shown below. As you can see, Host On-Demand has limited function but is very useful in certain situations.

Table 55 (Page 1 of 2). Host On-Demand Comparison

	PCOM Full	**PCOM Entry**	**HOD**
3270 Emulation	X	X	X
5250 Emulation	X	X	
HLLAPI, DDE, CPIC, APPC	X		
Run/Load from server	X	X	X
Run/Load from internet			X
Launch from container			X
Macros	X		
Scripting	X		
Edit functions	X	X	
Host graphics	X		
Full MFI capability	X	X	
File transfer	ind$file	Cmd line	
Pop-up keypads	X	X	subset

Table 55 (Page 2 of 2). Host On-Demand Comparison

	PCOM Full	**PCOM Entry**	**HOD**
NLS	X	X	
CICS client support	X		
IPX, IP, SNA	X		
Data compression	X		
Host print	X		
Zipprint	X		
Hotspots	X		
Drag&Drop color mapping	X		

Chapter 7. IBM TCP/IP Products

TCP/IP (Transmission Control Protocol/Internet Protocol) products enable participation in multivendor, open networking envirionments using the TCP/IP protocol suite for communications.

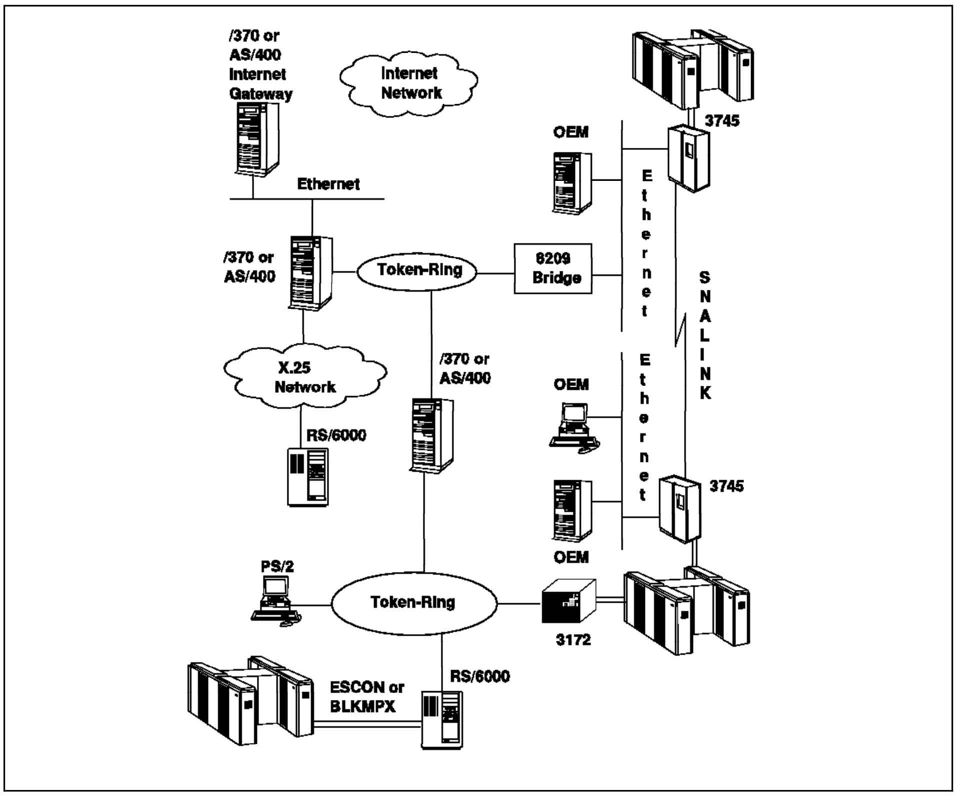


Figure 37. TCP/IP Network

Among the IBM TCP/IP offerings for operating systems are the following:

- TCP/IP V3.2 for MVS and features:
  - Network Station Client
  - Host On-Demand
  - CICS and IMS Sockets
  - DES or non-DES Kerberos
  - Network Print Facility
  - OpenEdition Application
- TCP/IP for OS/390 Unix System Services, which will be part of the base package in OS/390 V2.4 and OS/390 V2.5. It is a replacement of the OpenEdition feature of TCP/IP for MVS V3R2. It is for OpenEdition MVS

and assembler applications only. For non-OpenEdition applications you need TCP/IP V3R2.

- DFSMS NFS feature
- TCP/IP V 2.4 for VM
- OS/400 V3R2 and OS/400 V3.7 have an optionally installable TCP/IP V3R1 component. DCE Base Services/400 V3 provides additional functions.
- AIX V4.2 and AIX V4.1.5 include TCP/IP functions.
- IBM 3174 Telnet support (see 4.4.4, "3174 TCP/IP" on page 108 and 4.4.5, "3174 Ethernet and TCP/IP Enhancements (RPQ 8Q1041)" on page 110).
- TCP/IP V3.0 for OS/2 (a component of Warp Connect V3 or Warp Connect with WIN-OS/2 V3), Version 3.1 (a component of OS/2 Warp Server), Version 3.5 (a component of WARP Server SMP) and Version 4.0 (a component of WARP 4).

Table 56 (Page 1 of 2). TCP/IP Function Summary

Systems ▸ Functions ↓	**TCP/IP V 2.4 for VM**	**TCP/IP V 3.2 for MVS**	**TCP/IP in OS/400 V3R2 / OS/400 V3.7**	**TCP/IP in OS/2 WARP**	**TCP/IP in AIX V4.1.5 / V4.2**
End User Functions					
Telnet	C/S	C/S	C/S	C/S	C/S
TN3270	C/S	C/S	C/S	C	C
TN5250			C/S	C	C
Telnet VT100	C/S 5	S 1 5	C/S	C/S	C/S
Telnet VT220		C/S 4	C/S	C	C/S
File Transfer Program (FTP)	C/S	C/S	C/S	C/S	C/S
Trivial File Transfer Program (TFTP)	C			C/S	C/S
SMTP	C/S	C/S	C/S	C/S	C/S
REXEC	C/S	C/S	2	C/S	C/S
Remote Shell (RSH)	C/S	C/S		C/S	C/S
Network Database (NDB)	S	C/S			C
X-Windows	C	C		S	C/S
NFS	C/S	S 3	S	C/S	C/S
LPR/LPD	C/S	C/S	C/S	C/S	C/S

Table 56 (Page 2 of 2). TCP/IP Function Summary

Remote Procedure Call (RPC)	C/S	C/S	C/S 8	C/S	C/S
Network Computing System (NCS)	C/S	C/S			C/S
Talk				C/S	C/S
Kerberos	C/S	C/S	C/S 8		C/S
Internet Connection		S 6	C	C	
Gopher				C	
Internet Connection Secure Server					S 7
Network Management					
Finger				C	C/S
BootP				C/S	C/S
SNMP	M/A	M/A	C	M/A	C/S
PING	Y	Y	Y	Y	Y
NETSTAT	Y	Y	Y	Y	Y
RouteD	Y	Y		Y	Y
Domain Name Server (DNS)	R/S	R/S	R	R/S	R/S
DHCP				C	C/S

Note:

LEGEND:

- A: Agent support.
- C: Client support.
- M: Monitor support.
- R: Resolver support.
- S: Server support.
- Y: Yes, function is supported.

1 3270 DBCS transform mode
2 With FTP
3 Part of DFSMS/MVS
4 Via Communications Subsystem for Interconnection (CSFI) R2 - 5688-132.
5 Available as a separate program: IBM Cooperative Software - A-Net for TCP/IP from Teubner and Associates
6 Available as a separate program: IBM Internet Connection Server (5655-156) as a transport
7 Within Bonus Pack for AIX 4.2
8 With DCE Base Services/400 (5733-167)

7.1.1 TCP/IP Connectivity

Table 57 on page 184 is an overview of the network connectivity supported by the IBM TCP/IP products.

Table 57. TCP/IP Supported Link Types						
	TCP/IP V 3.2 for MVS	TCP/IP V 2.4 for VM	TCP/IP in OS/2 WARP	TCP/IP in AIX V4.1.5 / V4.2	TCP/IP in OS/400 V3R7 / V3R2	3745 NCP
Link Level Protocols						
Token-Ring	x	x	x	x	x	x
Ethernet V2	x	x	x	x	x	x
IEEE 802.3	x	x	x	x	x	x
FDDI	via 3172	via 3172	x			
PC Network	x	x	x			
X.25	x	x	x	x	x	
Channel DLC (CDLC)	x		x	x		x
Frame Relay			x	x		x
WAN Access						
3174	x	x				
3172 ICP	x	x				
3172 Offload	x	x				
2216	x	x				
SNALINK	LU 6.2 LU 0	LU 0	LU 6.2			LU 0
Channel Access						
HYPERchannel	x	x				
HIPPI	X			X		
CTC	X	X				
CETI	X					
CLAW	X	X	X	X		
CDLC	X					X
ESCON	X	X		X		X
LAN Access						
ODI						
Coax			X			
NDIS			X			
SLIP			X	X		

Chapter 8. APPN Product Implementation

Today′s complex networks require a new approach to networking, an intelligent technology that ties together diverse computing platforms, topologies, and applications into a single network. That approach is Advanced Peer-to-Peer Networking (APPN).

APPN is an open data networking architecture that is easy to use. It has decentralized control, but centralized network management, allows arbitrary topologies, has connection flexibility and continuous operation without requiring special communication hardware.

APPN′s any-to-any connectivity makes it possible for large and small computers alike to communicate over local and wide area networks, across slow and fast links. APPN provides flexibility, reliability, performance and ease-of-use. APPN is an extension to SNA featuring:

- Greater distributed network control that avoids critical hierarchical dependencies, thereby isolating the effects of single points of failure
- Dynamic exchange of network topology information to foster ease of connection, reconfiguration, and adaptive route selection
- Dynamic definition of network resources
- Automated resource registration and directory lookup
- APPN extends the LU 6.2 peer orientation for end-user services to network control and supports multiple LU types, including LU 2, LU 3, and LU 6.2

The APPN architecture defines three major types of nodes:

- Low Entry Network (LEN) end node
- APPN end node (EN)
- APPN network node (NN)

The LEN end node provides peer-to-peer connectivity to other LEN end nodes, APPN end nodes, or APPN network nodes. A LEN end node requires that all network-accessible resources, either controlled by the LEN end node itself or on other nodes, be defined at the LEN end node. LUs on adjacent nodes need to be defined with the control point name of the adjacent node.

LUs on non-adjacent nodes need to be defined with the control point name of an adjacent network node, as LEN end nodes assume that LUs are either local or reside on adjacent nodes.

Unlike APPN end nodes, the LEN end node cannot establish CP-CP sessions with an APPN network node; therefore, a LEN end node cannot register resources at a network node server, nor can it request its network node server to search for a resource, or, to calculate the route between the LEN end node and the node containing a destination resource.

An APPN end node extends the capabilities of a LEN end node. The APPN end node provides limited directory and routing services for LUs local to it. It can establish a CP-CP session with APPN network nodes, and select an adjacent APPN network node and request this network node to be its network node server. If accepted by the network node, the APPN end node may register its local resources at the network node server. This allows the network node server to intercept Locate search requests for resources that are located on the APPN end node and pass the request on to the APPN end node for verification.

As part of the non-verify function, an APPN end node may register its connections to adjacent APPN nodes at its network node server. This allows the network node server to immediately respond to Locate search requests for LUs residing on the APPN end node, without forwarding the request to the APPN end node first.

An APPN network node provides distributed directory and routing services for all LUs that it controls. These LUs may be located on the APPN network node itself or on one of the adjacent LEN or APPN end nodes for which the APPN network node provides network node services. Jointly, with the other active APPN network nodes, an APPN network node is able to locate all destination LUs known in the network.

The APPN network node exchanges topology database information 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.

As part of the non-verify function an APPN network node may cache resource information and connection information of the APPN end node.

A facility known as central resource registration allows an APPN network node to register its resources at a central directory server. Once a resource is registered, all APPN network nodes can locate the resource by querying the central directory server instead of using a broadcast search thus improving network search performance during session establishment.

There are other node types available in the APPN architecture to connect traditional SNA with APPN networks. These nodes often represent functions performed on one of the mentioned major APPN nodes.

- Boundary and Peripheral Node

  A boundary node provides protocol support for attached peripheral nodes. These nodes are typically used within the hierarchical structure of traditional SNA. Peripheral nodes are either a T2.0 or T2.1 node.

- Composite Node

  The term composite node is used in some publications to represent a group of nodes that appear as one T2.1 node to another T2.1 node. For example, a subarea network that consists of one VTAM host and one or more NCPs consists of multiple nodes, but when connected to an APPN node, appears as one logical node.

- Virtual Routing Node

  A virtual routing node (VRN) is not a node, but it is a way to define an APPN node′s attachment to a shared-access transport facility. It reduces end node definition requirements by relying on the network node server to discover the common connection and supply necessary link-level signaling information as part of the regular Locate search process; LU-LU session data can then be routed directly, without intermediate node routing, between APPN nodes attached to the SATF. For more information see 8.3, “Connection Network” on page 191.

- Interchange Node

  An interchange node (ICN) routes sessions from APPN nodes into or through the subarea network using subarea routing, without exposing the subarea implementation to the APPN part of the network. This is accomplished by making the APPN node and all its owned resources appear to other nodes like one single node with different connections; for the subarea part of the network, the ICN will still appear as a subarea node.

- Border Node

  APPN architecture does not allow two adjacent APPN network nodes to connect and establish CP-CP sessions when the network nodes do not share the same NETID. The border node function is an additional APPN function to overcome this restriction. It enables network nodes with different NETIDs to connect and allows session establishment between LUs in different NETID subnetworks. Topology information flowing within different NETID subnetworks is prevented from crossing subnetwork boundaries.

The border node function can also be used to partition APPN networks with the same NETID, reducing the flow of topology updates and the storage requirements for the network topology database on network nodes in each of the network partitions.

- Branch Extender

  An APPN border node subset designed to enhance performance in large APPN networks with many ′branch′ sites. A branch extender filters out network control messages that are unnecessary to the branch. A branch extender poses as a network node with DLUR support to nodes in it′s branch. At the same time it poses as an end node to nodes in the WAN. The branch extender does not receive topology data or directory broadcasts from the WAN. It lets a network node in the WAN choose routes for nodes in the branch.

- HPR Node

  An HPR node is an APPN node that has the optional HPR functions implemented. It can either be an APPN network node or an APPN end node.

Sessions between these nodes used to perform management and service functions are called CP-CP sessions. There is a pair of parallel CP-CP sessions between adjacent nodes throughout the APPN network. These CP-CP sessions use LU 6.2 protocols. Both of the parallel sessions must be active to start their interaction.

Network nodes use CP-CP sessions for directory and session services and to update the topology database. To perform these functions the network node establishes CP-CP sessions with adjacent APPN network nodes and APPN end nodes. LEN end nodes do not support CP-CP sessions.

APPN provides various connectivity options: async, data link switching, ESCON channel, Ethernet, FDDI, frame relay, ISDN, OEM channel, SDLC, PC-Net, token-ring, X.21, X.25 and others.

APPN/APPC is supported on most IBM platforms and there are a great number of vendors providing APPN support, too.

8.1 APPN Product Support Summary

Table 58 on page 189 provides a summary of some of the APPN functions supported by IBM communication products.

Table 58. APPN Node Support

APPN Support	VTAM V4R2	VTAM V4R3	VTAM V4R4	OS/400 V3R1 / V3R6	Com Server for OS/2 Warp	Com Server for NT	3174 C6	6611 MPNP V1R4	Comm Server for AIX V4	3746-900 NN / 3746-950	2210	PComm AS/400 and 3270 V4.11
APPN NN	X	X	X	X	X	X	X	X	X	X	X	
APPN EN	X	X	X	X	X	X			X			Win 95, OS/2, NT
Peripheral Border Node	X	X	X	X								
Extended Border Node	X	X	X									
Branch Extender					X							
Central Directory Server	X	X	X									
Connection Network Route Calculation	X	X	X	X					X		X	
Member of Connection Network	X	X	X	X	X			X	X			
Dependent LU Requester					X	X	X	X			X	Win 95, OS/2,NT
Dependent LU Server	X	X	X									
HPR Support		RTP ANR (NCP 7.3)	RTP ANR	ANR	RTP ANR	ANR	ANR (Rpq)	RTP ANR	ANR		ANR	RTP (Win 95, OS/2, NT)

8.2 Dependent LU Requester/Server (DLUR/DLUS)

As SNA products move from subarea-based protocols to APPN-based protocols, it has become increasingly important to provide dependent LU services in APPN. The Dependent LU Requester/Server enables dependent devices to communicate with their host applications across an APPN network. Dependent LUs are those LUs requiring assistance from a System Services Control Point (SSCP) in order to activate and manage LU-LU sessions. Dependent LU Requester/Server functions consist of:

- Dependent LU Server (DLUS)
- Dependent LU Requester (DLUR)
- DLUS-served LU registration

DLUR/DLUS provides dependent SLU support by establishing an LU 6.2 session pipe (known as the CP-SVR pipe) between the requester and its server. Once this pipe has been established, the requester can obtain

SSCP services for its dependent LUs from the server. This is done by multiplexing the necessary SSCP-PU and SSCP-LU sessions over the CP-SVR pipe and sending the dependent LU session initiation and management flows directly between the SSCP server and the PLU node.

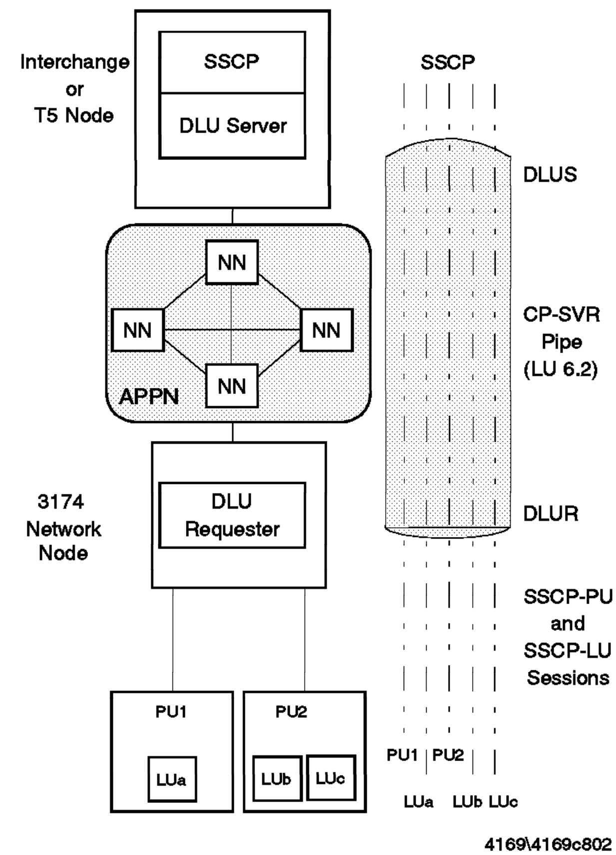


Figure 38. DLUR/DLUS Example

Notes:

a. The DLUs must be in an APPN network node.
b. Each DLUS can handle multiple PU/LUs.
c. The CP-SVR pipe from the DLUS to the DLUR must not pass through a subarea network unless it uses a virtual route transmission group (VR TG).

8.3 Connection Network

A shared-access transport facility, such as a LAN, and all nodes defined as having a connection to a virtual routing node (VRN) representing the shared-access transport facility are said to comprise a connection network.

Without the connection to the virtual routing node, link definitions must be made for each pair of link stations that require connection to each other. The number of topology database updates (TDU) increase as more stations have direct links defined. Within a virtual routing node no TDUs are being sent, so there is no increase of additional traffic on the network.

The VRN is not a node, but it is simply a way to define an APPN node′s attachment to a shared-access transport facility. It allows LU-LU session data to be routed without intermediate node routing through APPN network nodes, and reduces the number of TDUs flowing in the network.

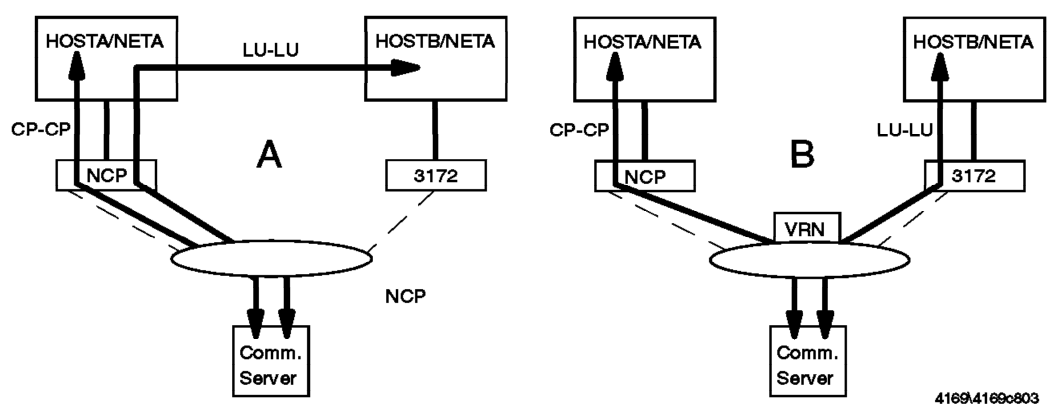


Figure 39. Connection Network. Host A is the network node server for the CM/2 or Communications Server node.

- *(A) LU-LU session route without a connection network.*
- *(B) LU-LU session route with a connection network.*
- *Routes traversing a virtual node cannot be used for CP-CP sessions.*
- *A connection network cannot be used for connectivity across network boundaries.*

8.4 High-Performance Routing (HPR)

High-Performance Routing (HPR) is an addition to APPN. HPR features include non-disruptive rerouting around failed links or nodes, pro-active congestion control and enhanced routing efficiencies. This makes APPN with HPR a very desirable routing protocol for the backbone.

High-Performance Routing has two major components:

- Automatic Network Routing (ANR)
- Rapid Transport Protocol (RTP)

Automatic Network Routing (ANR) provides the transport path between any two RTP endpoints in the network. The originator of the packet explicitly defines the exact path on which the packet is to flow through the network; thus, ANR is a special implementation of a source-routing protocol.

RTP is a connection-oriented, full-duplex protocol designed to transport data in a high-speed network. RTP nodes are capable of session re-routing in case of link or node failures. To control the HPR data flow, RTP nodes will implement the Adaptive Rate Based (ARB) flow and congestion control procedures. ANR nodes use a low-level routing mechanism that minimizes cycles and storage requirements for routing packets through intermediate nodes.

ANR can be implemented on network nodes only. RTP can be implemented on both end nodes and network nodes.

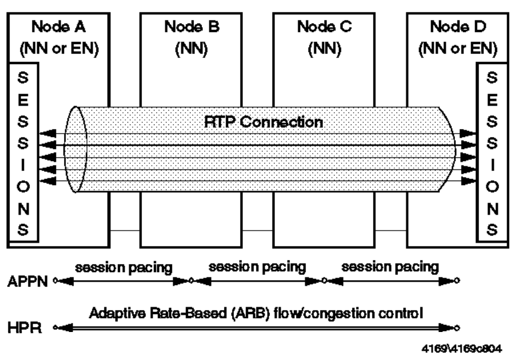


Figure 40. HPR Overview

Chapter 9. Frame Relay

Frame relay is a fast packet switching technology. Because fast packet switching operates at layer 2 of the OSI model, it is protocol independent. The fast packet switch examines each packet and is able to route packets based on a common addressing technique, allowing a reduction in the number of ports and lines through traffic consolidation.

Frame relay is connection-oriented, with virtual circuits defined between endstations (the frame relay terminating equipment or FRTE). The switching is done by a frame relay frame handler (FRFH). The standards for permanent virtual circuits (PVCs) are adopted and appear as recommendations in the ANSI and ITU-T (formerly CCITT) standards.

Frame relay incorporates mechanisms to attain certain network performance objectives, minimizing the number of occurrences of user perceived congestion. Forward explicit congestion notification (FECN) and Backward explicit congestion notification (BECN) indicators are sent through the network to inform network nodes of congested conditions. Endstations are able to prioritize their traffice by using the discard eligibility (DE) bit in the frame headers. The network will discard frames with the DE bit set first in the case of congestion.

Frame relay provides guaranteed bandwidth for each virtual circuit, which prevents any one user from consuming all the bandwidth. At the same time, it allows any unused bandwidth to be shared by the active users. Standards concerning committed information rates (CIRs) have been adopted.

Communication Network Management (CNM) is facilitated by the local management interface (LMI) standards adopted for the user-to-network interface (UNI) and network-to-network interface (NNI). As an example, Figure 41 on page 194 shows how IBM products may be interconnected with frame relay, using either private lines or a public frame relay service.

Figure 41 shows possible frame relay connections. The FRFH nodes provide frame relay switching.

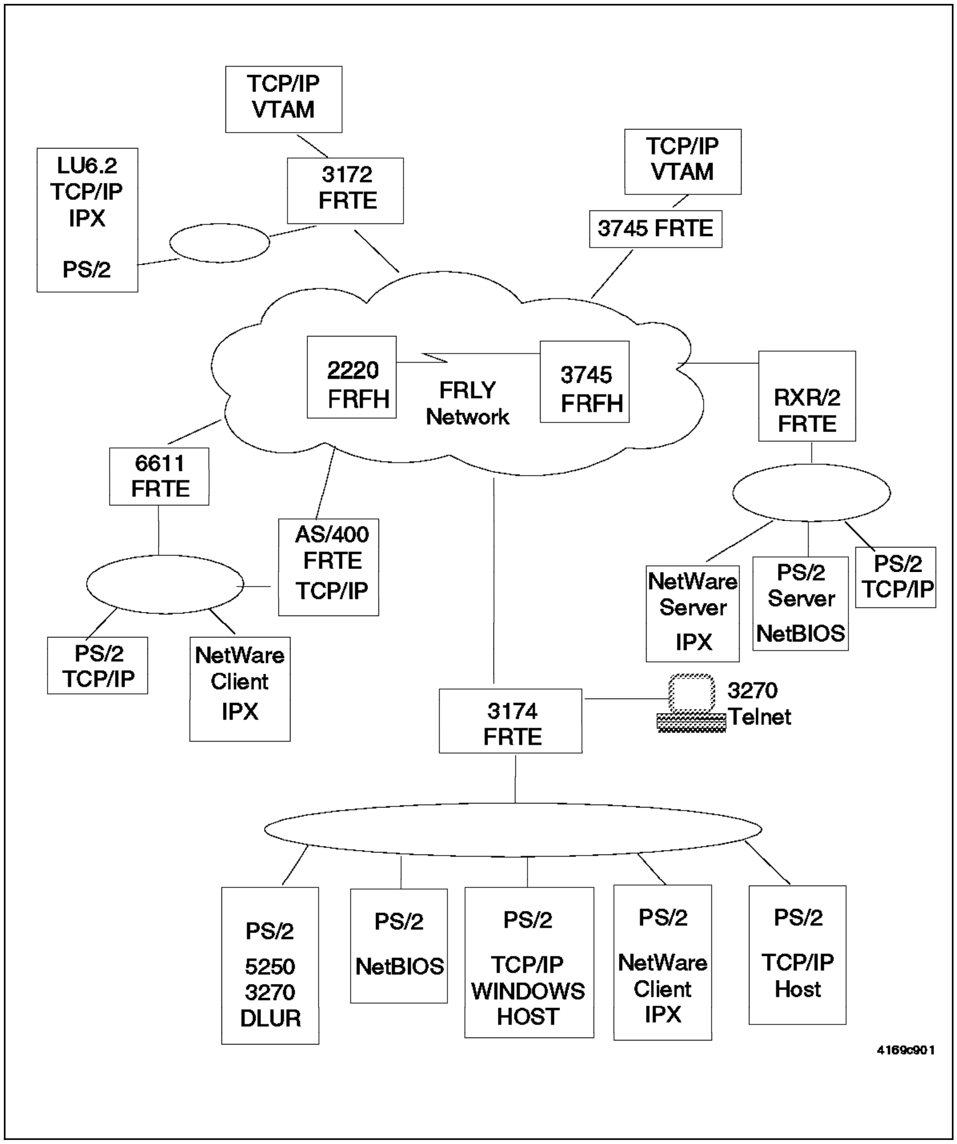


Figure 41. Local Gateway Communication

9.1 Multiprotocol Interconnect over Frame Relay

RFC 1490 describes an encapsulation method for carrying LAN interconnection traffic over a frame relay backbone. Additionally it describes a simple fragmentation procedure for carrying large messages over a frame relay network with a smaller frame size and procedures to obtain a higher level protocol address dynamically. RFC 1490 details how data should be encapsulated when sent across a frame relay network. Two types of encapsulated protocols are distinguished: routed and bridged protocol data units (PDUs).

IBM frame relay Boundary Network Node (BNN) and Boundary Access Node (BAN) use RFC 1490 standards for encapsulation of SNA traffic over frame relay networks.

9.1.1.1 Boundary Network Node (BNN)

Frame relay Boundary Network Node (BNN) uses the RFC 1490 Routed Frame Format for encapsulation of SNA traffic over frame relay networks. BNN provides support for SNA functions on the frame relay access device (FRAD) and for downstream PUs to access the frame relay WAN link. APPN nodes communicating over frame relay links use this type of encapsulation.

9.1.1.2 Boundary Access Node (BAN)

BAN uses the RFC 1490 Bridged Frame Format for encapsulation of SNA traffic over frame relay networks. BAN support includes:

- Support of source route bridging (SRB) to bridge traffic between LAN and frame relay WAN links.
- Local SNA use of SRB to bridge traffic from the SNA components in the BAN router internally onto the same frame relay WAN link.
- LLC termination (BAN-2) to terminate LLC connections in the BAN router and multiplex that traffic onto LLC connections across the frame relay WAN.

9.2 Frame Relay Access Devices (FRADs)

Frame relay access devices (FRADs), also known as frame relay assemblers and disassemblers, enable endstations to communicate using the service of a frame relay network without native frame relay support on the end stations themselves. FRADs operate in pairs, one on either end of the frame relay network. The FRAD concept is depicted in Figure 42 on page 196.

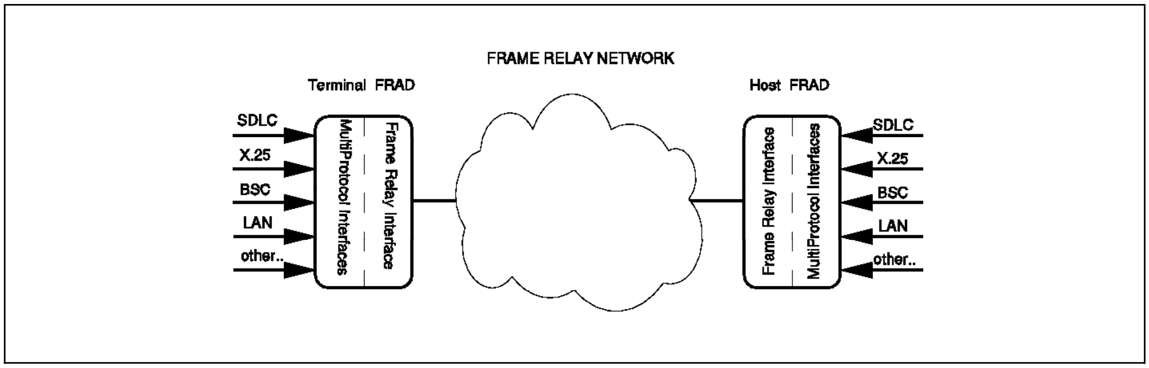


Figure 42. Frame Relay Access Devices

9.3 Frame Relay to ATM Interworking

With the advent of ATM, the networking industry will begin migrating their existing voice and data networks to ATM, and using traditional variable length packet technologies as ″feeder interfaces″ to high speed ATM backbones. Frame relay is cited as being one of the more prevelant technologies to be used in conjunction with ATM for transporting data up to the ATM backbone. It is also used over ATM in conjunction with the ATM Adaptation Layer (AAL5) as a method for transporting data within an ATM backbone.

Network interworking is essentially frame relay encapsulated within AAL5 of ATM. The interworking unit uses the frame relay Service Specific Convergence Sublayer (FR-SSCS) (ITU 365.1) of ATM to encapsulate the frame relay data and pass it across the ATM network where it is extracted at a second interworking unit or by the FR-SSCS layer of an ATM end system.

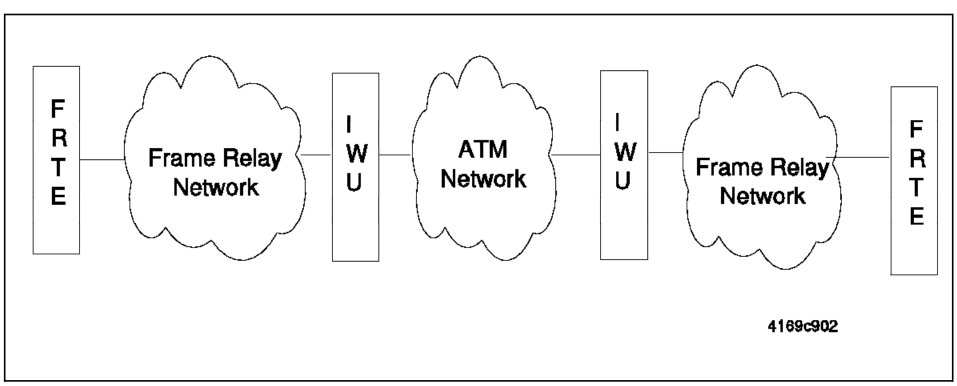


Figure 43. Frame Relay/ATM Interworking

9.4 ACF/NCP and 3745/6 Frame Relay Support

NCP can participate in a frame relay network to provide boundary support for peripherals attached through a frame relay network, subarea support for NCPs attached to each other through a frame relay network, and as a frame relay frame handler routing frames through the NCP into the frame relay network.

Currently frame relay is supported on all leased line attachments on the TSS, HSS, and CLP (IBM 3746 Model 900) serial ports with line speeds up to 2 Mbps.

Frame relay in the NCP provides you with many advantages, including the following:

- Line consolidation of physical lines using frame relay to route traffic to various destinations.
- Network consolidation of SNA and multiprotocol networks into one frame relay network.
- Hybrid networks can be formed with both private lines and a public carrier frame relay network.
- True bandwidth on demand for frame relay traffic is provided.
- Congestion control, alerting endstations to throttle back the traffic they send into the network when congestion exists.
- Alternate physical link capability for FRFH connection reliability, providing an alternate route in the event a link or node between NCPs fails.
- NPM, NetView, and NTune support for frame relay resources.
- Dynamic reconfiguration support in VTAM for adding NCP frame relay logical connections or virtual circuits.
- INN flexibility allowing you to define subarea links as virtual circuits with a full mesh of end-to-end connections between NCPs, even though they may be physically non-adjacent. The NCPs at each end of the INN link appear to be adjacent to each other. When the data passes through intermediate NCPs enroute to its destination, the data avoids the SNA processing and enjoys reduced transit delays.
- Multiprotocol transport uses load balancing to allow each protocol to be isolated on an individual virtual circuit with its own guaranteed bandwidth.

Frame relay is the only type of serial interface that is supported by all 3745 and 3746 protocol stacks. A single frame relay interface (port) can be activated simultaneously by each protocol stack, 3746 NN/DLUR and IP, and 3745 NCP. Frame relay together with the 3745 and 3746, is ideally suited for building a multiprotocol network backbone.

9.4.1 NCP Frame Relay Support

Frame relay support was introduced with NCP Version 6 Release 1 and has been enhanced with each new release.

- NCP V6R1
  - NCP-to-NCP subarea traffic support
- NCP V6R2
  - Frame relay switching (FRFH) capability for SNA and non-SNA
  - Backup PVC routing
- NCP V7R1
  - Boundary function for SNA (BNN FRTE) peripheral devices, such as RouteXpander/2, 3174, and AS/400, so they can attach by means of frame relay virtual circuits to the boundary node support of NCP.
- NCP V7R2
  - 3746 Model 900 frame relay support for subarea and SNA boundary support (FRTE and FRFH).
  - 3746 LMI support
- NCP V7R3
  - Multiple BNN stations per DLCI for 3746 lines
  - Frame relay over token-ring to support FRFH functions between NCPs
  - IP over Frame relay without encapsulation in SNA frames (native IP routing)
  - BAN support
- NCP V7R4
  - Internal frame switching support for the 3746-900
  - Extended addressing capabilities for BAN configurations.
- NCP V7R5
  - The ability for frame relay ports to be shared by NCP, 3746 Network Node Processor, and 3746 IP functions
  - BAN over subarea (PU4)
  - Frame relay inoperative ″error count″ management upgrades
  - 3746 DLCI sharing
  - Enhanced dynamic windowing algorithm
- NCP V7R6
  - 3745 communication rate enhancements
  - Improved flow control
  - 3745 frame relay switched dial backup support

9.4.1.1 3746-900 Frame Relay Support

The communication line adapter (CLA) of the 3746 Model 900 consists of one to four LICs that provide SDLC, frame relay, or a combination of support for both. The data link control is outboarded from NCP to the 3746 CLA. This is called ODLC support, and for frame relay this means that the LMI functions, RFC 1490 encapsulation, and IEEE 802.2 LLC, are performed by the communication line processor (CLP) in the CLA and not by the NCP code. RFC 1490 describes an encapsulation method for carrying multiprotocol traffic over a frame relay backbone.

This provides much higher switching rates; each communication line adapter can switch 64-byte frames up to the rate of 3,000 frames per second enabling efficient consolidation of other networks and protocols on the 3745/3746 Model 900 based transport network.

9.4.1.2 NCP Frame Relay Frame Handler Support

NCP provides the frame relay frame handling (FRFH) function to route frame relay packets through the NCP network, or into another frame relay network. The special set of frame relay functions and the basic frame relay frame handler (FRFH) function are referred to collectively as frame relay switching equipment (FRSE) support in the NCP product. The related and optional frame relay support includes such things as the alternate frame relay virtual circuit routing capability, NCP/VTAM FRSE set dynamic reconfiguration (FRSE DR), and NNI LMI support.

9.4.1.3 Supported LMI Procedures

NCP determines the mode of LMI support at activation of the LMI subport. This is only done if an LMI support is defined on the physical line. NCP supports the network-user (NUI), network-network (NNI), and user-network interfaces (UNI). NCP determines the mode based on LMI frames received. This process is not defined by the frame relay standards, but is an NCP specific implementation.

NCP supports the following LMI procedures:

Bidirectional LMI
NCP will use bidirectional LMI support whenever the other end supports bidirectional LMI. Both status enquiry messages and status messages are sent.

Asynchronous status message
Asynchronous status messages are only sent by the network side. NCP will report a DLCI status change with an asynchronous status message unless:

- NCP operates in 'user-side' mode
- LMI support is not active
- The DLCI is new - in this case, NCP will send a Status (FULL) message to the next Status Enquiry
- NCP is in the process of building a Status (FULL) message, or
- A buffer is not available

NCP will not send LMI Status (FULL) messages larger than MAXFRAME.

9.5 6611 Network Processor Frame Relay

The IBM 6611 Network Processor running Multiprotocol Network Program (MPNP) is a powerful multiprotocol router that uses frame relay (among others) as a DLC to transport higher layer protocols between multiple routers in a network. The 6611 supports many functions and protocols over frame relay links. Some of them are the following:

- Source route bridging
- Transparent bridging
- Translational bridging
- IP routing
- IPX routing
- AppleTalk
- Banyan VINES
- XNS
- DECnet
- Boundary Access Node (BAN)
- SNA and multiprotocol LAN encapsulation (RFC 1490)

The 6611 provides frame relay terminating equipment (FRTE) functions only and cannot be used as a frame relay frame handler (FRFH). It supports both connections to a frame relay network, FRTE-FRFH, and direct, FRTE-FRTE, attachments.

The IBM 6611 supports frame relay encapsulation of SNA and multiprotocol traffic described in RFC 1490. Both fragmentation of long frames and re-assembly of fragmented frames are supported. The maximum frame size is fixed, so maximum frame size negotiation, using XID, is not supported.

Support for frame relay is available on all serial ports on the 2-port serial, the 4-port serial, and the combination (2 serial plus one LAN port) adapters. Configuration of each port on these adapter cards is totally independent of any other port.

Interfaces and speeds supported are:

- EIA 422/449, from 9600 bps to 2.048 Mbps
- CCITT V.35, from 9600 bps to 2.048 Mbps
- CCITT V.36, from 9600 bps to 2.048 Mbps
- CCITT X.21, from 4800 bps to 2.048 Mbps
- EIA 232/CCITT V.24, from 4800 bps to 19.2 kbps

9.5.1.1 Local Management Interface (LMI)

The 6611 Network Processor uses LMI procedures, either LMI REV.1, ANSI T1.617 Annex-D, or ITU-T Q.933 Annex A, to detect active and newly active DLCIs. The following LMI procedures are supported:

- Unidirectional LMI support, user-to-network (UNI) only

  The frame relay network must support the Network-to-User (NUI) interface.
- Asynchronous LMI support

  The 6611 accepts unsolicited status reports, for a single DLCI, received from the frame relay network.
- No LMI support

  When connected in a point-to-point configuration the other partner must support the Network-to-User Interface (NUI) or LMI must be disabled. In the latter case, all DLCIs have to be configured and are assumed active.

Scenarios in which DLCIs have to be explicitly specified are as follows:

- LMI disabled
- LMI REV.1, ANSI T1.617 Annex D or ITU-T Q.933 Annex A selected
  1. When bridging or AppleTalk is enabled, DLCIs for **all** other protocols must be configured for the port in question.
  2. When InARP is disabled or the partner does not support InARP.
  3. When some protocols are restricted to specific DLCIs.

9.5.2 Congestion Management

The 6611 support for congestion includes:

- Forward Explicit Congestion Notification (FECN)

  The 6611 will log the number of frames with FECN set within its frame relay MIB. However, it will not take action to relieve the congestion. The 6611 will never set FECN itself.
- Backward Explicit Congestion Notification (BECN)

  The 6611 will log the number of frames with BECN set within its frame relay MIB; however, it will not take action to relieve the congestion. The 6611 will never set BECN itself.
- Discard Eligibility (DE)

  The 6611 will never set or take action on DE.
- Committed Information Rate (CIR)

  The 6611 does not allow the CIR to be configured. Data may be sent into the frame relay network at the speed of the access line.
- Excess Burst Size (B_c)

  The 6611 does not allow an excess burst size to be configured.

Congestion avoidance and recovery is dependent upon flow control mechanisms available at the higher protocol layers.

9.6 2220 Nways Broadband Switch

The IBM 2220 Nways BroadBand Services is a fast packet and ATM cell switch based on IBM′s Nways BroadBand Services (NBBS) architecture. This architecture is designed specifically to meet the challenges of broadband, multi-service transport networks.

Frame relay support is offered by an NBBS component called Access Services. Access Services are provided by protocol-specific access agents that, by presenting a standard interface to an attaching device, ensure that the endstation protocol does not need any changes in order to be supported over an NBBS network. The frame relay access agent appears to an attaching device as a frame relay frame handler (FRFH).

The IBM 2220 Nways Broadband Switch provides the following frame relay modes:

- Frame Relay Standard Mode (FRS)
- Frame Relay IBM Add Mode (NBBS)

The first provides frame relay transport using fixed CIR, while the latter uses Nways BroadBand Services automatic bandwidth adaptation to provide bandwidth-on-demand.

Figure 44 on page 203 shows a frame relay network using the Nways switch.

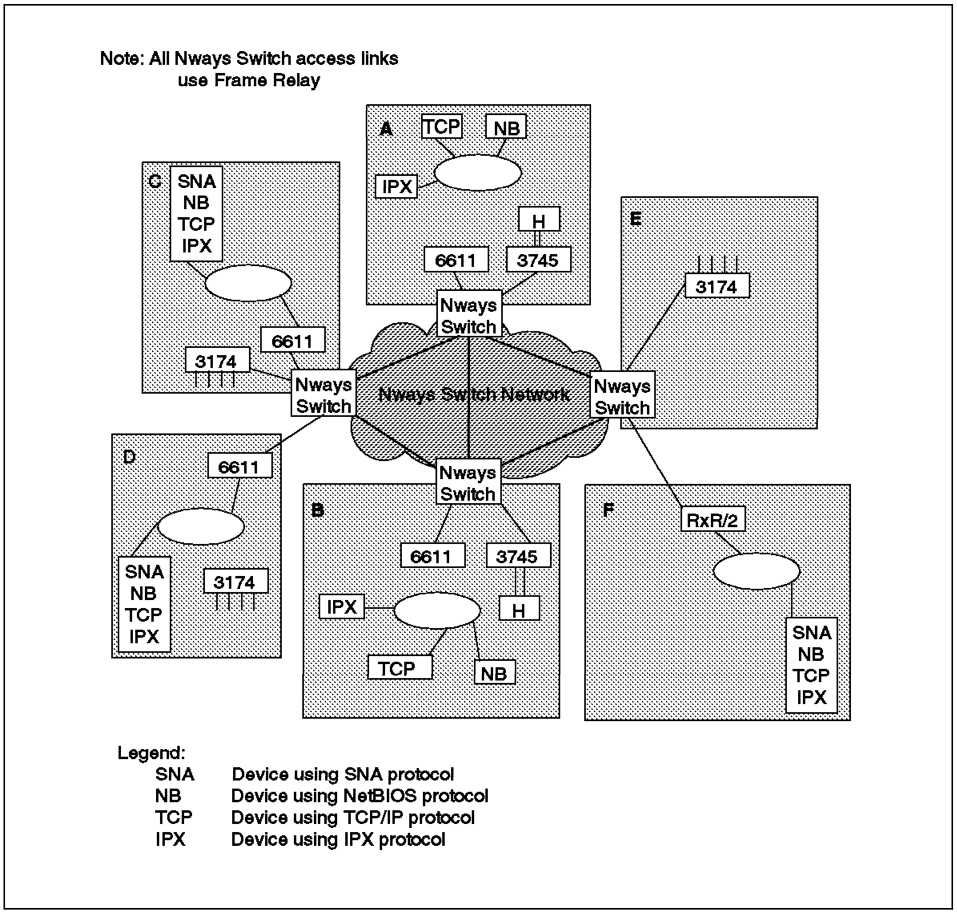


Figure 44. Frame Relay Network Using the Nways Switch

9.6.1.1 Frame Relay Standards and Protocol

The 2220 provides FRFH functions only. It supports attachments to end equipment (FRTE) and/or connections to frame relay networks.

9.6.1.2 LMI Support

The frame relay access agent supports the network-to-user interface (NUI), user-to-network (UNI), and the network-to-network interface (NNI).

9.6.1.3 2220 Frame Relay Physical Interfaces

Table 59 on page 204 depicts the interfaces and speeds supported for frame relay attachments to the IBM 2220 Nways Switch. The last column depicts the number of lines per adapter.

Table 59. Frame Relay Physical Interfaces			
Interfaces	**LIC Type**	**Speeds**	**No of lines**
V.35/X.21/RS.232	LIC 511	2.4-256 Kbps	60
V.35/X.21	LIC 512	56-2048 Kbps	4
DS3	LIC 513	45 Mbps	1
DS1/J1	LIC 514	56/64-1536 Kbps	4
E1 75 ohms	LIC 515	64-2048 Kbps	4
E1 120 ohms	LIC 516	2 Mbps	4
V.36/X.21	LIC 522	56-2048 Kbps	4
E2/E3/J2	LIC 523	up to 34 Mbps	1
HSSI	LIC 530	up to 52 Mbps	1

9.7 IBM 3174 Establishment Controller Frame Relay

Frame relay support for the 3174 is available for Models 11R, 12R, 13R, 14R, 21R, 23R, 41R, 43R, 61R, and 62R. The 3174 supports FRTE functions only. It cannot be used as a frame handler. The frame relay communications feature (#7020 or #7070) requires Configuration Support-C Release 5. The routing and bridging functions available depend on the 3174 model. Source route bridging requires Configuration Support-C Release 6.

Table 60. 3174 Models and Protocols Supported					
3174 Model	**Protocol**				
	SRB•	**SNA Type 2.0**	**SNA LAN Gateway**	**SNA Type 2.1 (APPN)**	**IP**
11R, 12R, 21R, 41R, 61R, 62R	y	y	y	y	y
13R, 14R, 23R, 24R, 43R	y•	n	n	y	y

Notes::

1. Source route bridging (SRB) is supported between local and remote token-ring LANs only and is therefore limited to the 3174s equipped with a token-ring adapter.

9.7.1.1 Adapter Type and Speed

The 3174 supports physical lines to frame relay networks as non-switched full-duplex lines over the following adapter types:

- CCITT V.24 (Type 1 Communication Adapter) for speeds up to 19.2 kbps
- CCITT V.35 (Type 1 Communication Adapter) for speeds up to 256 kbps
- CCITT X.21 (V.11) (Type 2 Communication Adapter) for speeds up to 256 kbps

The Communication Adapter (CA) is the normal TP adapter found in remote 3174 models. The Type 1 CA, found in Models x1R, allows V.24 or V.35 physical attachment; the Type 2 CA found in Models x2R supports X.21 physical attachment. Only 4-wire mode of operation is supported.

Frame relay is not supported on Concurrent Communication Adapters (CCA) or ISDN BRI adapters. For 3174 Models 13R, 14R, 23R, and 24R a CA can be installed in lieu of a CCA. In this case frame relay functions are limited to IP and APPN, since the token-ring is the *primary* SNA (type 2.0) link to the host.

The 3174 frame relay functions made available with Configuration Support-C Release 5 significantly extend the connectivity and networking flexibility of the IBM 3174 Establishment Controller.

9.7.1.2 SNA Routing over Frame Relay

The 3174 supports SNA functions, type 2.1 and type 2.0 over frame relay. SNA type 2.0 connectivity over frame relay requires either ACF/NCP (V7R1 or higher) or a 3172 at the other end of the PVC. RFC 1490 encapsulation is used to transport SNA frames so the remote partner must also support this encapsulation method.

LAN gateway support is provided over frame relay. Downstream PUs (DSPUs) can be defined using the same DLCI but with different SAP values, multiples of X′04′, for each DSPU.

The APPN dependent LU requester (DLUR) function is also supported over frame relay.

9.7.1.3 IP Routing over Frame Relay

Configuration Support-C Release 5 and RPQ 8Q1289, or Configuration Support-C Release 6 enable the 3174 to route IP frames between its LAN (token-ring or Ethernet) and frame relay interface, providing IP communication between LAN-attached and remote IP hosts. The 3174 does not support dynamic routing protocols. Static routes have to be defined for all destination hosts.

9.7.1.4 Source Route Bridging

The 3174 remote source route bridging (SRB) function has become available with Configuration Support Release 6. The SRB function enables the 3174 to bridge data of local LAN-attached devices to remote LAN-attached devices.

9.7.1.5 3174 LMI Support

The 3174 supports the following LMI procedures:

- Unidirectional LMI support, user-to-network (UNI) only

  Regularly the 3174 will solicit a *full* PVC status report. The adjacent node will respond by sending a status overview for all DLCIs defined on the frame relay link.
- Asynchronous LMI support

The 3174 accepts unsolicited status report, for a single DLCI, received from the adjacent node.

Bidirectional LMI is not supported. In a point-to-point connection the other side must support the network-to-user (NUI) interface. LMI must be disabled when the partner does not support the NUI interface.

The type of LMI support used is customized in question 562.

Configuration options are:

```
1 = None
2 = LMI REV 1
3 = ANSI ANNEX-D
5 = CCITT ANNEX-A
```

The default response is 3 (ANSI). Make sure that the same LMI standard is selected at both ends of the frame relay link.

9.8 IBM 3172 Interconnect Controller Frame Relay

The IBM 3172 Interconnect Controller provides a wide variety of local and wide area networking functions. Frame relay connectivity requires the installation of SNA Communications Program (SNA\Comm).

The 3172 provides FRTE functions only and cannot be used as an FRFH. SNA/Comm supports connections to a frame relay network, FRTE-FRFH, and direct, FRTE-FRTE, attachments.

9.8.1.1 3172 SNA Communications Program (SNA/Comm)

3172 SNA Communications Program enables SNA, including APPN, routing functions over frame relay. The actual SNA functions are performed by VTAM. Full APPN support requires VTAM Version 4 Release 1.

The following additional routing and bridging functions over frame relay can be made available in addition to the SNA functions:

- IP routing

  TCP/IP Offload can coexist with SNA Communications Program in the same 3172. This software solution provides for a high throughput TCP/IP and SNA host gateway over frame relay.

  To enable IP routing functions requires the installation of the following:
  - TCP/IP for OS/2 Version 2 or higher
  - TCP/IP Offload (either VM or MVS)
  - TCP/IP for VM or MVS
- IPX routing

To enable 3172 IPX routing requires the installation of RXR/2.

- Remote source route bridging

  3172 SNA Communications Program requires the installation of RXR/2 Version 2 to enable source route bridging functions between token-rings attached to the 3172 and remote frame relay connected bridges.

  Note: RXR/2 Version 2 does not support transparent bridging.

SNA Communications Program runs under OS/2 and is used to provide support for frame relay PVCs connecting to VTAM. SNA Communications Program is a link services architecture (LSA) device and appears to VTAM as an external channel adapter (XCA) device.

SNA PU types supported are the following:

- SNA type 2.0
- SNA type 2.1 (APPN)
- SNA type 4 (NCP)
- SNA type 5 (VTAM SSCP)

3172 SNA/Comm supports up to four frame relay links using WAC adapter cards with the following support:

- A single line at speeds up to 2048 kbps, or up to four lines with a total aggregate bit rate of 768 kbps.
- Maximum frame packet size is 4486 bytes.

9.8.2 Local Management Interface (LMI)

The 3172 supports both unidirectional LMI support (user-to-network and network-to-user) and bidirectional LMI support, and dynamically decides on the LMI support it should use. The 3172 will either use formats and procedures defined by the Frame Relay Forum, defined in LMI Revision 1 or conform to the ANSI standard. 3172 does not support the ITU-T LMI standard.

All basic frame relay functions, including LMI procedures, are offered by the same WAN access device driver as used by RXR/2.

9.8.3 Congestion Management

The 3172 support for congestion conditions include:

- Forward Explicit Congestion Notification (FECN)

  3172 will log the number of frames with FECN set within its frame relay MIB; however it will not take action to relieve the congestion. 3172 will never set FECN itself.

- Backward Explicit Congestion Notification (BECN)

When receiving a frame with BECN set, the 3172 transmit scheduler will skip servicing the output queue for the DLCI that is experiencing congestion one time. The MIB counter for the number of BECNs received will be incremented and an alert forwarded to NetView. 3172 will never set BECN itself.

- Discard Eligibility (DE)

  3172 will never set or take action on DE.

- Committed Information Rate (CIR)

  3172 allows the CIR to be defined; however it will not enforce a transmit rate according to the specified value. The CIR is defined per port and constitutes an aggregate value for all DLCIs using the port. When the CIR is exceeded, the 3172 will log the incident and forward an alert to NetView.

  Note: The ratio of committed information rate and committed burst size (CIR/B_c) decides the committed information measurement interval.

- Excess Burst Size (B_c)

  3172 allows an excess burst size to be defined; however it will not enforce a transmit rate according to the specified value.

9.9 IBM AS/400 Frame Relay

The AS/400 offers a variety of networking facilities and supports connectivity to a large number of devices. The AS/400 supports SNA and IP connectivity over frame relay, either across a frame relay network or via a point-to-point attachment. Both SNA and TCP/IP connectivity over frame relay are provided using RFC 1490 encapsulation. Bridged and routed formats are supported. The routed format is used between two adjacent stations connected via a PVC, which both support the RFC 1490 routed format. The bridged format is used to a remote station that is adjacent to the frame relay network (active PVC between both stations) but does not support the RFC 1490 routed format, or is LAN attached and the actual frame relay connectivity, for either SNA or IP traffic, is provided by a frame relay network attached LAN bridge.

SNA connectivity over frame relay includes communication to remote SNA type 2.1 nodes, for APPN including high-performance routing (HPR) functions, SNA type 4 nodes (using the NCP boundary function), or to SNA type 5 nodes (3172, using the VTAM boundary function). IP connectivity is available to any IP device.

The AS/400 provides FRTE functions only and cannot be used as an FRFH. It supports both connections to a frame relay network, FRTE-FRFH, and direct, FRTE-FRTE, attachments.

In addition, the AS/400 complies with RFC 1490:

- Multiprotocol interconnect over frame relay and SNA extensions.
- RFC 1940 encapsulation method is used for SNA and IP frames, but other frames will be discarded.

AS/400 frame relay connections are made using the 2666 High-Speed Communications Adapter with support for the following interfaces:

- V.36 and EIA RS-499 with speeds up to 2048 kbps
- V.35 at speeds up to 64 or 2048 kbps

  Note: The speed depends on the cable used. 2048 kbps is supported only for the 6-meter cable, but other cable lengths support up to 64 kbps.
- X.21 at speeds up to 2048 kbps

9.10 IBM Nways 2219 and IBM Nways 2225

This section contains information about frame relay functions supported by the IBM Nways 2219 and the IBM Nways 2225. The information contained within this section is based on Nways Wide Area Element Manager V4R1, unless indicated differently.

9.10.1 IBM Nways 2219 Frame Relay Switch

The IBM Nways 2219 Frame Relay Switch is a fully featured, high-performance, low-cost frame relay switch designed for building private, public carrier and hybrid frame relay networks. The 2219 is a 6-slot modular frame relay switch with 5 I/O module slots and RISC processing.

Table 61 is a summary of the supported I/O modules.

Table 61. IBM Nways 2219 I/O Modules Summary

I/O module	Port Speeds	Port Capacity	Frame Relay
Channelized E1	1.920	1 30-bundle E1	yes
Channelized T1	1.536	1 24-bundle T1 (full or fractional)	yes
V.35	4.096 Mbps	6 V.35	yes
6-port Universal	4.096 Mbps	6 V.35, 6 X.21,	yes
8 or 18-port Universal	128 Kbps	8 V.24, 8 X.21, 18 V.24, or 18 X.21	yes

9.10.2 IBM Nways 2225 MultiService Switch Models 400 and 450

The IBM Nways 2225 MultiService Switch provides a flexible and cost-effective multiservice WAN platform for interworking among frame relay, SMDS ISDN and ATM. Interworking lets technologies at either end point of a connection to communicate seamlessly with one another or make use of new network transport services.

The IBM Nways 2225 MultiService Switch family consists of two models: Model 400, which is an 8-slot unit (6 I/O slots), and Model 450, which is a 16-slot (14 I/O slots) unit. The 2225 processing is RISC multiprocessing.

Note: There is no upgrade path from Model 400 to Model 450.

The following table summarizes the main characteristics of I/O modules available in the IBM Nways 2225:

Table 62. IBM Nways 2225 I/O Modules Summary

IOP module	Port Speeds	Port Capacity	ATM	SMDS	frame relay
Universal IO	8 Mbps	8 V.35 or 8 X.21	yes*	yes	yes
Unchannelized T1/E1	1.544 or 2.048 Mbps	4 24-bundle T1 or 4 30-bundle E1	yes *	yes	yes
Channelized T1/E1	24 or 30 56/64 Kbps channels	4 24-bundle T1 or 4 30-bundle E1	yes*	yes	yes
HSSI	45 Mbps	2 HSSI	yes*	yes	yes
DSX-1	1.54 Mbps	10 24-bundle T1 or 10 30-bundle E1	yes*	yes	yes
Channelized DS3	56 Kbps through to 1.54 Mbps	Up to 28 T1 channels	no	no	yes
ATM UNI T3/E3	44.736 Kbps or 34.368 Kbps	1 T3 or E3 port	yes	no	no

9.10.2.1 2219 and 2225 LMI Support

The following LMI standards are supported:

- ANSI T1.617 Annex D (default)
- ITU-T Q.933 Annex A
- LMI Revision 1

Additionally, the IBM Nways 2219 and the IBM Nways 2225 Switches could be configured for autodetection or have Link Management Interface disabled. When you configure a port for autodetection, the IBM Nways Switch automatically senses the type of the protocol employed by the user devices and adjusts accordingly.

9.10.2.2 2219 and 2225 Congestion Management

The Nways 2219 and 2225 WAN switches use standard congestion notification bits, FECN and BECN, to inform users about network congestion. The user device should slow down transmission when notified.

9.11 2210 Nways Multiprotocol Router and 2216 Nways Multiaccess Connector

The 2210 Nways Multiprotocol Router and 2216 Nways Multiaccess Connector software support is provided by IBM Nways Multiprotocol Routing Services (MRS) and IBM Nways Multiprotocol Access Services (MAS) respectively. This information focuses on product details relevant to frame relay only. More information about the 2210 and 2216 can be found in Chapter 2, "Local Area Network" on page 35.

The 2210 Nways Multiprotocol Router and 2216 Nways Multiaccess Connector support frame relay on the following serial interfaces:

- EIA 232D/V.24
- V.35
- V.36/RS 449
- X.21

Frame relay is also supported over the ISDN interface.

Protocols supported over frame relay are:

- Banyan VINES
- TCP/IP
- DECnet IV
- DECnet V/OSI
- BGP
- NetBIOS
- LNM
- IPX
- AppleTalk
- SNA
- Source route bridging
- Translational bridging
- Source route transparent bridging
- Source route to transparent conversion bridging

The 2210 and 2216 frame relay functionality includes RFC 1490-compliant routed and bridge frame formats and Boundary Access Node (BAN) support

9.11.1 Local Management Interface (LMI)

The following LMI standards are supported:

- ANSI T1.617 Annex D
- ITU-T Q.933 Annex A
- LMI Revision 1

When LMI is enabled, the exchange of LMI messages is used to determine whether or not an interface is up (that is, operational). The default standard is ANSI T1.617 Annex D.

9.11.2 Congestion Management

The 2210 Nways Multiprotocol Router and 2216 Nways Multiaccess Connector use some special parameters to control congestion. These are:

- Minimum Information Rate (IR)

  The minimum information rate is the minimum data rate for a PVC that the router throttles down to when it is notified of congestion. The minimum IR is set as a percentage of the CIR (in case of a CIR equal to 0, the minimum IR is 64 bps).
- Maximum Information Rate

  The maximum information rate is the maximum data rate at which the router transmits for a PVC.
- Variable Information Rate (VIR)

  The variable information rate ranges from the configured minimum IR to the calculated maximum IR when the CIR monitoring or congestion monitoring features are enabled. The VIR is gradually decreased down to the minimum IR when the router is notified of congestion on a circuit and is gradually increased to the maximum IR when the router stops receiving congestion notifications. The percentages of the IR to decrease and increase can be configured.

Two types of monitoring can be enabled: CIR monitoring and Congestion Monitoring.

CIR monitoring is an optional frame relay feature that can be set for each interface to prevent the router from creating congestion conditions in the frame relay network. CIR monitoring allows the VIR for a PVC to range between the configured minimum and maximum IR. CIR monitoring is disabled by default.

Congestion monitoring is an optional feature, set per interface, that allows the VIR of PVCs to vary in response to network congestion. The VIR assumes values between the minimum IR and a maximum IR of the line speed. Congestion monitoring is enabled by default.

CIR monitoring, if enabled, overrides congestion monitoring. If both CIR monitoring and congestion monitoring are disabled, the VIR for each PVC on the interface is set to the line speed and does not decrease in response to network congestion.

9.12 Communications Server for OS/2 Warp V4R1

Communications Server for OS/2 Warp V4R1 has implemented frame relay data link control (DLC) to support SNA and TCP/IP protocols. In previous releases, the RXR/2 product was required in order to connect to a frame relay network. In this chapter, we review the newly integrated frame relay implementation, which includes BAN (border access node) and BNN (border network node) support. If you require more information about frame relay, please see *Communications Server for OS/2 Warp V4R1 Frame Relay*, GC31-8319-01.

> **Note**
>
> Communications Server for OS/2 Warp V4R1 has integrated frame relay support as a DLC only. Other frame relay functions such as source route bridging (SRB) are not supported.

9.12.1 SNA over Frame Relay

Communications Server supports the SNA extensions to RFC 1490 that define routed format frames used for SNA traffic. ACF/NCP and 3174 support these extensions. If the remote end does not support the extensions, Communications Server can use bridged format frames to communicate.

Frame relay does not participate in windowing or retransmissions, so SNA Communications Server uses Logical Link Layer Type II (LLC2 IEEE 802.2) protocol over frame relay.

The Communications Server frame relay support was extracted from the RouteXpander/2 product. Communications Server′s frame relay consists of a network driver and a protocol module. This allows the association of 802.2 or IP protocols with the frame relay WAN access for 802.5. This software lets the workstation communicate through the frame relay WAN access as though it were a token-ring LAN adapter device driver. Software that ordinarily communicates over token-ring LANs can communicate through the WAN access for 802.5 without any knowledge of the network it is traversing. This allows LAN-based protocols and the programs that they support to run without being changed. The protocols are bound to the WAN access for 802.5 and the network handles the communication.

9.12.2 TCP/IP over Frame Relay

Frame relay in Communications Server can also be used to transport TCP/IP traffic using the RFC 1490 routed frame format. The ARP requests are broadcast in order to learn the correct DLCI. Then the flows are broadcast as if this was a token-ring LAN.

You could use a Communications Server machine as an IP router between a LAN network and a frame relay network. In this case you only have to define the TCP/IP support, enable the routing function (ipgate on), and, if you want, start the routed program in order to propagate the routing table in both networks.

If you also have defined Sockets over SNA Gateway you could start the gated program making a check in the RIP box of the backup and load balancing. If you are running in a Sockets over SNA parallel gateway, you already have the gated program started, so you must not start any other routed program.

9.13 IBM 2218 Nways Frame Relay Access Device

The 2218 can operate either as a Frame Relay Node (FN) or a Conversion Node (CN) in a network.

In Conversion mode, the serial protocols are converted to LLC2 for transport over a token-ring or Ethernet LAN. The CN uses the LAN as its network to transport data. The CN does not support frame relay.

The frame relay node uses RFC 1490 (Multiprotocol Interconnect over Frame Relay Networks) to transport LLC2 data over frame relay. In addition, SNA sessions can be locally terminated to provide increased *session resiliency*.

Protocols supported by the 2218 on its synchronous port are frame relay, X.25, SDLC, BSC and Polled Async. One FN can concentrate multiple protocols and transport the data via a single PVC to another 2218 that converts back to the native protocol and vice-versa. Data can also be transported onto multiple PVCs for mutiple host support. At the host end, the 2218 can attach to a FEP (for example, IBM 3745) via a token-ring, or if the FEP supports frame relay then directly to the FEP.

The FN with extended support allows remote bridging and routing across frame relay to a compatible partner such as 6611, 2210, RxR/2, and 3174. Extended support is available only with 2218-3xx models.

Since it supports RFC 1490 encapsulation, the 2218 can be configured for SNA BNN, SNA BAN, transparent and source route bridging, and end node support.

9.13.1 2218 SNA Support

The 2218 FRAD SNA support provides the following functions:

- Point-to-point or multidrop SDLC support
- Primary and secondary emulation (poll spoofing)
- SDLC to LLC2 conversion with local termination
- Boundary network node (BNN) and boundary access node (BAN)
- Support for PU1 (5x94), PU2 (3x74), PU2.1 (AS/400), and group poll devices (3174R)
- Line speeds up to 64 kbps
- Half or full-duplex SDLC

9.13.2 2218 Bisync Support

The Bisync option enables you to connect a bisync host with bisync PUs and their attached devices across a frame relay network, token-ring or Ethernet LAN. BSC protocol support includes the following:

- Support up to 60 CUs (SDLC and/or Bisync) and up to 250 devices (printers and/or terminals).
- BSC to LLC2 encapsulation for WAN transport
- Bisync 3270 to SNA 3270 conversion, eliminating BSC centralized computer requirement
- Line speeds up to 19.2 kbps
- Point-to-point or multidrop connection
- Primary or secondary station emulation (poll spoofing)
- Multiple BSC, representing multiple locations as a single multidrop link

9.13.3 Other 2218 Protocol Support

There are other protocol options available with the IBM 2218 FRAD Frame Node support such as Legacy Bisync Transport, Polled Async Devices support, TCP/IP routing and bridging, and IPX bridging. See the IBM 2218 publications for more details.

9.13.4 Summary of IBM 2218 Features

- Frame relay interfaces
  - 1-8 ports, maximum line speed = T1 / E1
  - Frame relay network connection or point-to-point connection
  - Up to 200 DLCIs per frame relay port
- Logical management interface
  - LMI and Annex D
  - Link polling timer (T391/nt1)
  - Status polling timer (N391/nN1)
- Supported frame relay protocols
  - RFC 1490 multiprotocol over frame relay
    - SNA/BNN

        - Transparent/source route bridging
        - IP endnode
  - RFC 1294 SNA over frame relay
- LAN interface : optional token-ring or Ethernet LAN support
- Access ports : 2,4,or 8 ports.
- Supported protocols
  - SDLC
    - Point-to-point/multidrop
    - NRZI/NRZ
    - Primary/secondary emulation
    - Switched/constant carrier
    - DTE/DCE Interface
  - Bisync/3270 (optional protocol)
  - LLC2 (LAN)
  - Async (optional ptorocol)
- Supported DSPUs
  - 60 serial line-attached PUs and 60 LAN attached PUs (optional)
  - SNA
    - PU 1, 2, 2.1
    - Bisync/3270
    - Bisync
- Management support
  - SNMP
  - NetView
  - FRAD/Talk
  - FRAD/Manager

9.13.5 2218 Frame Relay Node Features

Table 63. 2218 Frame Relay Node Models		
Serial Link Support	**2218 - 1xx**	**2218 - 3xx**
Access Port protocols - any combination of:		
SNA/SDLC BNN	YES	YES
BSC/3270	YES	YES
Multiprotocol Async	YES	YES
Supported Controllers	16	60(see note)
WAN Port Protocols		
Frame Relay Annex D	YES	YES
Frame Relay LMI	YES	YES
Point-to-Point	YES	YES
RFC 1490 BNN & BAN	YES	YES
Priority Bandwidth Allocation	YES	YES
CIR Conformance	YES	YES
Special Ports		
Local/Remote Management	YES	YES
Local T7	YES	YES
SLIP	Planned	Planned
Note: The 2218 - 3xx can support an additional 60 LAN PUs		

9.14 IBM RouteXpander/2 Frame Relay

RXR/2 is designed to be used as a bridge and/or a multiprotocol router to provide small LANs within an enterprise access to the rest of the network. It can be used as a low-cost feeder node from a LAN to a high-performance router while at the same time communicate with other RXR/2 nodes. RXR/2 is a program product that runs on the OS/2 platform and in tandem with other OS/2 program products provides the following routing and bridging functions over frame relay:

- SNA, including APPN, routing
- IP routing
- IPX routing
- Remote source route bridging
- Remote transparent bridging (RXR/2 Version 1 only)

The following table shows how RXR/2 is able to interoperate with the various IBM networking products discussed in this book.

Table 64. RouteXpander/2 Frame Relay Interoperability Matrix					
Networking Product	**Bridging**		**Routing**		
	Source Route	**Transparent•**	**SNA•**	**IP•**	**IPX**
RXR/2	• RXR/2 • 6611 • TR Bridge Program • 3174	• RXR/2• • 6611	• RXR/2• • 3745 • 3174 • 3172 • AS/400	• RXR/2• • 6611 • 3745• • 3174 • 3172 • AS/400	• RXR/2 • 6611

Notes::

1. RXR/2 Version 1 Only
2. Based on SNA functions (Type 2.x) offered by CM/2
3. Requires TCP/IP for OS/2
4. Statement of direction

RXR/2 provides FRTE functions only and cannot be used as an FRFH. It supports connections to a frame relay network, FRTE-FRFH, and direct FRTE-FRTE, attachments.

The number of physical links supported by RXR/2 is dependent on the higher-layer protocols. RXR/2 Version 2.00 provides support for the following:

- Source route bridging, 2 ports (1 WAN, 1 LAN recommended)
- IPX, 2 ports (1 WAN, 1 LAN recommended)
- IP, 8 ports (1 LAN maximum recommended)
- SNA/APPN, 2 LAN or WAN ports

RXR/2 Version 2.0.2 increases the number of supported ports as follows:

- Source route bridging, 3 ports (2 LAN maximum recommended)
- IPX, 9 ports (2 LAN maximum recommended)

In addition, with RouteXpander Multiport Support/2 added to the V2.0.2 base, support for source route bridging is increased to nine ports (2 LAN maximum recommended). Link speeds can be up to 2 Mbps. The maximum frame size available is 4486 bytes.

Chapter 10. AnyNet

AnyNet is a family of software products consisting of multiprotocol access nodes and multiprotocol gateway nodes that are based on the multiprotocol transport networking (MPTN) architecture.

The multiprotocol transport networking architecture describes the logical structures, formats, protocols and operating principles that allow applications to use networks other than the one originally written for, without any change to the existing application. Included among the implementations of the MPTN architecture include:

- Sockets over IPX
- Sockets over NetBIOS
- Sockets over SNA
- SNA/APPC over TCP/IP
- IPX over TCP/IP
- IPX over SNA
- NetBIOS over TCP/IP
- NetBIOS over SNA

Traditionally, networking APIs are tied to one particular network protocol family. For example, if you develop a program that uses the sockets API, such a program is traditionally tied to the TCP/IP protocol stack. If you develop a program that uses the CPI-C API, such a program is traditionally tied to the SNA protocol stack. Multiprotocol transport networking removes the tie between a particular API and a particular network protocol family, allowing your socket programs to use an SNA network and your CPI-C programs to use a TCP/IP network.

AnyNet implements two different node types:

- An AnyNet Access Node

  An access node provides functions that allow an application program running on the access node to use a network for which the API was not originally intended. On an access node you can, for example, run a socket program that uses an SNA network to communicate with another socket program on another access node.
- An AnyNet Gateway Node

  A gateway node connects two different networks and provides network protocol conversions between the related network protocols. A gateway node can, for example, connect a TCP/IP and an SNA/APPN network, allowing a socket program on an access node in the SNA/APPN network to communicate with a socket program that runs on a native TCP/IP host attached to the TCP/IP network.

See Figure 45 for an example of AnyNet node types.

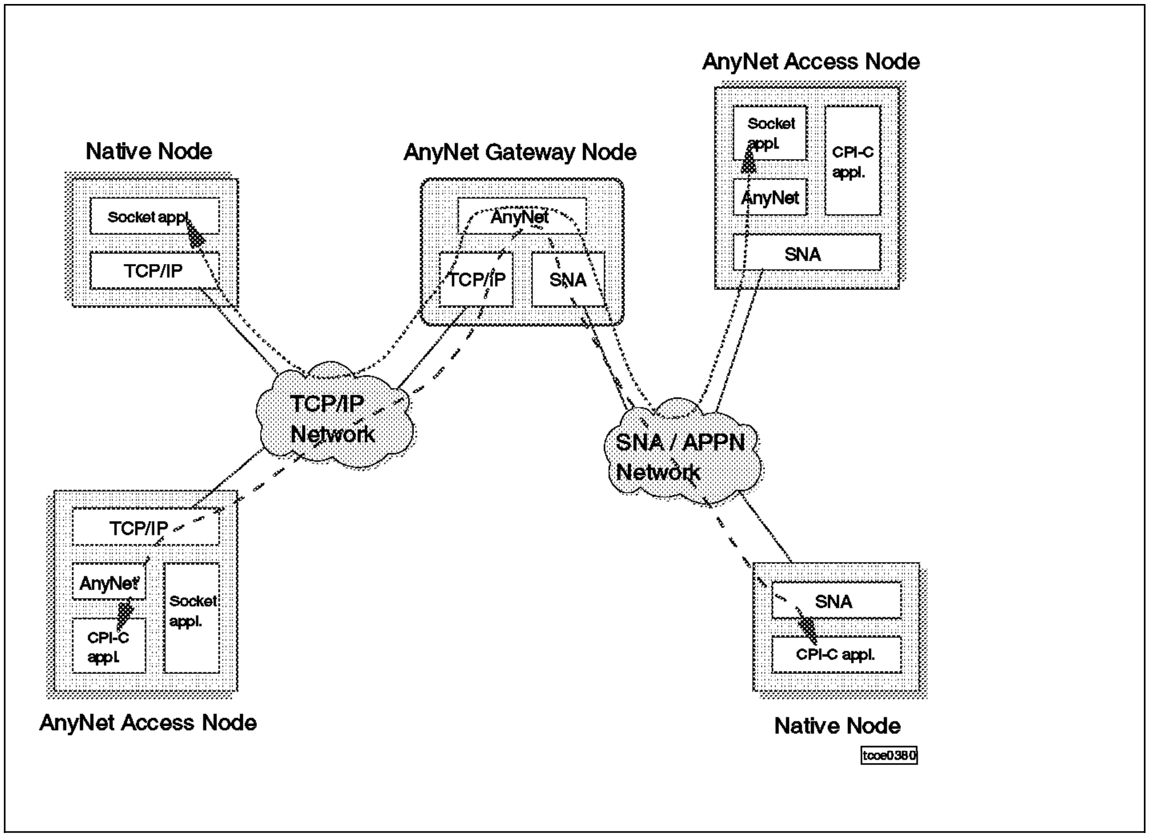


Figure 45. AnyNet Node Types

Since AnyNet supports connectivity across heterogeneous networks, it must deal with different address formats of the network protocols it supports. In order to avoid disruption of either transport users or transport providers, AnyNet allows a transport user to use its existing transport address format, while the serving transport provider uses transport addresses that its network expects.

AnyNet provides address mapping between a transport user′s address and a transport provider′s address when different addressing schemes are used.

10.1 AnyNet Product Overview

Table 65 shows an overview of IBM products that provide AnyNet functions.

Table 65. AnyNet Products Overview

Protocols / Products	**AnyNet/2 V2.0**	**AnyNet/2 NetBEUI over SNA**	**AnyNet IPX over SNA Gateway for OS/2**	**AnyNet SNA over TCP/IP Gateway for OS/2**	**AnyNet APPC over TCP/IP for Windows**	**AnyNet/400 in OS/400**	**MVS VTAM 4.2 - 4.4 AnyNet Feature**	**Communications Server for AIX V4.2**	**2217 Nways Multiprotocol Concentrator**	**Communications Server for OS/2 Warp V5**	**Com Server for Windows NT**
Sockets over IPX	X					X					
Sockets over NetBIOS	X										
Sockets over SNA	X					X	X	X		X	X
Sockets over SNA Gateway								X	X	X	X
SNA/APPC over TCP/IP	SNA				APPC	APPC	SNA	APPC		SNA	SNA
SNA/APPC over TCP/IP Gateway				SNA			SNA	APPC	SNA	SNA	SNA
IPX over SNA Gateway			X						X	X	
IPX over IP Gateway										X	
NetBIOS over IP Gateway										X	
NetBIOS over SNA		X									
NetBIOS over SNA Gateway									X	X	

10.1.1 Sockets over IPX

Sockets over IPX enables C application programs using the IBM TCP/IP AF_INET socket interface to communicate with each other over IPX networks.

10.1.2 Sockets over NetBIOS

Sockets over NetBIOS enables C application programs using the IBM TCP/IP AF_INET socket interface to communicate with each other over NetBIOS networks.

10.1.3 Sockets over SNA

Sockets over SNA allows application programs written to the socket API to run over an SNA transport. Sockets over SNA will intercept the request, perform IP address to LU name mapping and send the request out over the SNA network. For example, installing Sockets over SNA access node capability at the end nodes would allow sockets applications like Web browsers to communicate over SNA ports.

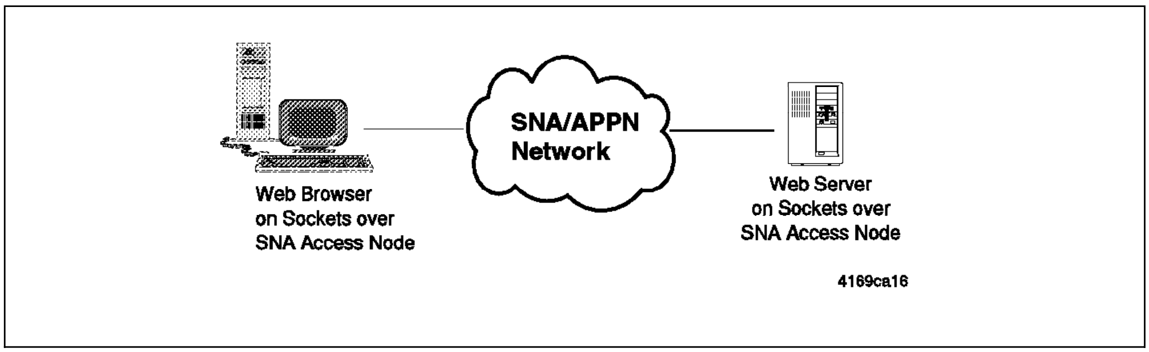


Figure 46. Sockets over SNA Access Nodes

A Sockets over SNA gateway could be used in combination with a Sockets over SNA access node to provide the gateway between the SNA and TCP/IP protocols.

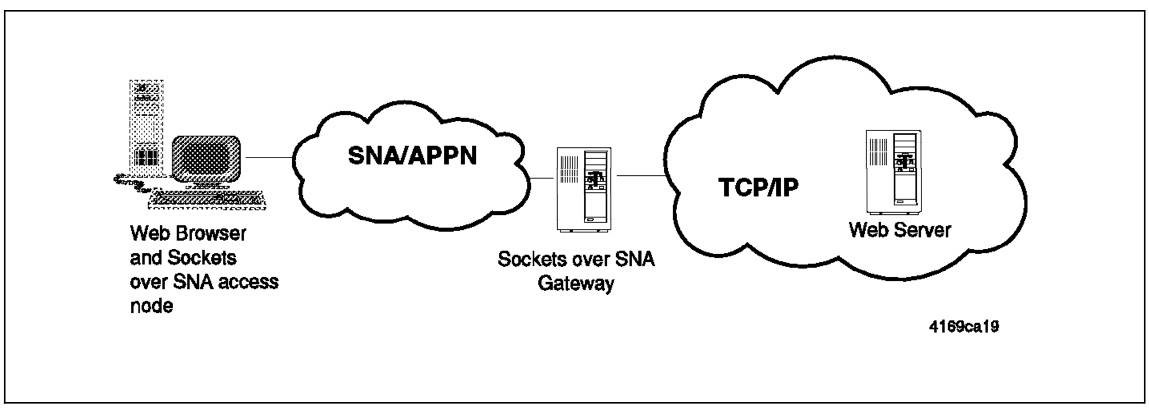


Figure 47. Sockets over SNA Access and Gateway Nodes

Sockets over SNA gateways can be cascaded to connect two TCP/IP networks over SNA. Using gateways between the SNA and TCP/IP networks would allow communication between the clients without any change in software on the client platform.

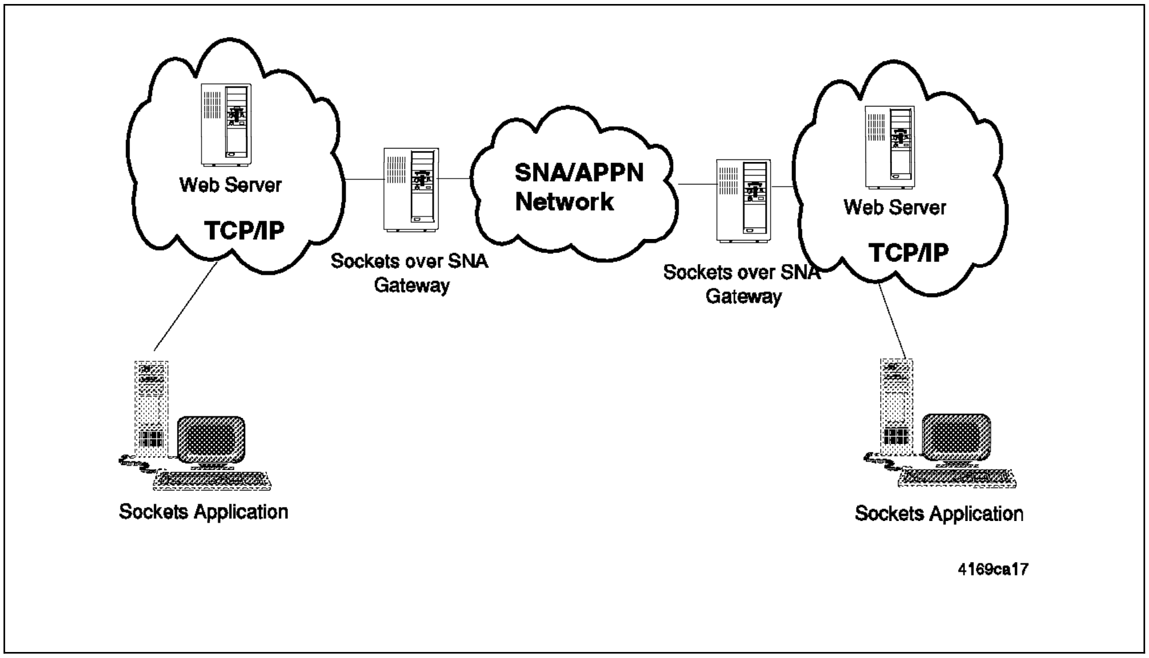


Figure 48. Cascaded Sockets over SNA Gateways

Sockets over SNA access nodes and gateways can be combined to allow socket applications on SNA platforms to communicate when there is a TCP/IP network between the two SNA networks.

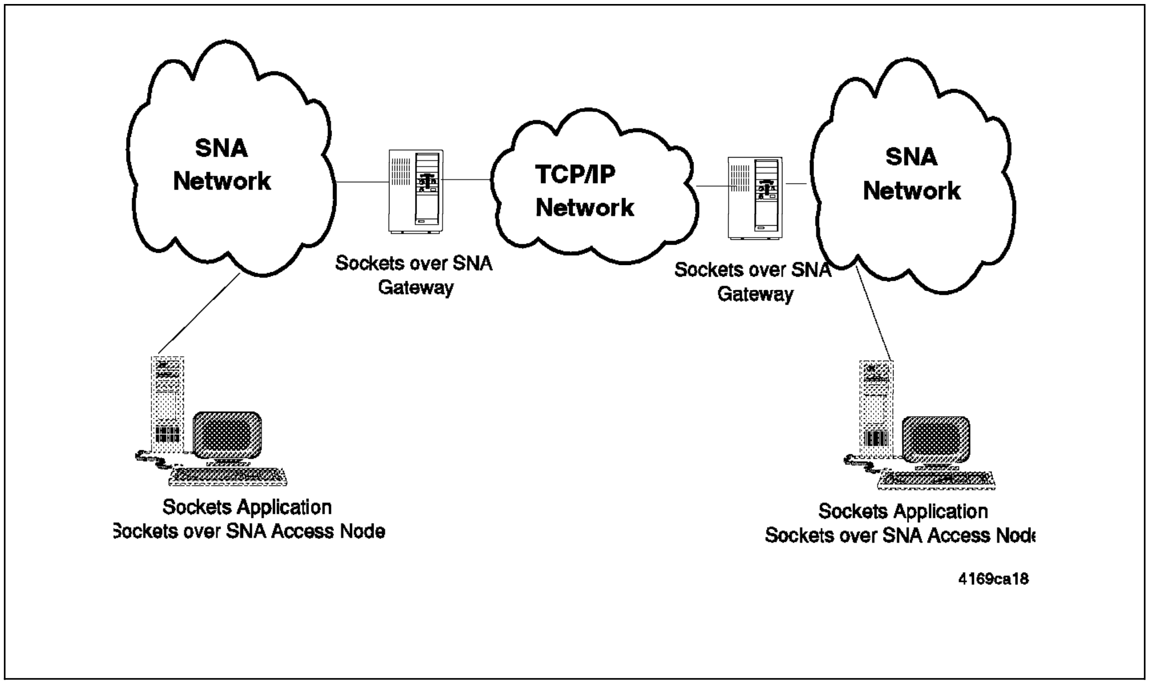


Figure 49. Cascaded Sockets over SNA Gateways

10.1.4 SNA over TCP/IP and APPC over TCP/IP

Communication between SNA applications can be transported over TCP/IP networks using SNA over TCP/IP AnyNet functions. SNA over TCP/IP includes LU 6.2 and dependent LU communication. APPC over TCP/IP support includes LU 6.2 only.

Installing SNA over TCP/IP access node capability at the end nodes allows SNA applications to communicate over TCP/IP ports.

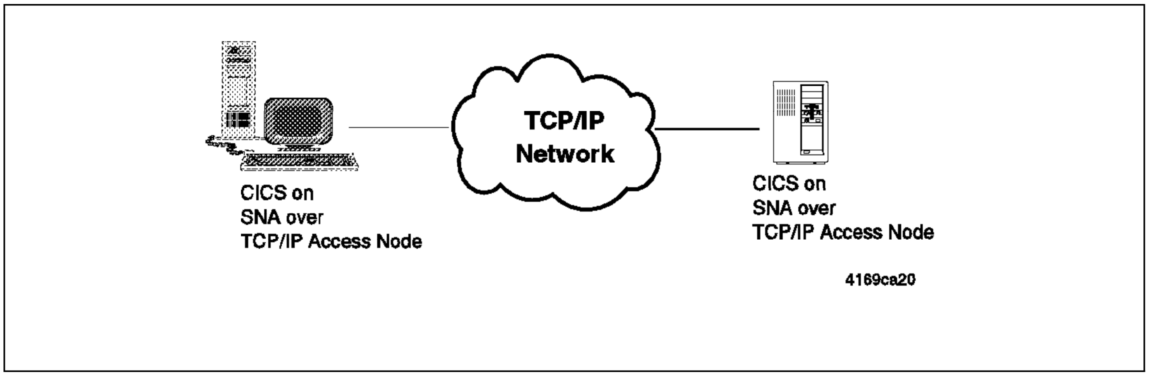


Figure 50. SNA over TCP/IP Access Nodes

An SNA application on a TCP/IP platform can communicate with SNA applications in an SNA network by using an SNA over TCP/IP access node and gateway.

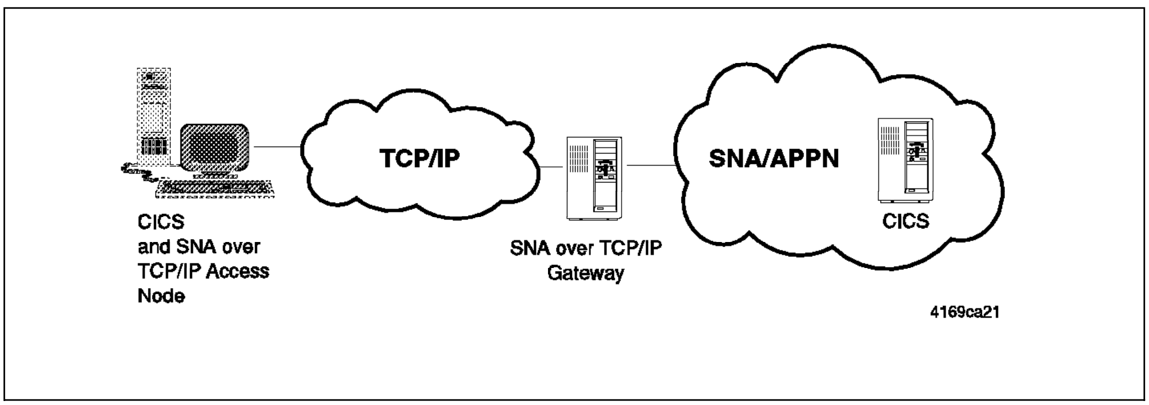


Figure 51. SNA over TCP/IP Access and Gateway Nodes

SNA over TCP/IP gateways can be used to connect two SNA networks over a TCP/IP network.

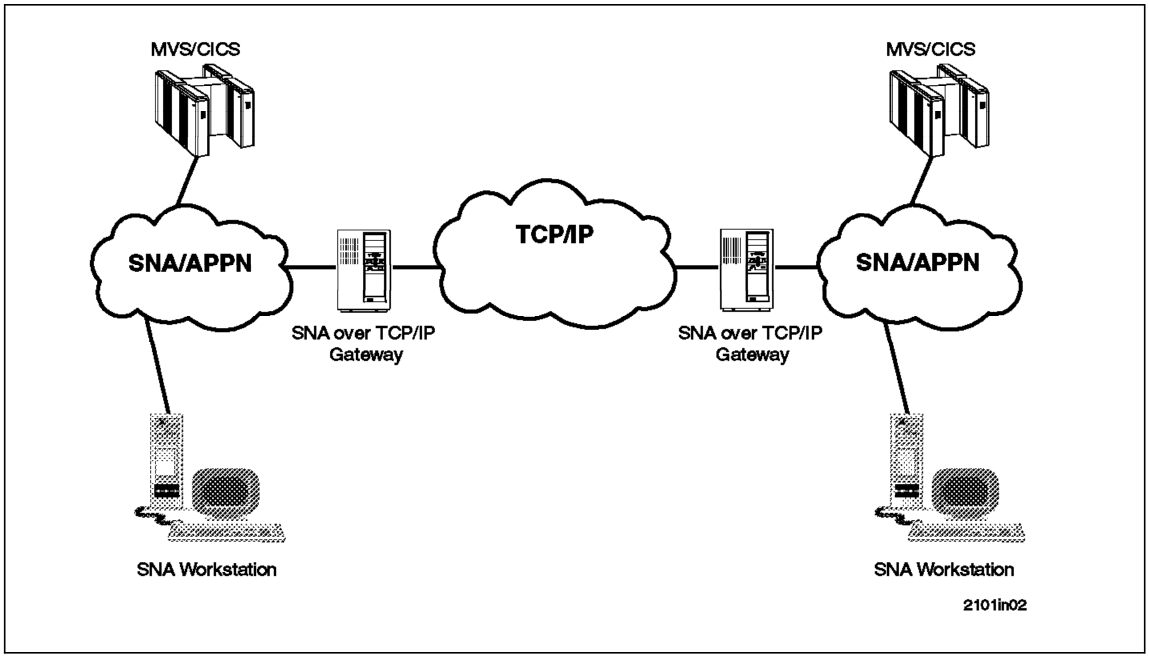


Figure 52. Connecting Two SNA Networks over TCP/IP

In the case where there is a mix of TCP/IP and SNA networks and SNA applications reside on nodes in TCP/IP networks, a combination of SNA over TCP/IP access and gateway nodes can be used.

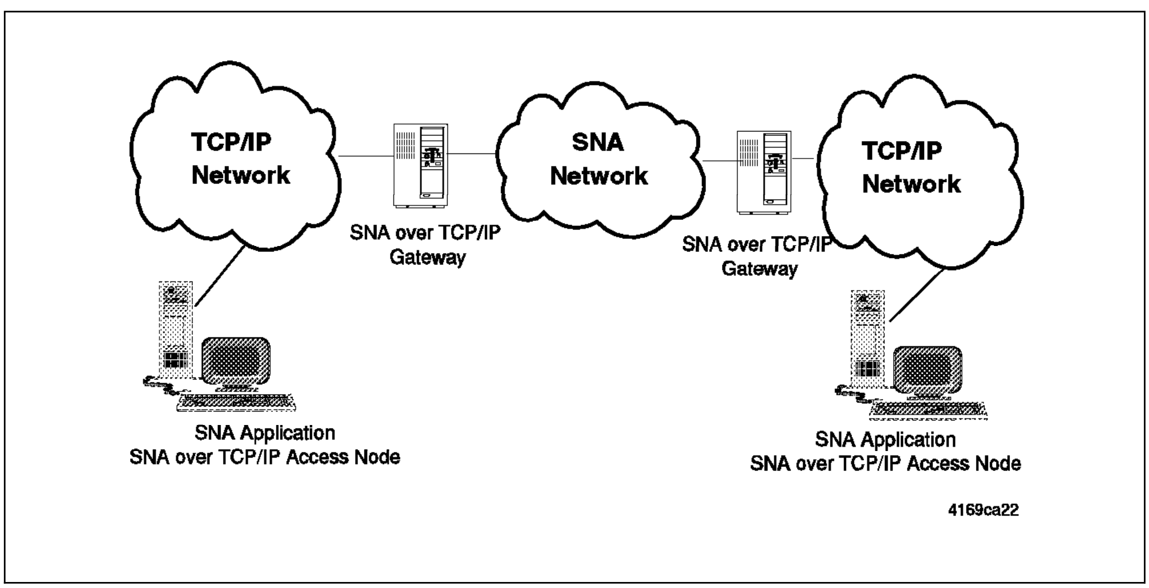


Figure 53. Cascaded SNA over TCP/IP Gateways

10.1.5 IPX over SNA Gateway

The IPX over SNA gateway function enables Novell NetWare Internet Packet Exchange (NetWare IPX) communication from one LAN to another over an existing wide area network (WAN).

10.1.6 NetBEUI over SNA

NetBEUI over SNA enables NetBIOS applications to communicate over SNA networks. NetBIOS Extended User Interface (NetBEUI) over SNA uses full-duplex conversations, non-blocking APPC operation, data compression, LU-LU session-level security, and modem support.

10.2 MVS VTAM AnyNet Feature

The VTAM AnyNet function enables application programs to communicate, without change, over different transport networks and across interconnected networks.

Beginning with MVS VTAM 4.2 AnyNet was offered as a feature to provide the following:

- Sockets over SNA
- SNA over TCP/IP

SNA over TCP/IP provides support for all LU types, dependent and independent. It allows concurrent sessions over the TCP/IP network to LUs in different SNA networks. DLUR/DLUS sessions are supported. An SNA over TCP/IP gateway is provided to allow SNA applications located in an SNA network to communicate through the gateway to SNA application programs located in a TCP/IP network.

The Sockets over SNA function enables application programs that use the C socket API to communicate over SNA networks with other application programs that also use the C socket interface. Sockets over SNA supports LU 6.2 full-duplex conversations and VTAM′s fully qualified network name capability.

VTAM 4.3 expands these options by adding the following:

- OE DCE RPC socket application support across APPN and subarea networks
- Support for OpenEdition MVS/ESA integrated sockets
- Support for OpenEdition MVS/ESA converged sockets

These enhancements provide UNIX applications with access to the SNA network, including the security and reliability associated with an SNA network.

Converged sockets support allows OE socket applications to dynamically choose to communicate across either APPN/SNA, TCP/IP or both networks based on whether the application has a session with an endpoint in a TCP/IP or SNA network.

10.3 Communications Server for Windows NT

Communications Server for Windows NT provides access and gateway node support for both Sockets over SNA and SNA over TCP/IP.

SNA over TCP/IP support includes LU 0, 1, 2, 3, and 6.2 either with or without dependent LU requester (DLUR).

Sockets over SNA support allows applications using the WinSock 1.1 and Winsock 2.0 socket interface to communicate over an SNA network.

In addition to the AnyNet features, Communications Server for Windows NT has TN3270E server support. This server delivers 3270 terminal and printer emulation to TCP/IP users using open standards and multivendor solutions.

10.4 AIX SNA Server/6000 V2.1.2 and Communications Server for AIX V4.2

Both AIX SNA Server/6000 (for AIX V3.2.5) and Communications Server for AIX (for AIX V4) provide the following AnyNet functions:

- APPC over TCP/IP
- Sockets over SNA

Communication Server for AIX V4.2 also supports:

- APPC over TCP/IP gateway
- Sockets over SNA gateway

10.4.1 AIX APPC over TCP/IP and APPC over TCP/IP Gateway

This AIX-based function enables APPC and CPI-C application programs to communicate with other APPC or CPI-C application programs over a TCP/IP network. AIX APPC over TCP/IP can have up to 5000 APPC/IP connections in which the node serves as either an access node or gateway node. This number can be extended by setting up parallel gateways.

Configuration for APPC over TCP/IP includes:

- A routing protocol preference profile
- IP to LU name mapping

A routing protocol preference profile is configured at the Communications Server for AIX access node to determine the preferred transport for each

APPC session. The default transport is SNA. To use TCP/IP a profile must be defined for that session. The routing protocol preference profile is only used at access nodes.

IP to LU mapping is done in the /etc/hosts file or in the domain name server.

To run as a gateway node, Communications Server for AIX must be defined as an APPN network node.

10.4.2 AIX Sockets over SNA and Sockets over SNA Gateway

AIX Sockets over SNA enables AIX-based C application programs using the AF_INET socket interface to send and receive information over an SNA network. Application programs designed to use the IBM TCP/IP AF_INET interface can generally use AIX Sockets over SNA with *no* modifications. AIX Sockets over SNA supports all streams and datagram sockets.

AIX Sockets over SNA emulates a full-duplex TCP connection by using two half-duplex LU 6.2 conversations (one for each direction). These conversations are allocated when a stream socket connection is established and deallocated when the stream socket connection is closed.

Datagram applications are supported by allocating an LU 6.2 conversation to send all datagrams destined for a given IP address. These datagram conversations are deallocated if they are unused for the period of time specified in the ″Datagram conversation timeout″ field of the Minimum Configuration Profile for AIX Sockets over SNA.

The following applications can use Sockets:

- FTP, FTPPM, TFTP
- TELNET
- TALK
- REXEC
- RSH
- Remote login (rlogin)
- Remote copy (rcp)
- PING
- User information display (finger)
- IP name/number conversion using a domain name server (HOST, NAMED, and NSLOOKUP)
- NFS
- SNMP

Note: For a complete list of all supported and unsupported programs, you should refer to the official product manuals.

Configuration of Sockets over SNA involves setting up the IP-LU mapping table and assigning a host IP address for the Sockets over SNA node. A new network interface (sna0) is created for the Sockets over SNA interface. When a socket application request is issued, Sockets over SNA uses standard IP routing algorithms to decide whether to route information to the sna0 interface or to one of the TCP/IP interfaces (for example, tr0). Sockets over SNA handles the requests for the sna0 interface. Other requests are forwarded to TCP/IP.

The Sockets over SNA gateway function was introduced with Communications Server for AIX Version 4.2. It is used to connect SNA and TCP/IP networks. Configuration for the gateway node is the same as the access node function with the addition of the TCP/IP forwarding function enabled with the **no -o ipforwarding=1** command.

The following restrictions apply when using AIX Sockets over SNA:

- Sockets does not support applications that use broadcasting.
- Sockets over SNA cannot be used to communicate with AnyNet/2 Sockets over SNA Version 1.0 or with AnyNet/2 Sockets over SNA Gateway Version 1.0.

10.5 Communications Server for OS/2

Communications Server for OS/2 V4.1 provides networking support to allow applications to run in different environments. It allows client/server applications using interfaces such as APPC, CPI-C and Sockets to run over SNA networks, TCP/IP networks or both.

Multiprotocol support in Communications Server for OS/2 V4.1 includes:

- TN3270E Server

  This server delivers 3270 terminal and printer emulation to TCP/IP users using open standards and multivendor solutions.
- LAN Gateway

  The LAN Gateway function enables workstations, requesters, or servers located on different local area networks (LANs) to communicate across SNA on TCP/IP wide area networks (WANs). The LAN Gateway supports both Novell NetWare Internet Packet Exchange (IPX) and NetBIOS protocols across WANs. Each LAN attaches to the WAN through one of the following LAN Gateways:
  - IPX over SNA
  - IPX over TCP/IP
  - NetBIOS over SNA
  - NetBIOS over TCP/IP

- SNA over IP access node (included in the OS/2 Access Feature)
- SNA over IP gateway
- Sockets over SNA access (included in the OS/2 Access Feature) and Sockets over SNA gateway nodes featuring:
  - Backup and load balancing
  - Datagram retry delay
  - Route discovery
  - Routing Information Protocol (RIP)
  - Maximum number of connections has been increased to 2000
  - Variable subnetting support

10.5.1 LAN Gateway

The LAN Gateway feature of Communications Server is one of IBM′s AnyNet software offerings. The LAN Gateway enables workstations, requesters, or servers located on different local area networks (LANs) to communicate across SNA or IP wide area networks (WANs). The LAN Gateway supports both Novell NetWare Internetwork Packet Exchange (IPX) and NetBIOS protocols across WANs. Each LAN attaches to the WAN through a LAN gateway.

WAN sessions between two LAN gateways use APPC or TCP/IP. The LAN gateways appear to the WAN as independent LU 6.2 application programs or TCP/IP application programs. The WAN connection between the LAN gateways is either an LU 6.2 session or a TCP/IP stream.

10.5.1.1 Connecting NetBIOS and IPX Applications over an SNA WAN

Figure 54 on page 232 shows how the LAN gateway supports communication between LANs across an SNA WAN. In this example:

- LAN A and LAN B support both IPX and NetBIOS applications. Each LAN can be either a token-ring or an Ethernet LAN.
- Workstation A connects LAN A to the WAN and runs as an independent LU 6.2 application program. In this example, Workstation A is a LAN gateway.
- Workstation B connects LAN B to the WAN and is shown as a LAN gateway. Workstation B could be running the following products:
  - IBM AnyNet IPX over SNA Gateway (IPX traffic on SNA WANs only)
  - IBM LAN-to-LAN wide area network (LTLW) program (on SNA WANs only)
  - IBM Nways 2217 Multiprotocol Concentrator

Using an SNA WAN, NetBIOS and IPX applications running on Workstation 1 in LAN A and on Workstation 2 in LAN B can communicate. The LAN gateway supports communications across both APPN and subarea WANs.

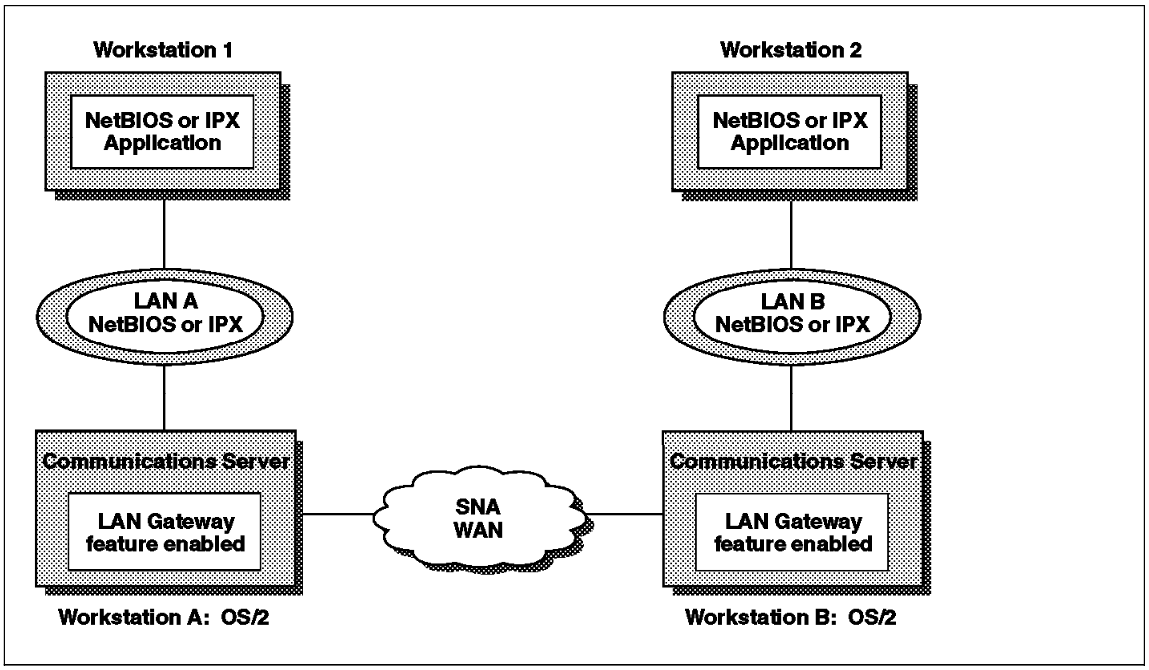


Figure 54. Configuration Using LAN Gateways to Support NetBIOS and IPX Communication across an SNA WAN

10.5.1.2 Connecting NetBIOS and IPX Applications over an IP WAN

Figure 55 on page 233 shows how the LAN gateway supports communication between LAN workstations across an IP WAN. In this example:

- LAN A and LAN B support both IPX and NetBIOS applications.
- Each LAN can be either a token-ring or an Ethernet LAN.
- Workstation A, a LAN gateway, connects LAN A to the WAN.
- Workstation B, a LAN gateway, connects LAN B to the WAN.

Using an IP WAN, NetBIOS and IPX applications running on Workstation 1 in LAN A and on Workstation 2 in LAN B can communicate.

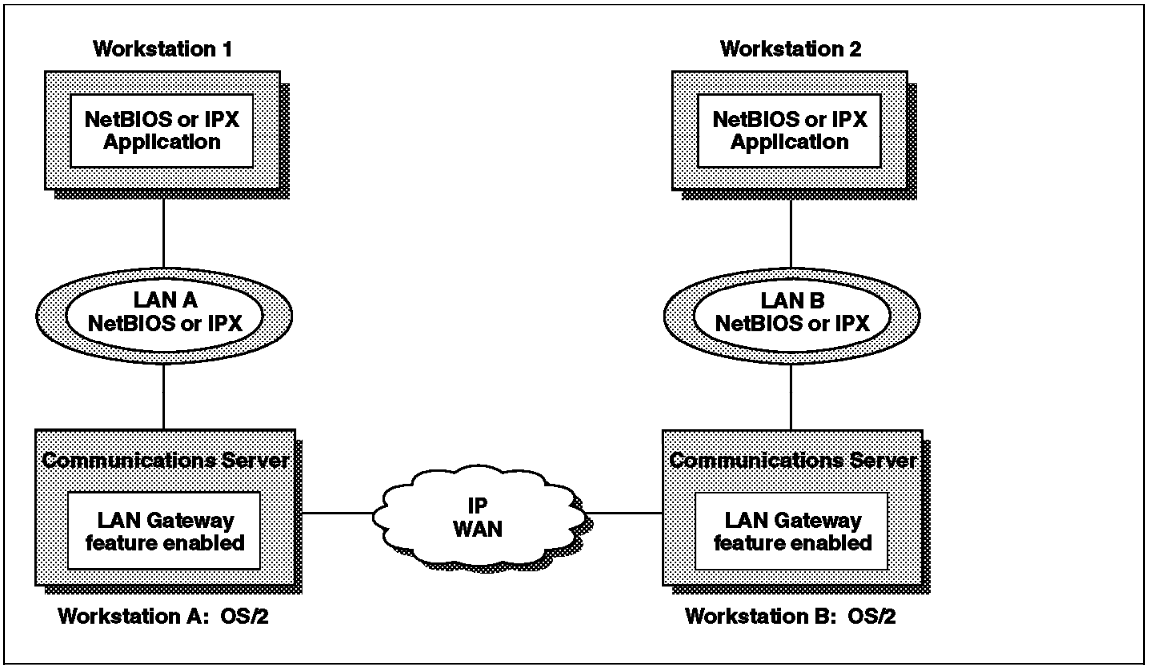


Figure 55. Configuration Using LAN Gateways to Support NetBIOS and IPX Communication across an IP WAN

10.5.1.3 Running NetBIOS and IPX Applications on the LAN Gateway Using the Loopback Mode

Figure 56 on page 234 shows how the LAN gateway loopback driver can enable stand-alone workstations, such as laptop computers or non-LAN desktop workstations, to access an IP or SNA WAN using a modem instead of LAN hardware. The loopback driver simulates an IBM token-ring LAN adapter (including protocols supported by such an adapter) for OS/2.

In this example:

- LAN A and LAN B are connected over an SNA or IP WAN.
- Workstation A and Workstation B are LAN gateways that have not enabled the loopback option.
- Workstation C is a LAN gateway that has enabled the loopback option.

  Workstation C operates as an access node, allowing local application programs to communicate with application programs running on Workstation 1 in LAN A and on Workstation 2 in LAN B.

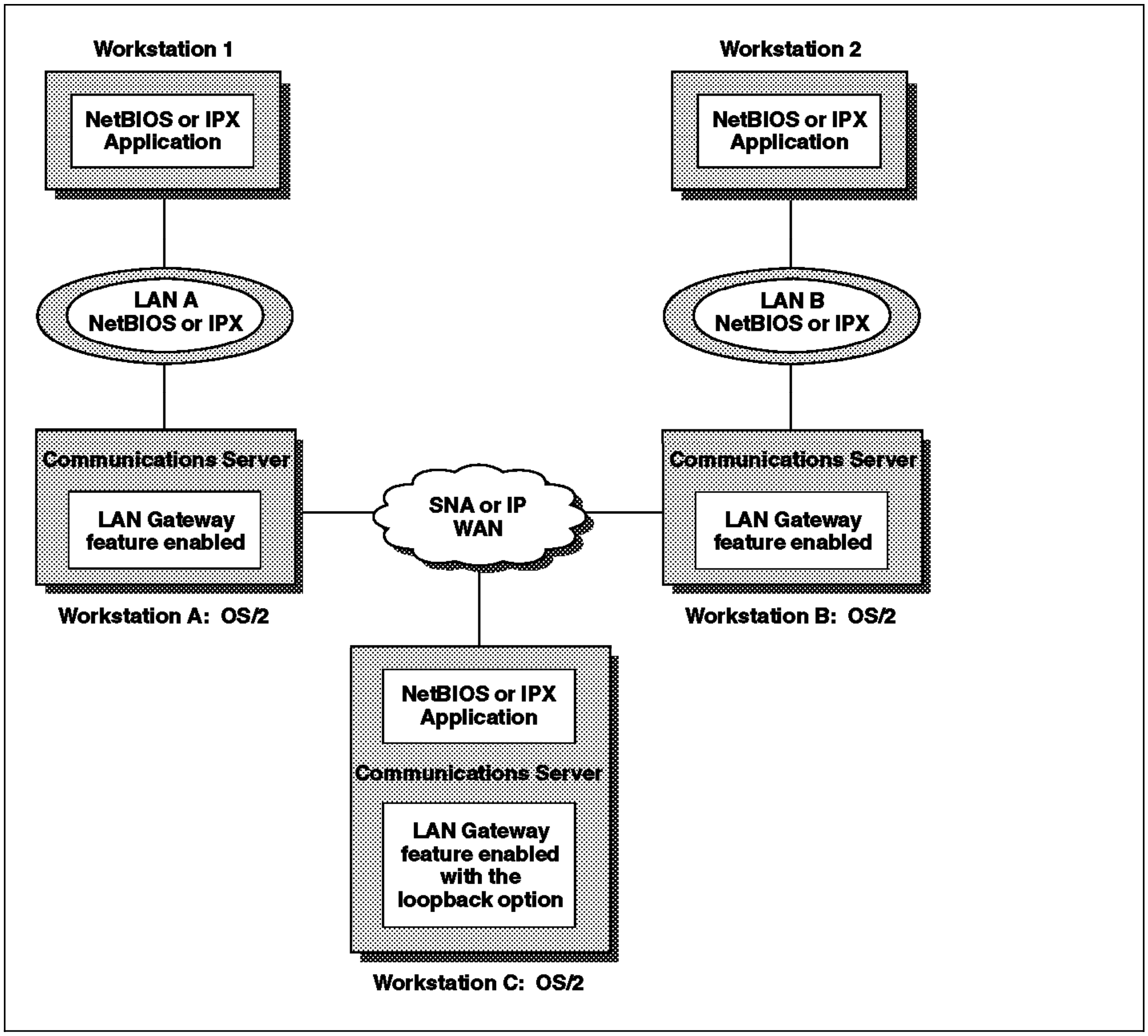


Figure 56. Configuration Using the Loopback Mode on the LAN Gateway Workstation

10.6 AnyNet/2 V2.0

AnyNet/2 runs on an OS/2 platform. AnyNet/2 V2.0 includes two connectivity functions: SNA over TCP/IP and Sockets over SNA. Service pack IP20403 upgrades AnyNet/2 V2.0 to V2.0.2 and adds Sockets over IPX and Sockets over NetBIOS support.

10.6.1 SNA over TCP/IP

AnyNet/2 V2.0 SNA over TCP/IP allows communication between SNA applications across TCP/IP networks using all SNA LU types including LU0, 1, 2, 3, and 6.2. Any SNA application that runs with Communications Manager/2 such as CICS OS/2, DB2/2, and terminal emulators can communicate between OS/2 workstations across a TCP/IP network without changing application programs. AnyNet/2 2.0 SNA over TCP/IP is compatible with AnyNet/MVS, provides connectivity to the host environment and is compatible with the Dependent LU Requester (DLUR) currently provided by VTAM 4.2 and above for Communications Manager/2. AnyNet/MVS continues to provide the host-based SNA over TCP/IP gateway function providing connectivity into native SNA environments. SNA over TCP/IP is compatible with IBM′s DCE environment.

10.6.2 Sockets over SNA

The AnyNet/2 V2.0 Sockets over SNA feature has full-duplex support for SNA and compatibility with the DCE environment. Berkeley Software Development (BSD) 4.3 sockets applications such as FTP, Telnet, and NFS can communicate between OS/2 workstations across SNA networks. AnyNet/2 V2.0 provides this without changing application programs. AnyNet/2 V2.0 is compatible with AnyNet/MVS and provides connectivity across any combination of APPN and SNA subarea. Additional flexibility is provided when combined with the AnyNet/2 Sockets Gateway. With the gateway you can interconnect your SNA workstations running TCP/IP applications to native TCP/IP networks. You can also use two gateways to connect TCP/IP networks across an SNA network. AnyNet/2 provides you with the ability to reduce costs by eliminating duplicate networking hardware, software, and communications lines.

10.6.3 Sockets over NetBIOS

Sockets over NetBIOS enables OS/2-based C application programs using the IBM TCP/IP AF_INET socket interface to send and receive information over a NetBIOS network. Sockets over NetBIOS requires Network Transport Services/2 (NTS/2) Version 1.0 or later.

Application programs written to non-IBM implementations of the Berkeley Software Distribution (BSD) AF_INET interface can use Sockets over NetBIOS with few modifications.

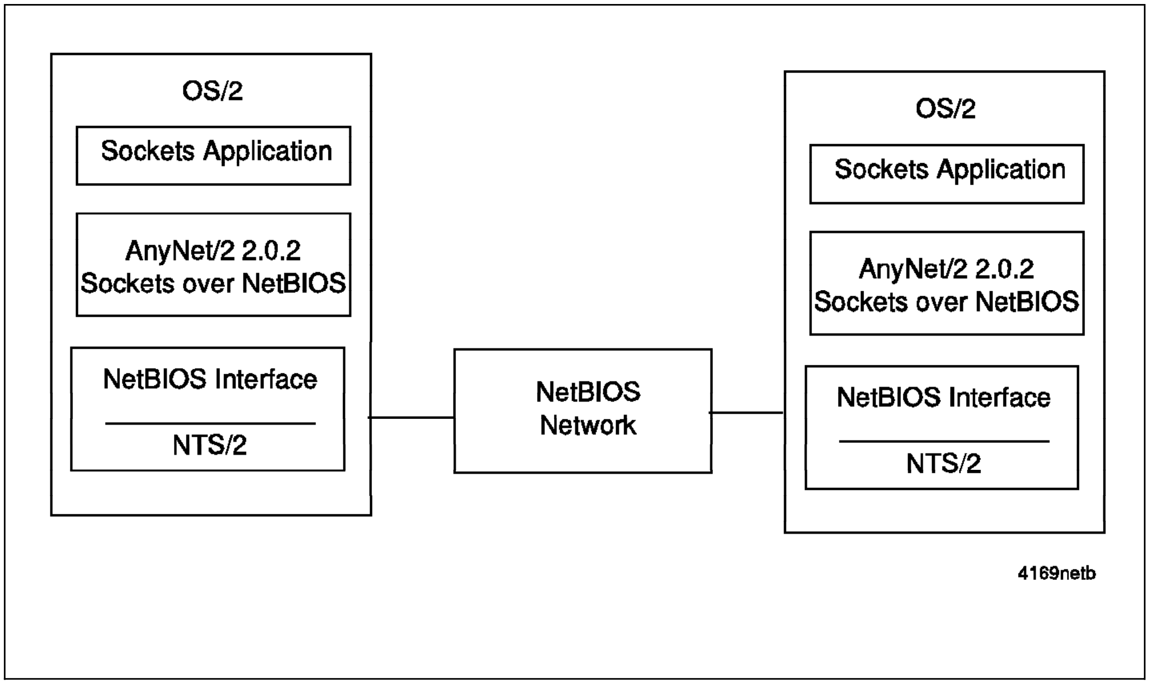


Figure 57. Sockets over NetBIOS

Sockets over NetBIOS supports all stream and datagram sockets including:

- Distributed computing environment (DCE)
- Distributed system object model (DSOM)
- File transfer protocol (FTP, FTPPM, and TFTP)
- Virtual terminal protocol (TELNET)
- Interactive conversation (TALK)
- Remote execution protocol (REXEC)
- Remote shell execution (RSH)
- Packet Internet groper (PING)
- IP name/number conversion using DNS (HOST, NAMED, NSLOOKUP)
- X Window System (PMX)
- Network File System (NFS)
- Simple Network Management Protocol (SNMP)

10.6.4 Sockets over IPX

Sockets over IPX enables OS/2-based C application programs using the IBM TCP/IP AF_INET socket interface to send and receive information over an IPX network.

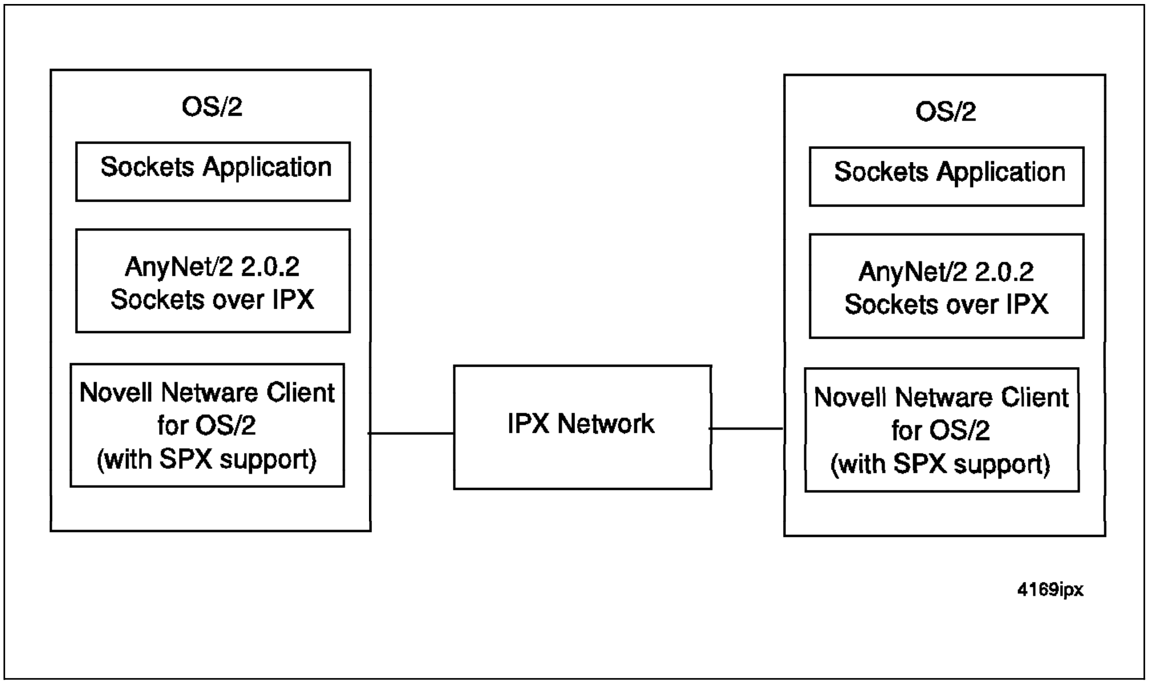


Figure 58. Sockets over IPX

Application programs written to non-IBM implementations of the Berkeley Software Distribution (BSD) AF_INET interface can use Sockets over IPX with few modifications.

Sockets over IPX supports all stream and datagram sockets including:

- Distributed computing environment (DCE)
- Distributed system object model (DSOM)
- File transfer protocol (FTP, FTPPM, and TFTP)
- Virtual terminal protocol (TELNET)
- Interactive conversation (TALK)
- Remote execution protocol (REXEC)
- Remote shell execution (RSH)
- Packet Internet groper (PING)
- IP name/number conversion using DNS (HOST, NAMED, NSLOOKUP)
- X Window System (PMX)
- Network File System (NFS)
- Simple Network Management Protocol (SNMP)

10.7 AnyNet/2 NetBEUI over SNA

With AnyNet/2 NetBEUI over SNA V1.0 you can use existing SNA networks to connect NetBIOS applications. NetBIOS Extended User Interface (NetBEUI) applications such as Lotus Notes and Time and Place/2 will operate without changing the application programs. This function delivers tremendous flexibility. As you use and develop NetBEUI applications, they can be run over SNA networks using any combination of APPN and SNA subarea without change to either the applications or the SNA network.

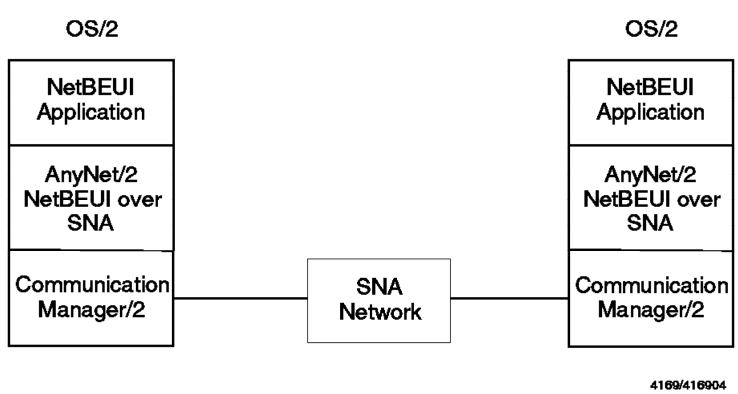


Figure 59. A Scenario AnyNet/2 NetBEUI over SNA

10.8 AnyNet IPX over SNA Gateway for OS/2

The IBM AnyNet IPX over SNA Gateway for OS/2, Version 1.0 provides IPX connectivity across SNA networks. To the IPX network, the IPX over SNA gateway has the appearance of a NetWare router. It provides the service and routing information protocols required to participate in IPX connectivity. The IPX over SNA gateway fully protects the SNA backbone by ″firewalling″ IPX broadcasts. It automatically learns the locations of local servers, and sends information about changes to partner gateways only as needed. It also uses data compression and traffic prioritization (class of service) available in Communications Manager/2 to provide bandwidth beyond rated links for the backbone network. All of the following benefits of an SNA network, such as reliability and predictable response time, become available to IPX traffic routed through the AnyNet IPX over SNA gateway:

- Connects IPX LANs across SNA networks
- Requires no changes in installed applications

- Allows the traditional benefits of an SNA network, such as reliability and predictable response time
- Requires no special hardware
- Provides four gateway sizes (20, 100, 250, or 500 workstations)

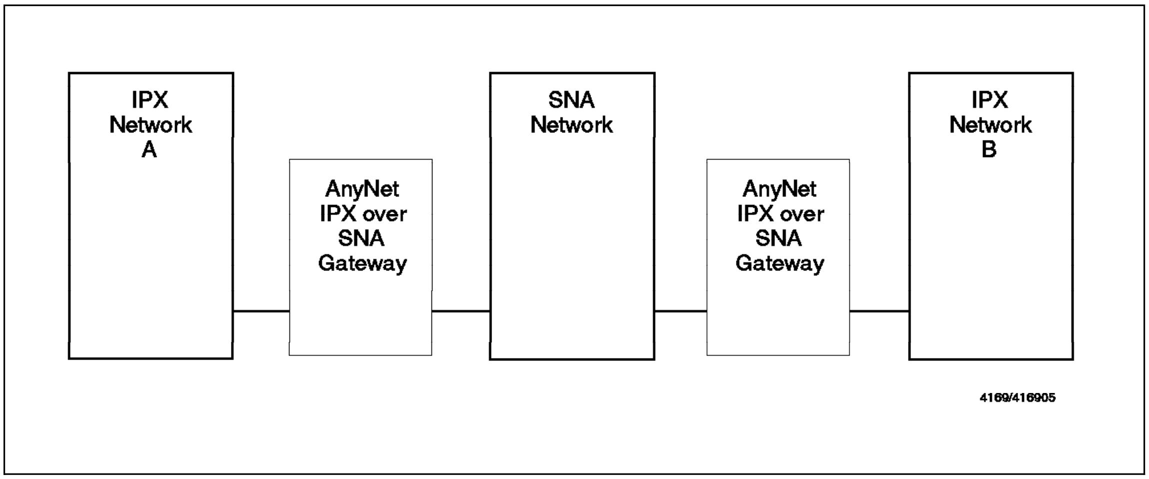


Figure 60. IPX/SNA Scenario

At the link layer, Novell′s IPX protocol is a connectionless protocol. IPX relies on servers to advertise their services in order for clients to find addresses of those servers. Routers also help by passing the advertisements of these servers around the network. These functions in NetWare IPX are called Service Advertising Protocol (SAP) and Routing Information Protocol (RIP). When a requestor wants to access a server, it sends out frames asking where the nearest server is and then asks that server how to get to the server it wishes to attach to.

The IPX over SNA gateway supports the SAP and RIP protocol in IPX to provide the function of addressing remote resources. The gateway obtains the SAP and RIP information on the local LAN when starting up and passes this information to its partner gateways over the WAN. The gateway is capable of supporting information for 300 servers and 300 routers (300 SAP and 300 RIP entries). To provide a way of managing a potential network with more than 300 servers, one may apply an access filter list to the SAP entries. This filters out the local servers that should not be accessed over the gateway links. By applying the access filter to the NetWare SAP entries, the user can assure certain servers may not be addressable over the WAN and that only a number of the NetWare resources need be advertised to help manage the number of NetWare connections over a WAN.

To limit the amount of broadcasts over the WAN and keep the SAP and RIP information up to date, the gateway only sends SAP or RIP messages when a change in the IPX network occurs, such as a server coming up or going down. These changes are queued on a minute basis so multiple changes can be sent in a fewer number of frames on the WAN. For example, if a server shuts down at one site, the information about the server will be sent as a change to the SAP information after about a minute. This delay will allow time for other changes to accumulate and be sent in a single package of changes, thus reducing the amount of traffic over the WAN.

NetWare IPX supports various types of LAN protocols on the LAN. The gateway may be configured to support 802.2 protocol (token-ring or Ethernet), which uses the E0 Service Access Point, or the SNAP (token-ring or Ethernet) protocol, which uses the AA Service Access Point on the LAN. The gateway will keep information about each type of server in its SAP table. NetWare stations running on the 802.2 NetWare interface on one LAN can connect to NetWare stations running the SNAP interface on another LAN, via the IPX over SNA gateway.

10.9 AnyNet APPC over TCP/IP for Windows

With AnyNet APPC over TCP/IP for Windows, you can connect your APPC applications across a TCP/IP network to other AnyNet APPC over TCP/IP products in Windows, OS/2, AIX, OS/400, and MVS/ESA environments. When used with the new AnyNet SNA over TCP/IP Gateway for OS/2, AnyNet for Windows allows you to connect APPC applications across a TCP/IP network and into an SNA network.

AnyNet APPC Over TCP/IP for Windows provides the following:

- AnyNet APPC over TCP/IP connectivity on Windows workstations
- Interoperability with AnyNet on Windows, OS/2, AIX/6000, OS/400, and MVS host environments
- IBM and non-IBM TCP/IP products on Windows

APPC over TCP/IP for Windows enables APPC or CPI-C application programs running on Windows to communicate with other APPC or CPI-C application programs over an Internet Protocol (IP) network. It does not require any changes in the installed applications, hardware or communication lines.

10.10 AnyNet Advantages

By using AnyNet, applications can run over non-native networking protocols they weren′t designed to run over. This means you can reach new applications through the existing network.

10.10.1 Sockets over SNA Advantages

The following list shows the advantages of Sockets over SNA:

- **Performance** TCP/IP Sockets applications benefit from the steady throughput and predictable response time of SNA networks.
- **Traffic prioritization** AnyNet Sockets over SNA allows the use of class of service (COS) for TCP/IP applications such as Telnet or FTP. So the traffic can be prioritized throughout the network. That is, Telnet traffic is configured to have a higher priority than FTP traffic.
- **Administration** One Sockets over SNA subnet is sufficient for assigning host addresses across the network. IP addresses are mapped to LU names, so there can be one subnet for the whole network.
- **IP address location independence** A Sockets over SNA address can be moved within the network without requiring a new IP address.
- **Session-level security** The identity of the partner node is verified before establishing a session.
- **Data compression** The amount of data being exchanged between the nodes is reduced.

10.10.2 NetBIOS over SNA Advantages

The following list shows the advantages of NetBIOS over SNA:

- **Connectivity options** Normally, native NetBIOS applications can only communicate within a bridged LAN environment. By using AnyNet other connections such as SDLC, ISDN and frame relay can be used.
- **Session-level security** The identity of the partner node is verified before establishing a session.
- **Data compression** The amount of data being exchanged between the nodes is reduced.
- **NetBIOS Broadcast** NetBIOS over SNA eliminates NetBIOS broadcasting and thus reduces traffic on the network.
- **Performance** TCP/IP Sockets applications benefit from the steady throughput and predictable response time of SNA networks.
- **Control of network resources** Each NetBIOS over SNA connection between applications is a separate SNA sessions, and can be managed like any other SNA sessions
- **End-to-end timers** NetBIOS over SNA replaces the traditional NetBIOS timers with SNA reliable connections.
- **Datagram size** NetBIOS over SNA supports datagrams from 512 bytes up to 30 KB. Traditional NetBIOS datagrams are limited to 512 bytes.

10.10.3 SNA over TCP/IP Advantages

The following list shows the advantages of SNA over TCP/IP:

- **Non-disruptive session rerouting** Link failures do not result in session failures.
- **Connectivity** Using TCP/IP networks provides access to the worldwide Internet, so SNA applications on AnyNet have a wider connectivity.

10.10.4 IPX over SNA Advantages

The following list shows the advantages of IPX over SNA:

- **IPX broadcast** IPX over SNA gateway protects the SNA backbone by filtering IPX broadcasts and caching names.
- **Traffic prioritization** AnyNet IPX over SNA allow the use of class of service (COS) and priority to gateway-to-gateway links.
- **Data compression** The amount of data being exchanged between the partners is reduced.

Chapter 11. Mobile Connectivity

This chapter describes IBM′s solutions for connecting mobile computers to your enterprise network.

IBM eNetwork Wireless, formerly known as ARTour, is IBM′s communications middleware that enables and simplifies the management and implementation of applications in the mobile environment. eNetwork Wireless extends IP connectivity across a diverse set of wireless and dial networks to seamlessly enable TCP/IP applications to access the networks.

You can find further information about eNetwork Wireless at Web site http://www.networking.ibm.com/art.

11.1 eNetwork Wireless Network Integration

eNetwork Wireless consolidates the leading international wireless packet data, cellular, and wireline networks, including Mobitex, DataTAC, Motorola Private Mobile Radio (PMR), Cellular Digital Packet Data (CDPD), Mobitex, and the following dial networks: Global System for Mobile Telecommunication (GSM), Advanced Mobile Phone System (AMPS), Personal Communication System (PCS) and Public Switched Telephone Networks (PSTN), under a single interface. All the network-specific details are hidden to make the network transparent to your application, so you can support multiple networks without additional effort.

11.2 The eNetwork Wireless Product Family

The eNetwork Wireless family of products consists currently of these packages:

- eNetwork Wireless Gateway for AIX V4R1
  - Gateway for AIX
  - Mobile client for OS/2
  - Mobile client for Windows (Windows V3R1, Windows V3R11, Windows for Workgroups V3R11, Windows 95, Windows NT)
- eNetwork Emulator Express Server for AIX V4R1
  - Emulator Express Server for AIX
  - Emulator Express Client for Windows 95
  - Emulator Express Client for OS/2
- eNetwork Emulator Express Server for Windows NT V4R1
  - Emulator Express Server for Windows NT
  - Emulator Express Client for Windows 95
  - Emulator Express Client for OS/2

- eNetwork Web Express Server for AIX V2R1
  - Web Express Server for AIX
  - Web Express Client for Windows 95
- eNetwork Web Express Server for Windows NT V2R1
  - Web Express Server for Windows NT
  - Web Express Client for Windows 95

eNetwork Wireless is based on a client/server architecture and focuses on communications between its two components:

- Mobile client
- Gateway

The following figure shows the basic eNetwork Wireless components.

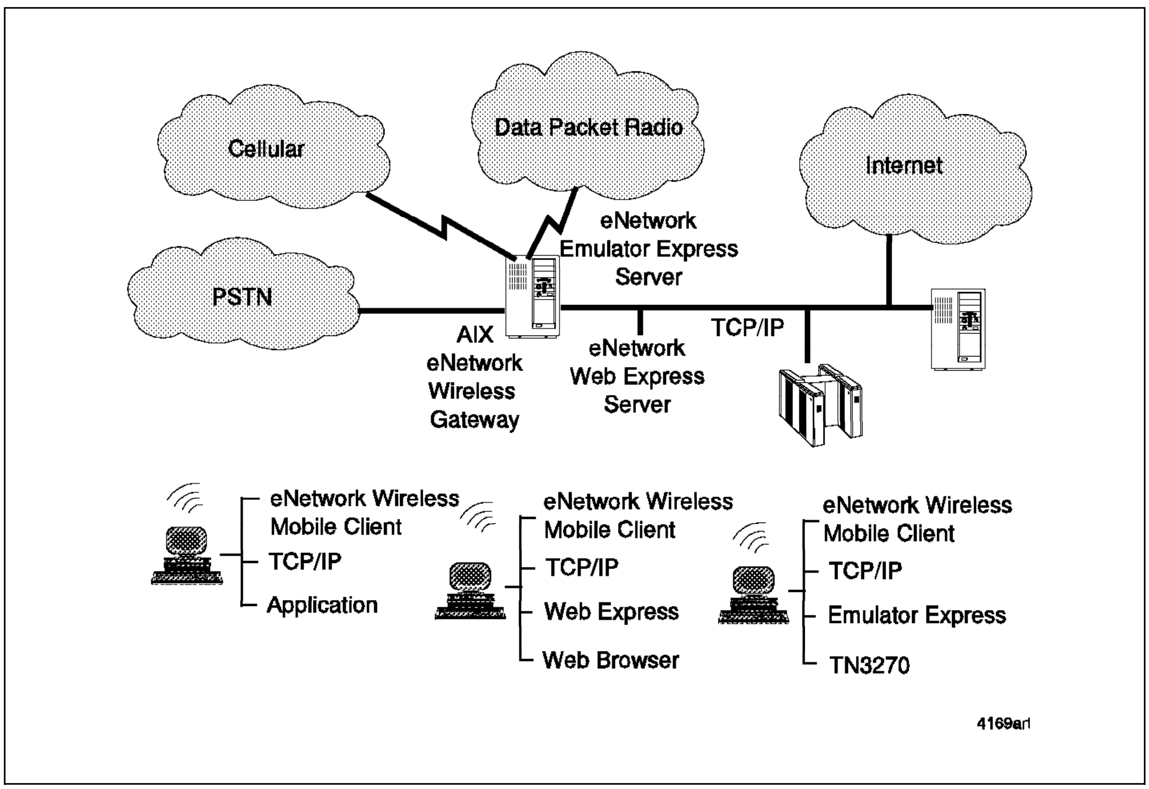


Figure 61. eNetwork Wireless Network Components

11.2.1 eNetwork Wireless Mobile Clients

The eNetwork mobile client resides on the user′s mobile computer and communicates with the eNetwork Wireless Gateway via wireless and/or dial networks. Mobile clients are available for OS/2, Windows 3.1, Windows NT and Windows 95.

You can use the client′s end-user interface to configure the mobile client to use different radio or data networks and start the connection. When the radio connection is established, you can run IP applications on your mobile computer. The eNetwork Wireless communication layer is positioned below TCP/IP and shields all radio-specific details inside a common interface layer. For the end user, a wireless network becomes another network that does not require any specialized communication protocols or programming interfaces. Thus, mobile applications using the TCP/IP interface have access to both, wireless and wireline networks.

11.2.2 eNetwork Wireless Gateway

eNetwork Wireless Gateway integrates all supported wireless networks within a single AIX gateway and provides the link to the enterprise network. All mobile users can use the same Wireless Gateway and access the same enterprise applications, regardless of the networks they use. Wireless Gateway also enables mobile users to connect to multiple applications, even if the applications are in different networks, such as wide area networks (WANs), LANs, intranets, and the Internet.

Wireless Gateway uses a mobile network interface (MNI) to integrate access to the different wireless networks inside eNetwork Wireless Gateway. As shown in Figure 62 on page 246, the mobile network interface is the interface through which the IP layer communicates with all supported wireless networks.

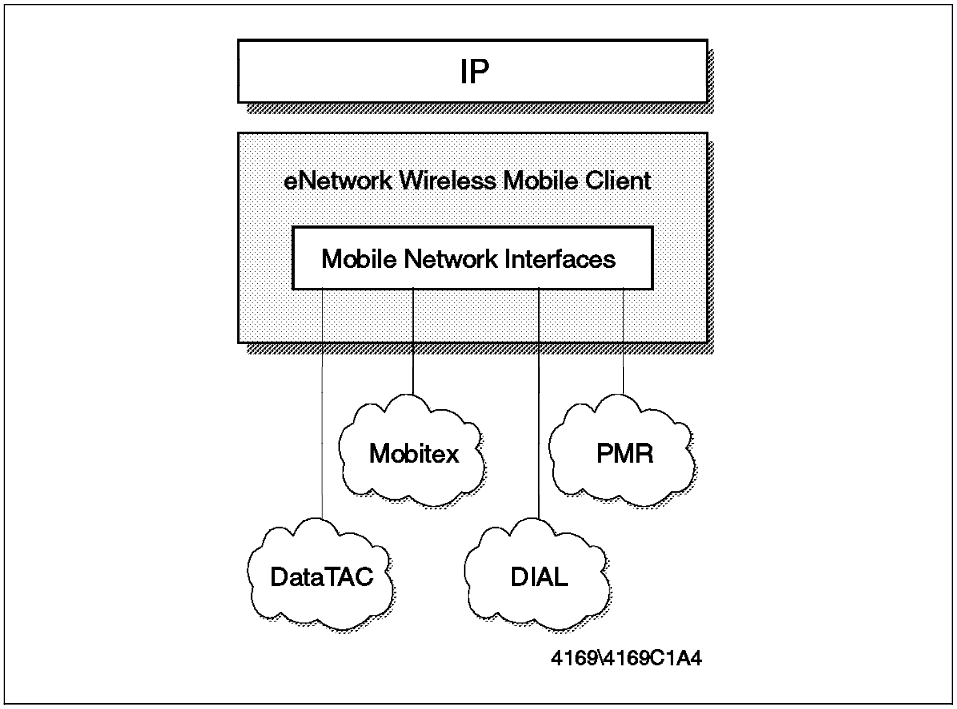


Figure 62. Mobile Network Interface in the eNetwork Wireless Gateway

11.2.3 eNetwork Web Express

eNetwork Web Express consists of server and client software components. Web Express significantly reduces data traffic in Web applications enabling optimized Web access for mobile clients. The Web Express client component is available for Windows 95 mobile clients. The Web Express server component is available for Windows NT and AIX. Web Express is designed to work with the eNetwork Wireless Gateway and client software.

The client appears as a local Web proxy that is co-resident with the Web browser and communicates with it using a local TCP connection and HTTP protocol. When the browser makes requests to access information on a Web site the Web Express client and server enable the optimized exchange of information (HTML, GIF and CGI responses) across wireless and wireline networks using intelligent caching, protocol reduction, header reduction, and data compression.

In addition, Web Express also supports foreground and background queuing of browser requests and disconnected operations to enhance the productivity of the mobile worker. The client component resides on the mobile device, and the server component runs on a system at the customer location. The server component communicates with the Web server using TCP/IP and HTTP protocols and passes the transmission (filtered and compressed) to the mobile unit across a persistent TCP/IP connection.

Most Web browsers reduce network traffic by caching documents and images that they request from the Internet. Web Express extends this caching and uses compression techniques that result in faster response times and less data that has to be sent across the wireless connection.

More information can be found at Web site http://www.networking.ibm.com/art/artwewp.htm. The following figure explains the Web Express intercept model.

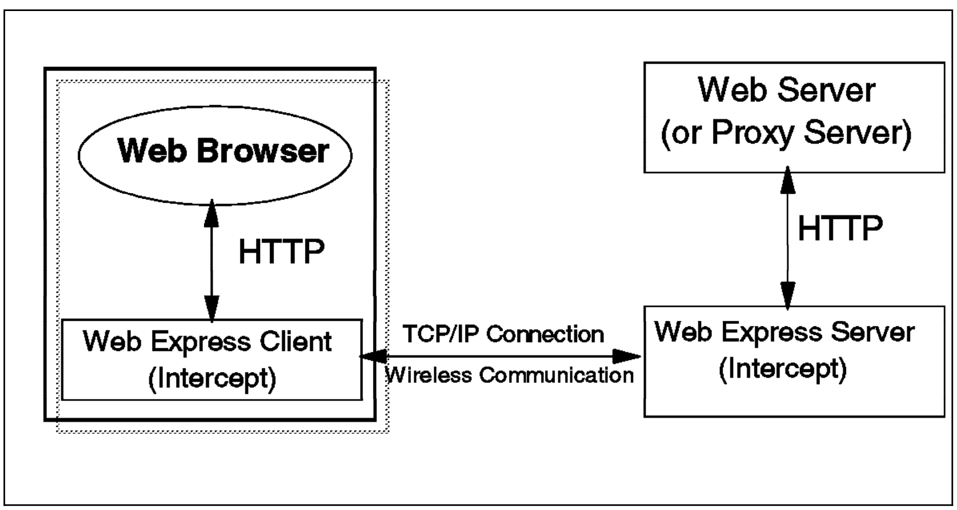


Figure 63. eNetwork Wireless Web Express Intercept Model

The Web Express server can reside on:

- The same system as the Web server
- The same system as the eNetwork Wireless Gateway server
- A system separate from the eNetwork Wireless Gateway server, accessible via a LAN
- A stand-alone system in an environment in which the eNetwork Wireless Gateway is not used, as when using a cellular digital packet data (CDPD) transmission

11.2.4 eNetwork Emulator Express

The eNetwork Emulator Express offering consists of server and client software components. The Emulator Express Server provides for efficient access (from mobile computers using IP protocols) to existing mainframe and AS/400 applications developed for SNA terminal protocols. The

Emulator Express client component is available for OS/2 and Windows 95 mobile clients. The Emulator Express server component is available for Windows NT and AIX. If Emulator Express is used over a wireless network enabled for IP or a wireline PSTN network, the eNetwork Wireless Gateway and mobile Client are not required.

The client is installed on the user′s mobile computer and communicates with the server. The Emulator Express Client optimizes the data stream of a 3270 or 5250 session. The emulator appearance is resident on the client end. The server connects to the host and communicates with clients over wireless or dial-up connections. The Emulator Express Server is connected to the network or directly to the enterprise LAN or WAN.

By supporting standard emulators, Emulator Express provides the familiar screens and commands that in-office workers would use if directly connected to the enterprise network. The mobile worker perceives the same accessibility and ease-of-use when working from a portable computer with a wireless modem in the field as he would experience with a hard-wired connection back at the office. This is a vast improvement over previous wireless solutions, which require the applications to be rewritten to match the interface of the wireless data network.

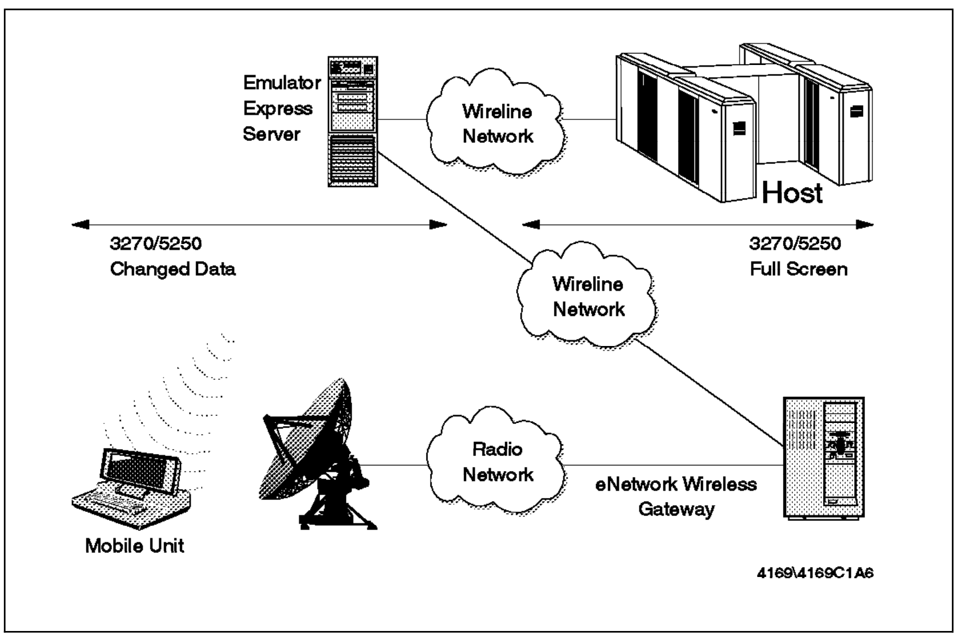


Figure 64. eNetwork Emulator Express Configuration

Both the Emulator Express server and the client maintain local caches for the contents of those screens that are used most often in the current session. The cache usage is synchronized by the exchange of messages attached to user data messages.

Before sending a host screen to the client, the server searches its cache of screens for a similar screen. If the search is successful, the variable information is extracted from the newly arrived screen and sent to the client together with codes that identify the non-variable portions of the screen. The client then locally restores the full screen from this information. If the server does not find a similar screen in its local cache, it adds this screen to its local cache, compresses it, and then sends the compressed data to the client. The client decompresses the data and restores the full screen and then adds it to its local cache.

Once Emulator Express has stored a number of screens, the amount of data to be transferred over the wireless or dial-up link is substantially reduced. When the sessions are closed, both the server and the client saves their screen cache buffers so they can be used in a future session.

Chapter 12. Network Management

This chapter provides information about the IBM products for network management.

12.1 Nways Network Manager Family

IBM offers network management solutions for small workgroups to large wide area networking environments.

Figure 65 on page 252 shows the Nways manager product family blueprint. The Nways management family is divided into two main areas: campus and wide area management. Campus management covers the Nways campus managers, the Nways workgroup managers for LAN and ATM and ReMon applications, and the Nways RouteSwitch managers. The Nways workgroup manager applications provide networking hardware device management for the IBM SNMP manageable networking devices, plus a ReMon application for monitoring and reporting LAN performance through RMON (Remote Network Monitoring) technology. The workgroup environment is assumed to be a small network in the range of from 1 to 200 nodes.

The box labeled Nways Campus Managers shows the various applications to provide LAN, ATM, ReMon and traffic management and the platforms they run on. The products that are designed to support this environment are Nways Campus Managers. The third box shows the Nways RouteSwitch manager applications and the platforms they run on. The wide area management box covers the Nways enterprise managers and the Nways WAN element manager. The WAN is a network usually consisting of LAN switches and routers. This environment is often interconnected with public networks. The product associated with this environment is the Nways Enterprise Manager and the associated Nways WAN element manager.

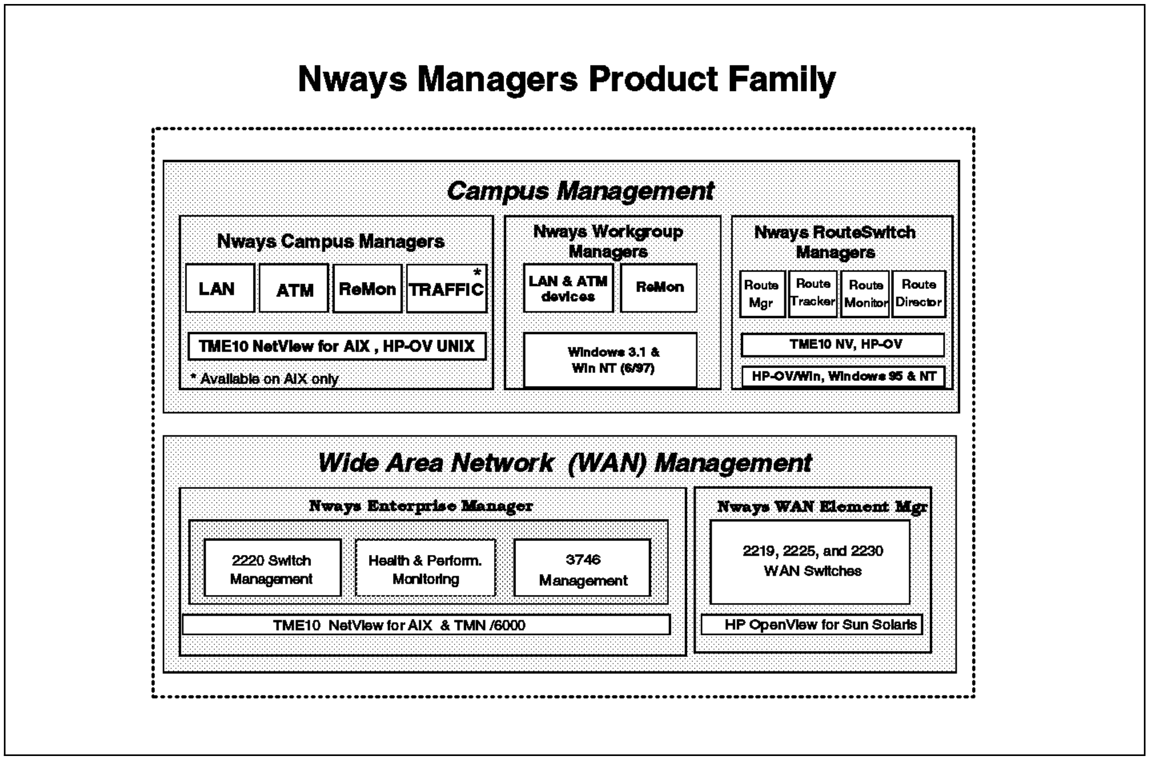


Figure 65. Nways Managers Product Family

IBM′s family of products to do network management currently consists of the following products:

- Nways Manager for AIX
  - Nways Campus Manager for AIX
  - Nways Campus Manager for ATM
  - Nways Campus Manager LAN ReMon Advanced
  - Nways Traffic Monitor for AIX
- Nways Campus Managers (NCM) HP-UX
  - Nways Campus Manager LAN
  - Nways Campus Manager ATM
  - Nways Campus Manager ReMon
  - Nways Campus Manager ReMon Advanced
- Nways Workgroup Managers
  - Nways Workgroup Manager for NT
  - Nways Workgroup ReMon for Windows
- Nways RouteSwitch Managers
  - Nways Route Manager
  - Nways RouteTracker Manager
  - Nways Route Monitor

– Nways Route Director

- Nways Wide Area Network Element Manager for HP OpenView
- Nways Enterprise Manager
- LNM Network Manager for OS/2 Version 2

12.1.1 Management Solutions for Small to Medium Networks

With the Nways Workgroup Managers you can manage small to medium sized networks or autonomous workgroup environments from a Microsoft Windows 3.x or NT operating environment. The products are:

- Nways Workgroup Manager and Workgroup Remote Monitor
- Nways RouteSwitch Network Management Suite

These products do fault, performance and configuration management of LANs, VLANs and ATM. All have full RMON support for token-ring and Ethernet segments. You can do graphical device management for routers, hubs, switches and any other device able to be graphically managed.

The following figure shows the Nways low-end campus offering, the Nways Workgroup Manager for NT and the Nways Workgroup ReMon for Windows. The Nways Workgroup Manager for Windows NT runs on Windows NT Workstation or Windows NT Server Version 4. The workgroup managers use SNMP to manage a variety of networking resources.

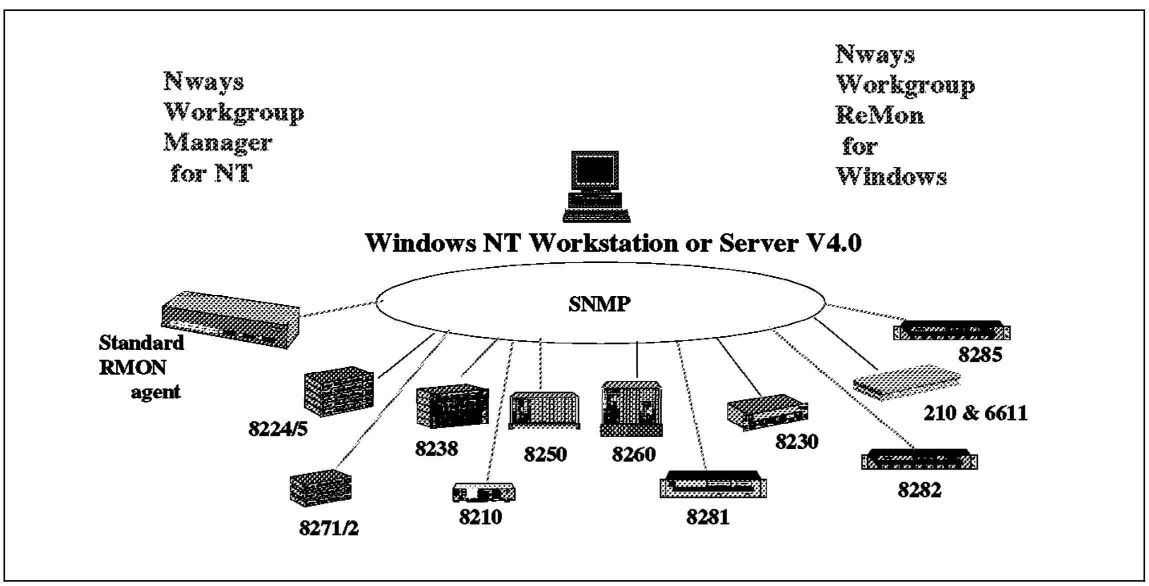


Figure 66. Nways Workgroup Management Solutions

The Nways Workgroup Remote Monitor for Windows can run as a stand-alone application on a Windows 3.1 or a Windows NT operating system. Alternatively, it can run as an additional application on the SNMP platform included in the Nways Workgroup Manager for Windows NT. When integrated with the Workgroup Manager, the ReMon application can be used to display and configure LAN performance monitoring through RMON agents discovered within the network nodes which are managed through SNMP.

The following table shows the hardware products that are supported by Nways Workgroup Manager for Windows NT and Nways Workgroup Remote Monitor for Windows.

Table 66. Nways Workgroup Manager Supported Hardware Products

Nways Workgroup Manager Product	**Devices Supported**
Nways Workgroup Manager for Windows NT	• IBM 8210 Nways Multiprotocol Switched Services (MSS) server • IBM 8224 Ethernet Stackable Hub • IBM 8225 Fast Ethernet Stackable Hub • IBM 8230 Token-Ring Controlled Access Unit • IBM 8235 Dial-In Access to LANs (DIALs) Server including IBM 8235 Dial-In Access to LANs (DIALs) Switch Model I40 • IBM 8237 Stackable Ethernet Hub • IBM 8238 Token-Ring Stackable Hub • IBM 8250 Multiprotocol Intelligent Hub • IBM 8260 Nways Multiprotocol Switching Hub • IBM 8271 EtherStreamer/Nways Ethernet LAN Switch • IBM 8272 LANStreamer/Nways Token-Ring LAN Switch • IBM 8273 Nways Ethernet RouteSwitch (requires IBM Nways Route Switch Manager) • IBM 8274 Nways LAN RouteSwitch (requires IBM Nways Route Switch Manager) • IBM 8281 Nways ATM LAN Bridge • IBM 8282 Nways ATM Workgroup Concentrator • IBM 8285 Nways ATM Workgroup Switch • IBM 2210 Nways Multiprotocol Router • IBM 6611 Network Processor
Nways Workgroup Remote Monitor for Windows	• IBM 8225 Fast Ethernet Stackable Hub • IBM 8230 Token-Ring Controlled Access Unit • IBM 8237 Stackable Ethernet Hub • IBM 8238 Token-Ring Stackable Hub • IBM 8250 Advanced Token-Ring Management Module • IBM 8260 Token-Ring Media Access Daughter Card • IBM 8260 Ethernet Media Access Daughter Card • IBM 8271 EtherStreamer/Nways Ethernet LAN Switch • IBM 8272 LANStreamer/Nways Token-Ring LAN Switch • IBM 8273 Nways Ethernet RouteSwitch (requires IBM Nways Route Switch Manager) • IBM 8274 Nways LAN RouteSwitch (requires IBM Nways Route Switch Manager) • Other RMON-compliant probes

Nways Workgroup Manager provides an SNMP management platform and a suite of graphical device management applications that bring integrated, heterogeneous SNMP management to the Windows NT 4.0 environment. It provides fault, performance, configuration, accounting and security management for SNMP-enabled workstations, hubs, routers, bridges and switches. Because IBM embeds RMON agents in its networking devices, if you also have Nways Workgroup Remote Monitor (ReMon) running then Nways Workgroup Manager has the ability to access the Nways Workgroup ReMon information (RMON coupling).

Nways Workgroup ReMon is a remote monitoring (RMON) application that collects, monitors, analyzes and displays network statistics from RMON and RMON2 agents. Nways Workgroup ReMon supports all the RMON MIB groups (RFC 1757 and RFC 1513 extension for token-ring) and IBM′s RMON2 implementation, which is based on the Enterprise Communications Analysis Module (ECAM).

Nways Workgroup ReMon′s support of RMON2 (ECAM) lets you go beyond the current RMON standards to full seven-layer data collection, including segment, host and conversation statistics, for the major protocols and application types. With this information you can tune your network.

The Nways Workgroup Manager is a true 32-bit native Windows NT application that operates on Windows NT Version 4.0. Nways Workgroup ReMon operates on both Windows Version 3.1 or higher and Windows NT Version 4.0.

Key network features of the Nways Workgroup Manager include:

- Automatic Internet network discovery
- Real-time, graphical views of network topology
- Ability to browse, update and compile MIBs
- Color-coded and aggregated network and device real-time status
- Trouble-ticketing
- Trap management, including specifying trap severities
- Trap compiler
- Polling configuration and notification
- Performance threshold configuration and notification
- Inventory management
- Collection and presentation of real-time and historical statistics

The graphical user interface of the device-management applications gives you real-time views of your network devices, with color-coded status of components and overall status of the device. The Nways Workgroup Manager device-management applications provide a complete set of messages, traps and event notifications for devices in the network. In addition the device management applications support ″hot spots″ for point-and-click problem determination and action (for example, click on a port and status information and clickable actions are displayed immediately).

Key features of the Nways Workgroup Manager device-management applications are the ability to:

- View or change device, module or port configurations
- Display statistics at a device, module or port level
- Select a specific component via point-and-click with a mouse
- Receive real-time, color-coded status at a glance
- Define and monitor performance thresholds
- Define and monitor real-time and historical statistics
- Monitor real-time events
- Download microcode
- Telnet and FTP to a device

Nways Workgroup Manager for Windows NT provides virtual LAN configuration management. A virtual LAN (VLAN) is a subnetwork defined by software instead of physical wiring. VLANs enable networks to support the needs of workgroups, which improves worker productivity and network security and, ultimately, cuts administration costs.

The IBM 8271 Nways Ethernet LAN Switch and IBM 8272 Nways Token-Ring LAN Switch have VLAN capability built in. You can set up a VLAN remotely, using the drag-and-drop feature of Nways Workgroup Manager, without having to go to the wiring closet.

Nways Workgroup Manager for NT is the first IBM Nways manager that offers Web-based device management. Java applets are included in the product to provide real-time status graphical representations, based on polling of the IBM 8210 or IBM 8273. Another Java applet allows Web browser access to the Management Information Base (MIB) information, which is supported by every SNMP manageable networking device.

Nways Workgroup ReMon for Windows provides remote monitoring of your network′s performance, through RMON and RMON2 support. RMON and remote RMON2 are standards from the Internet Engineering Task Force (IETF) that advance the state-of-the-art in open network performance management and fault diagnosis. RMON defines a standard set of MAC-layer statistics and the ability to filter and capture data packets for analysis. RMON2 (RFCs 2021 and 2074) provides additional statistical information at the network and application layers of the protocol stack. IBM′s RMON2 support is based on the ECAM that will be migrated to RMON2.

Nways Workgroup ReMon provides not only the RMON functions but also takes advantage of the ECAM capabilities (RMON2) to provide address translation and protocol distribution within your network. Address translation translates MAC addresses to network-layer addresses. Protocol distribution allows you to view the protocols and applications being used on the network.

Use Nways Workgroup ReMon to proactively manage your network performance. It enables you to perform key functions such as:

- Watching for emerging problems and short-term trends
- Checking network performance and utilization
- Setting network service objectives
- Planning short-term and long-range network capacity
- Determining the busiest stations in your network
- Troubleshooting network problems and outages
- Capturing and analyzing network traffic based on definable filter criteria
- Analyzing network-traffic trends, including protocol distribution
- Associating MAC-layer addresses to network-layer addresses
- Configuring RMON and RMON2 agents

12.1.2 Management Solutions for Medium to Large Networks (Campus)

The following products are designed to manage medium to large networks with a requirement for UNIX-based management:

- Nways Campus Managers
  - Nways Campus Manager LAN for AIX
  - Nways Campus Manager LAN for HP-UX
  - Nways Campus Manager ATM for AIX
  - Nways Campus Manager ATM for HP-UX
  - Nways Campus Manager Remote Monitor for AIX
  - Nways Campus Manager Remote Monitor for HP-UX
- Nways RouteSwitch Network Management Suite

The operating environment is TME 10 NetView for AIX, or HP OpenView. The products let you do fault, performance and configuration management of LANs, VLANs and ATM. They have full RMON and RMON2 support for token-ring and Ethernet segments and graphical device management for hubs, routers, switches, etc. The VLAN management is topology and policy-based. They allow network performance monitoring of IBM and non-IBM devices. The products have support for APPN and Data Link Switching (DLSw) implemented.

Table 67 (Page 1 of 2). Nways Campus Manager Supported Hardware Products	
Nways Campus Manager Product	**Devices Supported**
Nways Campus Manager LAN for AIX	• IBM 8210 Nways Multiprotocol Switched Services (MSS) server • IBM 8224 Ethernet Stackable Hub • IBM 8225 Fast Ethernet Stackable Hub • IBM 8229 LAN Bridge • IBM 8230 Token-Ring Controlled Access Unit • IBM 8235 Dial-In Access to LANs (DIALs) Server • IBM 8237 Stackable Ethernet Hub • IBM 8238 Nways Token-Ring Stackable Hub • IBM 8244 FDDI Workgroup Concentrator • IBM 8250 Multiprotocol Intelligent Hub • IBM 8260 Nways Multiprotocol Switching Hub • IBM 8271 EtherStreamer/Nways Ethernet LAN Switch • IBM 8272 LANStreamer/Nways Token-Ring LAN Switch • IBM 8281 Nways ATM LAN Bridge • IBM 2210 Nways Multiprotocol Router • IBM 6611 Network Processor • Other equipment manufacturer (OEM) routers, such as those of CISCO, Wellfleet and Proteon
Nways Campus Manager ATM for AIX	• IBM 8210 Nways Multiprotocol Switched Services (MSS) server • IBM 8281 Nways ATM LAN Bridge • IBM 8282 Nways ATM Workgroup Concentrator • IBM 8285 Nways ATM Workgroup Switch • IBM 8260 Nways Multiprotocol Switching Hub ATM components • Other ATM devices that implement the ATM MIB or LAN Emulation (LANE) standard MIBs
Nways Campus Manager ReMon for AIX	• IBM 8225 Fast Ethernet Stackable Hub • IBM 8230 Token-Ring Controlled Access Unit • IBM 8237 Stackable Ethernet Hub • IBM 8238 Token-Ring Stackable Hub • IBM 8250 Multiprotocol Intelligent Hub • IBM 8250 Token-Ring Management Module • IBM 8260 Nways Multiprotocol Switching Hub • IBM 8260 Token-Ring Media Access Daughter Card • IBM 8260 Ethernet Media Access Daughter Card • IBM 8270 Nways Token-Ring Switch Universal Feature Card (UFC) • IBM 8271 EtherStreamer/Nways Ethernet LAN Switch • IBM 8272 Nways Token-Ring LAN Switch UFC • IBM 8273 Nways Ethernet RouteSwitch • IBM 8274 Nways LAN RouteSwitch • Other RMON-compliant probes
Nways Campus Manager LAN for HP-UX	• IBM 8224 Ethernet Stackable Hub • IBM 8225 Fast Ethernet Stackable Hub • IBM 8230 Token-Ring Controlled Access Unit • IBM 8235 Dial-In Access to LANs (DIALs) Server • IBM 8238 Nways Token-Ring Stackable Hub • IBM 8250 Multiprotocol Intelligent Hub • IBM 8260 Nways Multiprotocol Switching Hub • IBM 8271 EtherStreamer/Nways Ethernet LAN Switch • IBM 8272 LANStreamer/Nways Token-Ring LAN Switch • IBM 8281 Nways ATM LAN Bridge • IBM 2210 Nways Multiprotocol Router • IBM 6611 Network Processor

Table 67 (Page 2 of 2). Nways Campus Manager Supported Hardware Products	
Nways Campus Manager Product	**Devices Supported**
Nways Campus Manager ATM for HP-UX	• IBM 8210 Nways Multiprotocol Switched Services (MSS) server • IBM 8281 Nways ATM LAN Bridge • IBM 8282 Nways ATM Workgroup Concentrator • IBM 8285 Nways ATM Workgroup Switch • IBM 8260 Nways Multiprotocol Switching Hub ATM components • Other ATM devices that implement the ATM MIB or LAN Emulation (LANE) standard MIBs
Nways Campus Manager ReMon for HP-UX	• IBM 8225 Fast Ethernet Stackable Hub • IBM 8230 Token-Ring Controlled Access Unit • IBM 8237 Stackable Ethernet Hub • IBM 8238 Token-Ring Stackable Hub • IBM 8250 Advanced Token-Ring Management Module • IBM 8260 Token-Ring Media Access Daughter Card • IBM 8260 Ethernet Media Access Daughter Card • IBM 8271 EtherStreamer/Nways Ethernet LAN Switch • IBM 8273 Nways Ethernet RouteSwitch • IBM 8274 Nways LAN RouteSwitch • Other RMON-compliant probes

12.1.2.1 Support of Large Networks Including APPN and DLSw

Network device performance monitoring is available through the Nways Campus Manager LAN. It supports large networks by using the distributed polling capabilities provided by the TME 10 Mid-Level Manager (MLM). Distributed polling means that the discovery and polling functions are distributed to a set of nodes, rather than having one node (the network management workstation) poll large groups of devices. This reduces management loads on the networks and reduces processing at the management workstation. With TME 10 MLM, each MLM (usually in a remote node) performs the polling and sends information back to the management workstation only when thresholds are exceeded.

Nways Campus Manager LAN provides one MLM for the HP-UX platform; other MLMs for remote node platforms (HP-UX, Windows NT, SUN, AIX, OS/2) are available through the Systems Monitor component of the TME 10 Distributed Monitoring product.

Nways Campus Manager LAN supports APPN and DLSw topologies. With the APPN topology feature you can view your APPN networks end to end. You can discover participating APPN resources, view them and view their status as color-coded icons. APPN protocol performance and error events (data and graph) are also provided. The DLSw technology provides the ability to transport SNA, NetBIOS and APPN traffic across an IP network. The DLSw topology displays connectivity, resources and color-coded status in your DLSw network. The topology is refreshed as new nodes are discovered.

12.1.2.2 RMON and RMON2 Support

Nways Campus Manager ReMon provides remote monitoring of your network′s performance, through RMON and RMON2 support. RMON and RMON2 are standards from the IETF that advance the state-of-the-art in open network performance management and fault diagnosis.

RMON (RFC 1757 and RFC 1513 extension for token-ring) defines a standard set of MAC-layer statistics and the ability to filter and collect data packets for analysis. RMON2 provides additional statistical information at the network and application layers of the protocol stack. IBM′s RMON2 support is based on the ECAM that will be migrated to RMON2.

ECAM lets you go beyond the current RMON standards to full seven-layer data collection, including segment, host and conversation statistics for the major protocols and application types. By viewing conversations across the network, the real communications patterns and the use of expensive links become apparent. With this information you can tune the network and adjust the location of key resources such as file servers. ECAM also allows network operators to view the internetwork traffic for troubleshooting.

Nways Campus Manager ReMon Advanced provides not only the RMON functions but also takes advantage of the ECAM capabilities (RMON2) to provide address translation and protocol distribution within your network. Address translation translates MAC addresses to network-layer addresses. Protocol distribution allows you to view the protocols and applications. Nways Campus Manager ReMon Advanced provides the RMON2 ability to do protocol-matrix analysis of Layer 3 or higher protocols using the ECAM capability in the RMON2 probe. The protocol matrix provides information about who is talking to whom in the network and what protocols they are using. Nways Campus Manager ReMon Advanced also includes the Traffic Transmission Monitor Module (TTMM), which provides a fast, effective means of transmitting captured packets to specific segments or rings for stress-testing or network simulation. The captured data can also be loaded from other LAN analysis tools, such as IBM DatagLANce Network Analyzer.

12.1.2.3 Support for ATM Networks

Nways Campus Manager for ATM provides easy-to-use management for ATM networks, including virtual networks formed from ATM Forum-compliant ELANs, and manages ATM devices that use ATM Forum-compliant MIBs.

One of the premiere features of Nways Campus Manager ATM is its ability to fine-tune the auto-discovery capability for ATM. You can allow discovery of particular SNMP agents, such as non-IBM ATM devices, you can filter discovery based on criteria such as IP address or device type, and you can set the discovery interval to optimize polling.

When viewing the topology map you can display an entire ATM network, or you can zoom in on the subnetwork or device of interest. You can choose monitored resources by selecting resource icons using drag-and-drop to place them on the monitor panel.

You can select key performance counters and track their variations over time. This data can be stored and displayed in various graphical forms across a selected time interval.

With the connection-tracking function, you get true ATM end-to-end management capability. This function graphically displays any virtual connections between two endpoints on the ATM network. Connection-tracking shows all the actual hardware resources that support the entire path of the connection, such as adapters, concentrators, switches and bridges. This function launches other management functions on these devices, such as performance-monitoring.

Also included with Nways Campus Manager ATM is support for Web access to ATM topology discovered by TME10 NetView for AIX, including ATM clusters, peer groups and ATM devices. Each ATM device displayed is represented by a selectable icon and by its IP address.

With the ATM Web-based management support, you can refresh and display the ATM topology, update node agent values, reload the HTML page with the new node values, display a list of ATM modules located in a selected ATM device, and list events related to a selected ATM device. The Web-based support also provides access to selected ATM devices using the Telnet protocol.

The following figure is a conclusion of the above-mentioned features and functions of the Nways Campus Managers. It shows all the supported IBM devices in the traditional LAN area, and the RMON agents connected to the ReMon application, which can be found in OEM stand-alone probes or in networking devices such as IBM hubs or switches. The right side shows the ATM application connected to the IBM devices it supports.

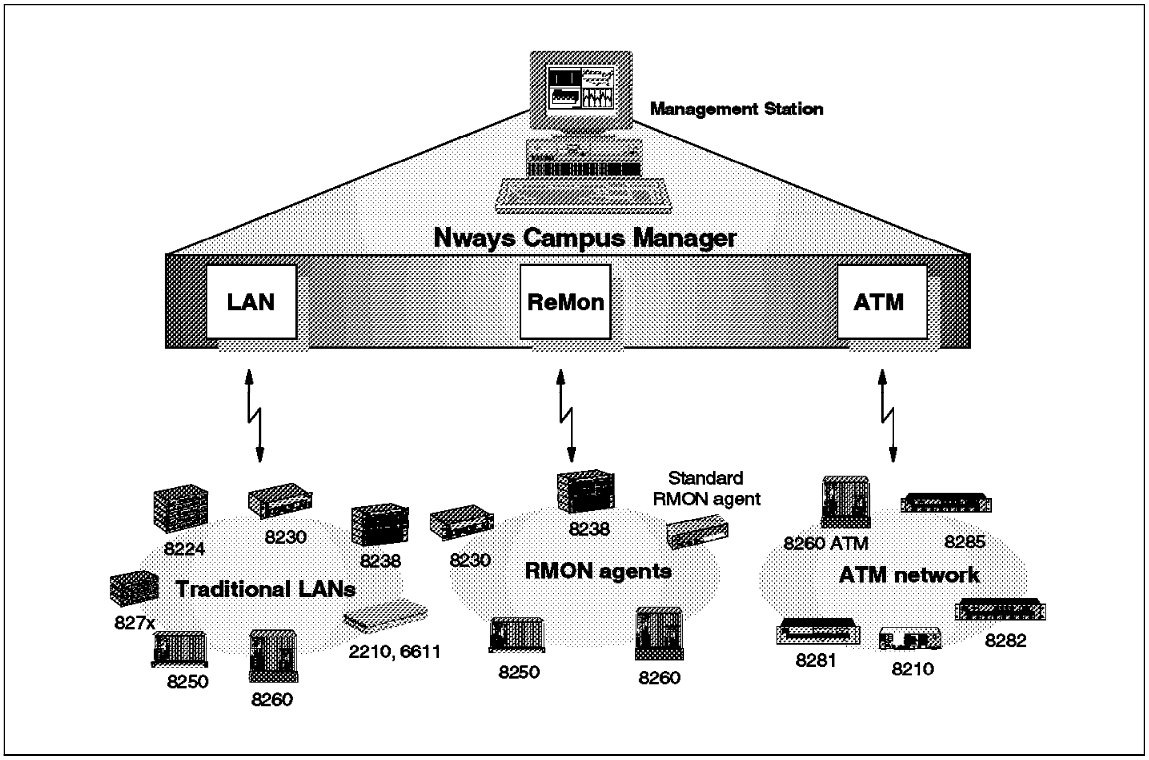


Figure 67. Managing LAN and ATM Campus Networks from Mid-Range Systems

Note: See also chapter Chapter 17, "Asynchronous Transfer Mode (ATM)" on page 295 for more information about ATM connections and IBM's ATM products.

12.1.3 Management Solutions for Wide Area Networks (WAN)

To manage a wide area networking (WAN) environment with a UNIX-based solution, IBM offers the following products:

- Nways Enterprise Manager
- Nways Wide Area Element Manager

Their operating environment is:

- TME 10 NetView for AIX and TMN NetView (Enterprise Manager)
- HP OpenView for Solaris (Wide Area Element Manager)

These products give you fault, configuration and security management functions. They also support Euro-ISDN and Q.SIG management and do performance monitoring. You can do graphical device management of hubs, routers, switches, etc.

The Nways Enterprise Manager supports networks comprised of IBM 2220 family switches, routers and 3746 controllers.

The Nways Wide Area Element Manager supports networks with IBM 2219, 2225 and 2230 Nways Wide Area Switches.

Figure 65 on page 252 shows the elements that comprise the Nways enterprise manager. There are three basic elements:

- The 2220 Broadband Switch Manager
- The Alert Transport function
- The Health and Performance Monitor

The highlights of the 2220 Broadband Switch Manager include:

- Graphic network topology discovery
- Detailed resource display of the node with command menus available
- Operations management for the switch resources including diagnostic tools
- Problem management through alarms and switch status changes

Some of the more important strengths of this product include:

- Graphs, tables and filing options of real-time performance
- Monitoring of trunks, ports and connections, including counters for ATM and frame relay
- Accounting management with logging of NBBS connections traffic in a special accounting file to be used with billing

The Health and Performance Monitor is a new version of the Router and Bridge Manager/6000 (RABM) product. It includes support for APPN and DLSw topologies.

The Alert Transport function is designed to translate IBM 3746 alerts into SNMP traps. IBM now offers an SNMP manageable 3746 option. The Alert Transport receives SNMP traps containing SNA alerts and translates them into SNMP events, which can then be displayed and manipulated in the platform event log.

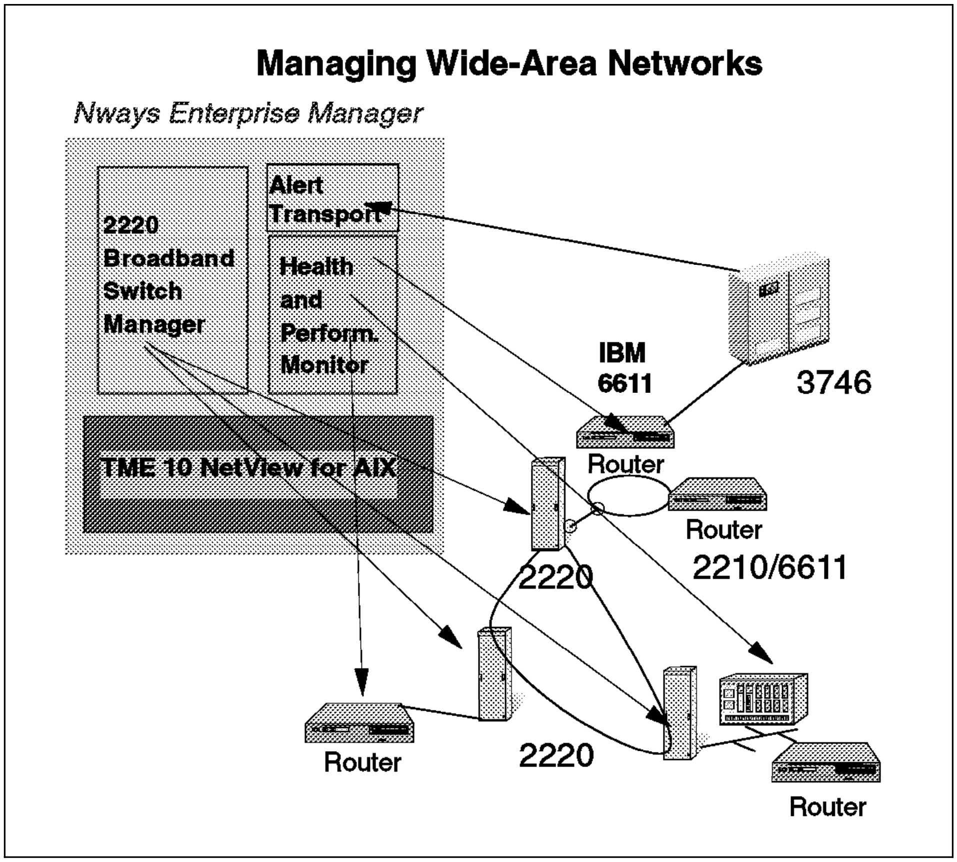


Figure 68. Managing Wide Area Networks with Nways Enterprise Manager

Figure 69 on page 265 shows the management environment of Nways Enterprise Manager (NEM), TME 10 NetView and the Telecommunications Management Network (TMN). The TMN family of products is designed around the management network framework and standards called Telecommunications Management Network or TMN. This is widely accepted as the appropriate infrastructure for the deployment and management of networks in the telecommunications industry where voice-oriented services are giving way to data and multimedia. The IBM NetView TMN Support Family for AIX is a management platform for the execution of management applications or agents. TMN capitalizes and extends the strengths of NetView for AIX providing, specifically for the Nways Enterprise Manager, integration with a wide range of management application services offered by independent TELCO software vendors. This allows the 2220 Switch Manager to be managed from the same platform as other CMIP managed agents. NetView TMN Support Facility for AIX can be used instead of the TME 10 NetView for AIX as the management platform for NEM.

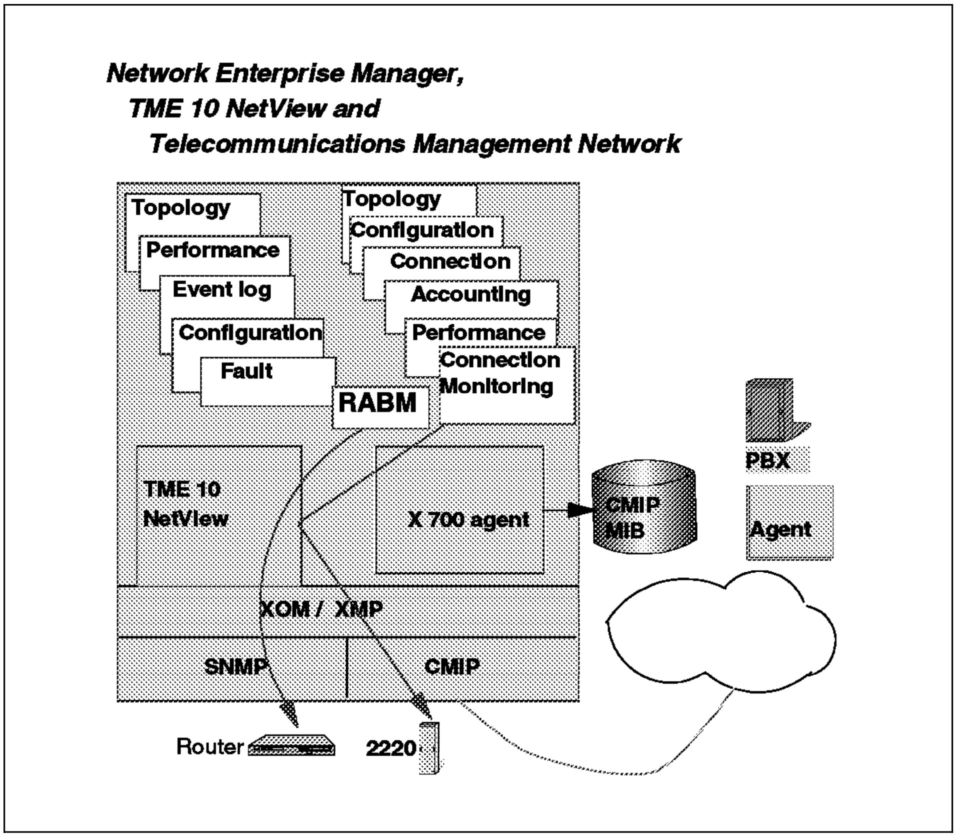


Figure 69. Managing Wide Area Networks with Nways Enterprise Manager, TME 10 NetView and Telecommunications Management Network

12.2 Management Options of IBM Networking Devices

A list of some of IBM′s more recent networking hardware devices and their management options can be found in Table 68.

Table 68 (Page 1 of 5). Management Options of IBM Networking Devices

IBM Device	IBM Management Product
8210 MSS Stand-alone Server V1.0	• Nways Manager for Windows V2 • Nways Campus Manager - ATM for AIX V2.1 • Bridge management within NCM LAN for AIX V3 • NCM ATM for HP-OV V2
8210 MSS Stand-alone Server V1.1	• Nways Workgroup Manager for NT • Nways Campus Manager - ATM for AIX V2.2 • Bridge management within NCM LAN for AIX V3 • NCM ATM for HP-OV V2

<table>
<caption>Table 68 (Page 2 of 5). Management Options of IBM Networking Devices</caption>
<tr><th>IBM Device</th><th>IBM Management Product</th></tr>
<tr><td>8224 Ethernet Stackable Hub</td><td>Stackwatch for Windows (stand-alone)
Stackwatch for Novell NMS
8224 PSM within Nways Manager for Windows
Nways Workgroup Manager for NT
Nways Campus Manager LAN for AIX
Nways Campus Manager LAN for HP-OV</td></tr>
<tr><td>8225 Fast Ethernet Stackable Hub</td><td>Nways Manager for Windows V2
Nways Workgroup Manager for NT
Nways Campus Manager LAN for AIX V3
Nways Campus Manager LAN for HP-OV V2
RMON management with:
Nways LAN ReMon for Windows
Nways Workgroup ReMon for NT
NCM ReMon Base for AIX
NCM ReMon Base for HP-OV</td></tr>
<tr><td>8209 Token-Ring to Token-Ring and Token-Ring to Ethernet Bridge</td><td>Bridge and connected Token-Ring Segment management by LAN Network Manager (LNM) for OS/2 V2)
Bridge and connected Token-Ring Segment management by NCM LAN for AIX V2, V3 through LNM for OS/2 V2 proxy agent</td></tr>
<tr><td>8229 Token-Ring to Token-Ring and Token-Ring to Ethernet Bridge</td><td>SNMP
Bridge and connected Token-Ring Segment management by NCM LAN for AIX V3
LLC/CMOL
Bridge and connected Token-Ring Segment management by LNM for OS/2 (V1.1 or V2)
Bridge and connected Token-Ring Segment management by NCM LAN for AIX V3 through LNM for OS/2 V2 proxy agent</td></tr>
<tr><td>8240 FDDI Concentrator</td><td>NCM LAN for AIX V2, V3 (through SNMP proxy agent program)</td></tr>
<tr><td>8244 FDDI Workgroup Concentrator</td><td>NCM LAN for AIX V2, V3 (through SNMP proxy agent program)</td></tr>
<tr><td>8230 Controlled Access Unit Mod. 001/002</td><td>LLC management:
LNM for OS/2 V1.1 or V2
NCM LAN for AIX V2, V3 (through LNM for OS/2 V2 proxy)</td></tr>
<tr><td>8230 Controlled Access Unit Mod. 003/013/04A/04P/213</td><td>CMOL management:
LNM for OS/2 V2 plus PTF UR43844
SNMP management:
8230 PSM within Nways Manager for Windows
Nways Workgroup Manager for NT
NCM LAN for AIX
NCM LAN for HP-OV
RMON management:
Nways LAN ReMon for Windows
Nways Workgroup ReMon for NT
NCM ReMon Base for AIX
NCM ReMon Base for HP-OV</td></tr>
</table>

Table 68 (Page 3 of 5). Management Options of IBM Networking Devices	
IBM Device	**IBM Management Product**

8237 Stackable Ethernet Hub	• Nways Workgroup Manager for NT
	• Nways Campus Manager LAN for AIX V3.2
	• RMON management:
	  – Nways LAN ReMon for Windows
	  – Nways Workgroup ReMon for Windows
	  – Nways Campus Manager ReMon Base for AIX
	  – Nways Campus Manager ReMon Base for HP-OV
	• Nways Campus Manager LAN for HP-OV

8250 Intelligent Hub	• Intelligent Hub Management Program DOS Entry V2 (stand-alone) • NCM LAN for AIX • NCM LAN for HP-OV • Nways Workgroup Manager for NT • 8250 PSM within Nways Manager for Windows • Bridge Blade management with NCM LAN for AIX V3 • Token-Ring segment management through Bridge Blade by LNM for OS/2 V1/V2 • TR Bridge Blade and connected TR segment management by NCM LAN for AIX V2/V3 through LNM for OS/2 V2 proxy • RMON management of Ethernet probe by NCM ReMon for AIX • RMON management of Ethernet probe by NCM ReMon for HP-OV
8260 Intelligent Hub	• NCM LAN for AIX • NCM LAN for HP-OV • Nways Workgroup Manager for NT • 8260 PSM within Nways Manager for Windows V2 (V1 with PTF UR44773) • Bridge Blade management with NCM LAN for AIX V2/V3 • Token-Ring segment management through Bridge Blade by LNM for OS/2 V1/V2 • RMON groups management by NCM ReMon for AIX • RMON groups management by NCM ReMon for HP-OV • RMON TR ring station group offers LAN topology for LNM for AIX (TMAC card)
8271 Etherstreamer Switch Model 100	• 8271 PSM within Nways Manager for Windows • Nways Workgroup Manager for NT • Bridge management by NCM LAN for AIX V2/V3 • NCM LAN for AIX • NCM LAN for HP-OV
8271 Etherstreamer Switch Model 108	• 8271 PSM within Nways Manager for Windows V2 (V1 with PTF UR44773) • Nways Workgroup Manager for NT • Bridge management by NCM LAN for AIX V2/V3 (PTF U438903) • NCM LAN for AIX V2 (V1 with PTF UR44965)
8271 Etherstreamer Switch Model 216	• 8271 PSM within Nways Manager for Windows V2 • Nways Workgroup Manager for NT • Bridge management by NCM LAN for AIX • NCM LAN for AIX V3 • NCM LAN for HP-OV V2
8272 Token-Ring Switch Model 108	• 8272 PSM within Nways Manager for Windows V2 • Nways Workgroup Manager for NT • NCM LAN for AIX V2 (V1 with PTF UR44965)

Table 68 (Page 4 of 5). Management Options of IBM Networking Devices

IBM Device	**IBM Management Product**
8272 Token-Ring Switch Model 216	• 8272 PSM within Nways Manager for Windows V2 • Nways Workgroup Manager for NT • Bridge management by NCM LAN for AIX V2/V3 (PTF U438903) • NCM LAN for AIX V3 • NCM LAN for HP-OV V2
8273 Nways Ethernet RouteSwitch	• Nways RouteSwitch Network Manager for NT, AIX, HP • VLAN management through Nways RouteTracker for NT, AIX, HP • Launch of RouteSwitch Network Manager application via: – Nways Workgroup Manager for NT – NCM LAN for AIX V3.2
8274 Nways LAN RouteSwitch	• Nways RouteSwitch Network Manager for NT, AIX, HP • VLAN management through Nways RouteTracker for NT, AIX, HP • Launch of RouteSwitch Network Manager application via: – Nways Workgroup Manager for NT – NCM LAN for AIX V3.2
8281 ATM LAN Bridge	• 8281 PSM within Nways Manager for Windows V2 • Nways Workgroup Manager for NT • Bridge management by LNM for AIX • NCM ATM for AIX • NCM ATM for HP-OV • NCM LAN for AIX V2 (V1 with PTF UR44998)
8282 ATM Concentrator	• 8282 PSM within Nways Manager for Windows V2 • Nways Workgroup Manager for NT • NCM ATM for AIX • NCM ATM for HP-OV
8238 Nways Token-Ring Stackable Hub	• Intelligent Hub Management Program DOS Entry V2 • RMON agent in 8238 provides TR segment view to LNM for AIX • 8238 PSM within Nways Manager for Windows V2 (V1 with PTF UR44773) • Nways Workgroup Manager for NT • NCM LAN for AIX • NCM LAN for HP-OV V2
8285 Nways ATM Switch	• 8285 PSM within Nways Manager for Windows V2 (V1 with PTF UR44773) • Nways Workgroup Manager for NT • NCM ATM for AIX • NCM ATM for HP-OV V2
8227 Wireless LAN Access Point	• Bridge management by LNM for AIX via SNMP

Table 68 (Page 5 of 5). Management Options of IBM Networking Devices	
IBM Device	**IBM Management Product**
6611 Network Processor	• 6611 PSM within Nways Manager for Windows V2 (V1 with PTF UR44773) • Nways Workgroup Manager for NT • NCM LAN for AIX • NCM LAN for HP-OV V2 • Bridge management by LNM for AIX via SNMP • Bridge and connected Token-Ring Segment management by LNM for OS/2 (V1.1 or V2) • Bridge and connected Token-Ring Segment management by NCM LAN for AIX V3 through LNM for OS/2 V2 proxy agent
2210 Nways Multiprotocol Router	• 2210 PSM within Nways Manager for Windows V2 (V1 with PTF UR44773) • Nways Workgroup Manager for NT • NCM LAN for AIX • NCM LAN for HP-OV V2 • Bridge management by LNM for AIX via SNMP
Local and Remote Token-Ring Bridge/DOS	• Bridge and connected Token-Ring Segment management by LNM for OS/2 (V1.1 or V2) • Bridge and connected Token-Ring Segment management by NCM LAN for AIX V3 through LNM for OS/2 V2 proxy agent
LANStreamer Token-Ring Bridge/DOS	• Bridge and connected Token-Ring Segment management by LNM for OS/2 (V1.1 or V2) • Bridge and connected Token-Ring Segment management by NCM LAN for AIX V3 through LNM for OS/2 V2 proxy agent
Frame Relay Token-Ring Bridge/DOS	• Bridge and connected Token-Ring Segment management by LNM for OS/2 (V1.1 or V2) • Bridge and connected Token-Ring Segment management by NCM LAN for AIX V3 through LNM for OS/2 V2 proxy agent
RouteXpander/2	• **SNMP** • Bridge management by LNM for AIX • Bridge management with Router and Bridge Manager/6000 V1.2 • **LLC/CMOL** – Bridge and connected Token-Ring Segment management by LNM for OS/2 (V1.1 or V2) (Version 1.1 supports single port bridge, V2 supports multi port
8235 Dial-in Access to LAN Server	• 8235 Management Facility for Windows 1.1 or V2) • Nways Manager for Windows V2 V3 through LNM for OS/2 V2 proxy agent • Nways Workgroup Manager for NT • NCM LAN for AIX V3

Note: The function of the former Router and Bridge Manager/6000 are now shipped within:

- Nways Campus Manager LAN (NCM LAN) for AIX (V1, V2, V3)
- Nways Campus Manager LAN (NCM LAN) for HP-OV V2, and/or

- Nways Enterprise Manager (NEM) for AIX V1

LAN Network Manager for AIX function is now shipped within Nways Campus Manager LAN for AIX V2 and V3.

Product Specific Modules (PSMs) for AIX require the installation of the Management Application Transport (MAT) feature, which is available in:

- PTF U440651 for Netview for AIX V2R1
- PTF U444148 for Netview for AIX V3R1
- PTF U440653 for Netview for AIX V3R1 Entry
- PTF U444149 for Netview for AIX V4R1

The Management Application Trasnport feature now ships in a CD-ROM package, which contains:

- Nways Manager for AIX V1.1, which contains the latest versions of:
  - Nways Campus Manager LAN for AIX
  - Nways Campus Manager ATM for AIX
  - Nways Campus Manager ReMon Advanced for AIX
  - Nways Traffic Monitor for AIX

Chapter 13. Internet Connection Secure Servers

This chapter provides information about IBM′s Internet Connection Secure Servers.

IBM provides Internet Connection Secure Servers for the following operating system platforms:

- OS/390
- AS/400
- AIX
- OS/2 Warp
- Microsoft Windows NT
- Microsoft Windows 95
- Sun Solaris
- Hewlett-Packard HP-UX

In addition, the Domino version of Lotus Notes has Internet server capability.

13.1 IBM Internet Connection Secure Server for AIX, Windows NT, OS/2 Warp, HP-UX, and Solaris

The IBM Internet Connection Secure Servers (ICSS) provide these standard features:

- Home Page repository - acts as a repository for resources (home pages) created with Hypertext Markup Language (HTML)
- HTTP support with full HTTP 1.1 compliance
- ICSS has a Simple Network Management Protocol (SNMP) subagent that maintains ICSS information and performance data in an SNMP management information base (MIB). From any SNMP-capable network manager, such as NetView/AIX, you can display, monitor, and threshold on your server performance. This function is not currently supported on the Solaris or HP-UX platforms.
- Proxy support - that is the server acts as an agent for the browser to access remote servers which are not directly accessible by the browser because of security access restrictions. The proxy server supports requests from HTTP, FTP, Gopher, WAIS, and S-HTTP, and acts on their behalf.
- Proxy caching - means that the proxy server can temporarily store files and therefore make subsequent requests for those files available to the requester much quicker.

- CGI support - the server provides an application interface using the Common Gateway Interface (CGI). CGI is an API used between the Internet Connection Server and another application, such as a database.
- Integration of DB2 Gateway (in AIX and OS/2 only) - allows access to DB2 data using standard Web browsers. With this feature, you can develop Web applications without a proprietary language, data encapsulation, or database reformatting. Application developers can combine dynamic SQL with HTML forms to access DB2 databases.
- Internet security (available in the IBM Internet Connection Secure Servers) - the secure servers use the two popular security protocols:
  - Secure Sockets Layer (SSL)
  - Secure Hypertext Transfer Protocol (S-HTTP)

  The secure servers are available in two versions:
  - US/Canada version
  - Export version

  The Export versions of the Secure Servers use a security level that is approved by the US government for export. Both the US/Canada and the Export versions fully interoperate with each other internationally.
- Integration of CICS Gateway (AIX and OS/2 only) - this feature allows you to develop and run transaction processing applications on the Web and to access new and many existing CICS applications using standard Web browsers.
- Quick and easy installation:
  - For OS/2 Warp, the Internet Connection Server is installed using the standard OS/2 installation tool, the Software Installer
  - For AIX, the Internet Connection Server uses SMIT and installp
  - For Windows NT and Windows 95 it is installed using InstallShield
  - For Solaris it is installed using Admintool
  - In HP-UX it is installed using SAM
- IBM HTTPD API - this API allows you to write extensions to perform site-specific processes.
- NSAPI support - the HTTPD API includes an NSAPI compatibility module that supports the Netscape API. With this module you can port your existing NSAPI programs to run on the IBM Interconnection Servers.
- Server-side Includes - this allows for dynamic insertion of information into an HTML document that the server sends to a client. Examples of dynamic information are the current date, the file size, and the last change of a file.

- Error-message customization - this allows you to customize basic CERN messages that the server sends back to the client when error conditions occur.
- Enhanced logging and reporting - this is to control which requests the server logs, as well as create and view reports based on the information the server logs.
- Multiple IP address support - this allows you to maintain multiple Web sites on a single Internet Connection Server. When the server runs on a machine with multiple network connections, you can serve different files based on the host name entered by the client that sent the request. The clients can reach each of the home pages with a simple URL that does not specify a file name or port number.

13.2 IBM Internet Connection Secure Server for OS/390

The IBM Internet Connection Secure Server for OS/390 supports the following S/390 features:

- Use of the Cryptographic Hardware feature, if available, instead of software to perform encryption and decryption. S/390 Cryptographic Hardware support provides the option of using hardware instead of software to perform the encryption and decryption if the required hardware is installed on the host machine. Up to now, the ICSS for OS/390 has used software algorithms to encrypt and decrypt data flows. In this release, the server has been enhanced to detect the presence of crypto hardware on the S/390 system. If it is present, the encryption and decryption function will be performed using the hardware rather than software.
- Use of Workload Manager (WLM) and dynamic Web server workload balancing to achieve customer-specified goals and policies. ICSS for OS/390 is Workload Manager (WLM) enabled, which:
  - Allows tasks to be managed by WLM to customer-specified goals and policies
  - Allows work to be spread across multiple address spaces, which will improve the number of requests processed per second
  - Improves availability because WLM will re-start address spaces that have abended
- OS/390 System Management Facilities (SMF) support allows configuration data to be written at startup and performance data at intervals specified by the user.
- OS/390 data set support is provided as well as OS/390 OpenEdition Hierarchical File System with OS/390 Dataset Support. World Wide Web

documents may be retrieved from native OS/390 data sets as well as the OS/390 Open Edition Hierarchical File System.

- ICSS for OS/390 will now have a Simple Network Management Protocol (SNMP) subagent, which will maintain ICSS information and performance data in an SNMP Management Information Base (MIB). Now, from any SNMP-capable network manager, such as NetView/AIX, you can display, monitor, and set thresholds on your server performance.
- SOCKS support provides the capability to use ICSS for OS/390, when located behind a firewall, as a proxy server to the destination host via a SOCKS server on the other side of the firewall.
- The Common Gateway Interface (CGI) support has been expanded to include the Java programming language in addition to the other languages such as C, REXX, and PERL already supported.
- SSL tunneling allows the server to act as a proxy server for secure transactions.
- ICSS for OS/390 will write two types of data to the OS/390 System Management Facilities (SMF) logs. At startup of ICSS, configuration data will be written, and, at intervals specified by the customer, performance information will be written during operation.

Chapter 14. Network Station

This chapter deals with the IBM Network Station. The Network Station combines the advantages of non-programmable terminals (NPTs) and Personal Computers (PCs).

The IBM Network Station allows you to take advantage of application technologies such as the corporate intranet, the Internet and Java, and at the same time it provides the simplicity of an NPT.

14.1 IBM Network Station Overview

The IBM Network Station is a compact desktop network computer. It is available in four models, depending on connectivity and base memory requirements. An overview of the Models are:

Model	Type	Base Memory	Expanded Memory	Processor
100	Ethernet	8 MB	64 MB	Power PC
110	Ethernet	16 MB	64 MB	Power PC
200	token-ring	8 MB	64 MB	Power PC
210	token-ring	16 MB	64 MB	Power PC

The IBM Network Station client consists of a PowerPC microprocessor, memory I/O interfaces, and an operating system program kernel. Programs are loaded to the IBM Network Station from a server by the Network Station Manager residing on the server.

The logic units use the TCP/IP protocol to communicate with the server. In addition to the PowerPC microprocessor the desktop network computer subsystems are integrated, including video, serial and parallel ports, mouse, and keyboard.

The logic unit contains two sockets that are used to add optional video memory modules. Video memory supports the functions of higher-resolution VGA monitors. IBM manufactures the logic unit with 1 MB of video memory. You can add an additional 1 MB of video memory by installing the optional modules in the sockets.

The video subsystem supports attachment of industry-standard personal computer monitors. Screen resolutions supported range from 640x480 up to 1600x1280 (with video memory feature installed) depending on the choice of monitor.

IBM Network Station operates without local disk storage. When powered on the Network Station performs initial diagnostics and contacts the server to request the IBM Network Station Manager to download the Network Station′s program kernel. After the server connection and successful entry of a user ID and password, the predefined user preferences are returned to the IBM Network Station.

The IBM Network Station communicates through the RJ-45 cable connector on the back of the logic unit. The used protocol is TCP/IP; the type of communication is Ethernet or token-ring. The type of communication is defined by the model of the Network Station:

- 8361 Model 100 and 110 provides Ethernet connection
- 8361 Model 200 and 210 provides token-ring connection

The Network Station Models 100 and 110 require an Ethernet Telephone Twisted Pair (TTP) cable with an RJ-45 (8-position) connector. This is an industry-standard 10Base-T (RJ-45 plug) cable with the normal requirements and standards for distances, hubs and taps.

The Network Station Models 200 and 210 require a token-ring Telephone Twisted Pair (TTP) cable with an RJ-45 (8-position) connector. Industry-standard token-ring requirements and standards apply for distances and tabs. Different cables (UTP/STP) are required for 4 MB and 16 MB ring speeds. The Network Station software packages support any of the following tasks:

- Operates as a 5250 workstation or 3270 workstation.
- Uses network computing technologies such as a Web browser to connect to the Internet.
- Accesses PC applications on a PC server by using X-Windows terminal support. This requires additional support programs on the PC server.
- Prints output on a locally attached printer or on a printer that is connected to a host.
- Accesses Java applications with the local Java Virtual Machine (JVM).
- Can use Lotus Notes via a Web browser and Domino server.

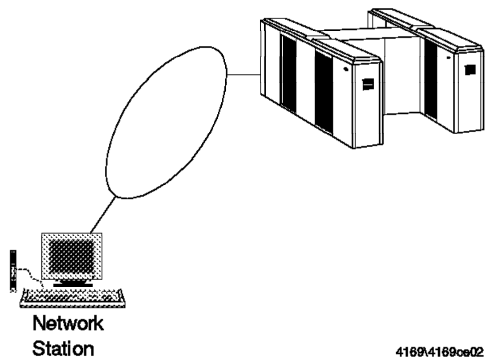


Figure 70. Network Station

14.2 Supported Platforms

The Network Station attaches to any IBM platform server:

- **AS/400**

  The Network Station was initially developed as the next generation 5250 terminal, and therefore has an extremely high affinity with the AS/400. The native 5250 function built into the Network Station will guarantee the customer 100% compatibility with all their applications.

- **PC Server**

  The Network Station is not positioned to be a replacement for mainstream desktop PCs, because it has no stand-alone capability and must be started via a server. It is intended to replace NPTs, and to provide enhanced functions to former NPT workstations.

- **RS/6000**

  For the RS/6000, the Network Station provides an X-Windows GUI and Java Virtual Machine (JVM) environment.

- **S/390**

  The Network Station provides simple access to not only 3270 applications but also to any application that can be reached by a TCP/IP connection. The former NPTs can now take advantage of new GUI interfaces, more facilities and Web interfaces.

The following table gives an overview of the different functions that are/will be supported on the various platforms.

Table 69. Network Station Overview							
	OS/390	**MVS**	**VM/ESA**	**OS/400**	**AIX**	**Windows NT**	**OS/2**
Official Download Boot Code available	YES	YES	YES	YES	YES	YES	TBA
Network Station Manager available	YES	YES	YES	YES	10/97	YES	TBA
Mininum Operating System Level required	R1	SP5.2.2	V2.1	V3R2	4.1.5	NT 4.0	TBA
Boot Protocol supported	NVRAM, BOOTP (via DHCP server), DHCP	NVRAM, BOOTP (via DHCP server), DHCP	NVRAM, BOOTP	NVRAM, BOOTP	NVRAM, BOOTP, DHCP	NVRAM, BOOTP, DHCP	NVRAM
Target Server	YES	YES	YES	YES	YES	YES	NA
Note: TBA - to be announced							

14.3 Software Requirements

As shown in Table 69 the Network Station is supported on different platforms. To run the Network Station properly the following software requirements have to be satisfied:

- S/390
  - OS/390 or MVS 5.2.2
  - TCP/IP V3.2
  - TCP/IP Network Station Manager for OS/390
  - TCP/IP Network Station Client
  - IBM Internet Connection Server

  Full support for the Network Station requires an operational OpenEdition system with HFS and shell and utilities features. As soon as the Network Station Manager is available, the Secure Internet Connection Secure Server (ICSS) and a JavaScript-capable browser will be required, too.

  or

  - VM/ESA V2 R1.0 + VM60256, VM61080
  - TCP/IP V2.4 + PQ01770, PQ02301

  The VM/ESA OpenEdition shell and utilities feature is required in order to install the VM/ESA support for the IBM Network Station code into the Byte File System. When Network Station Manager is available an HTTP Server and a JavaScript-capable browser will be required, too.

- AS/400

- OS/400 V3.2, OS/400 V3.7, or AS/400 Advanced Entry BasePAK
- IBM Network Station Manager for AS/400

The IBM Network Station Browser or Navio NC Navigator browser is required.

- RS/6000
  - AIX V4.1.5 + IX66032

    or
  - AIX V4.2.1

  This software includes terminal support for 3270, 5250, X-Windows and Java.

- PC Server
  - Windows NT Server 4.0
  - IBM Network Station Manager for Windows NT

14.4 Network Station Manager

The Network Station Manager program is used to configure the Network Station. For the initial installation, before the Network Station can be operational a browser capable of HTML 3.2 is required.

The Network Station Manager is available on different platforms (see 14.3, "Software Requirements" on page 278). It manages the configuration tasks associated with the Network Station and their users. The Network Station Manager functions may be divided into:

- Hardware configuration

  These settings allow you to adjust the display, keyboard and mouse.

- Startup functions

  These functions tailor the Network Stations startup environment, such as menus and applications to be launched at startup.

- Desktop management functions

  The desktop management functions tailor the fonts and icons to be used.

- 3270/5250 session functions

  These functions tailor the session characteristics, such as screen size, port number and language settings.

- Internet functions

  These functions tailor the user's Internet profile, such as e-mail address, proxies and browser settings.

14.5 Network Station Operations

The Network Station does not have a hard disk, so there has to be a process of loading the operation code down to the Network Station. This process executes a program, the boot monitor, which uses information stored in the NVRAM of the Network Station to:

1. Locate a boot server. This is a server that provides Network Station boot files to the Network Station attached to the network.

2. Load the boot file (including the kernel program) into the Network Station.

After performing these two functions, the boot monitor terminates and control is given to the kernel program.

Using the boot information stored in NVRAM is not the only way to locate a boot server. There are the following boot alternatives:

- **NVRAM - Local Network Station Memory**

  The IP addresses of this Network Station and its server are hardcoded into the NVRAM for the Network Station. The Network Station powers on and requests the kernel download from the server without first requesting its own address or network configuration. This protocol is only practical in very small, stable LANs because of the amount of setup data that must be entered into the Network Station by hand.

- **BOOTP - TCP/IP Bootstrap Protocol**

  The Network Station broadcasts a special BOOTP request packet which is received by a server. The server matches the unique hardware number of the Network Station with an IP address for that Network Station maintained in a server database.

  This protocol is the most common boot protocol for diskless devices on TCP/IP networks. It requires that the system administrator of the server maintain the BOOTP table with data for all Network Stations that will be served boot images from that server machine. The address of the server is not required to be known to the Network Station in order for BOOTP to work.

- **DHCP - Dynamic Host Configuration Protocol**

  DHCP is similar to BOOTP with the additional feature that DHCP servers only lease the network address to the Network Station for a limited time and then the DHCP server may recover that address and reuse it for other Network Stations. This protocol is recommended for larger networks where a pool of boot servers can cooperate to share the load of hundreds of Network Stations.

After the kernel is loaded to the Network Station the Network Station is ready to contact the application server or target server, which provide different applications for common access.

The target server can be on the same system as the boot server or on a different system. An application server can be any server that can be reached using TCP/IP, either directly or indirectly, if using a network gateway server.

Chapter 15. IBM Personal Communications Family

IBM Personal Communications products provide 3270, 5250, and VT emulation support for PCs running DOS/Windows, Windows 95, OS/2, and Windows NT. They provide easy-to-use features such as macro support, keystroke record and playback, iconic toolbar, dynamic data exchange (DDE), and enhanced clipboard editing.

15.1 Personal Communications Overview

The IBM Personal Communications family currently consists of the following products:

- Personal Communications AS/400 and 3270 V4.1 for Windows
- Personal Communications AS/400 V4.1 for Windows
- Personal Communications AS/400 and 3270 V4.1 for Windows 95
- Personal Communications AS/400 V4.1 for Windows 95
- Personal Communications AS/400 and 3270 V4.1 for OS/2
- Personal Communications AS/400 V4.1 for OS/2
- Personal Communications AS/400 and 3270 V4.11 for DOS/Windows, Windows 95, Windows NT and OS/2
- Personal Communications AS/400 V4.11 for DOS/Windows, Windows 95, Windows NT and OS/2
- eNetwork Personal Communications for DOS/Windows, Windows 95, Windows NT and OS/2
- eNetwork Personal Communications AS/400 V4.2 for Windows, Windows 95, Windows NT and OS/2

15.1.1 Personal Communications for OS/2 V4.1

Personal Communications AS/400 and 3270 V4.1 for OS/2 provides both TN3270 and both 3270 and 5250 emulation in the OS/2 environment, while Personal Communications AS/400 V4.1 for OS/2 provides TN5250 and 5250 emulation only. Both products contain the OS/2 access feature providing additional communication and programming support.

Personal Communications AS/400 and 3270 V4.1 for OS/2 also supports 3174 Peer Communication.

The OS/2 access feature provides the following:

- AnyNet Sockets over SNA
- AnyNet SNA over TCP/IP
- APPN end node support including HPR and DLUR

See Table 70 on page 286 for a list of supported connections.

15.1.2 Personal Communications for Windows 95 V4.1

Personal Communications AS/400 and 3270 V4.1 for Windows 95 provides TN3270 and 3270 emulation in the Windows 95 environment while Personal Communications AS/400 V4.1 for Windows 95 provides TN5250 and 5250 emulation. Both products contain the Windows access feature providing additional communication and programming support.

The Windows access feature included in both products is a result of combining the Networking Services for Windows product and the AnyNet product.

Both products include APPN end node support including HPR and DLUR functions.

15.1.3 Personal Communications for Windows V4.1

Personal Communications AS/400 and 3270 V4.1 for Windows provides 3270 emulation in the Microsoft Windows 3.1 or Microsoft Windows for Workgroups V3.11 environment. It will also run on a workstation with Microsoft Windows for Workgroups V3.11 and Microsoft′s LAN manager, allowing the workstation to be used as a client to Microsoft′s SNA Server for Windows NT using the FMI interface.

Personal Communications AS/400 V4.1 for Windows provides TN5250 and 5250 emulation. It will run on Microsoft Windows 3.1 or Microsoft Windows for Workgroups V3.11.

Both products contain the Windows access feature providing additional communication and programming support.

Personal Communications AS/400 and 3270 V4.1 for Windows supports the following:

- 3270 emulation
- AnyNet SNA over TCP/IP

Personal Communications AS/400 V4.1 for Windows supports the following:

- 5250 emulation
- TCP/IP TN5250
- AnyNet SNA over TCP/IP
- PC Support/400 Router attachment including:
  - Client Access/400 router
  - Novell Router
  - IBM APPC Networking Services for Windows

The Windows access feature included in both products is a result of combining the Networking Services for Windows product and the AnyNet product.

15.1.4 Personal Communications AS/400 and 3270 V4.11

The CDs of both products, Personal Communications AS/400 and 3270 V4.11 for DOS/Windows, Windows 95, Windows NT and OS/2 and Personal Communications AS/400 V4.11 for DOS/Windows, Windows 95, Windows NT and OS/2, provide all features and functions that were included in the diskette versions of:

- Personal Communications AS/400 and 3270 V4.1 for Windows
- Personal Communications AS/400 V4.1 for Windows
- Personal Communications AS/400 and 3270 V4.1 for Windows 95
- Personal Communications AS/400 V4.1 for Windows 95
- Personal Communications AS/400 and 3270 V4.1 for OS/2
- Personal Communications AS/400 V4.1 for OS/2

Additionally, Personal Communications V4.11 provides a number of programming interfaces, which include:

- Emulator High-Level Language Application Programming Interface (EHLLAPI)
- Dynamic Data Exchange (DDE)
- Server-Requestor Programming Interface (SRPI)
- Personal Communications Application Programming Interface (PCSAPI)
- Common Programming Interface for Communications (CPI-C)
- Advanced Program to Program Communication (APPC)
- Host On-Demand function

15.1.5 eNetwork Personal Communications V4.2

Both products, eNetwork Personal Communications for DOS/Windows, Windows 95, Windows NT and OS/2 and eNetwork Personal Communications AS/400 V4.2 for Windows, Windows 95, Windows NT and OS/2, provide all features and functions that were included in:

- Personal Communications AS/400 and 3270 V4.1 for Windows
- Personal Communications AS/400 V4.1 for Windows
- Personal Communications AS/400 and 3270 V4.1 for Windows 95
- Personal Communications AS/400 V4.1 for Windows 95
- Personal Communications AS/400 and 3270 V4.1 for OS/2
- Personal Communications AS/400 V4.1 for OS/2
- Personal Communications AS/400 and 3270 V4.11 for DOS/Windows, Windows 95, Windows NT and OS/2
- Personal Communications AS/400 V4.11 for DOS/Windows, Windows 95, Windows NT and OS/2

In addition to the functions in the previous versions, eNetwork Personal Communications V4.2 adds several features including:

- ActiveX/OLE 2.0 support that allows an emulation session to be embedded in or linked to another program
- VT52, VT100, VT220 emulation and ASCII-host file transfer
- AS/400 database access via Open Database Connectivity
- S/390 database access via Distributed Relational Database Architecture
- Host Access Class Library programming interface
- Visual Basic scripting
- Lotus scripting
- TCP62 programmable API that simplifies configuration of AnyNet LU 6.2 support on TCP/IP

15.2 Personal Communications Family Products Comparison

The following table shows a comparison of some of the functions of the eNetwork Personal Communications products on their operating system platforms.

Table 70 (Page 1 of 2). Personal Communications Family Connection Interfaces

3270 Features	**OS/2**	**DOS/Windows**	**Windows 95**	**Windows NT**
Attachments				
LAN via IEEE 802.2	X	X	X	X
3174 Peer Communication	X	X	X	X
IPX/SPX (NetWare for SAA)	X	X	X	X
NWSAA Client				
APPC			X	X
LUA			X	X
TCP/IP TN3270	X	X	X	X
SNA Distributed Function	X	X	X	X
non-SNA DFT	X	X	X	X
Control Unit Terminal (CUT)	X	X		
SDLC	X	X	X	X
Wide Area Connector (WAC)	X		X	X
SNA-over-Async	X	X	X	X
Async for IGN	X	X	X	X
Home 3270	X	X	X	X
Hayes AutoSync	X	X		X

Table 70 (Page 2 of 2). Personal Communications Family Connection Interfaces				
3270 Features	**OS/2**	**DOS/Windows**	**Windows 95**	**Windows NT**
Hayes AutoSync II			X	X
MS SNA Server FMI WinAPPC WinLUA		 Windows only	 X X X	 X X X
APPC3270 (LU2 over APPC)	X	Windows	X	X
AnyNet - SNA over TCP/IP	X	Windows	X	X
3270 pass-through via AS/400	X	Windows	X	X
AnyNet - Sockets over SNA				X
ISDN, X.25	X	DOS	X	X
Network Management				
SNA data compression (Emulator session data)	X	X	X	X
SNA data compression (LU 6.2 sessions)			X	X
Session level encryption	X			
VPD/EVPD, RTM, Alert	X	X	X	X
Command start/stop/query SNA node			X	X
Programming Interfaces				
EHLLAPI, DDE, PCSAPI, CPI-C, APPC	X	X	X	X
SRPI	X	X	X	X
Host Access Class Library			X	X
DOS EHLLAPI	X	X	X	X
Lotus scripting			X	X
Visual Basic scripting			X	X
REXX EHLLAPI support	X		X	X
TCP62			X	X
Advanced Networking Support				
APPN End Node	X		X	X
APPN LEN Node		X		
HPR	X		X	X
DLUR	X		X	X
Gateway IEEE802.2, SNA DFT, SDLC, and X.25		DOS only		

The following table shows some of the 5250 features that are covered by eNetwork Personal Communications in the supported operating systems.

Table 71 (Page 1 of 2). Personal Communications Family Connection Interfaces				
5250 Features	**OS/2**	**DOS/Windows**	**Windows 95**	**Windows NT**
Attachments				
LAN via IEEE 802.2	X	X	X	X
IPX/SPX (NetWare for SAA)		X		
NWSAA Client APPC			X	X
TCP/IP TN5250	X	X	X	X
IPX/SPX TN5250			X	X
Twinaxial	X	X	X	X
Console (asynch and twinax)	X	X	X	X
SDLC autodial	X	X	X	X
SNA over ASYNC	X	X	X	X
Hayes Autosync	X	X	X	X
Hayes Autosync II			X	X
MS SNA Server APPC			X	X
AnyNet SNA over TCP/IP	X	Windows	X	X
S/3x	X	Windows	X	X
Programming Interfaces				
EHLLAPI, DDE, PCSAPI, CPI-C, APPC	X	X	X	X
Host Access Class Library			X	X
DOS EHLLAPI	X	X	X	X
Lotus scripting			X	X
Visual Basic scripting			X	X
REXX EHLLAPI support	X		X	X
TCP62			X	X
Host Print				
3812 Printer emulation	X	X	X	X
Host Print transform	X	X	X	X
ASCII transparent	X	X	X	X
Printer Definition Table (PDT)	X	X	X	X
Client Application Support				
File Transfer for AS/400	X	X	X	X
Virtual Print		X		
PC Organizer and Text Assist	X	X	X	X

Table 71 (Page 2 of 2). Personal Communications Family Connection Interfaces

5250 Features	**OS/2**	**DOS/Windows**	**Windows 95**	**Windows NT**
Enhanced Non-Programmable Terminal User Interface (ENPTUI)	X	X	X	X
Shared folders	X	X	X	X
Data transfer (SQL file transfer)	X	X	X	X
Open Database Connectivity (ODBC) and database access		X	X	
Advanced Networking Support				
APPN end node	X		X	X
APPN LEN node		X		
HPR	X		X	X
DLUR	X		X	X

Chapter 16. eNetwork

IBM′s eNetwork Software expands services that are provided by the IBM communications clients and servers. It provides a next-generation solution for universal connectivity and information access for Network Computing including host access, Internet/intranet access, multiprotocol/multiplatform network integration and increased services for interconnected LANs.

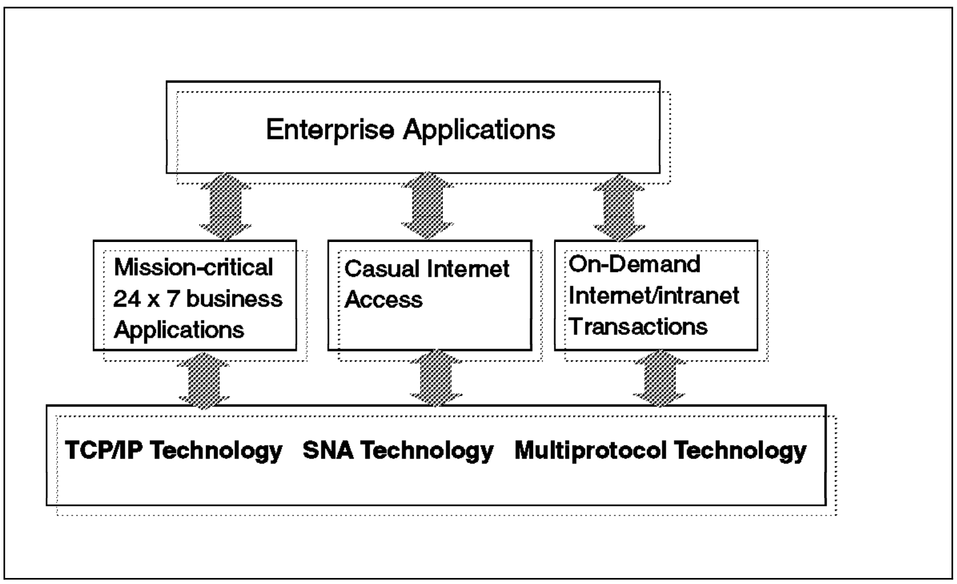


Figure 71. eNetwork Software Technology Directions

16.1 eNetwork - The Current Solution

The current communications client/server family was designed to address the issues for host access and the multiprotocol, multiplatform network integration across TCP/IP and SNA networks. Communication servers are provided for Windows NT, OS/2, AIX, OS/390, MVS, NetWare for SAA, and integrated capability available in OS/400. Personal Communications clients are provided for Windows 3.x, Windows NT, Windows 95 and OS/2. For remote access via wireless or dial networks the ARTour family of products is available with client/server applications for Web access and 3270 emulation. Figure 71 shows the current solution of eNetwork products that are available today.

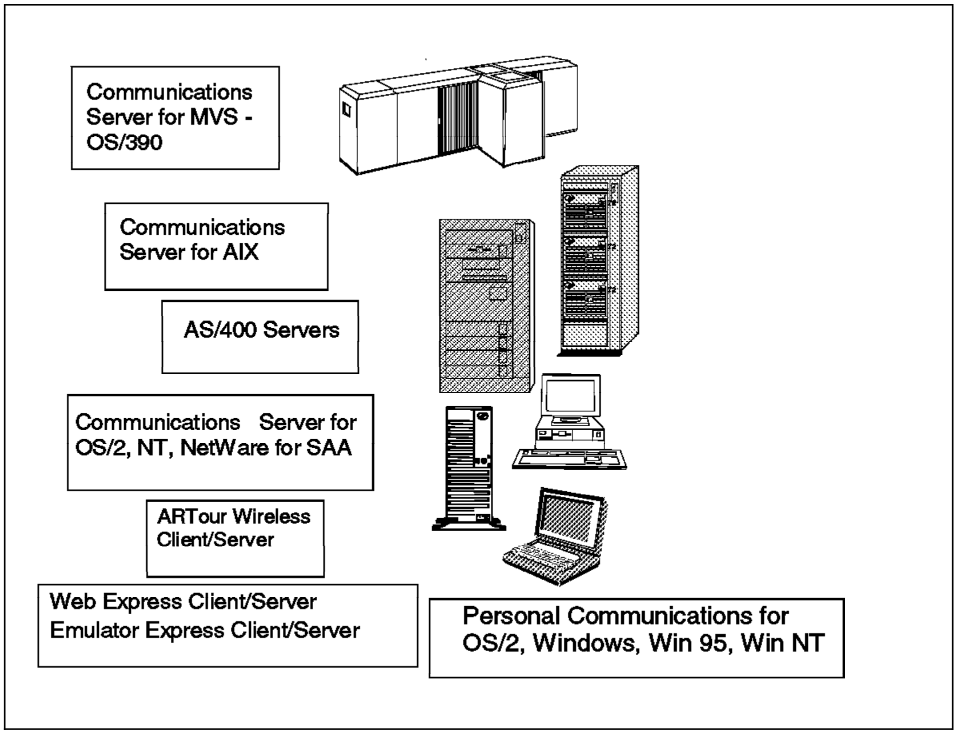


Figure 72. Communications Client/Servers for Host Access and Network Integration

16.2 eNetwork Communications Suite for Windows, Windows 95 and Windows NT V1

The IBM eNetwork Communications Suite delivers complete, easy access to all of your corporate intranets and host data, Lotus Notes, and the Internet. Communication Suite is a combination of these products:

- IBM Personal Communications AS/400 and 3270 Version 4.1 for Windows 3.1, Windows 95, and Windows NT
- Lotus Notes Mail Version 4.5
- FTP Software′s 16-bit and 32-bit TCP/IP protocol stacks and applications
- Netscape Navigator Version 3.0

Communications Suite′s remote access features give secure access to data over remote connections.

The Communications Suite provides a single installation interface for all applications contained in the suite.

Figure 73 on page 293 shows the current version of the eNetwork Communications Suite.

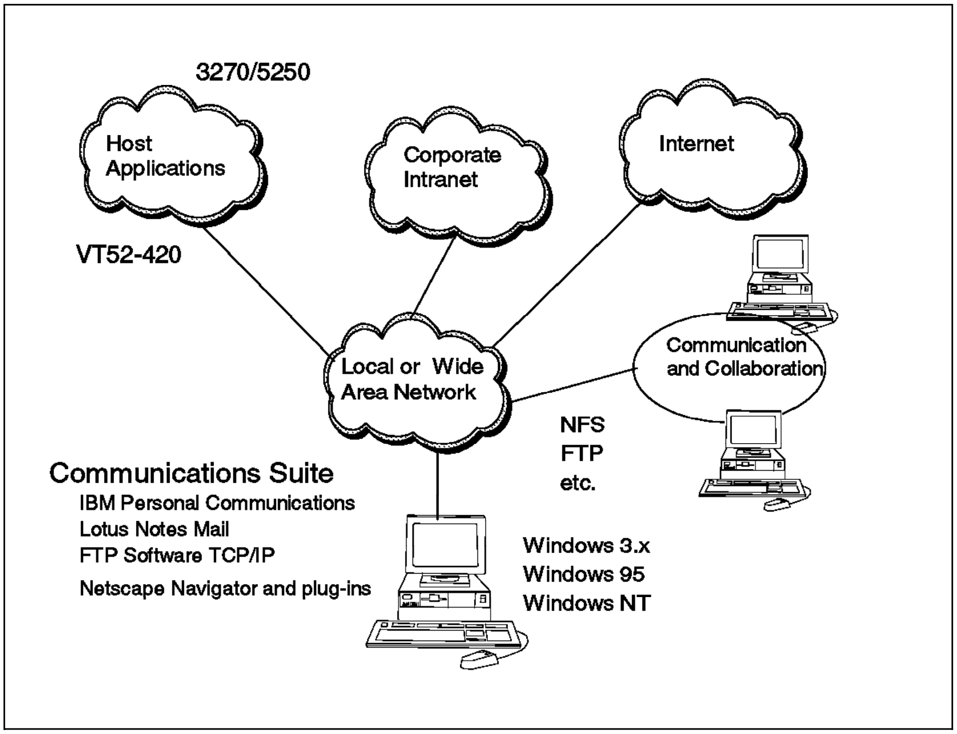


Figure 73. eNetwork Communications Suite for Windows, Windows 95 and Windows NT V1

The following list shows the various function within the products that build eNetwork Communications Suite for Windows, Windows 95 and Windows NT V1.

- Lotus Notes Mail
  - Client/server messaging system
  - Three-pane cc:Mail interface, which makes it simple to organize
  - OLE 2.0 support
  - Platform-independent file viewers
  - Enterprise calendaring and scheduling
  - Personal Web navigator
  - Task management
  - Document libraries
  - Personal journal
  - Phone messages
  - OfficeVision to Lotus Notes clients (through a Web-site download)
- FTP Software

- TCP/IP for Windows 95
    - IP, Version 6, Support (IPv6)
    - IP multicasting
    - WinSock 2.0 interface support
    - SNMP MIB II
    - DHCP client
    - IPSECurity
    - WinISDN, CAPI 2.0
    - Socks
- TCP/IP applications for Windows 3.1, 95, and NT
    - FTP client and server
    - Print client and server
    - Network File System (NFS) client
    - Timeclient
    - Dialer
- Terminal emulation for Windows 3.1, 95, and NT
    - VT52, VT100, VT220, VT320, VT420
    - IBM PC
    - SCO ANSI
    - WYSE-50 and WYSE-60
- Network tools for Windows 3.1, 95, and NT
    - IPTrace
    - Ping
    - Query (Whois, Finger, Host, DNS, NIS)
    - Remote command
    - Remote copy
    - Retriever
    - Statistics-monitor and tune TCP/IP
- Developer tools for Windows 3.1, 9 5, and NT
    - Open script for running and writing scripts to automate your work or the work of others
    - Open tools for writing network programs using FTP Software 32-bit stack and applications

• Netscape Navigator
  - Hypertext Markup Language (HTML) 3.0 support
  - Secured Sockets Layer (SSL) support
  - Framing
  - Java support
  - Netscape News
  - Netscape Mail (SMTP, MIME, IMAP4 and POP3)
  - FirstFloor Smart Bookmarks (plug-in)
  - Adobe Acrobat Reader (plug-in)

Chapter 17. Asynchronous Transfer Mode (ATM)

This chapter describes IBM′s family of ATM products and their interconnection with other IBM networking products. Information on IBM′s ATM products can be found at: http://www.networking.ibm.com/netprod.

17.1 What Is ATM?

ATM is a set of international standards for cell relay, a fast packet switching technology. With ATM you can transmit data, voice, image and video information over a single network.

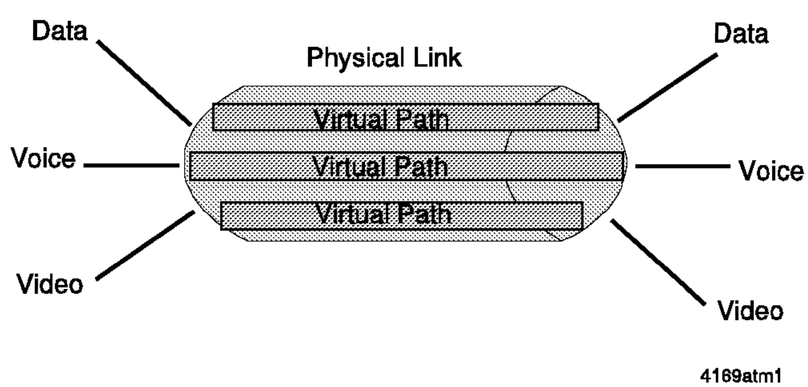


Figure 74. ATM Overview

ATM is scalable; it can be used in small workgroup LAN environments as well as in large global networks up to information superhighways. ATM supports both private and public networks and uses the same technology for local and wide area networks.

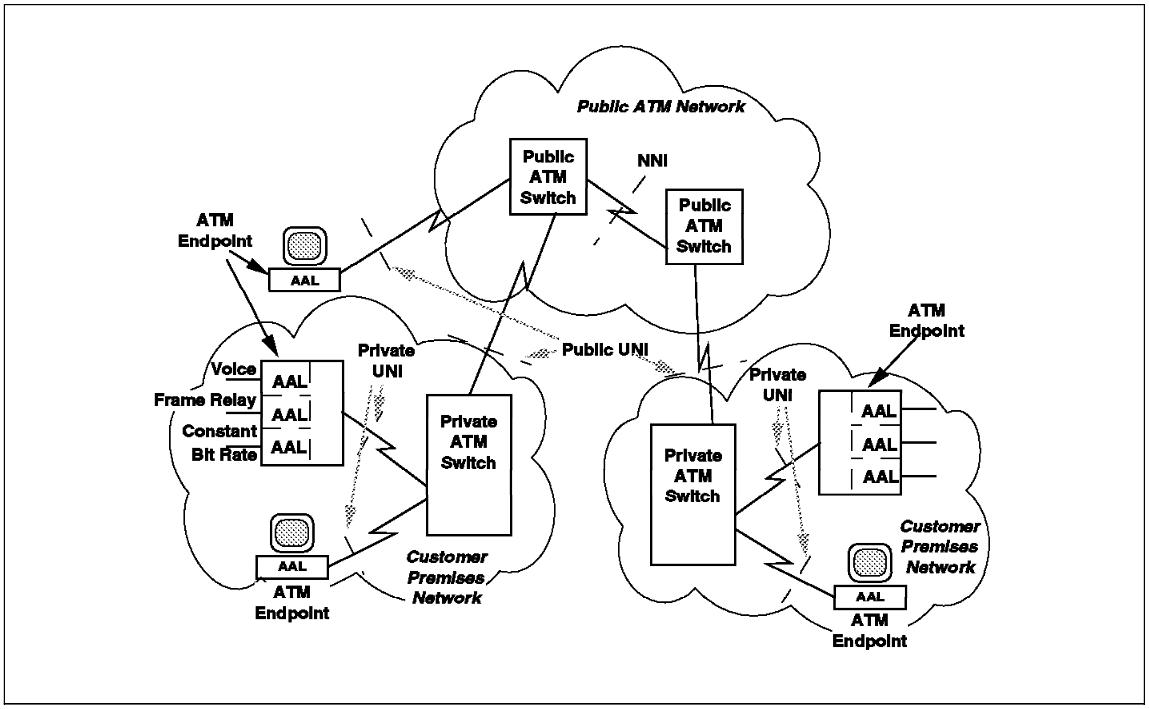


Figure 75. ATM Network Structure Overview

You can run a point-to-point communication between client and server and also complex multicast connections. ATM further delivers bandwidth on demand. It segments packets into 53-byte cells (48 bytes of data plus a 5-byte header). The packets are switched onto paths that operate at transmission speeds up to several gigabits-per-second.

There are various standardization organizations that are working on ATM standards. One group, the ATM Forum, is mostly responsible for defining the interfaces that are required to operate and manage ATM networks. These standards describe how ATM devices must communicate with each other and so enable the various vendor products to work together.

17.1.1 Terminology

There are some concepts necessary to understanding ATM. Below are a few of the terms used in this chapter. These are simplified explanations. For more information see *ATM Technical Overview*, SG24-4625.

17.1.1.1 ATM Switches

Four "ATM switches" are shown in Figure 75. These perform the backbone data transport within the ATM network.

17.1.1.2 ATM Endpoint

The ATM endpoint is a piece of end-user equipment that interfaces to an ATM network in a native way. An endpoint sends and receives ATM cells on link connections defined by ATM standards. An endpoint (and only an endpoint) contains an ATM Adaptation Layer (AAL) function. ATM switches will often contain ATM endpoint functions as well as switch functions.

An ATM endpoint connects to the ATM network over the User Network Interface (UNI).

17.1.1.3 User Network Interface (UNI)

The UNI is specified exactly by the applicable standards. There are two somewhat different UNIs, called “public” and “private”. The public UNI is for connection of end-user equipment to a public ATM network. The private UNI is for use within a single organization′s premises or for a private network using lines leased from the PTT.

The major differences between the two are link types allowed, addressing formats, and which organization specifies them. The public UNI is defined and controlled by the ITU-T. The private UNI is defined by the ATM Forum.

17.1.1.4 Network Node Interface (NNI)

As shown in Figure 75 on page 296, a NNI is the trunk connection between two network nodes.

17.1.1.5 Links

There may be one or many physical link connections between the nodes with multiplexing of virtual paths and virtual channels over a physical link connection. Links between nodes may be carried as “clear channels” such as over a direct point-to-point connection, but may also be carried over a Sonet/SDH connection or over a PDH connection.

17.1.1.6 Cells

The ATM network transports data (including voice and video) as cells. The objective is to provide a very short, constant transit time through the network. Within the network, there is no error recovery (there is error detection for cell header information). Flow and congestion control are done not by the detailed interactive protocols of traditional data networks, but by controlling the rate at which traffic is admitted to the network (and a strong reliance on the statistical characteristics of the traffic). When network congestion is experienced, there is no alternative - cells must be discarded.

17.1.1.7 ATM Adaptation Layers (AAL)

End users of an ATM network will be of two kinds:

- Those that interface to the ATM network directly, through either the public UNI or a private UNI
- Those that do not know anything about ATM, and interface using a non-ATM protocol (such as frame relay)

In either case, a significant amount of logic is required *over and above what is provided by ATM* in order to use the network productively.

For all types of users there are common tasks that must be performed in order to connect to the ATM network. In its definition, ATM includes processing for these common tasks. This is called the ATM Adaptation Layer (AAL). The AAL is the real end-user interface to ATM.

The AAL *never* interfaces to an external link or device. Rather, the AAL provides a programming interface and end users are connected to the ATM network by program functions external to ATM. The AAL only provides some common attachment functions - many protocol layers are usually required above the AAL for useful work to be performed.

17.1.1.8 LAN Emulation

LAN Emulation (LANE) allows Ethernet and token-ring networks to interface to ATM networks, thus utilizing the high-speed ATM links while still protecting the existing software and hardware investment. The implementation of LANE is at a low enough layer to allow any protocol (IPX, NetBIOS, DECnet, TCP/IP, SNA) to operate across it.

17.1.1.9 Classical IP

Classical IP is a standardized solution for sending IP traffic over ATM. With Classical IP the ATM infrastructure is transparent to IP. IP traffic can utilize the high speed link capability provided by ATM. Classical IP requires fewer framing bytes than, for example, a LAN containing source and destination MAC addresses. Thus less bandwidth is used for overhead. Classical IP requires no broadcast traffic for the resolution of ARP frames. ARP frames are processed by the ARP server and the end stations exchanging information, while other stations on the subnet are not affected. Non-broadcast traffic on a shared Ethernet or token-ring medium precludes other stations from using the media for discrete amounts of time. In Classical IP, independent channels are established between end points.

17.1.1.10 Networking Broadband Services (NBBS)

IBM has developed an architecture based on ATM standards for high-speed networking, which is called Networking BroadBand Services (NBBS). NBBS defines a working network by using the capabilities of ATM and adding the intelligence and management function.

Networking Broadband Services contain:

- Distributed network control to eliminate bottlenecks and to improve availability.
- Intelligent directory services to reduce network control overhead
- Routing mechanisms that enable the rapid distribution of control information and to reduce network control overhead
- Dynamic bandwidth allocation to optimize the bandwidth usage, to provide bandwidth on demand and to optimize the handling of isochronous traffic
- Guaranteed quality-of-service (QoS) measures that ensure appropriate end-to-end bandwidth, delay, and packet-loss characteristics
- Nondisruptive rerouting of connections around network-link failures
- Congestion control that focuses on avoiding, rather than reacting to, network congestion for traffic requiring QoS guarantees

17.2 The IBM ATM Family of Products

The IBM Nways family of switching hubs, routers and Ethernet and token-ring LAN switches consists of the following products:

- Wide area switches
  - IBM 2220 Nways BroadBand Switch
  - IBM 2225 Nways MultiService Switch
  - IBM 2230 Nways ATM Switch
- Switching hubs
  - IBM 8260 Nways Multiprotocol Switching Hub
  - IBM 8265 Nways ATM Switch
- Workgroup switch
  - IBM 8285 Nways Workgroup Switch
- Server
  - IBM 8210 Nways Multiprotocol Switched Services (MSS) Server
- Routers
  - IBM 2210 Nways Multiprotocol Router
  - IBM 2216 Nways Multiaccess Connector
- LAN switches
  - IBM 8270 Nways Token-Ring Switch
  - IBM 8271 Ethernet Switch
  - IBM 8272 Token-Ring Switch
  - IBM 8273 Ethernet RouteSwitch
  - IBM 8274 Nways LAN RouteSwitch
- Workstation and server adapters
  - IBM TURBOWAYS 25-Mbps ATM adapters

- IBM TURBOWAYS 100-Mbps ATM adapters
- IBM TURBOWAYS 155-Mbps ATM adapters

- Video encoder/decoder
  - IBM 8300 Video Access Node
  - IBM 8260/8285 Video Distribution Module

Table 72 (Page 1 of 5). ATM Products and Features

Product	ATM adapters	Functions
IBM 2220 Nways Broadband Switch • Model 300 - 6 adapter slots • Model 500 - 8 adapter slots • Model 501 - 14 adapter slots	ATM adapters: • 2-port ATM DS3 • 2-port ATM E3 • 1-port 155Mbps SONET STS-3c/SDH STM-1 Electrical • 1-port 155Mbps SONET STS-3c/SDH STM-1 SMF Long Range • 1-port 155Mbps SONET STS-3c/SDH STM-1 SMF Short Range • 1-port 155Mbps SONET STS-3c/SDH STM-1 MMF Interface	Fast packet and ATM cell switch. Designed for simultaneous frame/cell transport where integration of multiple information types, especially voice, onto a single backbone is required. Provides: • Circuit Emulation Service • Voice • Frame relay • HDLC • X.25 DCE
IBM 2225 Nways Multiservice Switch • Model 400 - 6 I/O slots • Model 450 - 14 I/O slots	• Universal IO - eight V.35 or X.21 (DXI) • Unchannelized T1/E1- four 24-bundle T1 or four 30-bundle E1 (DXI) • Channelized T1/E1- four 24-bundle T1 or four 30-bundle E1 (DXI) • 2-port HSSI (DXI) • 10-port DSX-1 (DXI) • 1-port ATM UNI T3/E3 • 1-port ATM UNI DS3 • ATM UNI OC3/STM1 CS/IWU • ATM UNI T3 CS/IWU	Designed for frame relay transport, provides interworking among frame relay, ATM, and Switched Multi-Megabit Data Service (SMDS). Allows existing network services to make use of an ATM network backbone or convert these services to ATM utilizing the established ATM Adaptation standards. ATM support includes: • ATM DXI • ATM FUNI • ATM switching and Frame Relay/ATM interworking
IBM 2230 ATM Switch • Model 600 - 6 I/O slots • Model 650 - 14 I/O slots	• 8-port ATM UNI DS3 • 8-port ATM UNI E3 • 4-port ATM UNI OC3-C/STM-1 • 1-port ATM OC12/STM-4	Designed for switching inbound and outbound ATM traffic on a high-speed ATM core backbone.
IBM 8260 Nways Multiprotocol Switching Hub • Model A10 - 10 slots • Model A17 - 17 slots	Two slots are needed for installing the ATM Control Point and Switch Module. ATM modules: • ATM Switch/Control Point module • ATM Media modules (25, 100, 155,622 Mbps) • ATM LAN Bridge Module • ATM Carrier Module • ATM WAN 2 Module (E1/J1/T1, E3/T3, OC3/STM-1) • ATM Video Distribution Module • MSS server module (equivalent to 8210) • 8271 and 8272 switch modules • Packet Channel ATM switch module	The 8260 is able to support Ethernet, token-ring, FDDI LANS, and ATM switched campus networks simultaneously. It supports direct attachment of workstations and servers and connection to other switches. The 8260 with permanent virtual path (PVP) tunneling and the MSS Server module allow the connection of campus networks into a virtual ATM wide area network.

Table 72 (Page 2 of 5). ATM Products and Features

Product	ATM adapters	Functions
IBM 8265 Nways ATM Switch • Model 17S - 17 slots	• 1-port OC12 622 Mbps MMF • 1-port OC12 622 Mbps SMF • 4-port OC3 155 Mbps Integrated • 4-port OC3 155 Mbps flexible • 8260 ATM modules: – 8210 MSS server module – 8272 ATM/LAN switch – 8271 ATM/LAN switch – VDM (Video Distribution Module) – 12-port 25 Mbps ATM – 1-port 155 Mbps MMF – 4-port 100 Mbps fiber – ATM WAN 2 module – ATM carrier 1.0 module – FiberCom Circuit Emulation	Built on the 8260 chassis, provides higher switching capacity than the 8260 and a richer set of ATM traffic management functions.
IBM 8285 ATM Workgroup Switch • 12 ATM 25.6 Mbps ports • Optional feature slot for I/O uplink • Optional expansion unit with 3 slots for installable 8285/8260 modules	• ATM 12-Port 25 Mbps UTP Concentrator Module • ATM 2-Port 155 Mbps Flexible Media Module – 1-port ATM 155 Mbps Multi-mode Fiber I/O card – 1-port ATM 155 Mbps Single-mode Fiber I/O card – 1-port ATM 155 Mbps UTP/STP I/O card (RJ-45) – 1-port ATM 155 Mbps STP I/O card (DB9) • ATM 3-Port 155 Mbps LAN Concentration Module – 1-port ATM 155 Mbps Multi-mode Fiber I/O card – 1-port ATM 155 Mbps Single-mode Fiber I/O card – 1-port ATM 155 Mbps UTP/STP I/O card (RJ-45) – 1-port ATM 155 Mbps STP I/O card (DB9) • ATM 4-Port 100 Mbps MIC Fiber Module • ATM 4-Port 100 Mbps SC Fiber Module • Video Distribution Module • ATM 4-Port TR/Ethernet Bridge Module • ATM WAN Module – 1-port E3 I/O card – 1-port DS3 I/O card – 1-port OC3 I/O card (SMF) – 1-port OC3 I/O card (MMF) – 1-port STM1 I/O card (SMF) – 1-port STM1 I/O card (MMF)	ATM switch that allows direct attachment of workstations and servers and connection to other switches. The 8285 with permanent virtual path (PVP) tunneling and the MSS Server module allow the connection of campus networks into a virtual ATM wide area network.

Table 72 (Page 3 of 5). ATM Products and Features		
Product	**ATM adapters**	**Functions**
IBM 2210 Nways Multiprotocol Router • Model 14T – 1 token-ring – 4 serial ports – 1 feature adapter slot • Model 24E – 2 Ethernet – 4 serial ports – 1 feature adapter slot • Model 24M – 1 token-ring – 1 Ethernet – 4 serial ports – 1 feature adapter slot • Model 24T – 2 token-ring – 4 serial ports – 1 feature adapter slot	• 1-slot 25Mbps ATM adapter	The 2210 can be used in a 25 Mbps ATM environment to provide connections to ISDN, frame relay, X.25, PPP and SDLC networks. The 2210 can be used with an 8285 to connect remote sites, providing graphics and multimedia workstations access to a WAN. The 2210 has Ethernet and token-ring connections that can connect 8271, 8272, 8273 or 8274 LAN switches to incorporate LAN switching with a router that has access to an ATM network.
IBM 2216 Multiaccess Connector • Model 400 - 8 slots	• 1-port ATM 155 Mbps MMF • 1-port ATM 155 Mbps SMF	The 2216 is IBM′s expandable router backbone for the campus on an ATM network. It provides a way to interconnect ATM backbones with non-ATM WANs such as frame relay, X.25, SDLC or ISDN. • Token-ring • Ethernet • WAN on EIA-232, V.35, V.36, X.21, ISDN primary • ATM (UNI, LANE, Classical IP) • ESCON channels
IBM 8210 Nways Multiprotocol Switched Services (MSS) Server • Model 001: 2 ATM adapter slots • 8260 blade: 1 ATM adapter slot	• 155 Mbps ATM adapter SMF • 155 Mbps ATM adapter MMF	Implements multiprotocol, distributed routing in switched networks. Release 1.1 of the MSS Server provides: • LAN Emulation • Classical IP • Routing • Bridging • Super LANE for ATM emulated LANs (Super VLAN) • FDDI to ATM routing
IBM 8270 Nways Token-Ring Switch • Model 800	• 1-Port ATM 155-Mbps Multimode Fiber/Token-Ring	Provides LAN switching for a token-ring environment. There are 8 UFC slots for token-ring or ATM adapters. The ATM UFC can switch data to another server or to an industry-standard ATM backbone switch. Supports ATM Forum-compliant LAN Emulation.

Table 72 (Page 4 of 5). ATM Products and Features

Product	ATM adapters	Functions
IBM 8271 Nways Ethernet Switch • Model 108 - eight 10Base-T ports and one universal slot feature. • Model 216 - sixteen 10Base-T ports and two universal slot features. • Model 524, 624 - 24 10Base-T ports, 1 100Base-TX uplink port, optional 155 Mbps ATM OC-3c module • Model 612 - 12 10Base-T ports, 1 100Base-TX uplink port, optional 155 Mbps ATM OC-3c module • Model 712 - 12 10Base-T/100Base-T autosensing ports, optional 155 Mbps ATM OC-3c module • 8271 module for 8260 (2-slot version) - eight 10Base-T ports and two universal slot features. • 8271 module for 8260 (3-slot version) - sixteen 10Base-T ports and four universal slot features.	• ATM 155-Mbps MMF/Ethernet UFC	Provides high-speed forwarding of Ethernet frames among Ethernet segments. Ethernet segments are connected to 10Base-T ports. An optional universal slot feature provides ATM capability for uplink connections, for example, to connect 8271s through a high-speed backbone network. Ethernet and Fast Ethernet frames can be switched between LAN segments connected to the LAN switch and an ATM network. Supports ATM forum-compliant LAN Emulation (LANE).
IBM 8272 Token-Ring Switch • Model 108 - 8 token-ring ports and 1 universal feature slot. • Model 216 - 16 fixed token-ring ports and 2 Universal Feature Slots. • 2-slot version 8260 module - 8 fixed token-ring ports and 2 Universal Feature Slots. • 3-slot version 8260 module - 8 token-ring ports and 4 Universal Feature Slots.	• ATM 155-Mbps MMF UFC	Provides LAN switching for a token-ring environment. An optional universal slot feature provides ATM capability, switching token-ring frames between LAN segments connected to the LAN switch and an ATM network. Supports ATM forum-compliant LAN Emulation (LANE).
IBM 8273 Ethernet RouteSwitch • IBM 8273 Model 100 – 12 Ethernet 10BASE-T – 2 slots for uplink modules • Model 10E – 12 Ethernet 10BASE-T – 2 slots for uplink modules • Model 10U – 8 universal slots for any mix of Ethernet adapter boards – 2 slots for uplink modules (100BASE-TX, CDDI, ATM, 100BASE-FX, FDDI, frame relay)	ATM modules are available: • 155 Mbps ATM OC3 MMF • 155 Mbps ATM OC3 SMF • 1-port E3 (coaxial)	Provides high-speed switching between a fixed number of Ethernet ports and uplinks for high-speed server and backbone access. ATM features include LAN Emulation, Multiprotocol Encapsulation over ATM and Classical IP over ATM. • Ethernet-to-Ethernet • Ethernet-to-FDDI • Ethernet-to-CDDI • Ethernet-to-ATM • Fast Ethernet-to-ATM • Ethernet-to-Fast Ethernet • Fast Ethernet-to-FDDI • Ethernet-to-WAN Frame Relay

Table 72 (Page 5 of 5). ATM Products and Features

Product	ATM adapters	Functions
IBM 8274 Nways LAN RouteSwitch • Model W33: 3-slot with up to 2 switching modules • Model W53: 5-slot with up to 4 switching modules • Model W93: 9-slot with up to 8 switching modules	• 1 or 2-port 155 Mbps OC3 SMF • 1 or 2-port 155 Mbps OC3 MMF • 1 or 2-port 155 Mbps OC3 over unshielded twisted pair • 1 or 2-port 45 Mbps DS3 over coax • 1 or 2-port 34 Mbps E3	Provides LAN switching with ATM speed for the desktop and the backbone. Provides access for LAN based workstations to ATM based servers. Provides high-speed backbone access. Each switching module supports 12 Ethernet, 6 Token-Ring, 8 100BASE-T or 8 CDDI ports for server connectivity or 4 FDDI or 2 ATM backbone connections. All can be switched within the same unit and can be switched directly to ATM interfaces. ATM support includes: • ATM LAN Emulation • Multiprotocol Encapsulation over ATM • Classical IP over ATM

Note:

- CDDI - copper distributed data interface (LAN)
- CS/IWU - cell switching (CS)/interworking (IWU)
- DS1 - 1.544 Mbps transmission rate and contains 24 circuits
- DS3 - 44.736 Mbps transmission rate and contains 672 circuits
- DXI - Data eXchange Interface (ATM support for low speed lines)
- E1 - European version of T1 (2.048 Mbps transmission rate)
- E3 - European version of T3 (34.368 Mbps transmission rate)
- FDDI - fiber distributed data interface (100 Mbps fiber optic LAN)
- FUNI - Framed User Network Interface
- IWU - inter-networking unit (gateway/relay for LANs)
- MMF - multimode fiber
- OC1 - 51.84 Mbps transmission rate (optical carrier)
- OC12 - 622.08 Mbps transmission rate (optical carrier)
- OC3 - 155.52 Mbps transmission rate (optical carrier)
- SDH - Synchronous Digital Hierarchy
- SDF STM-1, Sonet STS-3c - 155.52 Mbps SMF
- SDF STM-4c, Sonet STS-12c - 622.08 Mbps SMF
- SMF - single mode fiber
- Sonet - Synchronous Optical Network
- STM - Synchronous Transfer Mode
- T1 - 1.544 Mbps transmission rate and contains 24 circuits
- T3 - 44.736 Mbps transmission rate and contains 672 circuits
- UFC - universal feature card
- UNI - User network interface

17.3 ATM Workstation Adapters

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

17.3.1 TURBOWAYS 25 Mbps ATM Adapter

The TURBOWAYS 25 ATM adapters are an affordable way to bring high-bandwidth ATM connectivity to the desktop, with adapters available for ISA-bus, Micro Channel, Sbus, and PCI-bus computers. By including Forum-compliant LAN Emulation and Classical IP with the adapters, they are cost-effective upgrades to your existing Ethernet or token-ring infrastructure, providing a 25-Mbps, full-duplex connection to the ATM network.

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

The adapters support the following standards:

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

17.3.2 TURBOWAYS 100 Mbps ATM Adapter

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

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

The adapters support the following standards:

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

17.3.3 TURBOWAYS 155 Mbps ATM Adapter

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

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

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

The adapters support the following standards:

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

17.3.4 Interphase Adapters

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

- 5515 PCI Adapters
- 4915 GIO Adapters
- 4815 EISA Adapters

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

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

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

17.4 Adapters for Various Operating Systems

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

17.4.1 OS/2

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

Table 73. OS/2		
	OS/2 2.11 or higher	
ATM adapter	**Protocols enabled**	**Environment**
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP
TURBOWAYS 100 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 155 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP

17.4.2 Windows NT

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

Table 74 (Page 1 of 2). Windows NT		
	Windows NT 3.5 or higher	
ATM adapter	**Protocols enabled**	**Environment**
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP

Table 74 (Page 2 of 2). Windows NT		
	Windows NT 3.5 or higher	
ATM adapter	**Protocols enabled**	**Environment**
TURBOWAYS 100 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation	IBM LAN Emulation FC LAN Emulation
TURBOWAYS 155 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation	IBM LAN Emulation FC LAN Emulation
Interphase 155 Mbps ATM 5515 PCI	NetBIOS SNA IPX TCP/IP	FC LAN Emulation Classical IP SMP
Interphase 155 Mbps ATM 4815 EISA	NetBIOS SNA IPX TCP/IP	FC LAN Emulation Classical IP SMP

17.4.3 Windows 95

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

Table 75. Windows 95		
	Windows 95	
ATM adapter	**Protocols enabled**	**Environment**
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP

17.4.4 DOS/Windows V3.11

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

Table 76. DOS		
	MS-DOS 6.2 or PC-DOS 6.3 or higher	
ATM adapter	**Protocols enabled**	**Environment**
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP

Table 77. Windows V3.11		
	Windows V3.11	
ATM adapter	**Protocols enabled**	**Environment**
TURBOWAYS 25 ATM ISA	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	IBM LAN Emulation FC LAN Emulation Classical IP
TURBOWAYS 25 ATM PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation TCP/IP through Classical IP	FC LAN Emulation Classical IP

17.4.5 AIX

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

Table 78. AIX		
	AIX 3.2.5, AIX 4.1.4 and AIX 4.2	
ATM adapter	**Protocols enabled**	**Environment**
TURBOWAYS 100 ATM MCA	TCP/IP	FC LAN Emulation (AIX 4.2.1 only) Classical IP
TURBOWAYS 155 ATM MCA	TCP/IP	FC LAN Emulation (AIX 4.2.1 only) Classical IP
Interphase 155 Mbps ATM 5515 PCI	TCP/IP	FC LAN Emulation Classical IP

17.4.6 Novell NetWare

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

Table 79. NetWare

	NetWare 3.1.2 and 4.01 or higher	
ATM adapter	**Protocols enabled**	**Environment**
TURBOWAYS 100 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation	IBM LAN Emulation FC LAN Emulation
TURBOWAYS 155 ATM MCA	NetBIOS SNA IPX TCP/IP through LAN Emulation	IBM LAN Emulation FC LAN Emulation
Interphase 155 Mbps ATM 5515 PCI	NetBIOS SNA IPX TCP/IP through LAN Emulation	FC LAN Emulation SMP
Interphase 155 Mbps ATM 4815 EISA	NetBIOS SNA IPX TCP/IP through LAN Emulation	FC LAN Emulation SMP

17.5 ATM Solutions

IBM′s ATM products, used alone or combined, offer many networking solutions. A Solutions Fact Sheet can be found at the IBM networking Web site, http://www.networking.ibm.com/atm/atm0311f.html.

The following sections are taken from the Solutions Fact Sheet and are examples of combining ATM products to build a network. There are many possible combinations of products and technology to provide networking solutions. These are only a few.

17.5.1 Connect Ethernet with ATM

IBM′s solution for a switched Ethernet-to-ATM connection can be provided with the following stand-alone switches connected to an 8260 ATM backbone:

- IBM 8271 Nways Ethernet LAN Switch
- IBM 8273 Nways Ethernet RouteSwitch
- IBM 8274 Nways LAN RouteSwitch

The fast Ethernet modules in the 8260 with packet-channel-to-ATM connectivity on the 8260 allow fast Ethernet servers or Ethernet switches with fast Ethernet uplinks transparent connectivity to ATM and MSS.

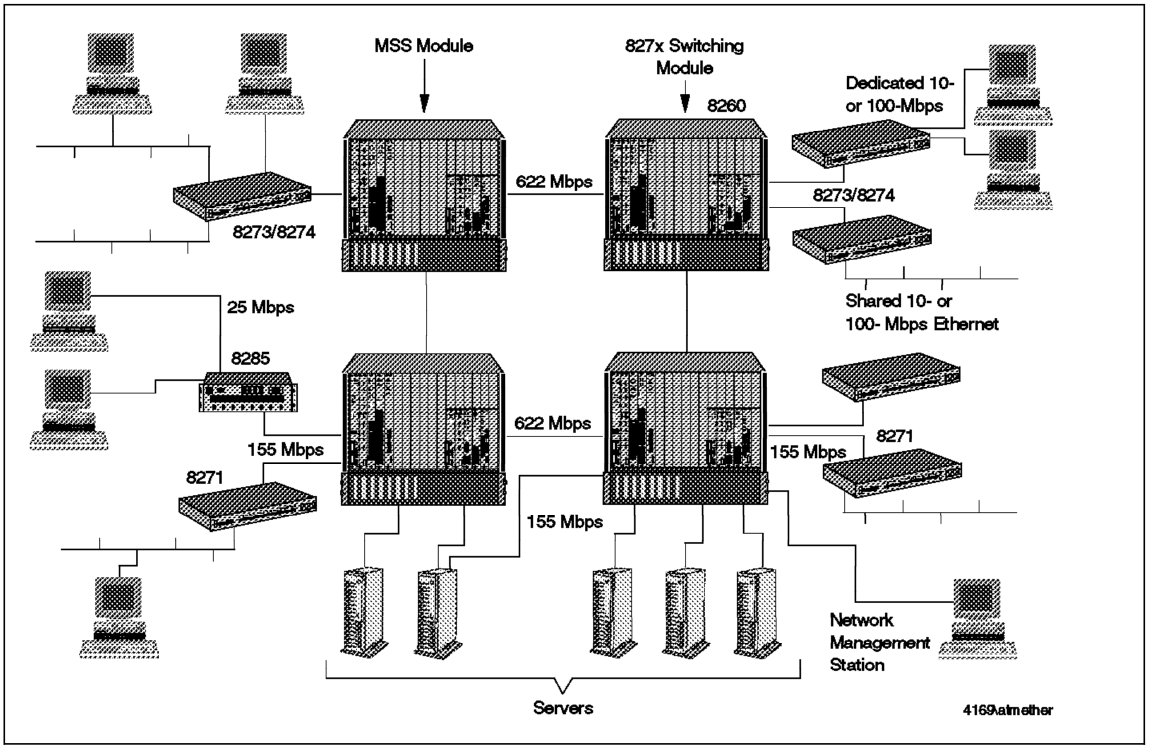


Figure 76. Ethernet to ATM Solutions

This IBM ATM solution provides the following features:

- Servers on ATM backbone
- Backbone redundancy and alternate paths
- Dynamic routes
- VLANs and broadcast reduction through MSS
- ATM network management

The IBM 8271 Models 108 and 216 are low-end workgroup ATM devices for Ethernet LANs. The ATM 155 Mbps Multimode Fiber UFC can switch data to an ATM backbone switch, such as the 8260 or 8265, over multimode optical fiber cables. The ATM 155 Mbps UFC can also be connected to an 8285 through its 155 Mbps ATM port.

The IBM 8285 is an ATM workgroup switching device for network speeds of 25 Mbps. It has twelve 25 Mbps ports and a single 155 Mbps port in the base unit. The base unit can be expanded with an expansion unit that provides three slots. You can use 8260 ATM modules in the expansion unit and so increase the number of connections up to 48 25 Mbps ports and a total of four 155 Mbps ports for main backbone uplinks or connections to local servers or to LAN switches with ATM uplinks.

The IBM 8285 Workgroup ATM Switch located in remote locations can be connected to an ATM WAN by using the 8260 ATM WAN modules in the 8285 expansion unit. For more information on the IBM 8285 see *IBM ATM Workgroup Solutions: Implementing the 8285 ATM Switch*, SG24-4817.

17.5.2 Token-Ring with 8272 and ATM 155-Mbps UFC

The IBM 8272 Models 108 and 216 are low-end workgroup ATM devices for token-ring LANs. The 8270 Model 800 provides 32 switched token-ring ports or 28 token-ring ports and one 155 Mbps ATM uplink port. The 8270 Model 800 provides 32 switched token-ring ports or 28 token-ring ports and one 155 Mbps ATM uplink port.

The 8272 module in the 8260 provides token-ring switching to ATM connectivity, utilizing the ATM backplane connection or the front-end ATM UFC. The shared token-ring modules in the 8260 connected to the 8272 modules provide shared-to-switched token-ring connectivity through the 8272 switch.

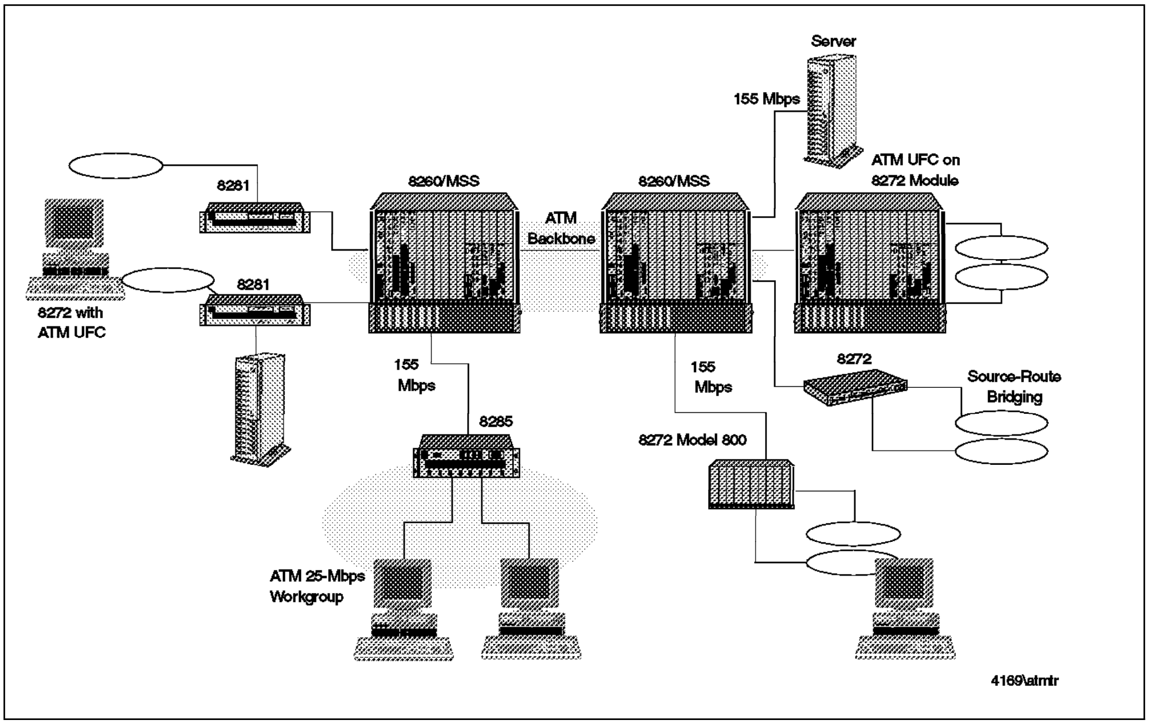


Figure 77. Token-Ring with 8272 and ATM 155 Mbps UFC

17.5.3 Bridging and Routing over ATM with 8210 MSS Server

The MSS server expands the capability of the ATM network in terms of scalability, reliability, performance, adaptability, connectivity and total redundancy. The MSS server supports the ATM Forum-compliant LANE standard and the IETF Classical IP (RFC 1577) standard. This allows you to build a logical IP subnet (LIS) in an IP environment and then to communicate with different emulated token-ring or Ethernet LANs (ELAN) and VLAN environments.

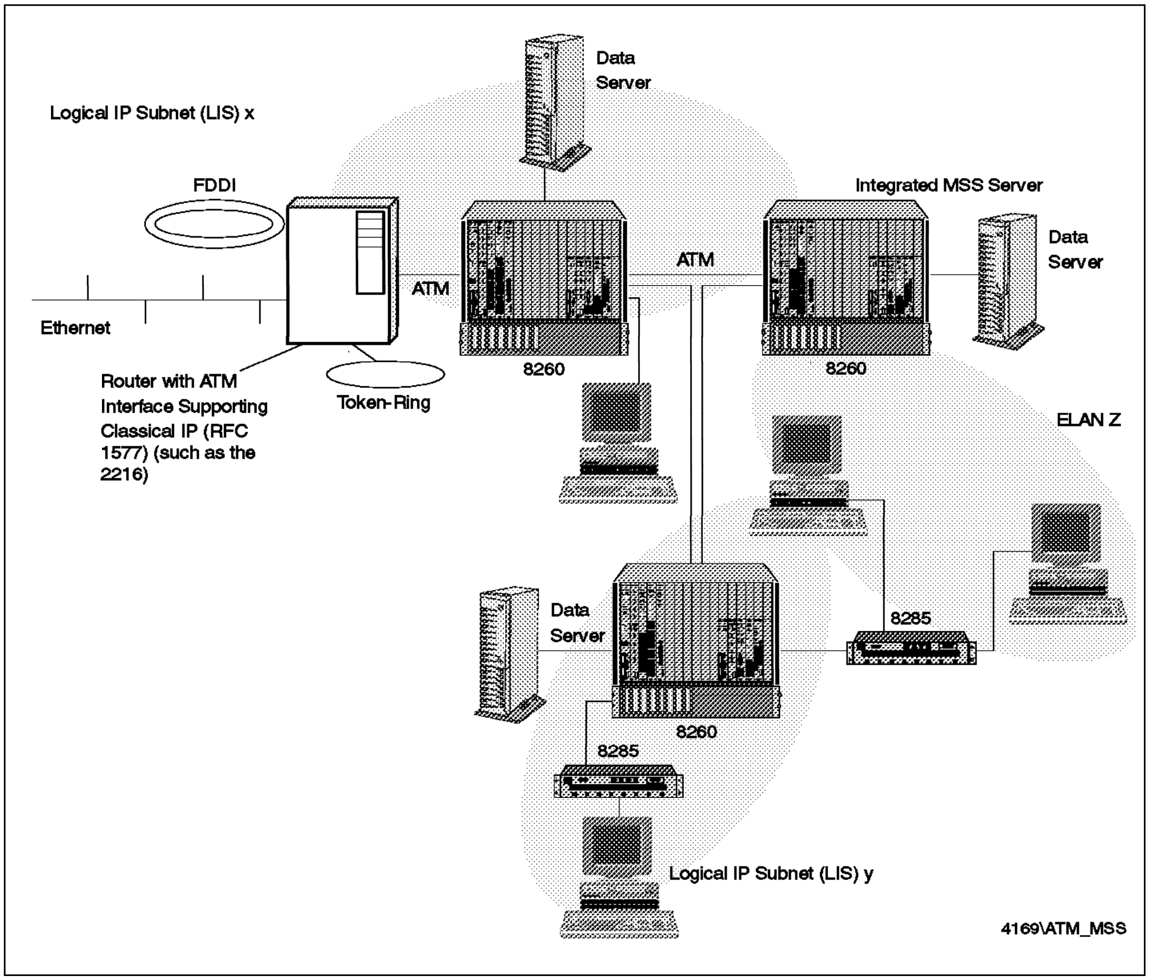


Figure 78. Classical IP and VLAN Communication with ATM/MSS

In this way, LIS x and y can communicate through the MSS ATM infrastructure.

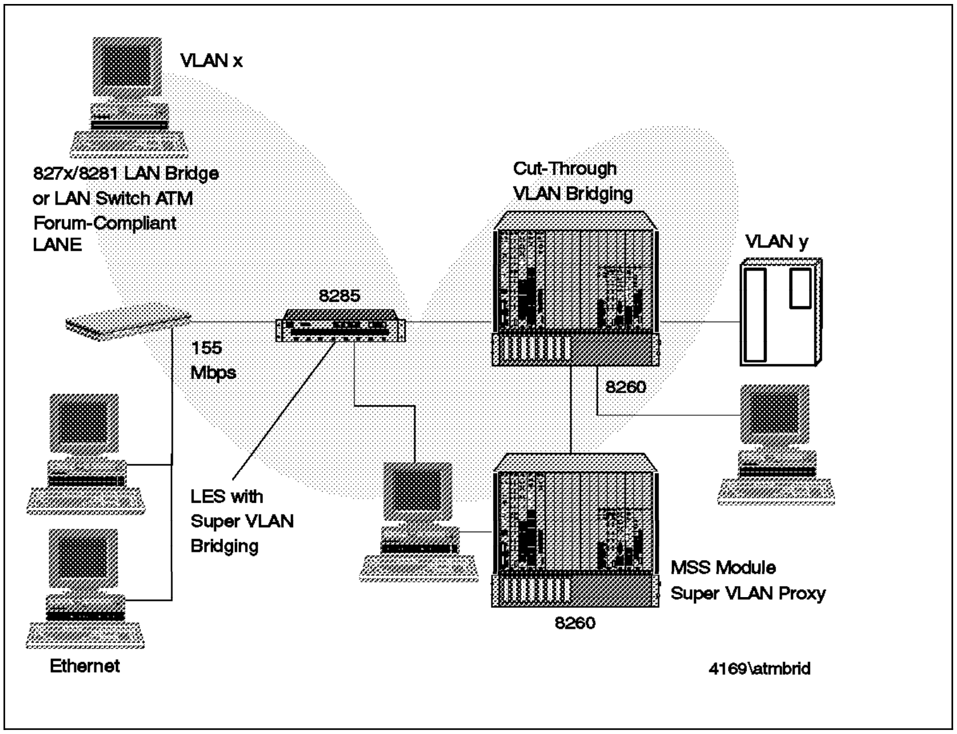


Figure 79. Super VLAN with MSS

With the super VLAN function in the MSS server you can go from one ELAN to another (virtual LAN-to-virtual LAN), without using a routing medium.

Release 1.1 of MSS delivers Super VLAN, which allows you to build large VLANS on ATM networks. A Super VLAN is a collection of multiple VLANs. MSS enables short-cut switching between VLANs in a Super VLAN through creation of direct virtual circuit connections (VCCs) between VLANs.

MSS Release 1.1 provides the following functions:

- Super VLAN for Ethernet ATM ELANs
- NHRP server capability
- SNA, NetBIOS, AppleTalk, DecNet and others over RFC 1483 bridging format
- Quality of Service within VLANs
- Distributed, redundant ARP server
- Redundant IP gateway function
- FDDI support in the 8210
- IP, IPX, AppleTalk routing capabilities

17.5.4 IBM 8260 Switching Modules with ATM Uplinks

Figure 80 shows how 10 Mbps shared IBM 8222 Ethernet workgroup hubs and IBM 8224 Ethernet stackable hubs are connected to 8273 or 8271 switches to a fast Ethernet and to the 8260 ATM backbone. In addition, fast Ethernet hubs such as the IBM 8223 and the IBM 8225 fast Ethernet stackable hub can be directly connected to the 8260.

The switch series modules allow an 8260 to use the existing infrastructure of the packet, as well as the ATM base backplane, to consolidate and connect Ethernet, FDDI and ATM together.

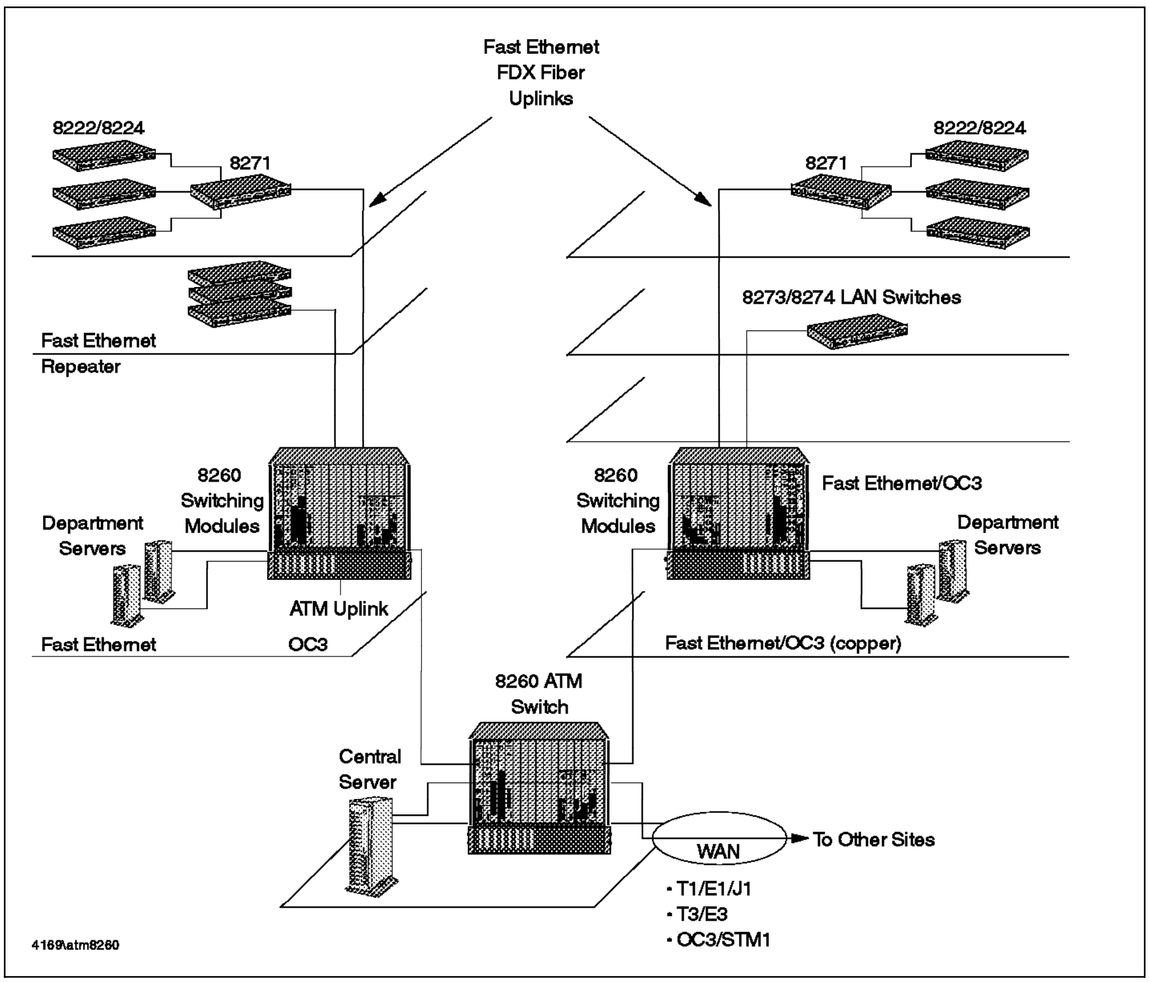


Figure 80. 8260 Switching Modules with ATM Uplink

Appendix A. Product Number List

Table 80 (Page 1 of 11). Products Overview					
Product	**Number**	**Announced**	**Available**	**Marketing Withdrawn**	**Service Discontinued**
Host Hardware					
IBM ES/9000 9021 Processor	9021-xxx	1990-1994	1990-1994	-	-
IBM ES/9000 9121 Processor	9121-xxx	1990-1993	1990-1993	-	-
IBM ES/9000 9221 Processor	9221-xxx	1990-1994	1990-1994	-	-
IBM 9672 S/390 Parallel Transaction Server	9672-Exx, 9672-Pxx	1994/04/06	1994/06/30	-	-
IBM 9672 S/390 Parallel Enterprise Server	9672-Rxx	1994-1997	1994-1997	-	-
IBM 9673 S/390 Parallel Query Server	9673-001 - 9673-008	1994/04/06	1994/04/08	-	-
Host Communications Software					
IBM Communications Server for MVS/ESA 1.2	5655-A29	1997/03/11	1997/03/28	-	-
IBM MVS/ESA JES2 5.2.2 OpenEdition	5655-068	1995/02/28	1995/09/29	-	-
IBM MVS/ESA JES3 5.2.2 OpenEdition	5655-069	1995/02/28	1995/09/29	-	-
IBM VM/ESA V2 R2	5654-030	1996/09/10	1996/12/20	-	-
IBM DFSMS Network File System (NFS) Feature V 1.4.0	5695-DF1	1997/06/09	1997/09/26	-	-
IBM ACF/VTAM V4.4 for MVS	5695-117	1997/03/11	1997/03/28	-	-
IBM ACF/VTAM V4.2 for VSE	5686-065	1995/01/26	1995/04/21	-	1999/12/30
IBM ACF/VTAM V4.2 for VM	5654-010	1995/01/26	1995/03/17	-	-
CICS/VS 3270-PC File Transfer Program	5798-DQH			-	-
IBM LAN File Services/ESA (LFS/ESA) V1.1.2	5648-039	1994/09/13	1994/09/30	-	-
IBM LAN Resource Extension and Services/VM (LANRES/VM) V1.3.0	5684-142	1994/09/13	1994/09/13	-	-
IBM LAN Resource Extension and Services/MVS (LANRES/MVS) V1.3.0	5695-123	1994/09/13	1994/12/30		
TCP/IP Software					
IBM TCP/IP V 3.1 for MVS	5655-HAL	1994/09/13	1994/09/30	-	-
IBM TCP/IP V 3.2 for MVS	5655-HAL	1996/09/10	1996/09/27	-	-
IBM TCP/IP V 2.3 for VM	5735-FAL	1994/09/13	1994/12/16	-	-
IBM TCP/IP V 2.4 for VM	5735-FAL	1996/09/10	1996/09/10	-	-
IBM TCP/IP File Server Support/400	5798-RYW	1993/02/16	1993/12/17	1995/12/29	-
IBM TCP/IP File Server Support/400 V3.1	5798-TAA	1994/05/03	1994/11/25	-	1998/10/31
IBM TCP/IP File Server Support/400 V3.7	5798-TAZ	1996/09/03	1996/11/08	-	1999/06/30
IBM TCP/IP V2.1.1 for DOS	87G7-184	1994/02/01	1994/02/04	1996/12/10	1995/01/31
Host Gateway Hardware					

Table 80 (Page 2 of 11). Products Overview					
Product	**Number**	**Announced**	**Available**	**Marketing Withdrawn**	**Service Discontinued**
IBM 3745 Communication Controller	3745-17A, 21A, 31A, 41A, 61A	1992-1994	1992-1994	-	-
IBM 3746-900 Expansion Unit	3746-900	1992/09/15	1993/06/25	-	-
IBM Nways Controller 950	3746-950	1995/07/10	1995/11/30	-	-
IBM 3174 Establishment Controller	3174-xxL, 3174-xxR	1989-1994	1989-1994	1997 x4R+ 90R	-
IBM 3172 Interconnect Controller Model 3	3172-003	1992/06/16	1992/09/25	-	-
Host Gateway Software					
IBM ACF/NCP V7R6	5648-063	1997/09/09	1997/09/26	-	-
IBM X.25 NCP Packet Switching Interface (NPSI) V3.8	5688-035	1995/03/21	1995/06/30	-	-
IBM 3172 Interconnect Controller Program (ICP) V3.4	5621-425	1995/10/09	1995/11/17	-	-
IBM 3172 Interconnect Controller Program (ICP) V3.5	5621-425	1997/03/11	1997/03/14	-	-
IBM SNA Communications Program (SNA/Comm) V1.1	5696-865	1994/04/27	1994/08/26	-	-
IBM 3172 IP Channel Communications Program V1	5697-196	1995/10/31	1995/11/17	-	-
LAN Bridge / Router /Gateway Hardware					
IBM 2210 Nways Multiprotocol Router	2210-1S4, 1U4, 1S8, 1U8, 127, 128, 12E, 12T, 14T, 24E, 24M, 24T	1994 - 1996	1994 - 1997	-	-
IBM 2216 Nways Multiaccess Connector	2216-400	1996/10/08	1997/03/28	-	-
IBM 2217 Model 200 Nways Multiprotocol Concentrator (MpC)	2217-200	1995/03/28	1995/05/26	-	-
IBM 2217 Model 300 Nways Multiprotocol Concentrator (MpC)	2217-300	1995/03/26	1996/04/26	-	-
IBM 2218 Nways Frame Relay Access Device	2218-02T, 02E, 02X, 18T,18E, 18X, 32T, 32E, 34T, 34E, 38T, 38E	1996 - 1997	1996 - 1997	-	-
IBM 2219 Nways Switch Access	2219-250	1996/04/02	1996/06/28	-	-
IBM 2220 Nways BroadBand Switch	2220-300, 500, 501	1994/06/28	1994/12/30	-	-
IBM 2225 Nways MultiService Switch	2225-400, 450	1996/04/02	1996/06/28	-	-

Table 80 (Page 3 of 11). Products Overview					
Product	**Number**	**Announced**	**Available**	**Marketing Withdrawn**	**Service Discontinued**
IBM 2230 Nways ATM Switch	2230-600, 650	1996/04/02	1996/06/28	-	-
IBM 6299 Hub for Midrange Systems	6299-100, 200, 900, 8DB, 8TC	1995/02/14	1995/03/17	-	-
IBM 6611 Network Processor	6611-120, 125, 145, 175	1993-1994	1993-1994	-	-
IBM 8209 LAN Bridge (follow on products : 8229-001)	8209-001	1989/09/05	1989/10/20	1994/06/15	-
8210 Nways Multiprotocol Switched Access Services	8210-001	1996/09/10	1996/09/27	-	-
IBM 8222 Nways Ethernet Workgroup Hub	8222-008, 0016	1995/02/07	1995/03/10	-	-
IBM 8223 Fast Ethernet Workgroup Hub	8223-008	1996/04/16	1996/04/26	-	-
IBM 8224 Ethernet Stackable Hub	8224-001, 002	1994/02/01	1994/04/29	-	-
IBM 8225 Fast Ethernet Stackable Hub	8225-001, 002, 003	1996/05/28	1996/09/30	-	-
IBM 8226 Token-Ring RJ-45 Connection	8226-001	1994/10/11	1994/10/28	-	-
IBM 8228 Token-Ring Multistation Access Unit	8228-001	-	-	-	
IBM 8229 LAN Bridge	8229-001, 002, 003	1994/03/15	1994/03/25	-	-
IBM 8230 Token-Ring Controlled Access Unit	8230-003, 013, 04A, 04P, 213	1994 - 1995/06/20	1994 - 1995/06/30	-	-
IBM 8235 Dial In Access to LANs (DIALs)	8235-021, 022, 031, 032, 051, 052, I40	1994 - 1996	1994 - 1996	-	-
IBM 8237 Ethernet Stackable Hub	8237-001, 002, 003	1997/05/27	1997/07/31	-	-
IBM 8238 Nways Token-Ring Stackable Hub	8238-PB1, PS1, PG1, AB1, AS1, AG1	1995/06/20	1995/07/28 - 1995/12/31	-	-
IBM 8244 FDDI Workgroup Concentrator	8244-06F, 06S, 06U, 12F, 12S, 12U	1994/05/17	1994/05/31 - 1994/12/15	-	-
IBM 8250 Multiprotocol Intelligent Hub	8250-6HC, 017	1992-1993	1992-1993	-	-
IBM 8260 Nways Multiprotocol Switching Hub	8260-010, 017, A10, A17, P10, P17, G17, P07	1994 - 1997	1994 - 1997	-	-

Table 80 (Page 4 of 11). Products Overview					
Product	**Number**	**Announced**	**Available**	**Marketing Withdrawn**	**Service Discontinued**
IBM8270 Nways Token-Ring Switch	8270-800	1996/10/08	1997/03/31	-	-
IBM 8271 EtherStreamer Switch	8271-108, 216, 524, 612, 624, 712	1995 - 1997	1995 - 1997	-	-
IBM 8272 LANStreamer Switch Model 108	8272-108	1995/03/14	1995/09/29		
IBM 8272 Nways Token-Ring LAN Switch Model 216	8272-216	1996/03/26	1996/04/26		
IBM 8273 Nways Ethernet RouteSwitch	8273-100, 10E, 10U	1996/09/12	1996/09/27		
IBM 8274 Nways LAN RouteSwitch	8274-W33, W53, W93	1997/03/11 - 1997/09/09	1997/06/13 - 1997/10/31		
IBM 8276 Nways Ethernet RoutePort	8276-360, 361, 362, 363, 364, 365	1997/03/11	1997/07/11		
IBM 8281 ATM LAN Bridge	8281-001	1994/10/25	1995/06/30	1997/07/08	-
IBM TURBOWAYS 8282 ATM Workgroup Concentrator	8282-001 (replaced by 8285-00B)	1994/06/28	1994/06/28	1996/12/27	-
IBM 8285 Nways ATM Workgroup Switch	8285-00B, 00P	1996/02/27	1996/06/28		
IBM 9733 IDNX Micro 20	9733-108	1993/10/28	1993/12/10	-	-
IBM 9733 IDNX Micro 20	9733-908	1993/10/28	1994/03/11	-	-
LAN Bridge / Router /Gateway Software					
IBM 2220 Nways BroadBand Switch Control Program V1.5	5622-388	1997/03/11	1997/06/13	-	-
IBM LAN Distance V1.1	52G8-358	1994/04/27	1994/04/29	1996/04/26	1996/04/29
IBM RouteXpander/2 (RXR/2) V1.0.1	04H9-900	1994/03/15	1994/03/25		1995/12/31
IBM RouteXpander/2 (RXR/2) V2	95G0-897	1994/03/15	1994/03/25		1995/12/31
IBM RouteXpander LNM Support/2	95G0-903	1994/03/15	1994/03/25		1995/12/31
IBM RouteXpander X.25 Support/2	95G0-906	1994/03/15	1994/03/25		1995/12/31
IBM RouteXpander Multiport Support/2	95G0-909	1994/03/15	1994/03/25		1995/12/31
IBM X.25 Xpander/2	95G0-912	1994/03/15	1994/03/25		1995/12/31
IBM Frame Relay Token-Ring Bridge/DOS V1.0 (replaced by 2210)	95G0-885	1994/03/15	1994/05/27	1997/01/31	1995/12/31
IBM Local Token-Ring Bridge/DOS V1.0	71G9-346	1993/06/22	1993/07/30	1997/01/31	-
IBM Remote Token-Ring Bridge/DOS V1.0	71G9-347	1993/06/22	1993/07/30	1997/01/31	-
IBM LANStreamer Token-Ring Bridge/DOS V1.0	71G9-348	1993/06/22	1993/07/30	1997/01/31	-
IBM LAN Bridge Manager/2 V1.0	71G9-349	1993/06/22	1993/07/30	1997/01/31	-
IBM LAN-to-LAN WAN Program (LTLW)	74F7-668	1990/09/05	1991/04/26		1995/06/30

Table 80 (Page 5 of 11). Products Overview

Product	Number	Announced	Available	Marketing Withdrawn	Service Discontinued
IBM Nways Multiprotocol Routing Network Services (MRNS) V1.3 (for 2210)	5765-368	1995/12/12	1995/12/29	1997/09/26	1997/12/26
IBM Nways Multiprotocol Routing Services (MRS) V2.1 for 2210	14J1771	1997/09/09	1997/09/09	-	-
IBM Multiprotocol Access Services (MAS) V2.0 for 2216	5765-C90	1997/09/09	1997/10/31	-	-
IBM Multiprotocol Network Program (MPNP) V1.4.1 (for 6611)	5648-016	1997/03/11	1997/03/28	-	-
IBM AIX Products					
IBM AIX V 4.3	5765-C34	1997/10/06	1997/10/31	-	2001/12/31
IBM AIX V 4.2.1 (repackaging of AIX 4.1.5 and AIX 4.2)	5765-C34	1997/04/15	1997/04/25	-	-
IBM AIX V 4.2 (replaced by 5765-C34)	5765-655	1996/04/23	1996/05/17	1997/10/31	1999/12/31
IBM AIX V 4.1.5 (replaced by 5765-C34)	5765-393	1996/10/08	1996/11/08	1997/10/31	1998/12/31
IBM AIX V 4.1.4 (with AIX Connections V4.1 option)	5765-393	1995/10/10	1995/10/20	1997/10/31	1998/12/31
IBM AIX for RISC System/6000 V 3.2.5	5756-030	1993/09/21	1993/10/15	1997/01/31	1997/12/31
IBM Communications Server for AIX V4.2 (for AIX 4.1.2 or later)	5765-652	1996/10/08	1996/11/22	-	1998/11/30
IBM SNA Client Access for AIX V1.2	5696-944	1996/01/23	1996/02/09	-	-
IBM SNA Application Access for AIX V1.2 (no replacement)	5696-943	1996/05/01	1996/05/03	1997/07/31	1997/12/31
IBM SNA Server for AIX V 3.1 (for AIX V4.1)	5765-582	1995/09/12	1995/09/15	1996/06/30	1997/03/31
IBM AIX SNA Server/6000 V2.1.2 (for AIX V3.2.5)	5765-247	1995/02/28	1995/03/31	1997/01/31	1997/12/31
IBM AIX SNA Gateway/6000 V2.1.2 (for AIX V3.2.5)	5765-261	1995/02/28	1995/03/31	1997/07/31	1997/12/31
IBM AIX SNA Server/6000 V2.1.1 (for AIX V3.2.5)	5765-247	1994/06/21	1994/07/29	1997/07/31	1997/12/31
IBM AIX SNA Gateway/6000 V2.1.1 (for AIX V3.2.5)	5765-261	1994/06/21	1994/07/29	1997/07/31	1997/12/31
IBM ESCON Channel Connectivity for AIX V1.1 (for use with SNA/Server 3.1)	5765-603	1995/09/12	1995/10/20	-	-
IBM Block Mux Channel Connectivity for AIX V1.1 (for use with SNA/Server 3.1)	5765-604	1995/09/12	1995/10/20	-	-
IBM AIXlink/X.25 V1.1.4	5696-926	1997/10/06	1997/12/05	-	-
IBM 3270 Host Connection Program for AIX V 2.1 (for AIX V4)	5765-398	1994/10/04	1994/10/28	-	1999/12/31
3270 Host Connection Program for AIX V1.3.2 (for AIX V3.2.5) replaced by 3270 Host Connection Program V2.1 for AIX V4.	5601-260	1994/05/24	1994/06/10	1997/01/31	1997/06/30
AIXWindows Environment/6000 V1.2.5 (replaced by 5765-655)	5601-257	1993/09/21	1993/10/15	1997/01/31	1997/12/31

Table 80 (Page 6 of 11). Products Overview					
Product	**Number**	**Announced**	**Available**	**Marketing Withdrawn**	**Service Discontinued**
Netware for AIX V3.11B	5697-021	1994/11/15	1994/12/23		1997/12/31
AnyNet Products					
IBM AnyNet/2 V2.0	87G7-776	1994/06/21	1994/06/24	-	-
IBM AnyNet/2 NetBEUI over SNA	87G7-794	1994/06/21	1994/06/24	-	-
IBM AnyNet IPX over SNA Gateway for OS/2	22H6-736	1994/11/08	1994/12/30	-	1995/12/30
IBM AnyNet SNA over TCP/IP Gateway for OS/2	22H6-830	1994/11/08	1994/12/30	-	1995/12/30
IBM AnyNet APPC over TCP/IP for Windows	20H1-709	1995/03/21	1995/03/31	-	-
IBM AnyNet/2 Sockets over SNA Gateway	87G6-700	1993/10/28	1993/12/31	1995/03/31	1994/12/31
OS/2 Products					
IBM Communications Manager/2 Version 1.1 (follow on products: Communications Server for OS/2 Warp V4.0, Personal Communications AS/400 and 3270 V4.1 for OS/2 (or other member of the PCOMM V4.1 family)	79G0-258	1993/10/12	1993/11/12	1997/12/31	1997/12/31
IBM OS/2 LAN Server/Entry V3.0	96F8-400	1992/10/13	1992/11/20	-	-
IBM OS/2 LAN Server/Advanced V3.0	96F8-414	1992/10/13	1992/11/20	-	-
IBM OS/2 LAN Server for Macintosh V3.0	96F8-455	1992/10/13	1992/11/20	-	-
IBM OS/2 LAN Server V4.0	52G8-474	1994/09/12	1994/10/10	1996/12/31	1996/12/31
IBM OS/2 Warp Server V4.0	25H8-002	1996/02/26	1996/02/27	-	2000/12/31
IBM OS/2 Warp Server Advanced V4.0	25H8-030	1996/02/26	1996/02/27	-	2000/12/31
LAN Server for Macintosh V1.01	28H0-081	1996/02/26	1996/02/27	-	2000/12/31
IBM OS/2 Warp V3	83G8-100	1994/10/11	1994/10/28	-	1996/10/31
IBM OS/2 Warp V3 with WIN-OS2	83G8-700	1994/10/11	1994/10/28	-	1996/10/31
IBM Warp Connect V3	10H9-800	1995/05/16	1995/05/16	-	1997/09/30
IBM Warp Connect with WIN-OS2 V3	10H9-810	1995/05/16	1995/05/16	-	1997/09/30
IBM OS/2 V2.1 (follow on products: OS/2 Warp V3)	61G0-900	1993/05/18	1993/06/14	1995/09/30	
IBM OS/2 2.1 Special Edition for use with Windows V3.1 (follow on products: OS/2 Warp V3 with WIN-OS2)	71G5-391		1993/11/09	1995/09/30	
PC Communications Products					
IBM Communications Server for OS/2 Warp V4.0	33H7-328	1996/03/12	1996/03/15	-	-
IBM Communications Server for OS/2 Warp V4.1	5622-878	1996/10/08	1996/11/30	-	-
IBM eNetwork Communications Server for OS/2 Warp V5.0	4301114	1997/09/09	1997/09/26	-	-

Table 80 (Page 7 of 11). Products Overview					
Product	**Number**	**Announced**	**Available**	**Marketing Withdrawn**	**Service Discontinued**
IBM eNetwork Communications Server for Windows NT V5.0.1	5639-B53* 4231747	1997/03/25	1997/03/28	-	1999/03/28
IBM Personal Communications/3270 V4.0 (DOS/Windows)	20H1-749	1994/09/20	1994/09/30	1996/06/19	1996/09/30
IBM Personal Communications/3270 V4.0 for OS/2 and Warp	85G8-697	1995/02/21	1995/02/24	1996/06/19	1997/02/24
eNetwork Communications Suite for Windows, Windows 95 and Windows NT V1	5697-C19* 39F1693	1997/04/01	1997/05/02	-	-
IBM Personal Communications AS/400 and 3270 V4.11 for DOS/WIN, Windows 95, Windows NT and OS/2	5622-972*	1997/02/04	1997/02/28	-	-
IBM eNetwork Personal Communications V4.2 for DOS/Windows, Windows 95, Windows NT and OS/2	4074548	1997/09/09	1997/09/26	-	2000/12/31
IBM eNetwork Personal Communications V4.2 AS/400 for Windows, Windows 95, Windows NT and OS/2	4107063	1997/09/09	1997/09/26	-	2000/12/31
IBM Personal Communications AS/400 V4.11 for Windows, Win 95, Win NT and OS/2	5622-971*	1997/02/04	1997/02/28	-	-
IBM Personal Communications AS/400 and 3270 V4.1 for Windows	39H3-778	1996/03/19	1996/03/22	-	-
IBM Personal Communications AS/400 V4.1 for Windows	39H0-478	1996/03/19	1996/03/22	-	-
IBM Personal Communications AS/400 and 3270 V4.1 for Windows 95	64H0-342	1996/03/19	1996/05/24	-	-
IBM Personal Communications AS/400 V4.1 for Windows 95	64H0-375	1996/03/19	1996/05/24	-	-
IBM Personal Communications AS/400 and 3270 V4.1 for OS/2	39H3-929	1996/03/19	1996/03/22	-	-
IBM Personal Communications AS/400 V4.1 for OS/2	39H3-369	1996/03/19	1996/03/22	-	-
IBM Personal Communications AS/400 V4.1 for OS/2 Twinaxial Entry Level V4.1	51H5-900	1996/03/19	1996/03/22	-	-
AS/400 Communication Products					
IBM 6250 X Terminal Family	6250-5ME, 4CE, 5MT, 4CT	1994/10/04	1994/10/07	1996/12/27	-
IBM 5394 Remote Control Unit	5394-01A, 01B, 02A, 02B	1988/06/21	1988/08/01	-	-
IBM 5494 EXT Remote Control Unit	5494-EXT	1994/10/04	1994/11/25	-	-
IBM OS/400 V3.2	5763-SS1	1996/04/04	1996/06/21	-	1998/10/31
IBM OS/400 V 3.6	5716-SS1	1995/06/21	1995/09/21	-	1998/10/31
IBM OS/400 V 3.7	5716-SS1	1996/09/03	1996/11/08	-	1999/06/30
IBM OS/400 V 4.1	5769-SS1	1997/08/19	1997/08/29	-	2000/05/31

Table 80 (Page 8 of 11). Products Overview					
Product	**Number**	**Announced**	**Available**	**Marketing Withdrawn**	**Service Discontinued**
Distributed Computing Environment (DCE) Base Services/400 V3.2	5733-167	1996/06/04	1996/06/21	1997/12/12	1998/10/31
IBM Personal Communications AS/400 V4.0 for OS/2 (follow on products : Client Access for OS/400 V3R1, V3R2)	85G8-661	1995/02/21	1995/02/21	1996/06/19	1997/02/24
IBM Personal Communications AS/400 V4.0 for Windows (follow on products : Client Access for OS/400 V3R1, V3R2)	20H1-624	1994/09/20	1994/09/20	-	1996/09/30
IBM Personal Communications AS/400 and 3270 V 4.0 for Windows (follow on products : Client Access for OS/400 V3R1, V3R2)	22H6-146	1994/09/20	1994/09/30	1996/06/19	1995/09/30
IBM Personal Communications AS/400 and 3270 V4.0 for OS/2 (follow on products : Client Access for OS/400 V3R1, V3R2)	85G8-805	1995/02/21	1995/02/24	1996/06/19	1997/02/24
IBM 5250 Emulation for Windows V1.1	11H1-303	1995/02/14	1995/03/03	-	-
IBM Enhanced 5250 Emulation Program V2.4	92G5-022	1994/03/29	1994/04/01	1996/12/31	1995/06/30
Client Access/400 V3.2	5763-XY1	1997/08/19	1997/09/12		2000/05/31
Client Access/400 V3.7	5716-XY1	1997/08/19	1997/09/12		2000/05/31
Client Access/400 V4.1	5769-XY1	1997/08/19	1997/08/29		2000/05/31
Client Access/400 for Windows V3.2	5763-XW1	1997/08/19	1997/09/12		2000/05/31
Client Access/400 for Windows V3.7	5716-XW1	1997/08/19	1997/09/12		2000/05/31
Client Access/400 for Windows V4.1	5769-XW1	1997/08/19	1997/08/29		2000/05/31
IBM 5250 Enhanced Link for DOS V3	5H15580 (rep′d by 88H0190)	1996/04/16	1996/04/26	1997/09/17	-
IBM 5250 Express Program Version 4.0	88H0190	1997/06/17	1997/06/27	-	1998/12/31
Network Management Products					
Nways Multiprotocol Routing Network Services V1R3	5765-368	1995/12/12	1995/12/29	1997/09/26	1997/12/26
TME 10 NetView	5697-NVW	1996/06/25	1996/06/28	-	-
Nways Workgroup Remote Monitor (ReMon)	5697-C18* 4019893	1997/03/11	1997/06/27	-	1998/06/27
Nways Workgroup Manager	5697-B96* 4019881	1997/03/11	1997/06/27	-	1998/06/27
Nways Campus Manager LAN for AIX V1	5697-208* 31H7060 (replaced by 4304028)	1995/10/24	1995/11/25	1997/10/08	1997/10/08
Nways Campus Manager ATM for AIX V1 31H7063 (replaced by 4304028)	5765-609*	1995/10/24	1995/11/25	1997/10/08	1997/10/08

Table 80 (Page 9 of 11). Products Overview

Product	Number	Announced	Available	Marketing Withdrawn	Service Discontinued
Nways Campus Manager LAN for AIX V2	5765-A15* 84H0033 (replaced by 4304028)	1996/05/28	1996/06/14	1997/10/08	1997/10/08
IBM Nways Manager for AIX V1R1	4304028	1997/05/27	1997/05/30		1998/05/31
Nways Wide Area Manager for HP OpenView	5765-A16 (replaced by 5765-C20)	1996/04/02	1996/06/28	199707/03	1997/06/28
Nways Campus Manager Suite for AIX V3	5697-B06 (replaced by 4304028)	1996/10/08	1996/12/28	1997/12/09	-
Nways Campus Manager LAN for AIX V3	5697-B07 (replaced by 4304028)	1996/10/08	1996/12/28	1997/12/09	-
Nways Campus Manager ATM for AIX V2	5697-B08 (replaced by 4304028)	1996/10/08	1996/12/28	1997/12/09	-
Nways Campus Manager Suite for HP-UX V2	5697-B10	1997/03/11	1997/03/28	-	1999/03/26
Nways Campus Manager LAN for HP-UX V2	5697-B11	1997/03/11	1997/03/28	-	1999/03/26
Nways Campus Manager ATM for HP-UX V2	5697-B12	1997/03/11	1997/03/28	-	1999/03/26
Nways Manager for Windows V2	84H2656 (replaced by 4019881)	1996/10/08	1996/10/08	1997/10/28	1997/10/28
Nways Campus Manager ReMon for AIX V2	5697-B17 (replaced by 4304028)	1996/10/08	1996/12/28	1997/12/09	-
Nways Campus Manager ReMon for HP-UX V2	5697-B18	1997/03/11	1997/04/04	-	1999/03/26
Nways Campus Manager ReMon Advance for AIX V2	5697-B19 (replaced by 4304028)	1996/10/08	1996/12/28	1997/12/09	-
Nways Campus Manager ReMon Advanced for HP-UX V2	5697-B20	1997/03/11	1997/04/04	-	1999/3/26
Nways Wide Area Element Manager for HP OpenView for SUN Solaris	5765-C20	1997/03/11	1997/07/18	-	1998/07/15
Nways Enterprise Manager	5777-AAK	1997/09/09	1997/12/12	-	1998/12/12
IBM Nways RouteSwitch Network Management Suite (NRSM) V3	4300388	1997/07/15	1997/07/25	-	1998/07/31
IBM Nways RouteSwitch Software Programs Version 3.0 (NRSP)	4300003	1997/07/15	1997/07/25	-	1998/12/31

Table 80 (Page 10 of 11). Products Overview					
Product	**Number**	**Announced**	**Available**	**Marketing Withdrawn**	**Service Discontinued**
Nways RouteDirector Manager V3 for Win 95/NT (replaced by 4300003)	5697-C10	1997/03/11	1997/06/13	1997/07/25	2001/09/27
Nways RouteMonitor Manager V3 for Windows 95 and Windows NT (replaced by 4300003)	5697-C11	1997/03/11	1997/06/13	1997/07/25	2001/09/27
Nways RouteSwitch Network Manager V3 (replaced by 4300003)	5697-B67	1997/03/11	1997/06/13	1997/07/25	2001/09/27
Nways RouteTracker Manager V3 (replaced by 4300003)	5697-B68	1997/03/11	1997/06/13	1997/07/25	2001/09/27
8273 Nways RouteSwitch Software Program V3 (replaced by 4300003)	5697-B69	1997/03/11	1997/06/13	1997/07/25	2001/09/27
8274 Nways RouteSwitch Software Program V3 (replaced by 4300003)	5697-B70	1997/03/11	1997/06/13	1997/07/25	2001/09/27
8274 Nways RouteSwitch Advance Software Program V3	5697-C14 (replaced by 4300003)	1997/03/11	1997/06/13	1997/07/25	2001/09/27
8273 Nways RouteSwitch Advance Software Program V3	5697-C13 (replaced by 4300003)	1997/03/11	1997/06/13	1997/07/25	2001/09/27
Mobile Computer Connectivity					
ARTour Mobile Client for OS/2 3.1	5639-B82 (replaced by 5765-D05)	1997/02/18	1997/02/21	1997/10/31	1999/02/27
ARTour Mobile Client for Windows 3.1 (replaced by 5765-D05)	5639-B83	1997/02/18	1997/02/27	1997/10/31	1999/02/27
ARTour Web Express Server OS/2 1.1	5639-B84	1997/02/18	1997/02/21	1997/10/31	1999/02/27
ARTour Web Express Client OS/2 1.1	5639-B85	1997/02/18	1997/02/21	1997/10/31	1999/02/27
ARTour Web Express Client Windows 95 1.1	5639-B86	1997/02/18	1997/02/21	1997/10/31	1999/02/27
ARTour Web Express Client Windows 1.1	5639-B87	1997/02/18	1997/02/21	1997/10/31	1999/02/27
ARTour Emulator Express Server Windows NT 3.1	5639-C81 (replaced by 5639-D67)	1997/06/24	1997/06/27	1997/10/31	1999/06/30
ARTour Emulator Express Client Windows 95 3.1	5639-C82	1997/06/24	1997/06/27	1997/10/31	1999/06/30
ARTour Web Express Server for Windows NT 1.1 (replaced by 5639-D66)	5639-C84	1997/06/24	1997/06/30	-	1999/06/30
ARTour Emulator Express Client OS/2 3.1	5639-C98	1997/06/24	1997/06/27	1997/09/30	1999/06/30
ARTour Gateway for AIX 3.1 (replaced by 5765-D05)	5765-C17	1997/02/18	1997/02/27	1997/10/31	1999/02/27
ARTour Web Express Server AIX 1.1 (replaced by 5765-D03)	5765-C18	1997/02/18	1997/02/21	1997/10/31	1999/02/27

Table 80 (Page 11 of 11). Products Overview					
Product	**Number**	**Announced**	**Available**	**Marketing Withdrawn**	**Service Discontinued**
ARTour Emulator Express Server AIX 3.1 (replaced by 5765-D05)	5765-C58	1997/06/24	1997/06/30	1997/09/26	1999/09/30
eNetwork Wireless Gateway for AIX V4R1 (5765-D05)	5765-D05	1997/09/30	1997/10/31	-	-
eNetwork Emulator Express Server for AIX V4R1	5765-D03	1997/09/30	1997/10/31	-	-
eNetwork Emulator Express Server for Win NT V4R1	5639-D67	1997/09/30	1997/10/31	-	-
eNetwork Web Express Server for AIX V2R1	5765-D04	1997/09/30	1997/10/31	-	-
eNetwork Web Express Server for Win NT V2R1	5639-D66	1997/09/30	1997/10/31	-	-
Internet Connectivity Server					
IBM Internet Connection Secure Server for OS/390	5697-B14	1997/03/11	1997/03/28	-	-
IBM Internet Connection Secure Server for AIX	5697-A74	1997/02/25	1997/04/25	-	1998/04/25
IBM Internet Connection Secure Server for AIX, Windows NT, OS/2 Warp, HP-UX, and Solaris	5697-B94* 84H7886	1997/02/25	1997/04/25	-	1998/04/25
IBM Internet Connection Secure Server for AS/400	5769-NCE	1997/08/19	1997/08/29	-	2000/05/31
Network Station					
IBM Network Station (Ethernet)	8361-100	1996/10/28	1996/11/28	-	-
IBM Network Station (Ethernet)	8361-110	1997/07/23	1997/07/25	-	-
IBM Network Station (Token-Ring)	8361-200	1996/10/29	1996/12/27	-	-
IBM Network Station (Token-Ring)	8361-210	1997/07/23	1997/07/25	-	-
Note: * European order number					

Appendix B. Special Notices

This publication is intended to the reader understand IBM networking products and their connectivity options. See the PUBLICATIONS section of the IBM Programming Announcement for each product for more information about what publications are considered to be product documentation.

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Appendix C. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

C.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see "How to Get ITSO Redbooks" on page 337.

- *IDNX Frame Relay Network Planning and Implementation*, GG24-4077
- *Introduction to Networking Technologies*, GG24-4338
- *Local Area Network Concepts and Products (VOL 1): LAN Architecture*, SG24-4753
- *Local Area Network Concepts and Products (VOL 2): LAN Adapters, Hubs and ATM*, SG24-4754
- *IBM ATM Workgroup Solutions: Implementing the 8285 ATM Switch*, SG24-4817
- *Local Area Network Concepts and Products (VOL 3): LAN Routers and Gateways*, SG24-4755
- *Local Area Network Concepts and Products (VOL 4): LAN Operating Systems and Management*, SG24-4756
- *IBM 2220 Nways BroadBand Switch: Concepts and Products*, SG24-4307
- *Asynchronous Transfer Mode (ATM) Technical Overview*, SG24-4625
- *New and Improved! Multisegment LAN Design Guidelines*, GG24-3398
- *IBM Frame Relay Guide*, GG24-4463
- *IBM Communications Server for OS/2 Warp Version 4.0 Enhancements*, SG24-4587
- *IBM Communications Server for OS/2 Warp Version 4.1 Enhancements*, SG24-4916
- *TCP/IP Tutorial and Technical Overview*, GG24-3376
- *TCP/IP Implementation in an OS/2 Warp Environment*, SG24-4730
- *Accessing the Internet*, SG24-2597
- *Subarea Network to APPN Network Migration Experiences*, SG24-4656
- *VTAM V4.3: High Performance Routing (HPR) Early User Experiences*, SG24-4507

- *VTAM V4.2 Early User Experiences*, GG24-4250
- *AnyNet: SNA over TCP/IP Installation and Interoperability*, GG24-4395
- *AnyNet: Sockets over SNA, NetBIOS over SNA Installation and Interoperability*, GG24-4396
- *Accessing OS/390 OpenEdition MVS from the Internet*, SG24-4721
- *The Basics of IP Network Design*, SG24-2580
- *NCP Version 7 Release 3 New Functions*, SG24-2592
- *IBM 3746 Nways Controller Model 950 and IBM Model 900 APPN Implementation Guide*, SG24-2536
- *NCP Tuning with NTune*, GG24-2520
- *Campus ATM Design Guidelines*, SG24-5002
- *3174 Network Server in Frame Relay and Multiprotocol Networks*, GG24-4376
- *Using 3174 in TCP/IP Networks*, GG24-4172
- *3174 APPN Implementation Guide Update*, SG24-4171
- *3174 Establishment Controller Networking Server Installation Guide*, GG24-3061
- *Personal Communications V4.1 for DOS/Windows and OS/2 Implementation Guide*, SG24-4681
- *Personal Communications for Coax, LAN and WAN Users, PCOMM V4.1 for DOS/Windows and OS/2 Connectivity Cookbook*, SG24-4688
- *Personal Communications for the Mobile Users, DOS, Windows 3.1, OS/2 Connectivity Cookbook*, SG24-4456
- *IBM 2210 Nways Multiprotocol Router Description and Configuration Scenarios*, SG24-4446
- *IBM Nways 2219, 2225, 2230 WAN Switches: Services and Technology*, SG24-4777
- *IBM Nways 2216 Multiaccess Connector Description and Configuration Scenarios - Volume I*, SG24-4957-00
- *8260 Multiprotocol Intelligent Switching Hub*, GG24-4370
- *The IBM 6611 Network Processor as an SNA/APPN Router*, GG24-4367
- *IBM 8250 Intelligent Hub and IBM Hub Management Program/6000*, GG24-4033
- *IBM 8260 as a Campus ATM Switch*, SG24-5003

- *Open Systems Adapter 2 Implementation Guide*, SG24-4770
- *RS/6000 Communications Solutions*, SG24-4899
- *Network Products Reference*, GX28-8002
- *Converging TCP/IP and SNA Networks: Web Access over SNA*, SG24-2101
- *A Guide to the Internet Connection Servers*, SG24-4805

C.2 Redbooks on CD-ROMs

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CD-ROM Title	Subscription Number	Collection Kit Number
System/390 Redbooks Collection	SBOF-7201	SK2T-2177
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RS/6000 Redbooks Collection (HTML, BkMgr)	SBOF-7230	SK2T-8040
RS/6000 Redbooks Collection (PostScript)	SBOF-7205	SK2T-8041
Application Development Redbooks Collection	SBOF-7290	SK2T-8037
Personal Systems Redbooks Collection	SBOF-7250	SK2T-8042

C.3 Other Publications

These publications are also relevant as further information sources:

- *AS/400 Advanced Series, System Handbook V4R1*, GA19-5486
- *Planning for Integrated Networks*, SC31-8062
- *3172 ICP Version 3.5 Supplemental Guide*, GC30-3771
- *3172 Systems Network Architecture Communications Program and TCP/IP Offload Feature User's Guide*, GC30-3675
- *3172 IP Channel Communications V1R1 User's Guide*, GC30-3724
- *3172 Hardware Planning Guide*, GA27-4003
- *AS/400 Client Access Family of Products Version 3*, SC41-3560
- *2216 Nways Multiaccess Connector ESCON Channel Adapter Planning and Setup Guide*, GA27-4193-00
- *ES/9000 9221 Processors Planning for System Installation*, GA24-4187-04
- *Planning for the System/390 Open Systems Adapter Feature*, GC23-3870

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Glossary

ACDI. Asynchronous Communications Device Interface

ACDI port. In Communications Manager/2, a serial port such as COM1, COM2 or COM3, that can be programmed for asynchronous communications through the Asynchronous Communications Device Interface (ACDI)

ACF. Advanced Communications Functions

Advanced Function Printing (AFP). In the AS/400 system, the ability of programs to print all-points-addressable text and images

Advanced Peer-to-Peer Networking (APPN). An extension to SNA featuring (a) greater distributed network control that avoids critical hierarchical dependencies, thereby isolating the effects of single points failure; (b)dynamic exchange of network topology information to foster ease of connection, reconfiguration, and adaptive route selection; (c) dynamic definition of network resources; and (d) automated resource registration and directory lookup. APPN extends the LU6.2 peer orientation for end-user services to network control and supports multiple LU types, including LU 2, LU 3, and LU 6.2.

APPN end node. A node that provides a broad range of end-user services and supports sessions between its local control point (CP) and the CP in an adjacent network node. It uses these sessions to dynamically register its resources with the adjacent CP (its network node server), to send and receive directory search requests, and to obtain management services. An APPN end node can also attach to other end nodes.

APPN network. A collection of interconnected network nodes and their client end nodes.

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

Advanced program-to-program communication (APPC). (1) The general facility characterizing the LU6.2 architecture and its various implementations in products. (2) Sometimes used to refer to the LU6.2 architecture and its product implementations as a whole, or to an LU6.2 product feature in particular, such as an APPC application programming interface.

AIX. Advanced Interactive Executive. IBM′s implementation of the UNIX operating system. The RS/6000 system, among others, runs the AIX operating system.

AnyNet product family. A group of IBM products that implement the multiprotocol transport networking (MPTN) architecture, thus enabling application programs to communicate independently of the underlying network transport protocol.

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 intermediate routing network. The portion of an APPN network consisting of the network nodes and their interconnections.

asynchronous (ASYNC). (1) Pertaining to two or more processes that do not depend upon the occurence of specific events such as common timing signals. (2) Without regular time relationship; unexpected or unpredictable with respect to the execution of program instructions.

Asynchronous Communications Device Interface (ACDI). An application programming interface or service that is used by application programs. Application programs use the ACDI service to communicate with programs on other systems that use asynchronous communications.

Asynchronous Transfer Mode (ATM). A transfer mode in which the information is organized into cells; it is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic. ATM is specified in international standards such as ATM Forum UNI 3.1.

ATM campus network. A network of ATM nodes providing connectivity for ATM endsystems located in buildings within the same general area (for example, the distance between buildings is one kilometer or less).

ATM end system. A node at which an asynchronous transfer mode (ATM) connection is initiated or terminated. An originating endsystem initiates the ATM connection, and a terminating endsystem terminates the ATM connection.

automatic network routing (ANR). In High-Performance Routing (HPR), a highly efficient routing protocol that minimizes cycles and storage requirements for routing network layer packets through intermediate nodes on the route.

AutoSync. In modems compatible with the Hayes AutoSync modem, a communication mode in which the modem provides synchronous communication with the remote data terminal equipment (DTE) while it is connected to an asynchronous port of the local DTE.

backbone LAN segment. (1) In a multiple segment configuration of a LAN, a centrally located LAN segment to which other LAN segments are connected by means of bridges. (2) In a hierarchical network, the LAN segment at the highest level of the hierarchy.

backbone network. A central network to which smaller networks, normally of lower speed, connect. The backbone network usually has a much higher capacity that the networks it helps interconnect or is a wide-area network (WAN) such as a public packet-switched datagram network.

bandwidth. (1) The difference, expressed in Hertz, between the highest and the lowest frequencies of a range of frequencies. (2) In asynchronous transfer mode (ATM) the capacity of a virtual channel, expressed in terms of peak cell rate (PCR), sustainable cell rate (SCR), and a maximum burst size (MBS). (3) A measure of the capacity of a communication transport medium (such as a TV cable) to convey data.

B-channel. In the integrated services digital network (ISDN), a 64 kilobits-per-second channel for the transport of speech or data between the ISDN service provider and user.

bridge. (1) A functional unit that interconnects two local area networks (LANs) that use the same logical link control protocol but may use different medium access control protocols. (2) A functional unit that interconnects multiple LANs (locally or remotely) that use the same logical link 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. (3) In the connection of local loops, channels, or rings, the equipment and techniques used to match circuits and to facilitate accurate data transmission. (4) Contrast with *gateway* and *router*.

cell. (1) In asynchronous transfer mode (ATM), a medium access control (MAC) protocol data unit (PDU) of fixed size.

channel-attached. (1) Pertaining to the attachment of devices directly by input/output channels to a host processor. (2) Pertaining to devices attached to a controlling unit by cables, rather than by telecommunications lines.

Common Link Access to Workstations (CLAW). A continuously executing program designed to minimize host interrupts while maximizing channel utilization.

cluster. (1) A station that consists of a control unit (a cluster controller) and the terminals attached to it. (2) A group of APPN nodes that have the same network ID and the same topology database. A cluster is a subset of a NETID subnetwork.

Common Programming Interface for Communications (CPI-C). An evolving application programming interface (API), embracing functions to meet the growing demands from different application environments and to achieve openess as an industry standard for communications programming. CPI-C provides access to interprogram services such as (a) sending and receiving data, (b) synchronizing processing between programs, and (c) notifying a partner of errors in the communication.

Communications Server. An IBM licensed program that supports the development and use of application programs involving two or more connected systems or workstations. The Communications Server provides multiple concurrent connectivities using different protocols to connect the application programs to other systems and workstations. It supports several application programming interfaces (APIs) that may be called concurrently and are designed for client/server and distributed application programs. The Communications Server includes the necessary interfaces for network management.

connectionless service. A network service that treads each packet or datagram as a separate entity that contains the source address and destination address and for which no acknowledgement is returned to the originating source. Connectionless services are on a best-effort basis and do not guarantee reliable or in-sequence delivery.

connection-oriented service. A service that establishes a logical connection between two partners for the duration that they want to communicate. Data transfer takes place in reliable, sequenced manner.

Controlled Access Unit (CAU). An intelligent concentrator, such as the IBM 8230. The CAU is used as a point to control physical access to the ring, and to provide a method to bypass faulty or inactive devices

control unit terminal (CUT) mode. An IBM protocol used for communications with an IBM 3174 or 3274 Control Unit or other appropriate interface unit. In this protocol, a program in the workstation emulates a 3278 or 3879 terminal for a user at a virtual terminal, and the interface unit is responsible for enforcing the protocol.

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.

D-channel. In the integrated services digital network (ISDN), a 16 kilobits-per-second channel for the transport of packet data or call establishment information between the ISDN service provider and user.

DECnet. A network architecture that defines the operation of a family of software modules, databases, and hardware components typically used to tie Digital Equipment Corporation systems together for resource sharing, distributed computation, or remote system configuration. DECnet network implementations follow the Digital Network Architecture (DNA) model.

dependent LU requester (DLUR). An APPN end node or network node that (a) owns dependent LUs in its local node or in adjacently attached nodes and (b) obtains SSCP services for these dependent LUs from a dependant LU server (DLUS) located elsewhere in an APPN network.

The flows of SSCP services between DLUR and DLUS are encapsulated in APPN formats and carried over a special pair of LU6.2 sessions.

dependent LU server (DLUS). An APPN network node that provides SSCP services for dependent LUs owned by dependent LU requesters (DLURs) located elsewhere in an APPN network.

distributed function terminal (DFT). (1) A protocol used for communication between a terminal and an IBM 3274 or IBM 3174 control unit that allows multiple concurrent logical terminal sessions. (2) A mode of operation that uses this protocol.

Emulator High-Level Language Application Programming Interface (EHLLAPI). In Communications Manager/2, an application programming interface that provides programming access to the area in computer memory that corresponds to the user′s screen image (this area in memory is known as the presentation space).

Enterprise Systems Connection (ESCON). A set of IBM products and services that provide a dynamically connected environment within an enterprise.

Fiber Distributed Data Interface (FDDI). An American National Standards Institute (ANSI) standard for a 100-megabit-per-second LAN using optical fiber cables.

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.

frame-relay switch. A frame-relay node that provides both the frame-relay frame handler function and the local management interface function.

high-availability cluster multiprocessing (HACMP). An application service that enables up to eight RS/6000 servers to access the same data in parallel. This optimizes application execution and scalability and protects against unplanned outages and server downtime.

high-level language application programming interface (HLLAPI). A programming interface that usually operates in conjunction with an emulator, such as 3270 emulation, and allows interaction using 3270 datastream between a host and a remote application program.

High-Performance Routing (HPR). An addition to APPN that enhances datarouting performance and session reliability.

IEEE 802.2. An Institute of Electrical and Electronics Engineers (IEEE) standard describing how data is formatted into frames for LAN transmission.

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

Internetwork Packet Exchange (IPX). (1) 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.

LAN Adapter and Protocol Support (LAPS). A subsystem that includes the software that manages and controls the network adapter cards, including the device drivers for those cards as well as the protocols that are used to communicate with other adapters on the network.

LAN emulation (LANE). The transparent use of an ATM network as an Ethernet-type LAN (IEEE 802.3) or a token-ring LAN (IEEE 802.5). LAN emulation enables equipment such as hosts, desktop computers, bridges, routers, and hubs with ATM interfaces to use an ATM network as an emulated LAN at the medium access control

(MAC) layer and to communicate readily with devices on existing LANs. ATM LAN emulation presents the same interface to higher level application programs and protocols as that presented by other types of LANs such as Ethernet , token-ring, and Fiber Distributed Data Interface (FDDI). When a higher layer protocol has native access to ATM, the protocol can control the bandwidth and quality of service (QoS) parameters used to establish ATM virtual channels. In contrast, when an ATM endsystem is operating in LAN emulation mode, ATM is hidden from the higher layer protocol by the LAN emulation client software that establishes best-effort delivery. Therefore, the ATM network services of guaranteed bandwidth and quality of service are not fully exploited.

LEN node. A node that supports independent LU protocols but does not support CP-CP sessions. It may be a peripheral node attached to a boundary node in a subarea network, an end node attached to an APPN network node in an APPN network, or a peer-connected node directly attached to another LEN node or APPN end node.

link access protocol balanced (LAPB). A protocol used for accessing an X.25 network at the link level. LAPB is a duplex, asynchronous, symmetric protocol, used in point-to-point communication.

logical link control (LLC). The data link control (DLC) LAN sublayer that provides two types of DLC operation for the orderly exchange of information. The first type is connectionless service, which allows information to be sent and received without establishing a link. The LLC sublayer does not perform error recovery or flow control for connectionless service. The second type is connection-oriented service which requires establishing a link prior to the exchange of information. Connection-oriented service provides sequenced information transfer, flow control, and error recovery.

logical link control (LLC) protocol. In a local area network (LAN), the protocol that governs the exchange of transmission frames between data stations independently of how the transmission medium is shared. The LLC protocol was developed by the IEEE 802 committee and is common to all LAN standards.

logical unit (LU). A type of network accessible unit that enables users to gain access to network resources and communicate with each other.

low-entry networking (LEN). A capability of nodes to attach directly to one another using basic peer-to-peer protocols to support multiple and parallel sessions between logical units.

low-entry networking (LEN) end node. A LEN node receiving network services from an adjacent APPN network node.

low-entry networking (LEN) node. A node that provides a range of end-user services, attaches directly to other nodes using peer protocols, and derives network services implicitly from an adjacent APPN network node, that is, without the direct use of CP-CP sessions.

LU type. The classification of an LU in terms of the specific subset of SNA protocols and options it supports for a given session, namely:

- The mandatory and optional values allowed in the session activation request
- The usage of data stream controls, function management headers (FMHs), request unit parameters, and sense data values
- Presentation services protocols such as those associated with FMH usage

LU types 0, 1, 2, 3, 4, 6.1, 6.2, and 7 are defined.

LU 6.2. A type of logical unit that supports general communication between programs in a distributed processing environment. LU 6.2 is characterized by (a) a peer relationship between session partners, (b) efficient utilization of a session for multiple transactions, (c) comprehensive end-to-end error processing, and (d) a generic application programming interface (API) consisting of structured verbs that are mapped into a product implementation.

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

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

Micro Channel architecture (MCA). The rules that define how subsystems and adapters use the Micro Channel bus in a computer. the architecture defines the services that each subsystem can or must provide.

Mid-Level Manager (MLM). A systems monitor function that performs a subset of systems and network management tasks (for example, polling, status monitoring, and node discovering) for a defined set of Simple Network Management Protocol (SNMP) devices in the network, thereby offloading these tasks from the top-level manager.

Multiprotocol Network Program (MPNP). The IBM software that controls the functions of the IBM 6611 Network Processor. It is a licensed program made up of base code and the Configuration Program.

multiprotocol transport networking (MPTN). A networking architecture that allows application programs using common upper-layer protocols and expecting the same transport services to communicate over transport networks that may use protocols different from the transport network the programs were designed to use. For example, socket application programs that were originally designed to communicate over a TCP/IP transport network can, using MPTN support, communicate over an SNA transport network.

multistation access unit (MAU). In the IBM token-ring network, a wiring concentrator that can connect up to eight lobes on a ring.

Network Basic Input/Output System (NetBIOS). A standard interface to networks, IBM personal computers (PCs), and compatible PCs, that is used on LANs to provide message, print-server, and file-server functions. Application programs that use NetBIOS do not need to handle the details of LAN data link control (DLC) protocols.

NetBIOS Extended User Interface (NetBEUI). The application programming interface (API) to the NetBIOS transport protocol.

network driver interface specification (NDIS). An application programming interface (API) definition that allows DOS or OS/2 systems to support one or more network adapters and protocol stacks. NDIS is a 16-bit, Ring 0 (for the OS/2 operating system) API that defines a specific way for writing drivers for layers 1 and 2 of the OSI model. NDIS also handles the configuration and binding of these network drivers to multiple protocol stacks.

Networking BroadBand Services (NBBS). An IBM architecture for high-speed networking that complements the asynchronous transfer mode (ATM) standards and provides access services, transport services, and network control for user traffic.

nonswitched connection. A connection that does not have to be established by dialing.

nonvolatile storage. A storage device whose contents are not lost when power is cut off.

OpenEdition. Pertaining to the elements of OS/390 that incorporate the UNIX interfaces standardized in POSIX.

packet switching. 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.

packet switching data network (PSDN). A network that uses packet switching as means of transmitting data.

permanent virtual channel (PVC). In ATM a predefined connection between two users that is similar to a leased line. Call setup and disconnection are unnecessary for a PVC.

permanent virtual circuit (PVC). (1) 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). Call establishment protocols are not required. (2) The logical connection between two frame-relay terminating equipment stations, either directly or through one or more frame-relay frame handlers. A PVC consists of one or more PVC segments.

Personal Communications product family. A group of IBM licensed programs that emulate 3270 and 5250 terminals and that run on several operating systems such as OS/2, DOS, Windows 3.x, Windows 95, and Windows NT.

physical unit (PU). The component that manages and monitors the resources (such as attached links and adjacent link stations) associated with a node, as requested by an SSCP via an SSCP-PU session. An SSCP activates a session with the physical unit in order to indirectly manage, through the PU, resources of the node such as attached links. This term applies to type 2.0, type 4, and type 6 nodes only.

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

Post Office Protocol (POP). A protocol used for exchanging network mail and accessing mailboxes.

proxy agent. A process or entity that is both an agent to its manager and a manager for one or more objects. It satisfies requests from its manager by relaying those requests and translating them for the objects that it manages.

proxy server. A server that receives requests intended for another server and that acts on the client′s behalf (as the client′s proxy) to obtain the requested service. A proxy server is often used when the client and the server are incompatible for direct connection (for example, when the client is unable to meet the security authentication requirements of the server but should be permitted some services).

public switched telephone network (PSTN). A communication common carrier network that provides voice and data communication services over switched lines.

quality of service (QoS). For an asynchronous transfer mode (ATM) virtual channel or a Networking BroadBand Services (NBBS) network connection, a set of communication characteristics such as end-to-end delay, jitter, and packet loss ratio.

route bridge. A function of an IBM bridge program that allows two bridge computers to use a telecommunication link to connect two LANs. Each bridge computer is connected directly to one of the LANs, and the telecommunication link connects the two bridges computers.

router. (1) A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses. (2) An attaching device that connects two LAN segments, which use similar or different architectures, at the reference model network layer. (3) In OSI terminology, a function that determines a path by which an entity can be reached. (4) In TCP/IP, synonymous with gateway.

Secure Sockets Layer (SSL). A security protocol that allows the client to authenticate the server and all data and requests to be encrypted. SSL was developed by Netscape Communications Corp. and RSA Data Security, Inc.

serial line Internet Protocol (SLIP). A protocol used to run Internet Protocol (IP) over serial lines, such as telephone circuits or RS-232 cables, interconnecting two systems.

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).

socks server. A circuit-level gateway that provides a secure one-way connection through a firewall to server applications in a nonsecure network.

socket. An endpoint provided by the transport service of a network for communication between processes or application programs.

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.

super VLAN. Super VLAN is a collection of emulated LANs that allows you to build large ATM networks. A client on any of the emulated LANs can establish a direct link, a data-direct VCC, to any other client on the Super VLAN. In essence, the Super VLAN is emulating a standard VLAN, except that the LAN Emulation Server (LES) function is distributed throughout the ATM network. Reliability and performance of the LE services increase with the number of service entities. Resource utilization becomes less centralized, allowing for a much larger Super VLAN than a standard ELAN.

switch. A node used to interconnect telephone or communication lines. For example, an ATM switch transfers cells from the entry communication line to the exit communication line.

switched connection. (1) A mode of operating a data link in which a circuit or channel is established to switching facilities as, for example, in a public switched network. (2) A connection established by dialing.

switched line. A telecommunication line in which the connection is established by dialing.

switched virtual channel (SVC). In ATM, a temporary connection between two users that is established when one user calls another. Although this is similar in concept to one person′s calling another person on the telephone, the signaling techniques are different.

switched virtual circuit (SVC). An X.25 circuit that is dynamically established when needed. The X.25 equivalent of a switched line.

Synchronous Data Link Control (SDLC). A discipline conforming to subsets of the Advanced Data Communication Control Procedures (ADCCP) of the ANSI and High-level Data Link Control (HDLC) of the International Organization for Standardization (ISO), 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.

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 users, to be independent of and unaffected by specific SNA network services and facilities used for information exchange.

telecommunication line. (1) The portion of a data circuit external to a data circuit-terminating equipment (DCE) that connects the DCE to a data-switching exchange (DSE), that connects a

DCE to one or more other DCEs, or that connects a DSE to another DSE. (2) Any physical medium, such as a wire or microwave beam, that is used to transmit data.

TN3270E Server. A component of Communications Server that enables a TCP/IP client workstation to communicate with a host processor. The TN3270E Server accepts SNA traffic from the host processor and converts it into Telnet format for the client workstation. It also accepts Telnet traffic from the client workstation and converts it into SNA format for the host processor. The TN3270E Server implements the protocols defined in Request for Comments (RFCs) 1646 and 1647; TN3270E refers to Telnet 3270 standard extensions.

tunneling. To treat a transport network as though it were a single communication link or LAN

Type 1 frame. In the IEEE 802.2 LAN standard, a frame sent without the establishment of a link-level connection. It is used for IP and IPX traffic as well as NetBIOS datagrams.

Type 2 frame. In the IEEE 802.2 LAN standard, a frame sent over an established link-level connection. It is used for NetBIOS and SNA links.

type 2.0 node. A node that attaches to a subarea network as a peripheral node and provides a range of end-user services but no intermediate routing services

type 2.1 node. A node that can be an APPN network node, an APPN end node, or a LEN node. It can also attach as a peripheral node to a subarea boundary node in the same way as a type 2 node.

type 4 node. A node that is controlled by one or more type 5 nodes. It can be a subarea node, or, together with other type 4 nodes and their owning type 5 node, it can be included in a group of nodes forming a composite LEN node or a composite network node.

type 5 node. A node that can be any of the following:

- APPN end node
- APPN network node
- Interchange node
- Migration data host (a node that acts as both an APPN end node and a subarea node)
- Subarea node (with an SSCP)

T1. In the United States, a 1.544 Mbps public access line. It is available in twenty-four 64 Kbps channels. The European version (E1) transmits 2.048 Mbps. The Japanese version (J1) transmits 1.544 Mbps.

virtual channel connection (VCC). In ATM, a connection between two ATM endsystems. A VCC can be either a permanent virtual connection (PVC) or a switched virtual connection (SVC) and may traverse several virtual path connections.

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

3174 Peer Communications Network. A function that provides peer-to-peer communication for programmable workstations connected to an IBM 3174 Control Unit through IBM 3270 communication adapters using coaxial cable or telephone twisted pair wire. This function is achieved through the following:

- 3174 Peer Communications Network network-driver-interface-specification (NDIS) media access control driver
- 3174 Peer Communications Network program running on the IBM 3174 Control Unit

Index

Numerics

2210 Nways Multiprotocol Router 40, 42, 44, 47, 56, 189, 211, 269, 299, 318
2216 Nways Multiaccess Connector 1, 3, 4, 5, 22, 41, 42, 46, 56, 211, 299, 318
2217 Nways Multiprotocol Concentrator 221
2217-200 Nways Multiprotocol Concentrator (MpC) 318
2217-300 Nways Multiprotocol Concentrator (MpC) 318
2218 Nways Frame Relay Access Device 48, 56, 214, 318
2219 Nways Switch Access 58, 209, 210, 318
2220 Nways BroadBand Switch 61, 202, 203, 299, 318
2220 Nways BroadBand Switch Control Program 320
2225 Nways MultiService Switch 59, 209, 210, 299, 318
2230 Nways ATM Switch 60, 299, 319
2480 AS/400 Wireless 36
3172 Interconnect Controller 1, 3, 4, 5, 14, 15, 16, 17, 18, 19
3172 Interconnect Controller Model 3 206, 218, 318
3172 Interconnect Controller Program (ICP) V3.4 318
3172 IP Channel Communications Program V1 16, 318
3174 Establishment Controller 1, 3, 5, 20, 97, 100, 101, 102, 105, 107, 108, 110, 189, 204, 218, 318
3174 Peer Communications Network 349
3270 Host Connection Program V1.3.2 for AIX V3 321
3270 Host Connection Program V2.1 for AIX V4 321
3745 Communication Controller 1, 5, 10, 11, 197, 218, 318
3746 Multiaccess Enclosure 12
3746-900 Expansion Unit 1, 3, 4, 5, 10, 11, 12, 189, 198, 199, 318
3746-950 Nways Controller 950 1, 3, 5, 11, 12
5250 Enhanced Link for DOS V 3 324
5250 Express Program Version 4.0 324
5250 for Windows V1.1 324
5394 Remote Control Unit 120, 121, 323
5494 EXT Remote Control Unit 120, 121, 122, 323
6250 X Terminal Family 323
6299 Hub for Midrange Systems 66, 319
6611 Network Processor 40, 42, 50, 51, 56, 200, 218, 269, 319
802.2 213
802.5 213
8209 LAN Bridge 266, 319
8210 Nways Multiprotocol Switched Access Services 47, 61, 254, 258, 265, 299, 319
8222 Nways Ethernet Workgroup Hub 36, 67, 73, 319
8223 Fast Ethernet Workgroup Hub 68, 73, 319
8224 Ethernet Stackable Hub 36, 68, 73, 254, 258, 266, 319
8225 Fast Ethernet Stackable Hub 36, 68, 73, 254, 258, 266, 319
8226 Token-Ring RJ45 Multistation Access 69, 73, 319
8227 Wireless LAN Acess Point 268
8228 Token-Ring Multistation Access Unit 319
8229 LAN Bridge 38, 42, 258, 266, 319
8230 Token-Ring Controlled Access Unit 69, 73, 254, 258, 266, 319
8235 Dial In Access to LANs (DIALs) 75, 254, 258, 269, 319
8237 Ethernet Stackable Hub 36, 70, 73, 254, 258, 267, 319
8238 Nways Token-Ring Stackable Hub 70, 73, 254, 258, 268, 319
8240 FDDI Concentrator 266
8244 FDDI Workgroup Concentrator 71, 73, 258, 266, 319
8250 Multiprotocol Intelligent Hub 39, 42, 72, 74, 254, 258, 267, 319
8260 Nways Multiprotocol Switching Hub 40, 72, 74, 254, 258, 259, 267, 299, 319

8270 Nways Token-Ring Switch 61, 258, 320
8271 Nways Ethernet LAN Switch 61, 62, 73, 74, 254, 256, 258, 259, 267, 299, 320
8272 Model 108 LANStreamer Switch 320
8272 Model 216 Nways Token-Ring LAN Switch 320
8272 Nways Token-Ring LAN Switch 61, 63, 74, 254, 256, 258, 268, 299, 312
8273 Nways Ethernet RouteSwitch 64, 254, 258, 259, 268, 299, 320
8273 Nways RouteSwitch Advanced Software Program V3 326
8273 Nways RouteSwitch Software Program V3 326
8274 Nways LAN RouteSwitch 64, 254, 258, 259, 268, 299, 320
8274 Nways RouteSwitch Advanced Software Program V3 326
8274 Nways RouteSwitch Software Program V3 326
8276 Nways Ethernet RoutePort 73, 74, 320
8281 ATM LAN Bridge 254, 258, 259, 268, 320
8282 ATM Workgroup Concentrator 254, 258, 259, 268, 320
8285 Nways ATM Workgroup Switch 65, 254, 258, 259, 268, 299, 320
9672 S/390 Parallel Transaction Server 7, 8, 317
9673 S/390 Parallel Query Server 317
9733 IDNX Micro 20 Model 108 320
9733 IDNX Micro 20 Model 908 320

A

AAL 297, 298
ACDI 341
ACDI port 341
ACF 341
Advanced Function Printing 341
Advanced Peer-to-Peer Networking 341
Advanced program-to-program communication 341
AFP 341
AIX 278, 341
AIX Connections 79, 91
AIX Connections V4.1 option 321
AIX for RS/6000 V 3.2.5 321
AIX SNA Gateway/6000 V2.1.2 321
AIX SNA Server/6000 V2.1.2 189, 321
AIX V4.1.5 79, 321
AIX V4.1.5 with AIX Connections V4 321
AIX V4.2 79, 321
AIX V4.3 79, 321
AIXlink/X.25 84, 95, 321
AIXWindows Environment/6000 V1.2.5 321
Annex-D 201
ANR 342
AnyNet 79, 219, 227, 228, 238, 240, 283, 284
AnyNet APPC over TCP/IP for Windows 322
AnyNet IPX over SNA Gateway for OS/2 322
AnyNet SNA over TCP/IP Gateway for OS/2 322
AnyNet Sockets over SNA 153
AnyNet/2 NetBEUI over SNA 322
AnyNet/2 Sockets over SNA Gateway 322
AnyNet/2 V2.0 322
APPC 341
APPC over TCP/IP 221, 224, 228, 240
APPC over TCP/IP gateway 228
AppleTalk 201, 341
APPN 185, 263, 284, 341
APPN border node 187
APPN composite node 187
APPN end node 341
APPN interchange node 187
APPN intermediate routing network 341
APPN network 341
APPN network node 341
APPN virtual routing node 187
ARP request 213
ARTour 77, 243
ARTour Emulator Express Client OS/2 326
ARTour Emulator Express Client Windows 95 326
ARTour Emulator Express Server AIX 327
ARTour Emulator Express Server Windows NT 326
ARTour Gateway for AIX 326
ARTour Mobile Client OS/2 326
ARTour Mobile Client Windows 326
ARTour Web Express Client OS/2 326
ARTour Web Express Client Windows 326

ARTour Web Express Client Windows 95 326
ARTour Web Express Server AIX 326
ARTour Web Express Server NT 326
ARTour Web Express Server OS/2 326
AS/400 25, 113, 116, 119, 121, 122, 124, 125, 144, 208, 218, 277, 323
AS/400 Client Access 125, 128, 129, 131, 134, 135, 137, 139
ASYNC 341
asynchronous 341
Asynchronous Communications Device Interface (ACDI) 342
Asynchronous Transfer Mode 342
ATM 8, 45, 59, 60, 61, 62, 63, 64, 73, 254, 257, 259, 261, 295, 297, 310, 342
ATM campus network 342
ATM end system 342
automatic network routing 342
AutoSync 342

B

B-channel 342
backbone LAN segment 342
backbone network 342
bandwidth 342
BECN 201, 207
  6611 201
bibliography 333
Block Multiplexer Channel Connectivity for AIX V1.1 95
Block Mux Channel Connectivity for AIX V1.1 80, 321
branch extender 155, 188
Bridge 35, 36, 342
bridged format 213
bridging 201

C

CAU 343
cell 342
channel-attached 342
CICS/VS 3270-PC File Transfer Program 317
CIR 201
  6611 201
CLAW 343
cluster 343
CM/2 V 1.1 322
Common Link Access to Workstations 343
Common Programming Interface for Communications 343
Communications Server 343
Communications Server for AIX 79, 84, 85, 174, 179, 221, 228, 321
Communications Server for MVS/ESA 179, 317
Communications Server for OS/2 154, 179, 189, 213, 221, 230, 322
Communications Server for OS/2 Warp V4.0 162, 163
Communications Server for S/390 173
Communications Server for Windows NT 167, 179, 189, 228, 323
Concentrator 66
Congestion Management 201, 207
  3172 207
  6611 201
Connection Program/400 90
Connection Program/400 for UNIX 147
connection-oriented service 343
connectionless service 343
control unit terminal mode 343
Controlled Access Unit 343
CPI-C 343
CUT 343

D

D-channel 343
data link control 343
Data Link Control (DLC) 213
data link switching 343
DCE Base Services/400 V3 324
DECnet 343
Dependant LU Requestor (DLUR) 175
dependent LU requester 343
Dependent LU Requestor (DLUR) 152
dependent LU server 344
DFSMS NFS Feature V 1.4.0 317
DFT 344
Discovery of Service Providers 171
distributed function terminal 344

DLC 343
DLCI 214
DLSw 47, 263, 343
DLUR 152, 175, 189, 283, 284, 343
DLUS 189, 344
DOS WSF 130

E

Emulator Express 243, 247
eNetwork Communications Suite for Windows, Windows 95 and Windows NT V1 292, 323
eNetwork Emulator Express 243, 247
eNetwork Software 291
eNetwork Web Express 243, 246
eNetwork Wireless 243
Enhanced 5250 Emulation Program V 2.4 324
Enterprise Systems Connection 344
ES/9000 317
ES/9000 9021 7, 317
ES/9000 9121 7, 317
ES/9000 9221 317
ESCON 47, 344
ESCON Channel Connectivity for AIX V1.1 80, 94, 321

F

FDDI 8, 39, 61, 63, 64, 65, 66, 71, 72, 73, 74, 81, 86, 344
FECN 201, 207
  6611 201
Fiber Distributed Data Interface 344
File Server I/O Processor (FSIOP) 115
File Server Support/400 146
frame relay 5, 10, 11, 12, 14, 16, 17, 18, 20, 42, 51, 52, 53, 54, 58, 74, 97, 101, 102, 120, 121, 122, 184, 193, 194, 197, 198, 199, 200, 202, 203, 204, 206, 208, 217, 344
Frame Relay Token-Ring Bridge/DOS V1.0 320
frame-relay switch 344

G

glossary 341

H

HACMP 344
High Performance Routing 151, 175
High performance routing (HPR) 208
high-availability cluster multiprocessing 344
high-level language application programming interface 344
High-Performance Routing 344
HLLAPI 344
Host On-Demand 79, 172, 177, 179
HPR 152, 175, 188, 191, 283, 284, 344
HPR Channel Connectivity Program 16
Hubs 35, 66

I

IBM 8260/8285 Video Distribution Module 299
IBM 8300 Video Access Node 299
IBM AnyNet APPC over TCP/IP for Windows 221, 240
IBM AnyNet IPX over SNA Gateway for OS/2 221, 238
IBM AnyNet SNA over TCP/IP Gateway for OS/2 221
IBM AnyNet/2 221, 234
IBM AnyNet/2 NetBEUI over SNA 221, 238
IBM Internet Connection Secure Server for AIX 327
IBM Internet Connection Secure Server for AIX, Windows NT, OS/2 Warp, HP-UX, and Solaris 271, 327
IBM Internet Connection Secure Server for AS/400 327
IBM Internet Connection Secure Server for OS/390 273, 327
IBM LAN Network Manager 39
IBM Rumba/400 142
IBM TURBOWAYS 155-Mbps ATM adapters 299
IBM TURBOWAYS 25-Mbps ATM adapters 299
IEEE 802.2 344
Integrated PC Server 115
integrated services digital network 344
Interconnect Controller Program (ICP) V3.5 318
Internet Connection Secure Servers 271
Internetwork Packet Exchange 344

IP 213
IPCS 115
IPX 344
IPX over IP Gateway 221
IPX over SNA 230, 238, 242
IPX over SNA Gateway 221, 227
IPX over TCP/IP 230
ISDN 44, 45, 46, 50, 59, 60, 75, 344

L

LAN Adapter and Protocol Support 344
LAN Bridge Manager/2 V1.0 320
LAN Distance V1.1 320
LAN emulation 344
LAN File Service/ESA (LFS/ESA) 317
LAN Gateway 230, 231, 232
LAN Resource Extension and Services/MVS (LANRES/MVS) V1.3.0 16, 317
LAN Resource Extension and Services/VM V1.3.0 16, 317
LAN Server for Macintosh V1.1 322
LAN-to-LAN WAN Program (LTLW) 54, 320
LANE 344
LANStreamer Token-Ring Bridge/DOS V1.0 320
LAPB 345
LAPS 344
LEN 345
LEN end node 345
LEN node 345
link access protocol balanced 345
LLC 345
LLC protocol 345
LLC2 213
LMI 201, 205, 207
  3172 207
  3174 205
  6611 201
Local Token-Ring Bridge/DOS V1.0 320
logical link control 345
logical unit 345
low-entry networking 345
LU 345
LU 6.2 345
LU type 345

M

MAN 346
Management information base 345
MAU 346
MCA 346
metropolitan area network 346
MIB 345
Micro Channel architecture 346
Microsoft ODBC 132
Mid-Level Manager 346
MLM 346
MPNP 346
MPTN 219, 346
MSS 299
Multi Function I/O Processor (MFIOP) 114
Multiplexer 35, 74
Multiprotocol Network Program 346
Multiprotocol Network Program (MPNP) 189, 200, 321
multiprotocol transport networking 346
multistation access unit 346
MVS 278
MVS/ESA JES2 5.2.2 OpenEdition 317
MVS/ESA JES3 5.2.2 OpenEdition 317

N

NBBS 346
NCP V7R6 197, 198, 318
NDIS 346
NetBEUI 346
NetBEUI over SNA 227, 238
NetBIOS 231, 346
NetBIOS Extended User Interface 346
NetBIOS over IP Gateway 221
NetBIOS over SNA 221, 230, 241
NetBIOS over SNA Gateway 221
NetBIOS over TCP/IP 230
NetWare for AIX V3.11B 93
NetWare for SAA 134
Network Basic Input/Output System 346
network driver interface specification 346
Network Station 275, 276, 327
Network Station Manager 279
Networking BroadBand Services 346

NNI 297
nonswitched connection 346
nonvolatile storage 346
Nways Campus Manager ATM for AIX V1 324
Nways Campus Manager ATM for AIX V2 325
Nways Campus Manager ATM for HP-UX V2 325
Nways Campus Manager LAN for AIX V1 324
Nways Campus Manager LAN for AIX V2 325
Nways Campus Manager LAN for AIX V3 325
Nways Campus Manager LAN for HP-UX V2 325
Nways Campus Manager ReMon Advance for AIX V2 325
Nways Campus Manager ReMon Advanced for HP-UX V2 325
Nways Campus Manager ReMon for AIX V2 325
Nways Campus Manager ReMon for HP-UX V2 325
Nways Campus Manager Suite for AIX V3 325
Nways Campus Manager Suite for HP-UX V2 325
Nways Controller 950 189, 318
Nways Enterprise Manager 325
Nways Manager for Windows V2 325
Nways Multiprotocol Routing Network Services (MRNS) V1.3 45, 321, 324
Nways Network Manager Family 251
Nways RouteDirector Manager V3 for Windows 95 and Windows NT 326
Nways RouteMonitor Manager V3 for Windows 95 and Windows NT 326
Nways RouteSwitch Network Manager V3 326
Nways RouteTracker Manager V3 326
Nways Wide Area Element Manager for HP OpenView for SUN Solaris 325
Nways Wide Area Manager for HP OpenView 325
Nways Workgroup Manager 324
Nways Workgroup Remote Monitor (ReMon) 324

O

ODBC 132
Open System Adapter (OSA) 1, 3, 4, 5, 6, 8
OpenEdition 346
OS/2 278
OS/2 LAN Server for Macintosh V3.0 322
OS/2 LAN Server V4.0 322
OS/2 LAN Server/Advanced V3.0 16, 322
OS/2 LAN Server/Entry V3.0 322
OS/2 V2.1 322
OS/2 Warp Server Advanced V4.0 162, 322
OS/2 Warp Server V4.0 162, 322
OS/2 Warp V3 162, 322
OS/2 Warp V3 with WIN-OS2 162, 322
OS/390 278
OS/400 189, 221, 278
OS/400 V3.7 323
OS/400 V3R2 323
OS/400 V4.1 323
OSI Reference Model 36

P

packet switching 346
packet switching data network 346
PC Communications Adapters 168
permanent virtual channel (PVC) 346
permanent virtual circuit (PVC) 347
Personal Communications AS/400 and 3270 V4.1 for OS/2 162, 163, 189, 323
Personal Communications AS/400 and 3270 V4.1 for Windows 323
Personal Communications AS/400 and 3270 V4.1 for Windows 95 189, 323
Personal Communications AS/400 and 3270 V4.11 for DOS/Windows, Windows 95, Windows NT and OS/2 323
Personal Communications AS/400 for OS/2 Twinaxial Entry Level V4.1 323
Personal Communications AS/400 V4.1 for OS/2 162, 163, 323
Personal Communications AS/400 V4.1 for Windows 323
Personal Communications AS/400 V4.1 for Windows 95 323

Personal Communications AS/400 V4.11 for DOS/Windows, Windows 95, Windows NT and OS/2 323
Personal Communications AS/400 V4.11 for Windows, Windows 95, Windows NT and OS/2 323
Personal Communications Family 283
  Personal Communications Overview 283
Personal Communications product family 347
Personal Communications/3270 V4.0 for DOS/Windows 323
physical unit 347
Point-to-Point Protocol 347
POP 347
Post Office Protocol 347
PPP 347
proxy agent 347
proxy server 347
PSDN 346
PSTN 347
PU 347
public switched telephone network 347
PVC 346

Q

QoS 347
quality of service 347

R

Remote Token-Ring Bridge/DOS V1.0 320
Repeater 35, 67
REV.1 201
RFC 1490 208, 213
RISC System/6000 1, 3, 4, 5, 24
route bridge 347
routed format 213
router 347
Routers 43
RouteXpander LNM Support/2 320
RouteXpander Multiport Support/2 320
RouteXpander X.25 Support/2 320
RouteXpander/2 16, 19, 42, 53, 213
RouteXpander/2 (RXR/2) 217
RouteXpander/2 (RXR/2) V1.0.1 320
RouteXpander/2 (RXR/2) V2 42, 217, 218, 320
RouteXpaneder/2 (RXR/2) 269
Routing Information Protocol (RIP) 231

S

S/390 277
SDLC 348
Secure Sockets Layer 347
serial line Internet Protocol 347
Simple Network Management Protocol 348
Six Line Communications Controller (SLCC) 115
SLIP 347
SNA 348
SNA Application Access for AIX V1.2 321
SNA Client Access 79, 88
SNA Client Access for AIX V1.2 321
SNA Communications Program (SNA/Comm) V1.1 16, 206, 318
SNA Gateway 150
SNA over TCP/IP 221, 224, 227, 235, 242
SNA Server for AIX V 3.1 321
SNMP 348
socket 348
Sockets over IPX 221, 236
Sockets over NetBIOS 221, 235, 236
Sockets over SNA 221, 222, 228, 231, 241
Sockets over SNA Gateway 221, 228
socks server 348
Source route bridging 37, 40, 41, 42, 211, 348
Source route to transparent conversion bridging 37, 38, 41, 42
Source route transparent bridging 37, 38, 40, 42
SSL 347
super VLAN 348
SVC 348
switch 348
switched connection 348
switched line 348
switched virtual channel (SVC) 348
switched virtual circuit (SVC) 348
Switches 35, 57
Synchronous Data Link Control 348
Systems Network Architecture 348

T
T1 349
TCP/IP File Server Support/400 317
TCP/IP File Server Support/400 V3.1 317
TCP/IP File Server Support/400 V3.7 317
TCP/IP for MVS 181, 182, 184
TCP/IP for VM 182, 184
TCP/IP in AIX 182, 184
TCP/IP in OS/2 WARP 182, 184
TCP/IP in OS/400 182, 184
TCP/IP V 2.1.1 for DOS 317
TCP/IP V 2.4 for VM 317
TCP/IP V 3.2 for MVS 317
telecommunication line 348
TME 10 NetView 324
TN3270E 179
TN3270E Server 152, 228, 230, 349
Transparent bridging 37, 40, 41, 42
Tunnel bridging 37, 38
tunneling 349
Type 1 frame 349
Type 2 frame 349
type 2.0 node 349
type 2.1 node 349
type 4 node 349
type 5 node 349

U
UNI 297

V
VCC 349
virtual channel connection 349
VLAN 61
VM/ESA 278, 317
VM/MVS Bridge 144
VTAM 189, 221, 227
VTAM 4.2 for VM 317
VTAM 4.2 for VSE 317

W
WAN 349
Warp Connect V3 162, 322
Warp Connect with WIN-OS/2 V3 162, 322
Web Express 243, 246
wide area network 349
Windows NT 278

X
X.25 NCP Packet Switching Interface (NPSI) V3.8 318
X.25 Xpander/2 320

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