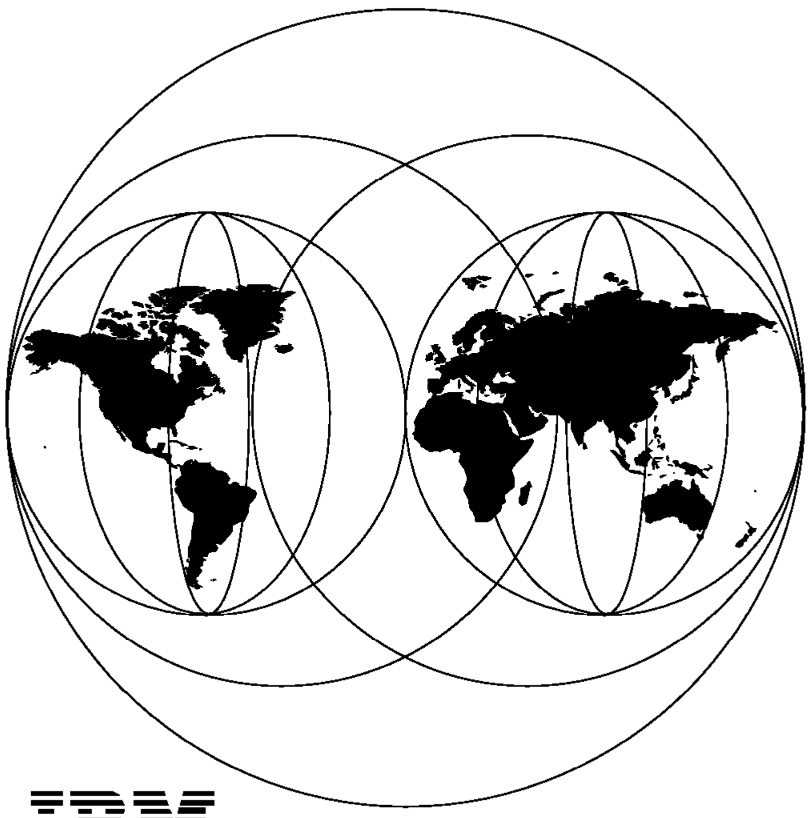
SG24-4754-00

Local Area Network Concepts and Products: Adapters, Hubs and ATM

May 1996



IBM

International Technical Support Organization
Raleigh Center

International Technical Support Organization

SG24-4754-00

Local Area Network Concepts and Products: Adapters, Hubs and ATM

May 1996

Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix E, “Special Notices” on page 291.

First Edition (May 1996)

This edition applies to the most recent IBM LAN products and LAN architectures.

Comments may be addressed to:
IBM Corporation, International Technical Support Organization
Dept. HZ8 Building 678
P.O. Box 12195
Research Triangle Park, NC 27709-2195

Contents

Preface

Local Area Network Concepts and Products is a set of four reference books for those looking for conceptual and product-specific information in the LAN environment. They provide a technical introduction to the various types of IBM local area network architectures and product capabilities. The four volumes are as follows:

- SG24-4753-00 - *LAN Architecture*
- SG24-4754-00 - *LAN Adapters, Hubs and ATM*
- SG24-4755-00 - *Routers and Gateways*
- SG24-4756-00 - *LAN Operating Systems and Management*

To obtain all four books, order the set SK2T-1306.

These redbooks complement the reference material available for the products discussed. Much of the information detailed in these books is available through current redbooks and IBM sales and reference manuals. It is therefore assumed that the reader will refer to these sources for more in-depth information if required.

These documents are intended for customers, IBM technical professionals, services specialists, marketing specialists, and marketing representatives working in networking and in particular the local area network environments. Details on installation and performance of particular products will not be included in these books, as this information is available from other sources.

Some knowledge of local area networks, as well as an awareness of the rapidly changing intelligent workstation environment, is assumed.

How This Redbook Is Organized

The redbook is organized as follows:

- Chapter 1, "LAN Adapters and Support"

  This chapter describes LAN adapters for PCs and other IBM equipment as well as LAN support programs and LAN driver information.

- Chapter 2, "Hubs"

  This chapter describes hubs and their functions in the LAN environment.

- Chapter 3, "Switches"

  This chapter describes switches and their functions in the LAN environment.

- Chapter 4, "Wireless"

  This chapter describes wireless technology and products avaliable in the LAN environment.

- Chapter 5, "ATM Products"

  This chapter describes ATM products and their functions in the LAN environment.

The Team That Wrote This Redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization Raleigh Center.

The advisors for this project were:

Ricardo Haragutchi
International Technical Support Organization, Raleigh

John Parker
International Technical Support Organization, Raleigh

The authors of this document were:

Edmilson Barbosa
IBM Brazil

Ingvar Hyleborg
IBM Sweden

Jefferson da Silva
IBM/GSI Brazil

Klaus Wichmann
ITSO Raleigh

Marcello Belloni Gomes
IBM Brazil

Thanks to the following people for their invaluable advice and guidance provided in the production of this document:

Toshi Shimizu
International Technical Support Organization, Austin

Aroldo Yai
Barry Nusbaum
Donna Fox
Fergus Stewart
Jose Boo
Juan Rodriguez
Mark DeCain
Mohammad Shabani
Robert Macgregor
Stephen Breese
Volkert Kreuk
International Technical Support Organization, Raleigh

Alan Millard
Arthur Bond
Bert Wendle
Carol Carson
Dean Stockwell
Erik Dixon
H. Parrish

Paul Carter
IBM Research Triangle Park, Raleigh NC.

Comments Welcome

We want our redbooks to be as helpful as possible. Should you have any comments about this or other redbooks, please send us a note at the following address:

redbook@vnet.ibm.com

Your comments are important to us!

Chapter 1. LAN Adapters and Support

This chapter discusses the most recently available LAN adapters for IBM devices and LAN support programs, including device driver information. Please consult the installation and planning manuals for each of these adapters for further information. IBM plans to supply drivers with each of its future LAN adapter packages.

1.1 OSI Reference Model and LAN Components

The OSI reference model chart, as shown in Figure 1 on page 2, relates the LAN product set to the seven-layer OSI reference model. The left column labeled OSI Model shows the seven-layer stack beginning at the application layer and moving down through the presentation, session, transport, network, data link, and finally the physical layer. From a product viewpoint (middle column), the LAN products are usually split into application programs, interfaces and protocols, and network support products. The right column gives examples of the products that fit each of these categories.

The following are examples of applications:

- Communications Manager (including 3270 and 5250 emulation)
- LAN Network Manager
- Station Manager
- LAN Server Requester
- Novell NetWare
- 3270 emulation
- 5250 emulation

Examples of protocols and interfaces are:

- Provided by LAN Support Program (LSP), a DOS product:
  - IEEE 802.2 (interface used by emulators, LAN Network Manager, etc.)
  - NetBIOS (the interface used by IBM LAN Server/Requester, PCLP, Microsoft LAN Manager/Requester, Lotus Notes, etc.)
- Provided by Network Transport/2 (NTS/2), an OS/2 product:
  - IEEE 802.2 (interface used by emulators, LAN Network Manager, etc.)
  - NetBIOS (interface used by LAN Server Requester, Microsoft LAN Manager, Lotus Notes, etc.)
- Communications Manager/2 APPN support
- TCP/IP support

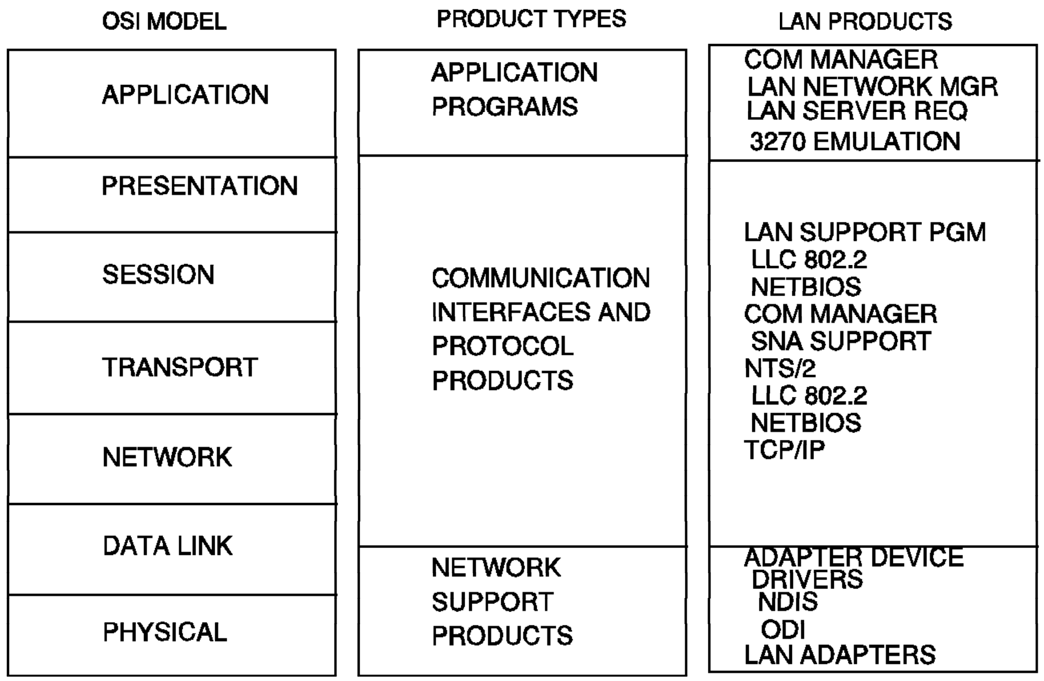


Figure 1. LAN Adapter Software Environment and the OSI Reference Model

From an architectural standpoint, IBM has produced two types of token-ring adapters. One is the shared RAM adapter and the other is the bus master or DMA adapter. The primary difference between these two architectures is the manner in which data is transferred between the adapter and system memory. See Appendix A, “Adapter Tables” on page 267 and Appendix B, “Microcode Level Tables” on page 273 for more information comparing functions and features of IBM token-ring LAN adapters.

1.2 Shared RAM Adapters

Shared RAM adapters derive their name from the fact that they carry on-board RAM and share that RAM with the system processor. The memory on the adapter card is mapped into an unused block of system memory above the 640 KB line in the upper memory area. The upper memory area is the 384 KB of memory immediately above the 640 KB line. The starting address of the shared RAM area is determined by the adapter device driver unless the adapter is a Micro Channel Adapter (MCA), in which case the address is determined by the setting of the reference diskette.

In size, shared RAM can be 8, 16, 32, or 64 KB depending on which adapter is used and how it is configured. Adapter cards with 64 KB support RAM paging which allows the system to view the 64 KB of memory on the card in four 16 KB pages. This scenario only requires 16 KB of contiguous system memory instead of the 64 KB required when not using RAM paging. RAM paging will not work unless the adapter's device driver supports it.

An example of a shared RAM adapter is the Shorty IBM Token-Ring 16/4/A which was announced on November 5, 1991. It is a 16-bit shared RAM adapter.

The shared RAM area itself contains various status and request blocks, service access points and link station control blocks, receive buffers, and transmit buffers. It is possible to alter the size and number of the transmit and receive buffers by altering parameters associated with adapter device drivers.

The primary advantages of the shared RAM architecture are the following:

- On-board logical link control (LLC)
- Low memory requirements for DOS environments
- Huge installed base of compatible applications and device drivers

The main disadvantage of the shared RAM architecture is that any data movement between the shared RAM area and other areas of system memory must be done under direct control of the system's CPU. This means that the CPU may be tied up doing the relatively menial task of moving data around within system memory when it could be doing something more useful such as performing a database transaction. This movement of data to and from the shared RAM area must be done because applications cannot operate on data while that data resides in the shared RAM area.

1.3 Bus Master/DMA Adapters

Bus master/DMA adapters utilize on-board DMA controllers to transfer data directly between the adapter and system memory without involving the system processor. The primary advantage of this architecture is that it frees up the system processor to perform other tasks, which is especially important in a server environment. Bus master/DMA adapters do not use the shared RAM mechanism to transfer data to system memory. However, bus master/DMA adapters do use shared ROM when they are performing the remote initial program load (RIPL) function.

The following are the primary advantages of the bus master/DMA adapter:

- The ability to transfer data directly to and from system memory without involving the system processor.
- High performance levels can be achieved in certain environments (OS/2 with LAPS or NTS/2 and Novell ODI), which cannot be obtained using the shared RAM architecture.

The following are the primary disadvantages of the bus master/DMA adapters:

- High system memory consumption: For example, in a DOS environment, the NDIS drivers for the 16/4 Adapter II may consume up to three times as much system memory as the drivers used for the shared RAM adapters. While memory is always a consideration, memory consumption is not so critical in the OS/2 environment. For this reason it makes more sense to use these adapters in the OS/2 environment and avoid the DOS environment unless you are not memory constrained. Remember that the bus master/A adapter is not supported in the DOS environment.

- Poor performance in certain DOS environments: In the DOS environment the 16/4 Adapter II and the LANStreamer Adapter are supported with NDIS and ODI drivers. Poor performance may be seen in the NDIS environment when using LAN Support Program′s DXME0MOD.SYS which is an 802.2 NDIS protocol driver. This driver must be used when running 802.2 applications such as PC/3270, AS/400 PC Support, DOS APPN, and TCP/IP V2.X for DOS when using the ASI (802.2) interface.
- No on-board logical link control (LLC): Since the adapter itself does not implement an LLC stack, one must be written into the NDIS MAC driver or protocol driver if one is needed. This means that additional system memory will be needed to implement the LLC stack. This is not much of a consideration in the OS/2 environment, but it may affect a memory constrained environment like that of DOS. Novell NetWare users will have to add a NetWare Loadable Module (NLM), LLC8022.NLM, for example, to add LLC support to the configurations of their server machines. The primary reason for doing so would be to enable the server adapter to be monitored as a critical resource from LAN Network Manager.
- Inability to address memory over 16 MB when bus master card only has twenty-four address lines: Bus master cards equipped with 24 address lines (such as the 16/4 Adapter II and the LANStreamer MC 16) cannot access memory over 16 MB. This means that if you have a machine with 24 MB of memory and a LAN application that resides in memory somewhere above the 16 MB line, problems could occur. If you have more than 16 MB of real memory in a machine, you should use an adapter with 32 address lines such as the LANStreamer MC 32. The really ironic thing about this is that a shared RAM adapter with only 24 address lines has no trouble getting to memory above the 16 MB line simply because the shared RAM adapter relies on the system processor to move the data to and from the card. The bus master cards perform this data transfer themselves and must have the ability to address all of the memory within the machine. It may be possible to write adapter device drivers which will overcome this problem.

1.4 Bus Architectures

This section covers the major PC bus architectures used in the market today. It is meant to give an overview of the differences in bus architectures.

1.4.1 Micro Channel Bus

The Micro Channel bus was first introduced by IBM in the PS/2 line of computers in 1987. SETUP cycles along with programmable option select (POS) were defined as part of the architecture in order to resolve adapter configuration resource conflicts. Micro Channel is an improvement over the preceding ISA standard in performance. Data bus width can be 16, 32 or 64- bits wide and bus cycles are 200 ns each, allowing for large channel bandwidth. The bus mastering architecture incorporates arbitration and fairness which means that a single adapter will not be able to take over the system, but must fairly surrender the channel to allow other adapters access. A special feature of the Micro Channel is streaming. While an adapter is a bus master, it can use the address lines as additional data lines to double the channel throughput.

1.4.2 ISA Bus

The industry standard architecture (ISA) bus is the original IBM PC/AT bus architecture. The main feature of the ISA bus is the 16 bits of data and 23 bits of address allowing the bus to address 16 MB of memory. Provisions are available for DMA and bus mastering, although bus speed is limited to 8 MHz. The advantage of ISA is that it has been around a while and therefore is available in 75% of the PCs manufactured today. The main disadvantages of this architecture, besides the slower bus speed, is the lack of provisions for automatically configuring adapters and resolving resource conflicts among adapters and the lack of bus master fairness and arbitration.

1.4.3 EISA Bus

The extended industry standard bus architecture (EISA) is a 32-bit superset of the ISA bus providing improved functionality and greater data rates while maintaining backward compatibility with the many ISA products already available. The main advancements of the EISA bus are 32-bit addressing and 16 or 32-bit data transfers for DMA and bus master devices. The EISA bus is synchronized by a 8.33 MHz bus clock and can achieve data transfer rates of up to 33 Mbps. A bus arbitration scheme is also provided which allows efficient sharing of multiple EISA bus devices. EISA systems can also automatically configure systems and adapters. The EISA specification is published by BCPR Services Inc.

1.4.4 PCI Bus

The peripheral component interconnect (PCI) bus is a new bus architecture for high performance throughput, originally introduced by Intel. The architecture is now controlled by an industry standards group. The bus has 32 or 64 bits of address and data, is processor independent and capable of speeds over 50 MHz. Eight and 16-bit devices are not supported. The 64-bit data bus width in combination with clock speeds over 50 Mhz can result in data transfer rates of several hundred megabytes per second, an order of magnitude faster than other PC bus architectures. In addition to memory space and I/O space, the bus includes a third address space, (or configuration space) to support automatic resource allocation and configuration of system and adapter boards.

Unique features of the PCI bus include parity on all bus lines and control lines. The parity is required, not optional as in other architectures. All PCI bus masters must support memory data streaming. Physical provisions in the connector keying accommodate both 5 volt and 3.3 volt chip technology. The processor independence has been underscored by public announcements from Apple announcing PCI for a future Macintosh, as well as IBM′s announcement to use PCI in the PowerPC and IBM PC families.

1.4.5 VL Bus (Local Bus)

The VESA VL bus is a local bus structure introduced by the Video Equipment Standards Association (VESA) in order to overcome the bottleneck caused by the 16-bit wide 8 MHz ISA bus. The VL bus is directly attached to the CPU, is 32 bits wide, and runs at processor speeds up to a maximum of 50 MHz. The architecture allows multiple bus masters. The VL bus is an extension of the ISA bus, but only supports a maximum of 3 VL bus slots. A single VL bus slot has normal ISA connectors as well as 112 additional pins located in the card slot to support the wider data path, wider address path and additional control signals for VL bus usage. This design allows either an ISA adapter or a VL adapter to be plugged into the slot. Like the ISA bus, the VL bus does not address the problem of device setup, configuration and resource allocation. This bus is used mostly for a fast video bus.

1.4.6 PCMCIA LAN Adapter

The PCMCIA (Personal Computer Memory Card International Association) is an organization of companies that are developing the personal computer card (PC card) standards. A PC card is a small form-factor package for personal computer use. Because of their shape and size, PC cards are often called *credit card adapters.* With the proliferation of notebook and hand-held computer systems, the search for smaller, lighter, and more portable tools for information is generating innovative developments in many aspects of the portable computer market. This includes displays, memory, and overall computer design and size. The credit card adapters are a key tool for adding memory, storage, and I/O capabilities to these portable systems.

The physical dimensions, electrical specifications, and communication protocols are arranged between three types. The first kind of credit card adapter is a Type I PC Card. Typically, this is used for various types of memory enhancements, including RAM, flash, one-time programmable (OTP), and electronically erasable programmable read-only memory (EEPROM). The second kind of credit card adapter is a Type II PC Card. It is used for I/O features (such as modem technology), LANs, serial communications, and parallel communications. The third type is the Type III card, which is used for PC hard drives. These adapters can be used with laptops, notebooks, palmtops, tablets, and other portable computer systems. The credit card adapters are a convenient alternative to pocket adapters and docking stations. The use of the credit card adapters merely requires that the portable hardware meets the PC card standards.

1.5 Token-Ring Adapters for the PC

This section covers the token-ring family of adapters from IBM. This will include Micro Channel, ISA, EISA, PCI and PCMCIA adapters.

1.5.1 IBM Auto 16/4 Token-Ring Adapters

auto 16/4 token-ring adapters are the following:

- IBM Auto 16/4 Token-Ring ISA Adapter(P/N 92G7632)
- IBM Auto 16/4 Token-Ring MCA Adapter(P/N 92G7682)

The IBM auto 16/4 token-ring adapters feature automatic ring-speed selection on the adapter using only 16 KB of the IBM auto 16/4 token-ring to determine and set the correct token-ring speed, 16 or 4 Mbps, without operator intervention. These adapters are also equipped with LED status indicators that allow you to determine both adapter and ring status without interrupting network operation. To further simplify setup, the auto 16/4 ISA adapter is enabled for plug and play, which allows the adapter configuration to be set automatically when installed in plug and play systems. For systems that are not plug and play enabled, the adapter comes with both a graphical, menu-driven software configurator called LANAID, and a command line software configuration utility called LANAIDC. And, the adapter is also NetWare@Ready, allowing you to be up and running as a NetWare requestor in minutes, with no switches to set or information to enter.

The auto 16/4 token-ring adapters provide enhanced workstation performance today and, because they are enabled for full-duplex operation, you can take greater advantage of your current investment. The full-duplex function provides you with the capability to work with token-ring full-duplex switches that will allow your departments to implement leading-edge, high-bandwidth applications like multimedia with no hardware upgrade required. What′s more, the adapter′s internal microcode in FLASH memory, not EPROM, can be upgraded for changes, if needed, or enhanced functions.

With your choice of cable whether you use unshielded twisted pair (UTP) or shielded twisted pair (STP), the auto 16/4 token-ring adapters install easily. The adapters automatically operate with either media type without operator intervention.

To maximize system resources the auto 16/4 token-ring adapters require even less conventional memory when used with IBM LAN client software. IBM LAN Client moves the device driver and protocol stacks into extended memory (over 1 MB). This reduces the amount of conventional memory required by the adapter, freeing this space for other requirements.

Implementing shared RAM on this adapter card enables you to reclaim client workstations′ processing power that other adapters use for communications management. The auto 16/4 token-ring adapters incorporate 64 KB of shared RAM that is mapped to an unused block of the workstation system′s upper memory. This is above the 640 KB that DOS can normally address.

1.5.2 IBM LANStreamer Adapters

The following text describes IBM′s LANStreamer adapter products as well as their features:

IBM Auto LANStreamer PCI Adapter - The IBM Auto LANStreamer PCI Adapter is ideally suited for both clients and servers. The high performance and low CPU utilization advantage of IBM′s LANStreamer technology is well known for servers and OS/2 workstations. Now, with IBM′s LAN client code, even memory constrained DOS and Windows workstations can realize these benefits.

IBM Auto LANStreamer MC 32 Adapter - The IBM Auto LANStreamer MC 32 Adapter is suited for servers and OS/2 or Windows 95 clients.

IBM Triple LANStreamer PCI Adapter - The IBM Triple LANStreamer PCI Adapter is ideal for servers with multiple LAN connections and limited open slots. The triple LANStreamer is a three-port PCI-bus adapter.

IBM Dual LANStreamer Adapter - The IBM Dual LANStreamer MC 32 Adapter is also ideal for servers with multiple LAN connections and limited open slots. The dual LANStreamer MC is a two-port MC-bus adapter.

1.5.2.1 LANStreamer Features

The LANStreamer adapters are based on the LANStreamer chip set, a token-ring implementation developed by IBM. This chip set provides unparalleled performance, approaching the theoretical maximum capabilities of 16 Mbps token-ring, as well as several important new features.

32-Bit Bus Master Interface: The LANStreamer adapters provide a 32-bit bus master interface to the Micro Channel supporting both 32-bit addressing and 32-bit data moves. LAN Streamer′s bus mastering capabilities free the system CPU from having to move data between the LAN adapter and system memory. LANStreamer handles this task, freeing the system CPU for other work and resulting in significantly lower system CPU utilization than shared RAM adapters such as Shorty.

With 32-bit addressing, the adapter is able to directly address 4 GB system memory. As the amount of data kept on servers has increased, the size of the file cache needed on the server has also increased. Today, servers often require more than the 16 megabytes of system memory which can be directly accessed by 16-bit bus master adapters (which have 24-bit addressing). LANStreamer 32′s 32-bit addressing allows it to support these servers as well as other applications which have hefty system memory requirements.

LANStreamer′s adapters are capable of moving data across the Micro Channel over four times as fast as competitive 16-bit bus master adapters. This high transfer rate is achieved through two improvements: the amount of data moved with each data transfer is doubled from 16 bits to 32 bits, and the streaming data mode available on many new PS/2s (including the PS/2 M95-0Mx) halves the time for each data transfer from 200 nanoseconds to 100 nanoseconds. The combination of these factors allows LANStreamer MC 32 to achieve peak burst transfer rates across the Micro Channel of 40 Mbps. LANStreamer′s high Micro Channel transfer rates allow it to minimize its utilization of the Micro Channel, leaving bus capacity for other adapters and applications.

The LANStreamer Micro Channel interface also supports parity checking for both data and address. This feature provides added robustness for mission critical applications.

Pipelined Frame Processing: LANStreamer achieves superior performance by changing the paradigm for how token-ring adapters transmit and receive frames. Traditional token-ring adapters all use variations of a store-and-forward architecture, where frames are moved into buffers in the adapter memory and processed by the adapter before being moved to their final destination. The processing that must be done includes managing the adapter′s interface with the device driver, handling hardware and software interrupts, managing adapter buffers, checking frame status, managing the protocol handler, and moving frames in or out of buffer memory. MAC (Media Access Control) frame processing is also performed by the adapter processor.

In contrast, LANStreamer uses a pipelined architecture. Frames are streamed directly between the token-ring and attaching system memory without being stored on the adapter and without any adapter processor intervention. Rather than first moving frames from system memory to the adapter, and then moving them from the adapter to the ring, LANStreamer simultaneously moves the frame from the system onto the adapter and out onto the ring. This new architecture is made possible by the implementation in VLSI of the functions previously done in software by the adapter processor. This dramatically improves performance, because the processing time required for each frame is the major bottleneck in the store-and-forward architecture.

To transmit a frame, the attaching system adds a control block to its transmit queue. The adapter bus master interface reads this control block into special hardware registers, and begins moving the frame from the system to the token-ring. There is a small FIFO (first-in-first-out) buffer on the adapter to guarantee that there is always data available to move onto the ring (in case the adapter loses the Micro Channel temporarily). Data is moved into this FIFO from system memory, and simultaneously moved from the FIFO onto the token-ring.

The process for receiving frames is similar. The adapter hardware sorts out MAC frames and they are processed on the adapter by the adapter processor. This processing does not affect the throughput performance of user information frames, which are passed directly to the system with no processor intervention.

The net result of the pipelined approach is that the adapter is never the bottleneck for throughput. If the system can handle it, LANStreamer can transfer or receive frames at 16 Mbps, even at small frame sizes. This means LANStreamer is capable of up to 48,000 frames per second throughput. By comparison, the bus master adapter has a throughput capacity approaching 3,000 frames per second. In a server such as the IBM PS/2 Model 95-0MF or 0MT, with a fast 50 MHz 80486 processor, a high bandwidth Micro Channel bus, and a LANStreamer token-ring adapter, each critical server component is optimized to provide high LAN I/O throughput capacity.

Another result of the pipelined architecture is the minimization of adapter latency. Adapter transmit latency is defined as the interval from when the adapter is informed of a frame to transmit to when the first bit of the frame is placed on the ring. Adapter receive latency is defined as the interval from when the last bit of the frame is copied from the ring into the adapter to when the last bit of the frame is in system memory and the system is informed of the frame.

Since there is no time spent on processing, and the frame is moved out of the adapter at the same time as it is moved in, LANStreamer adapter latency approaches the theoretical minimum possible. In a traditional adapter, the latency due to adapter processing is compounded by the storing of the frame in adapter memory. This makes the adapter latency increase as frame size increases (since it takes longer to move the whole frame in and out of adapter memory). In contrast, LANStreamer latency is essentially constant (less than 30 microseconds), regardless of frame size. By comparison, the latency to just store and forward a 4096-byte frame onto a 16 Mbps ring, without considering any processor overhead, is 2048 microseconds.

Multiple Group Addressing: Group addressing is part of the token-ring architecture, but today's token-ring adapters only implement one group address, which is not very useful for most applications. By implementing multiple group addressing, LANStreamer offers complete hardware support for multicasting. Multicasting can be thought of as a limited broadcast. Rather than sending a frame to either a single destination station or broadcasting it to every station on the network, multicasting allows a user to send frames to a limited group of destinations. Stations may assign themselves to a particular group by setting one of the 256 hardware group addresses available on LANStreamer. These 256 addresses allow each LANStreamer station to belong to up to 256 groups, but there can be more than 256 groups on a network.

Examples of applications which would use multiple group addressing include protocols and applications where large amounts of data are distributed to users. For example, TCP/IP uses ARP (Address Resolution Protocol) frames for discovering routes. Rather than burdening every station with receiving and discarding these frames, group addresses could be utilized/ so that only stations using the TCP/IP protocol used these frames. Another example might be a stock market application. Brokers might want to belong to groups which received information on specific stocks of interest, rather than receiving everything and having to sort through it. A third example is software distribution. Users owning a specific application would have an associated group address. Updates to that application could be automatically sent to the group.

Current token-ring adapters do have a solution for the above scenarios. Today′s implementation can be described as follows: frames are sent to every station on the network using broadcast. Each station′s CPU sorts each frame using the functional address, and discards frames not intended for it. There are obvious disadvantages to this approach. Each station′s CPU must sort every broadcast frame (whether it is intended for the local station or not) tying it up for significant amounts of time. In one case, where TCP/IP was being used on the network, users reported that even stations that did not use TCP/IP were spending 40%-50% of their CPU cycles decoding ARP frames.

Multiple group addressing has significant advantages over today′s implementation. Frames are sorted in hardware by the adapter, so the station only sees frames that are meant for it. Functional addresses are token-ring only, while group addressing is designed in all major LAN topologies and is the multimedia standard. It is important to note that token-ring adapters without group addressing can coexist on the ring with LANStreamer adapters using the multiple group addressing feature; the current adapters won′t be able to take advantage of this feature.

Priority Mechanisms: The LANStreamer chip set provides two mechanisms for prioritizing frames passing through the token-ring adapter. These are priority queueing in the adapter, and priority tokens on the ring. LANStreamer implements two prioritized transmit queues. High priority frames can be placed on the higher priority queue to be processed ahead of lower priority frames. The LANStreamer adapter will reserve priority tokens on the ring for these high priority frames.

The ability to prioritize traffic is valuable for applications which have high bandwidth requirements or need to minimize response time. In today′s token-ring adapters, frames are handled on a first-come first-served basis. A high priority frame must wait in line behind lower priority frames before being transmitted. Applications such as multimedia will benefit from LANStreamer′s priority mechanisms by being able to both guarantee bandwidth on the ring through priority token reservation, and minimize delays by using the priority queue.

Both these priority mechanisms transparently coexist with current token-ring implementations. The priority token is part of the token-ring architecture, and is already used in certain applications such as bridging. With LANStreamer, IBM has provided a mechanism, in conjunction with the priority queue, for making priority token reservation available to user applications. The priority queue is a system interface implementation that does not affect token-ring operation.

For more information on how these priority mechanisms can benefit multimedia applications, refer to *Multimedia Applications on IBM Token-Ring LANs* in the April, 1993 issue of Personal Systems Technical Solutions.

On-Card STP and UTP Support: The LANStreamer adapters include on-card filters for both STP and UTP media. The UTP support is tested to meet the standards of the IBM/Synoptics partnership. For EMEA countries, the

LANStreamer UTP solution meets CISPR and IOP requirements with the addition of an inexpensive UTP cable, P/N 60G0659.

Other Features: LANStreamer MC 32 includes RIPL support for both LAN Server (all levels) and NetWare (V3.X and beyond). LANStreamer provides full network management support, and is fully compatible with LAN Network Manager. The LANStreamer MC 32 adapter is available for the 3172 Interconnect Controller.

1.5.3 IBM Token-Ring PCMCIA Adapters

The IBM Token-Ring 16/4 Credit Card Adapter is a credit-card-sized adapter that provides an interface between computer systems and token-ring networks. The credit card adapter is designed to operate in computer systems with card slots that comply with the standards of Personal Computer Memory Card International Association (PCMCIA) Release 2.0, Type II slots.

Compliance with the Institute of Electrical and Electronics Engineers (IEEE) 802.5 standards allows the credit card adapter to be managed with network management tools such as the IBM Local Area Network (LAN) Support Program. The credit card adapter uses the following computer system software programs and PCMCIA services to operate:

- **Required System Software**
  - IBM or Microsoft DOS Version 5.0 (or higher)
  - IBM OS/2 Version 2.1 (with Card Services 2.0)
  - IBM or Novell token-ring network operating system software
- **Supported PCMCIA Environments**
  - PCMCIA Card Services Version 2.0
  - IBM-provided connectivity enablers for DOS (provided with the credit card adapter)

The IBM-provided connectivity enablers are used if the computer system does not support card services. The installation program determines the operating environment and, if required, prompts the selection of appropriate enabler software.

1.5.3.1 Features

- User productivity is enhanced by providing an easy-to-use, high-speed local area network (LAN) attachment to portable systems via a PCMCIA slot.
- The high-speed data transfer capability provided by the token-ring credit card adapter allows applications requiring this type of data transfer to be run on a portable system as well as on desktop or floor-standing systems.
- The addition of the token-ring credit card adapter to a portable computer system joins together and increases the value of two assets in which customers have already invested, local area networking and portable systems.
- The LAN attachment capability brings the same data transfer capability to portable computing that has been available to desktop and floor-standing systems in the past. This removes the high-speed data transfer inhibitor to running the same applications on portable systems.
- Adherence to IEEE 802.5 standards allow the adapter to be managed with IBM′s network management tools.

Compatibility: The token-ring credit card adapter is compatible with other IBM token-ring adapters operating at the same speed (16 Mbps or 4 Mbps). The cable furnished with the adapter provides attachment to the existing workstation cabling. The operation of the token-ring credit card adapter and standard-size IBM token-ring adapters in the same machine is not supported. Remote initial program load (RIPL) is not supported. A maximum of two token-ring credit card adapters may be active simultaneously.

1.5.4 Token-Ring Adapters Summary

The token-ring adapter table, is used to display the different types of token-ring adapters that are available. The chart gives the adapter name, the form and part number along with information of the bus type, memory and location of the the 802.2 LLC support. If the 802.2 support is in the host, this means that the code is executed on the PC processor and is normally supplied by a software package such as LAN Support Program (LSP) or Network Transport Systems/2 (NTS/2). If the 802.2 support is executed on the adapter, the adapter is generally termed to be a deep adapter. If the 802.2 is executed in the host engine, the adapter is termed a shallow adapter.

Table 1. Token-Ring Adapters Summary

Adapter Name	**Bus Type**	**Data Path**	**Memory**	**802.2 Support**
IBM Auto 16/4 Token-Ring ISA Adapter	ISA	Shared RAM	64 KB	On Card
IBM Auto 16/4 Token-Ring MCA Adapter	MCA	Shared RAM	64 KB	On Card
IBM Auto LANStreamer PCI Adapter	PCI	BUS MASTER	Shallow	In Host
IBM Auto LANStreamer MC 32 Adapter	MCA	BUS MASTER	Shallow	In Host
IBM Triple LANStreamer PCI Adapter	PCI	BUS MASTER	Shallow	In Host
IBM Dual LANStreamer MC 32 Adapter	MCA	BUS MASTER	Shallow	In Host
IBM Token-Ring 16/4 Credit Card Adapter	PCMCIA	Shared RAM	64 KB	On Card

1.6 Ethernet Adapters for the PC

This section covers the Ethernet family of adapters from IBM. This will include Micro Channel, ISA, PCI and PCMCIA adapters.

1.6.1 IBM MCA Ethernet Adapters

The following are the two Ethernet adapters for the Micro Channel PS/2 and IBM Industrial computer:

IBM Dual EtherStreamer MC 32 Adapter- The IBM Dual EtherStreamer MC 32 Adapter is a 32-bit bus master adapter for server systems and clients where high performance is required. The EtherStreamer Adapter provides 40 Mbps data streaming and supports full-duplex operations, which provides 200/20 Mbps Ethernet capabilities. The adapter supports transparent or source-route bridging and can detect and configure itself to the media type installed. Microcode upgrades are handled through flash EPROMS and provides 10Base-T attachment for two LAN segments, minimizing the number of PC slots and adapters required in the server. Device driver support includes NetWare 3.X and 4.X server drivers and DOS, OS/2 ODI/NDIS drivers, Novell DOS ODI Client and DOS Transport Modules.

IBM LAN Adapter/A for Ethernet- The IBM LAN Adapter/A for Ethernet is a client adapter which can be installed in either 16-bit or 32-bit slots and provides media connectors for 10Base-T, as well as 10Base2 and AUI (10Base5 and fiber). Supports the same devices drives as the IBM Dual EtherStreamer MC 32 Adapter.

1.6.2 IBM ISA Ethernet Adapters

There are three IBM ISA Ethernet Adapters that operate in ISA-based machines, using either 8-bit or 16-bit slots. These include the following:

IBM LAN Adapter for TP - For 10Base-T twisted-pair networks.

IBM LAN Adapter for CX - For 10Base2 thin-coaxial networks.

IBM LAN Adapter for Ethernet - Provides connections to 10Base-T, 10Base2, Attachment Unit Interface (AUI) thick coaxial or fiber media.

All IBM ISA Ethernet adapters are NE2000 compatible and work in either 8-bit or 16-bit slots. When adapters are NE2000 compatible, NetWare users from IBM or Novell can download the adapter device drivers directly from the NetWire main menu on CompuServ.

IBM 100/10 ISA Ethernet Adapter - The IBM 100/10 ISA Ethernet Adapter can operate at speeds of 100 or 10 Mbps in Industry Standard Architeture(ISA) bus computers. This adapter can operate in full-duplex mode at either speed providing up to 200 Mbps of bandwith. The IBM 100/10 ISA Ethernet Adapter follows the fast Ethernet specification for 100 Mbps operation as is being defined by the IEEE 802.3 standards committee. It features full-duplex operation and is enable for plug and play (PnP) hardware installation. Device drives are included for many of today′s leading operating systems, including IBM OS/2 LAN Server, Novell NetWare, Microsoft Windows NT and Windows 95. In addition, the adapter offers a single RJ-45 connector for attachment to 10Base-T and 100Base-TX networks.

The IBM 100/10 ISA Ethernet Adapter is an ISA adapter with 16-bit data bus attachment and is certified as FCC Class A and CISPR222-A. It provides support for symmetrical multiprocessors (SMP) and for all personal computers with ISA slots.

When operating in full-duplex mode, the computer, in which the IBM 100/10 ISA Ethernet Adapter is installed, will have to be directly connected to a switch, such as the IBM 8271 Nways Switch with the 100Base-TX Universal Feature card. It will also operate in FDX mode at 10 Mbps when connected to an FDX-enabled port on a switch such as the IBM 8271 Nways Switch.

IBM 100/10 ISA Ethernet Adapter is supported by a lifetime warranty and IBM′s PC Company HelpCenter, which offers 24 hours a day/7 days a week support.

1.6.3 IBM ISA Etherjet Adapters

IBM Etherjet ISA Adapter - The 16-bit IBM Etherjet ISA Adapter and IBM Etherjet 10Base-T ISA Adapter can operate at 10 million Mbps in Industry Standard Architecture (ISA) bus computers. Both adapters are identical in function, differing only in the types of Ethernet media supported. The IBM Etherjet 10Base-T ISA Adapter contains a single connector for attachment to 10Base-T networks, while the IBM Ethejet ISA Adapter contains connectors for 10Base-T, 10Base2 and AUI (10Base5 or fiber) networks.

The IBM Etherjet ISA Adapter and IBM Etherjet 10Base-T ISA Adapter follow IEEE 802.3 standards and are operate in 16-bit bus slots. Both adapters feature full-duplex operation and easy installation through IBM′s LANAID applications. They are plug and play enabled, and a remote initial program load (RIPL) option is available. In addition, support is provided for IBM′s LAN client. Device drivers are included for many of today′s leading operating systems, including IBM OS/2 LAN Server, Novell NetWare, Microsoft Windows NT and Windows 95.

The 16-bit IBM Etherjet ISA Adapter and IBM Etherjet 10Base-T ISA Adapter provide support for symmetrical multiprocessors (SMP) and all personal computers with ISA slots in addition to EISA, Micro Channel (MCA), and PCI slots.

The 16-bit IBM Etherjet ISA Adapter and IBM Etherjet 10Base-T ISA Adapter are supported by a lifetime warranty and IBM′s PC Company HelpCenter, which offers 24 hours a day/7 days a week support. Both adapters are certified FCC Class B.

1.6.4 IBM PCI Ethernet Adapters

The following IBM PCI Ethernet adapters are suitable for high-performance servers, clients and gateways:

- IBM PCI Ethernet Adapter
- IBM 100/10 PCI Ethernet Adapters

IBM PCI Ethernet Adapter - The PCI Ethernet Adapter is a high-performance Ethernet LAN adapter that operates in peripheral component interconnect (PCI) bus computers. It is a 32-bit bus master adapter that supports operation at 10 Mbps over unshielded twisted pair (UTP) or attachment unit interface (AUI) media. It is recommended for use in server or client applications, and comes with an attractive client price. The PCI Ethernet Adapter can be easily installed by using IBM′s LANAID application (available September 1995), and is plug and play-enabled. Device drivers are included for many of today′s leading operating systems, including OS/2 LAN Server, NetWare, Windows+ NT and Windows 95. The PCI Ethernet Adapter provides support for symmetrical multiprocessors (SMP) and all personal computers with PCI slots in addition to EISA, ISA, or Micro Channel slots.

The IBM PCI Ethernet Adapter meets FCC Class A criteria when configured with cabling that meets IBM specifications, and operates on all PCI bus computers that comply with PCI specifications. The IBM PCI Ethernet Adapter operates with the following operating systems and network environments:

- IBM or MS DOS 3.3, 4.0, and 5.0; MS DOS 6.0; IBM PC DOS 6.1, and later
  - IBM LAN Support Program 1.33, and later

- DOS NDIS device drivers, included on the diskette packaged with the IBM PCI Ethernet Adapter
- DOS transport modules for DOS 802.2 and NetBIOS applications

- IBM OS/2 Standard Edition (OS/2 SE) 1.30, IBM OS/2 Extended Edition (OS/2 EE) 1.30.2, IBM OS/2 2.0, and later, or IBM OS/2 Warp 3.0
  - IBM OS/2 Extended Services 1.0
  - IBM OS/2 LAN Server 3.0 and 4.0
  - IBM OS/2 Communications Manager/2
  - OS/2 and DOS NDIS device drivers, included on the diskette packaged with the IBM PCI Ethernet Adapter.

Note: The use of Communications Manager/2 on a LAN requires the LAN Adapter and Protocol Support (LAPS) function. Communications Manager/2 1.1 includes IBM Network Transport Services/2 (NTS/2), which provides the LAPS function. Communications Manager/2 1.0 does not include NTS/2 and does not provide the LAPS function, but can utilize the LAPS component provided with one of several other products, including the LAN Requester of the IBM LAN Server 2.0, the LAPS component shipped with the IBM LAN Server 3.0, and the Extended Services for OS/2 product. If one of these products is not installed on the workstation, the LAPS function can be acquired by installing the IBM NTS/2 product.

- Novell NetWare 3.1X and 4.X
- NetWare from IBM 3.1X and 4.X
- Novell NetWare and open data link interface (ODI) device drivers, included on the diskette packaged with the IBM PCI Ethernet Adapter.

IBM 100/10 PCI Ethernet Adapter - The IBM 100/10 PCI Ethernet Adapter can operate at speeds of either 100 or 10 million Mbps in peripheral component interconnect (PCI) bus computers. The IBM 100/10 PCI Ethernet Adapter can operate at speeds of 100 or 10 Mbps in industry standard architecture (ISA) bus computers. This adapter can operate in full-duplex mode at either speed, providing up to 200 Mbps of bandwidth.

The IBM 100/10 PCI Ethernet Adapter follows the fast Ethernet specification for 100 Mbps operation as is being defined by the IEEE 802.3 standards committee. It features full-duplex operation and is enabled for plug and play (PnP) hardware installation. Device drivers are included for many of today′s leading operating systems, including IBM OS/2 LAN Server, Novell NetWare, Microsoft Windows NT and Windows 95. In addition, the adapter offers a single RJ-45 connector for attachment to 10Base-T and 100Base-TX networks.

The IBM 100/10 PCI Ethernet Adapter is a PCI bus master adapter with 32-bit data bus attachment and is certified as FCC Class B and CISPR222-B. It provides support for symmetrical multiprocessors (SMP) and all personal computers with PCI slots in addition to EISA, ISA, or Micro Channel (MCA) slots.

When operating in full duplex mode the computer, in which the IBM 100/10 PCI Ethernet Adapter is installed, will have to be directly connected to a switch, such as the IBM 8271 NWAYS Switch with the 100Base-TX Universal Feature Card. See *8271 Switch Model 108 Planning and Installation Guide,* GA27-4984 for additional details on this switch.

The IBM 100/10 PCI Ethernet Adapter is supported by a lifetime warranty and IBM′s PC Company HelpCenter, which offers 24 hours a day, 7 days a week support.

1.6.5 IBM Ethernet Quad-BT/B2 PeerMaster Server Adapters

IBM Ethernet Quad PeerMaster Server Adapters are available in two versions. The Quad-BT PeerMaster is equipped with four ports with RJ-45 connectors for attaching four independent 10Base-T network segments via unshielded twisted-pair (UTP) cabling of Category 3 or better. The Quad-B2 PeerMaster provides four ports with BNC connectors for attaching four independent 10Base2 network segments through thin coaxial-shielded twisted-pair (STP) media. On both adapters, the LAN segments can support any number of nodes. For maximum flexibility with your existing wiring schemes, you can mix and match any combination of Quad-BT or Quad-B2 adapters, up to the maximum of six per server, and interconnect LANs on both media types through the adapter′s card-to-card switching capabilities.

The adapters have support for the following Networking Operating Systems: IBM OS/2 LAN Server and Novell NetWare.

1.6.6 IBM PCMCIA Ethernet Adapters

The IBM Credit Card Adapter for Ethernet is available in the following two versions:

- 10Base-T support
- 10Base2 support

The IBM Credit Card Adapter for Ethernet provides an interface between computer systems and Ethernet networks. The credit card adapter is designed to operate in computer systems having Personal Computer Memory Card International Association (PCMCIA) Release 2.0, Type II slots. The credit card adapter complies with PCMCIA and the Institute of Electrical and Electronics Engineers (IEEE) 802.3 standards.

The Ethernet credit card adapter enables portable system users to fully participate in all LAN features such as device sharing (plotters, printers, etc.), data and software retrieval from a server and, beyond that, access to a corporate database. This enables applications previously reserved for desktop or floor-standing systems to be candidates for running on a portable system. The pervasiveness of local area networks in enterprises provides the connectivity source required. The media choices available, are shielded twisted pair (STP) and unshielded twisted pair (UTP), which provide the adaptability for attachment to the media present at that location. The adherence to standards allows its use in systems supporting the PCMCIA Standard Type II for communication over local area networks conforming to the IEEE 802.3/Ethernet V2.0 Standard. The combination of high-speed data transfer capability, ease of use, and ease of attachment to a high-speed data source provide the user with functionality previously available only to desktop or floor-standing systems.

The credit card adapter uses the following computer system software programs and PCMCIA services to operate:

- **Required System Software:**

- IBM or Microsoft DOS Version 5.0 (or higher) or IBM OS/2 Version 2.1 (with Card Services 2.0)
- Ethernet network operating system software

• **Supported PCMCIA environments:**

- PCMCIA Card Services Version 2.0
- IBM-provided connectivity enablers for DOS (provided with the credit card adapter)

The IBM-provided connectivity enablers are used if the computer system does not support card services. The installation program determines the operating environment and, if required, prompts the selection of appropriate enabler software.

1.6.7 Ethernet Adapters Summary

The Ethernet adapter summary table, is used to display the different types of Ethernet adapters that are available. The chart gives the adapter name, the form and part number along with information of the bus type, memory and location of the 802.2 LLC support. For all the IBM Ethernet cards the 802.2 LLC code is executed on the PC processor and is normally supplied by a software package such as LAN Support Program (LSP) or Network Transport Systems/2 (NTS/2). Therefore, all Ethernet adapters are shallow adapters.

Table 2. Ethernet Adapters Summary

Adapter Name	Bus Type	Data Path	Memory	802.2 Support
IBM Dual EtherStreamer MC 32 Adapter	MCA	Bus master	Shallow	In Host
IBM LAN Adapter/A for Ethernet	MCA	Shared RAM	Shallow	In Host
IBM Etherjet ISA Adapter	ISA	Shared RAM	Shallow	In Host
IBM Etherjet 10Base-T ISA Adapter	ISA	Shared RAM	Shallow	In Host
IBM PCI Ethernet Adapter	PCI	Bus master	Shallow	In Host
IBM 100/10 PCI Ethernet Adapter	PCI	Bus master	Shallow	In Host
IBM 10Base-T Credit Card Adapter for Ethernet	PCMCIA	Shared RAM	Shallow	In Host
IBM 10Base2 Credit Card Adapter for Ethernet	PCMCIA	Shared RAM	Shallow	In Host

1.6.8 IBM TURBOWAYS ATM Adapters

IBM TURBOWAYS 155 ATM MC Adapter - The new TURBOWAYS 155 ATM MC Adapter is recommended initially for Micro Channel bus servers, clients operating in a LAN backbone structure that includes an OS/2 or NetWare server and the 8260 with a bridge module and AIX 3.2.5 servers and clients running IP-only traffic. Up to two TURBOWAYS 155 adapters can be installed in a single RS/6000 system.

IBM TURBOWAYS 100 ATM MC Adapter - The TURBOWAYS 100 ATM MC Adapter can operate in a LAN backbone structure that includes an OS/2 or NetWare server and an 8260 with a bridge module. It also supports AIX 3.2.5

servers and clients. A maximum of two TURBOWAYS 100 Adapters can be installed in a RS/6000 system.

IBM TURBOWAYS 25 ATM ISA And 25 ATM MCA Adapters - IBM′s TURBOWAYS 25 ATM Adapters provide a 25 Mbps full-duplex connection to the ATM network using low-cost cable for distances up to 100 meters. The TURBOWAYS 25 connects to the ATM network via the 8282 ATM Workgroup Concentrator or to an ATM switch that supports the 25 Mbps interface.

IBM TURBOWAYS 155 ATM SBus Adapters - The TURBOWAYS 155 ATM SBus UTP5 Adapter and TURBOWAYS 155 ATM SBus Multimode Fiber (MMF) Adapter are 155 Mbps speed adapters offering ATM connectivity for Sun workstations running Solaris and Sun OS.

IBM TURBOWAYS 25 ATM SBus Adapters - The TURBOWAYS 25 ATM SBus Adapter is a 25 Mbps speed client adapter providing ATM connectivity for Sun workstations. Operating system support includes Solaris and Sun OS.

These adapters offer the following benefits:

- A specialized chip that handles ATM segmentation and reassembly resulting in high throughput
- Configuration, installation and diagnostics for Sun OS or Solaris(155 ATM adapters) and OS/2(25 ATM adapters)
- An SNMP sub-agent for TCP/IP Network Management compatibility
- Support for ATM Forum UNI Specification V3.0 for switched virtual circuits 1 (SVC), permanent virtual circuits (PVC), and AAL-5 adaptation layer interface
- Enablement of the TCP/IP protocol
- Scalable options for bandwidth with 155, 100, 25 Mbps speeds in a variety of Bus types and operating systems
- Interoperability - IBM′s TURBOWAYS adapters are designed and tested to interoperate with ATM networks built on other vendors′ equipment
- Signalling channel setup
- Virtual connection setup and tear down
- Bandwidth allocation and management
- Capability of transmitting and receiving data on virtual connections

1.7 IBM FDDI Adapters for the PC

There are three adapters available for workstations based on MCA, ISA and EISA standards. These adapters are available for both dual-attach and single-attach stations. Both fiber and STP cabling are supported. The adapters are based on the ANSI X3T9.5 and ISO 9314 standards for FDDI workstation adapters.

The IBM FDDI MC Adapters are 16/32-bit bus master adapters designed for the PS/2 family of products and for non-IBM workstations implementing MC architecture.

The IBM FDDI ISA Adapters are 16-bit bus adapters designed for entry level PS/2 products implementing the Personal Computer AT bus, PS ValuePoint workstations and industry compatible personal computers that implement ISA.

The following are the supported workstations:

- The IBM PS/2, Industrial Computers, and non-IBM workstations implementing the Micro Channel architecture
- The IBM PS/2, PS/ValuePoint, Industrial Computers, and industry compatible personal computers implementing the ISA bus
- Non-IBM workstations implementing the EISA bus

These new IBM FDDI Adapters are replacing the current IBM FDDI Workstation Adapters (IBM FDDI Fiber Base and Extender Family). Support under new operating systems with corresponding device drivers is also offered. In addition a new range of IBM workstations are supported by the new adapters. The IBM FDDI Adapters are shipped at the latest level of FDDI Station Management Standard (SMT 7.3). The IBM 8240 FDDI Concentrator, and the FDDI SNMP Proxy Agent used to perform the network management, are also upgraded to the same SMT 7.3 level of the FDDI standard. The following is a list of the new FDDI adapters:

- IBM FDDI Fiber Base MC Adapter
- IBM FDDI Copper Base MC Adapter
- IBM FDDI Fiber Base EISA Adapter
- IBM FDDI Copper Base EISA Adapter
- IBM FDDI Fiber Base ISA Adapter
- IBM FDDI Copper Base ISA Adapter
- IBM FDDI Fiber Extender MC Adapter
- IBM FDDI Copper Extender MC Adapter
- IBM FDDI Fiber Extender EISA/ISA Adapter
- IBM FDDI Copper Extender EISA/ISA Adapter
- IBM FDDI UTP-5 MC Adapter
- IBM FDDI UTP-5 EISA Adapter
- IBM FDDI UTP-5 ISA Adapter

IBM FDDI MC ADAPTERS - These adapters should be used for IBM Personal System/2 systems (for server and client environments), particularly in OS/2 LAN Server and NetWare server environments, and for IBM Industrial Computers complying with the Micro Channel architecture. The 32-bit bus master interface, coupled with high frame throughput capacity and low latency, enables the adapters to achieve significant performance increases. The new adapter total throughput capacity is up to twice that of the older IBM FDDI Workstation Adapters (P/N 93F0345/0346/0347/0348, features 0345/6/7/8) in a NetWare 3.11 environment using industry standard benchmarks.

IBM FDDI ISA ADAPTERS - These adapters should be used for Personal System/ValuePoint systems, PS/2 systems, the IBM 7537 Industrial Computers, and non-IBM systems that implement ISA, particularly in DOS and NetWare client environments.

IBM FDDI EISA ADAPTERS - These adapters should be used for non-IBM workstations implementing the EISA bus. These new standards-based, ANSI X3T9.5 and ISO 9314 workstation adapters provide:

- An easy migration of networks from Ethernet and token-ring to FDDI as business needs require
- An IBM FDDI solution for all the user′s workstations

IBM FDDI UTP-5 Adapters - The IBM FDDI UTP-5 adapters are based on ANSI X3T9.5 and ISO 9314 standards and support unshielded twisted-pair category Type 5 (U in the UTP-5 (EIA/TIA TSB 36 and TSB 40) and FTP (EIA/TIA 568)) standards, the distance between FDDI stations is limited to 100 meters in this case.

The adapters work in machines with MC, ISA or EISA bus architectures, and they support all the software environments and perform the same functions as previous IBM FDDI adapters. The IBM FDDI UTP-5 MC Adapter is a 16/32-bit bus master adapter designed for the PS/2 family of system units and for OEM workstations implementing the Micro Channel architecture. The EISA adapter is a 32-bit bus adapter designed for those industry personal computers that implement the extended industry standard architecture bus. The ISA adapter is a 16-bit bus adapter for the low end of the PS/2 family of products (those system units having an AT bus), PS/Value Point, and compatible personal computers that implement the industry standard architecture bus. The adapters provide only the single access station (SAS) type of connection to an FDDI network; dual access station (DAS) is not supported.

Multimedia over FDDI is possible with these adapters using FDDI synchronous frame transmission and bandwidth allocation. The FDDI multimedia support is packaged with the the network driver interface specification (NDIS) OS/2 device driver on MC, ISA and EISA systems because the NDIS OS/2 device driver is synchronous enabled. The FDDI synchronous frame transmission function has characteristics that satisfy many multimedia applications. It is based on the Synchronous Forum Implementer′s Agreement. The IBM FDDI UTP-5 adapters support this synchronous frame transmission function.

Two synchronous upgrades are provided. The first, (endstation support) deals with the FDDI node′s ability to prioritize synchronous traffic over normal asynchronous traffic. Because the traffic priority is performed on the transmit path, synchronous support is suited for servers with time critical applications. The prioritization is designated based on the setting of the 802.5 Priority thus compatible with the IBM LAN Server Multimedia product. The synchronous endstation support includes an interaction with a synchronous bandwidth allocator (SBA) for the purpose of getting permission to transmit high-priority traffic. The second upgrade includes the SBA. This SBA application when enabled by the user will manage the pool of synchronous bandwidth.

The SBA protocol supports the following functions:

- Managing the allocation of the limited synchronous bandwidth resource
- Monitoring the amount of synchronous bandwidth allocated for use
- Monitoring the ring for over-allocation of synchronous bandwidth
- Monitoring for and recover from ring instability due to over-allocation of the total bandwidth

Operating system support through device drivers has been extended to include the latest levels of DOS and OS/2, Microsoft Windows NT, Novell NetWare 3.12 and 4.0 releases and SFT III levels, Santa Cruz Operation (SCO) UNIX V2.1, and Interactive UNIX. UNIX V2.1. device driver coverage now includes Windows NT NDIS 3.0 and Novell NetWare 4.0 ODI. The Software Fault Tolerance (SFT III) device driver provides a unique MC solution for high-availability IPX networks. This support is in addition to the current device drivers for NDIS on DOS and OS/2, ODI on DOS, OS/2 and NetWare, and UNIX SCO. Each of the adapters supports Remote IPL in NetWare environments.

IBM and non-IBM workstations with Micro Channel, ISA, and EISA bus architectures are supported.

- PS/2 models and industrial computers with Micro Channel architecture are supported. Original equipment manufacturer (OEM) workstations implementing the Micro Channel architecture are also supported. The IBM FDDI MC adapters comply with the September 1991 level of the Micro Channel architecture document.
- IBM AT bus PS/2 models and Industrial Computers and competitive workstations implementing the ISA bus are supported. The IBM FDDI ISA Adapters comply with the July 1991 level of the Personal System/2 Hardware Interface Technical Reference AT-Bus Systems (Model 35 and Model 40). The IBM FDDI ISA adapters also comply with the IEEE Personal Computer Bus Standard P996 for ISA 16-bit bus systems.
- Competitive workstations implementing the EISA bus are also supported.

The IBM FDDI EISA adapters comply with Version 3.12 of the EISA specification. The FDDI SNMP (Simple Network Management Protocol) proxy agent (an OS/2 application used to convert SMT to SNMP protocols for use by AIX NetView/6000 or any OEM SNMP-based network management system) is upgraded in order to support workstations at SMT 6.2 and 7.3 levels on the same FDDI ring. The Remote Program Update (RPU) function, which is used to upgrade the IBM 8240 FDDI Concentrator microcode from a PS/2 workstation, is available with the proxy agent. The IBM 8240 FDDI Concentrator is upgraded to the current level (SMT 7.3) of the FDDI standard of station management. The IBM FDDI adapters also provide access to a wide range of new applications for which FDDI performance is critical, such as multimedia, computer-aided design (CAD), simulations, modeling, and graphics. The new IBM FDDI MC adapters and IBM FDDI ISA adapters are available to attach PS/2, PS/ValuePoint, or other Micro Channel and ISA compatible workstations to FDDI networks through optical fiber and copper cabling. The IBM FDDI EISA adapters are also available to attach non-IBM EISA workstations to FDDI networks, allowing most workstations to access applications requiring the performance of FDDI networks.

Multiple group address (MGA) provides a simplified means to update a group of information (for example, time of day, stock quotes) or locate control entities (for example, network management, bridges, servers). This function is treated as a broadcast function, but only those stations recognizing this configured address will receive and process the data. Up to 16 group addresses can be configured. The IBM FDDI MC adapters provide both data and addressing support for 16/32 bits of information to be passed across the bus, thus providing greater throughput as well as addressing capabilities for the growing environments requiring addressing above the 16 MB range. This plus the 32 Mbps streaming data capability make the IBM FDDI MC adapters ideal for high-end workstations and servers.

The IBM FDDI adapters are delivered with the following device drivers:

- DOS NDIS (see note) 2.02 device driver
- OS/2 NDIS 2.02 device driver
- DOS ODI (see note) workstation device driver
- OS/2 ODI workstation device driver
- Novell NetWare/386 ODI server device driver
- Windows NT device driver

The following device drivers are two common types of industry device drivers that are offered for use with network adapters:

- Network driver interface specification (NDIS), jointly authored by 3Com and Microsoft Corporations
  - For DOS and OS/2 operating systems
  - Based on NDIS Version 2.01
  - IEEE 802.5 type Media Access Control (MAC) drivers that allow existing NDIS applications to operate on FDDI as they do on token-ring
- Open data link interface (ODI) from Novell
  - Available for the NetWare operating systems as well as the DOS and OS/2 operating systems

The *IBM Cabling System Optical Fiber Planning and Installation Guide*, GA27-3943 describes how to plan for and install optical fiber cabling for use with IBM products.

1.7.1 IBM Wireless LAN Adapters

IBM InfraRed LAN Adapter - IBM Infrared Wireless LAN adapters give you everything you′d get with a conventional network adapter except the hassle and expense of wiring. They give you a number of benefits over wired networks, thanks to versatility and functions that include:

- Quick and easy installation. Capability to create instant, ad hoc networks for new or temporary work groups with no need for in-wall cabling controllers and network support/administration.
- Non-line-of-sight infrared wireless communication.
- Complete coverage in most rooms up to 30 x 30 feet with no special placement of transceivers needed (17 x 17 when using the PCMCIA with integrated transceiver).
- Compatibility with IBM PC DOS, MS-DOS, and Microsoft Windows. Ability to connect systems via infrared links to wired networks through access points.
- Ethernet bridging access point software that provides a mechanism to access resources on a wired LAN.
- Ethernet roaming software that allows users to retain their LAN connection as they move between access points.
- Device drivers furnished with the adapters that support the most widely used network operating systems.

IBM PCMCIA II RF Adapter (Wireless LAN Entry) - The IBM PCMCIA II RF adapter meet the PCMCIA Type II Standard and allow a cell diameter of up to

1200 feet with data rates of up to 350 Kbps. The adapter operates in the frequency band of 2.4 GHz using spread spectrum frequency hopping (SSFH), which provides excellent interference protection.

IBM Wireless ISA/MCA and PCMCIA II RF Adapters (Wireless LAN) - The IBM Wireless RF adapters for ISA/Micro Channel and PCMCIA II machines, allow a cell diameter of up to 1600 feet with data rates of up to 2.2 Mbps. These adapters also operate in the frequency band of 2.4 GHz using SSFH for interference protection.

All the adapters support many major Network Operating Systems, including IBM LANServer, Novell NetWare, Novell Personal NetWare, Microsoft Windows for Workgroups, Microsoft LAN Manager, Windows NT and Artisoft LANtastic.

1.8 LAN Support Programs and Adapter Interfaces

This section covers the NDIS and ODI adapter interfaces. It will also cover the major LAN support programs available from IBM.

1.8.1 NDIS Interface

The NDIS is a de facto standard interface used in the LAN industry for adapter driver and protocol stack development. The current NDIS specification is Version 2.01 (NDIS 3.0 for Windows NT). Figure 2 on page 24 details the NDIS specification which was jointly developed by 3Com and Microsoft. It defines a configuration and binding process that is handled by a module called the Protocol Manager. The NDIS MAC driver, that is normally developed by the LAN adapter vendor, provides the communication between the adapter and the host resident protocol stack. This MAC driver handles packet transmission and reception to/from the LAN. The NDIS protocol stack provides the communication between the application and the NDIS MAC driver. The actual NDIS interface is the interface between the NDIS MAC driver and the NDIS protocol stack. The Protocol Manager helps manage the flow of data across the NDIS interface and reads configuration information and initialization information. IBM typically develops NDIS DOS and OS/2 drivers for each LAN adapter it markets.

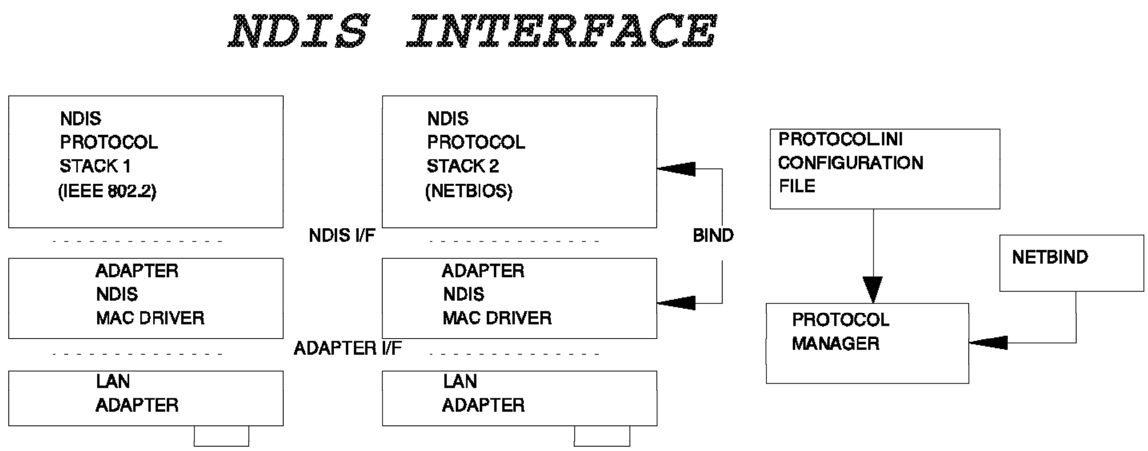


Figure 2. NDIS Specification

1.8.2 Open Data Link Interface (ODI)

The Open Data Link Interface is an interface that Novell has defined for the NetWare environment for adapter driver and protocol stack development. The current ODI specification is Version 4, which is based on the NetWare 4.0 product. Figure 3 on page 25 details the ODI structure. ODI actually has three major parts: the Protocol Stacks, the Link Support Layer, and the Multiple Link Interface Driver (MAC driver). Novell publishes a LAN driver developer′s toolkit that helps with the development of ODI MAC drivers. A separate toolkit is available for development of ODI protocols. The MAC driver is broken up into the following three portions:

- Media Support Module (MSM) to provide general driver functions.
- Topology Support Module (TSM) to provide specific frame type support. A different TSM is used for token-ring, Ethernet, FDDI, and AppleTalk.
- Hardware Support Module (HSM) to provide the device driver support code that supports the specific adapter interface.

ODI actually has multiple interfaces (MPI, MLI, and the internal interfaces of the MLID). IBM typically develops ODI DOS, ODI OS/2 and ODI NetWare drivers for each LAN adapter it markets.

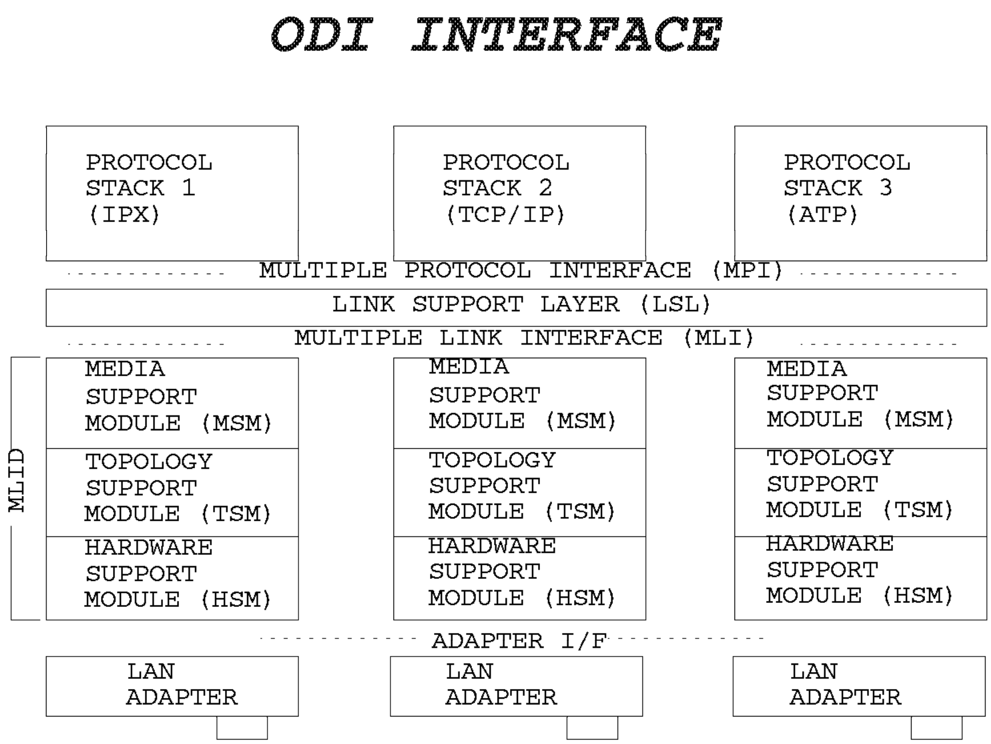


Figure 3. ODI Specification

1.8.3 Operating System and Driver Environments

The IBM set of LAN adapters functions in a variety of environments. Figure 4 on page 27 explains the most common environments in which the adapters are used.

The diagram shows the following three DOS environments:

- **Native Shared RAM Adapter Support:** This support is for the shared RAM token-ring adapters that have the LLC 802.2 protocol support resident on the adapter. The adapter handler code, which is currently shipped with LAN Support Program (DXMC0MOD.SYS), provides the 802.2 interface for the applications. This interface is in the Command Control Block structure as defined in the *LAN Technical Reference*, SC30-3383-3. For DOS, examples of applications are NetBIOS (DXMT0MOD.SYS) that LSP provides, 3270 emulation, and AS/400 PC Support (5250 emulation).
- **NDIS Support:** NDIS support is used for shallow adapter environments with all adapter types except for the PC Network, which is not supported in a DOS NDIS environment. The appropriate NDIS MAC drivers support various NDIS protocol stacks. An example of an NDIS protocol stack is the IEEE 802.2 support provided by LSP (DXME0MOD.SYS). This protocol also provides a CCB interface as did the DXMC0MOD.SYS module in the shared RAM environment.

- **Novell ODI Requester:** For the DOS Novell requester environment, the ODI MAC driver supports the ODI protocol (IPXODI.COM) along with the LSL module that is not shown in the picture. The IPX protocol provides support for the NetWare requester code in the DOS workstation.

The OS/2 environment shows the following two configurations:

- **NDIS Support:** The OS/2 NDIS support is similar to the DOS NDIS with the exception that the module names are different and the OS/2 environment provides a ring 3 and ring 0 interface for the protocol stacks.
- **ODI Support:** This also is very similar to the DOS structure, but once again the modules are different for this OS, and are loaded as entries in the CONFIG.SYS file.

NetWare Support: The support for Novell NetWare requires a separate ODI device driver. For NetWare 4.0, the HSM portion of the driver is loaded at the server as a separate module. For NetWare 3.11 servers, the HSM is linked with the MSM and TSM.

AIX Support: The support for AIX is shipped with the AIX product and not with the specific adapter. The drivers to support the LAN adapters are actually part of the AIX kernel. Only a subset of the Micro Channel LAN adapters sold by IBM are supported by the RS/6000 product.

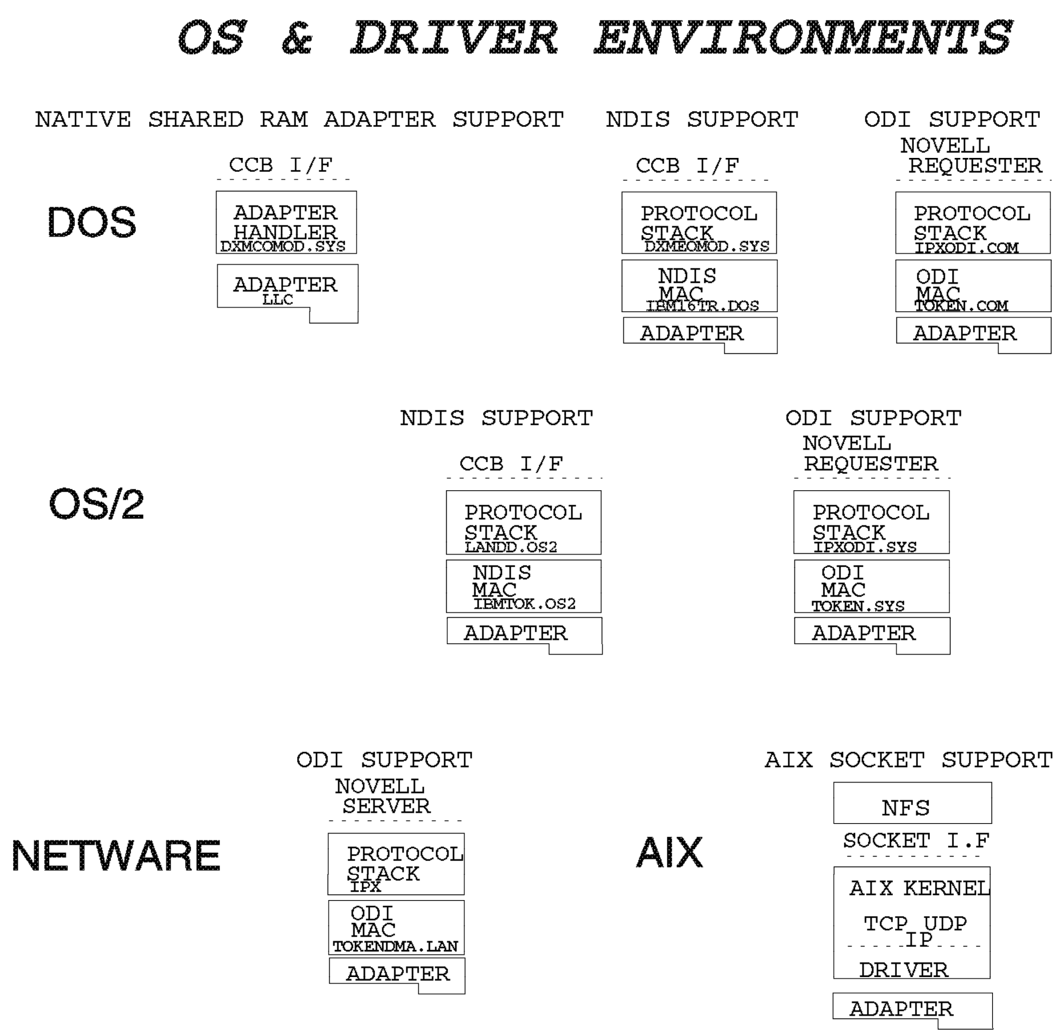


Figure 4. OS and Driver Environments with Module Name Examples

1.8.4 OS/2 Transport

The OS/2 Transport for IBM software support is an NDIS environment with no *native* support provided. The following are example applications for the OS/2 environment:

- LAN Network Manager
- 3270 and 5250 emulation (part of Communications Manager)
- SNA and 802.2 applications
- OS/2 LAN Server and other NetBIOS applications
- TCP/IP applications

Figure 5 on page 28, shows the OS/2 transport. The dotted area at the top isolates the portion of Communications Manager that provides LAN support. The emulator code uses the SNA support to make requests to the network. The SNA requests are translated to IEEE 802.2 requests via the LAN DLC module. The LAN DLC module uses the 802.2 Device Driver Interface (DDI) which in turn interfaces through NDIS to the appropriate LAN adapter. As the chart shows there is both a ring 0 and a ring 3 interface for both 802.2 and NetBIOS. Ring 0 is a low level device driver interface and ring 3 is a higher level application interface. The ring 0 interface is more complicated to program to, but provides a higher performing interface.

The current TCP/IP product set provides both TCP/IP support through 802.2 and also TCP/IP support directly through the NDIS interface. The bottom dotted area outlines the transport code that is being shipped with the Network Transport System/2 (NTS/2) product.

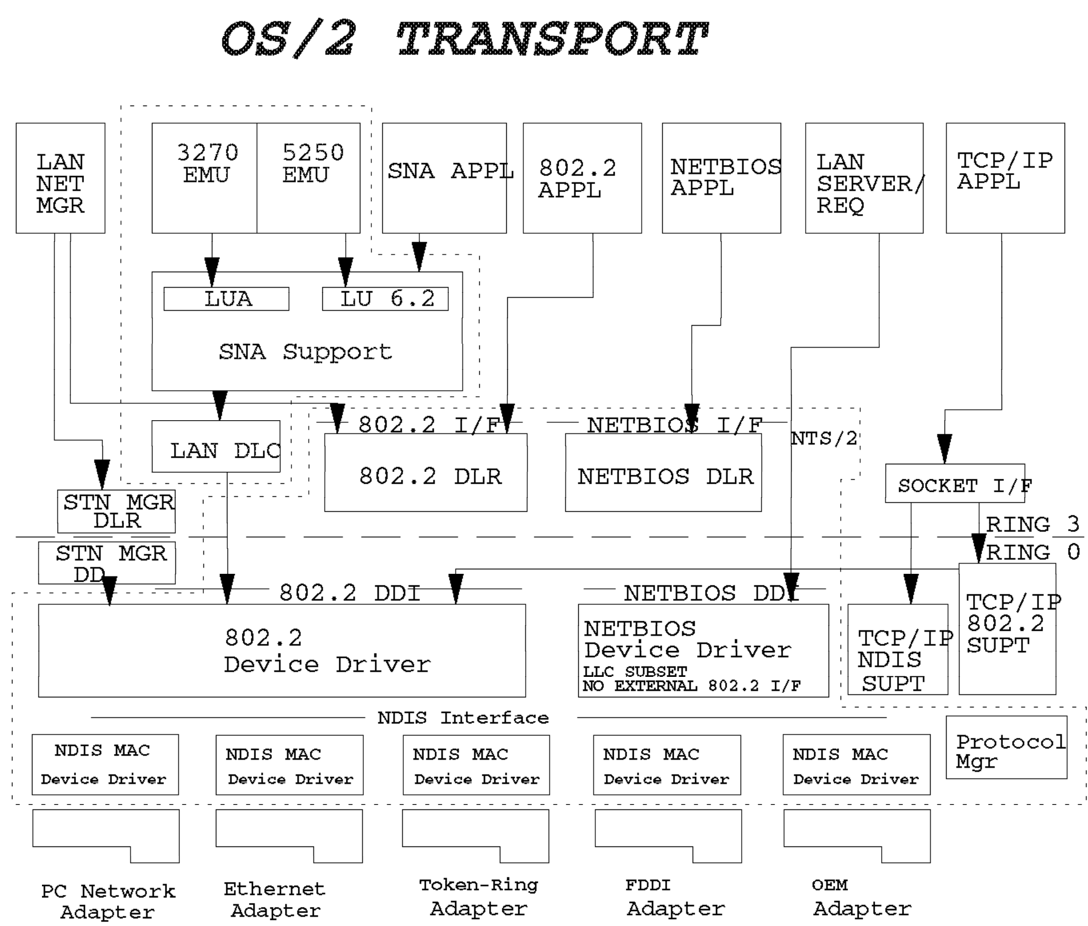


Figure 5. OS/2 Transport for IBM LAN Adapters

1.8.5 IBM Network Transport Services/2 (NTS/2)

IBM Network Transport Services/2 (NTS/2) provides programming interfaces (NetBIOS, IEEE 802.2, and Network Driver Interface Specification (NDIS)) necessary for OS/2 2.0 LAN enablement in customer environments where the OS/2 LAN Server is not required. NTS/2 provides the transport protocols and network adapter software to run network applications.

Integrated with NTS/2 is the LAN Configuration Installation Distribution Utility which supplies file system redirection and code server setup for OS/2 2.0-based products.

Through the NDIS interface, NTS/2 allows the Novell NetWare Requester for OS/2 to share network adapters with other network applications.

Using NTS/2, DOS applications written to the NetBIOS and IEEE 802.2 interfaces on OS/2 2.0 are supported. This virtual local area network (LAN) support enables these DOS applications to share an adapter with other DOS and OS/2 applications running on the same machine.

1.8.5.1 Features

- Provides LAN enablement for NetBIOS and IEEE 802.2 APIs.
- Provides NDIS compliant LAN Adapter and Protocol Support (LAPS).
- Enables Novell NetWare Requester adapter sharing.
- Provides OS/2 2.0 virtual NetBIOS and virtual IEEE 802.2 API support for DOS applications.
- Provides OS/2 2.0 LAN Configuration Installation Distribution Utility (CID).

1.8.5.2 Overview

IBM Network Transport Services/2 (NTS/2) provides LAN Adapter and Protocol Support (LAPS), which is a suite of network communication software. NTS/2 is a combination of the following:

1. Network Driver Interface Specification (NDIS) compliant transport protocol and network adapter software
2. Novell NetWare requester enablement for OS/2
3. OS/2 2.0 DOS support for NetBIOS and IEEE 802.2 APIs
4. Configuration, installation, and distribution (CID) enabling software

Note: The LAPS function was released earlier this year in the LAN Enabler/2 V2.0 product.

A suite of NDIS network adapter software is shipped with NTS/2 including a series of NDIS network adapter software that has been certified by an independent IBM certified test organization.

When available, new NDIS network adapter software from both IBM and qualified OEM vendors may be downloaded from the IBM National Support Center Bulletin Board System.

NTS/2 enables Novell NetWare Requester for OS/2 to share a single network adapter with NDIS-based network applications, for example IBM OS/2 TCP/IP, IBM OS/2 LAN Requester, and IBM OS/2 Extended Services 1.0. An example of how these applications share the adapter would be to use a single Ethernet adapter to concurrently access both a Novell NetWare V3.11 server and an IBM

LAN Server V3.0 server. This ability reduces the network hardware and network management costs.

In addition to the OS/2 API support, NTS/2 provides the OS/2 2.0 virtual LAN support for the IEEE 802.2 and NetBIOS APIs. This will enable DOS NetBIOS and IEEE 802.2 applications running in the OS/2 2.0 DOS environment to share an adapter with other DOS and OS/2 NetBIOS applications running on the same machine.

Integrated with NTS/2 is LAN Configuration Installation Distribution (CID) Utility which enables the LAN Adapter and Protocol Support (LAPS) installation diskette images to be installed and configured at a client workstation from a code server and supports the installation of other OS/2 CID enabled products. Please see Chapter 2 of *Local Area Network Concepts and Products: Routers and Gateways,* SG24-4755 for more information.

1.8.5.3 LAN Adapter and Protocol Support (LAPS)

The NTS/2 LAPS component supplies the LAN transport (network communication) software for OS/2 environments. It is comprised of the following:

- NDIS-compliant protocol drivers
- NDIS-compliant network adapter drivers
- Novell NetWare requester support
- OS/2 and DOS support for LAPS APIs (NetBIOS and IEEE 802.2)
- CID-enabled installation and configuration program

IBM Network Transport Services/2 offers additional performance improvements and enhanced network services over previous LAPS products. It was packaged with the Extended Services/2 and IBM LAN Server V2.0 products. It later became available separately with the LAN Enabler Version 2.0 product and is now a major component of the NTS/2 product.

The LAPS component of NTS/2 is CID enabled and therefore may itself be installed from a redirected drive. In addition, it also supports the use of a response file to drive its installation and configuration.

The Novell NetWare Requester support provided by LAPS enables Novell Open Data Link Interface (ODI) protocol stacks to share NDIS compliant network adapters with NDIS compliant protocols.

A suite of NDIS network adapter drivers is shipped with NTS/2. New NDIS network drivers from both IBM and qualified OEM vendors are made available by downloading from the IBM National Support Center Bulletin Board System, which is available to the public.

Also included is a series of NDIS network adapter drivers that have been certified by an independent IBM certified test organization.

- NTS/2 supports the appropriately configured hardware platforms supported by OS/2 Version 2.0. In addition to supporting appropriately configured IBM hardware and IBM operating system platforms, NTS/2 also supports selected OEM equivalent hardware that has passed the OS/2 2.0 compatibility test. The approved platforms are listed in numerous forums and publications such as Prodigy, CompuServ and OS/2 forums.

1.8.5.4 NTS/2 LAN VDD Support for OS/2

The Network Transport System/2 product provides support so that DOS LAN applications can execute in the Virtual DOS Machine of OS/2 and utilize the OS/2 transport for the actual communication. Figure 6 on page 32, shows the Multiple Virtual DOS Machines and the Protected Mode of OS/2. A Virtual Device Driver (VDD) is provided for both IEEE 802.2 and NetBIOS. The VDD will provide a link to the appropriate Physical Device Driver (PDD) in the ring 0 support of the OS/2 Protected Mode. The PDD modules use the ring 0 interfaces of the NetBIOS and 802.2 Interfaces. Note that this VDD support is provided for both the Virtual DOS Machine (VDM) and Virtual Machine Boot (VMBOOT) mechanisms of OS/2.

The NTS/2 package also contains a VDD that will support applications using the 2A interrupt interface of the DOS LAN Requester. This VDD will redirect the request to the OS/2 LAN Requester so that the DOS application requests will be handled by the OS/2 requester code.

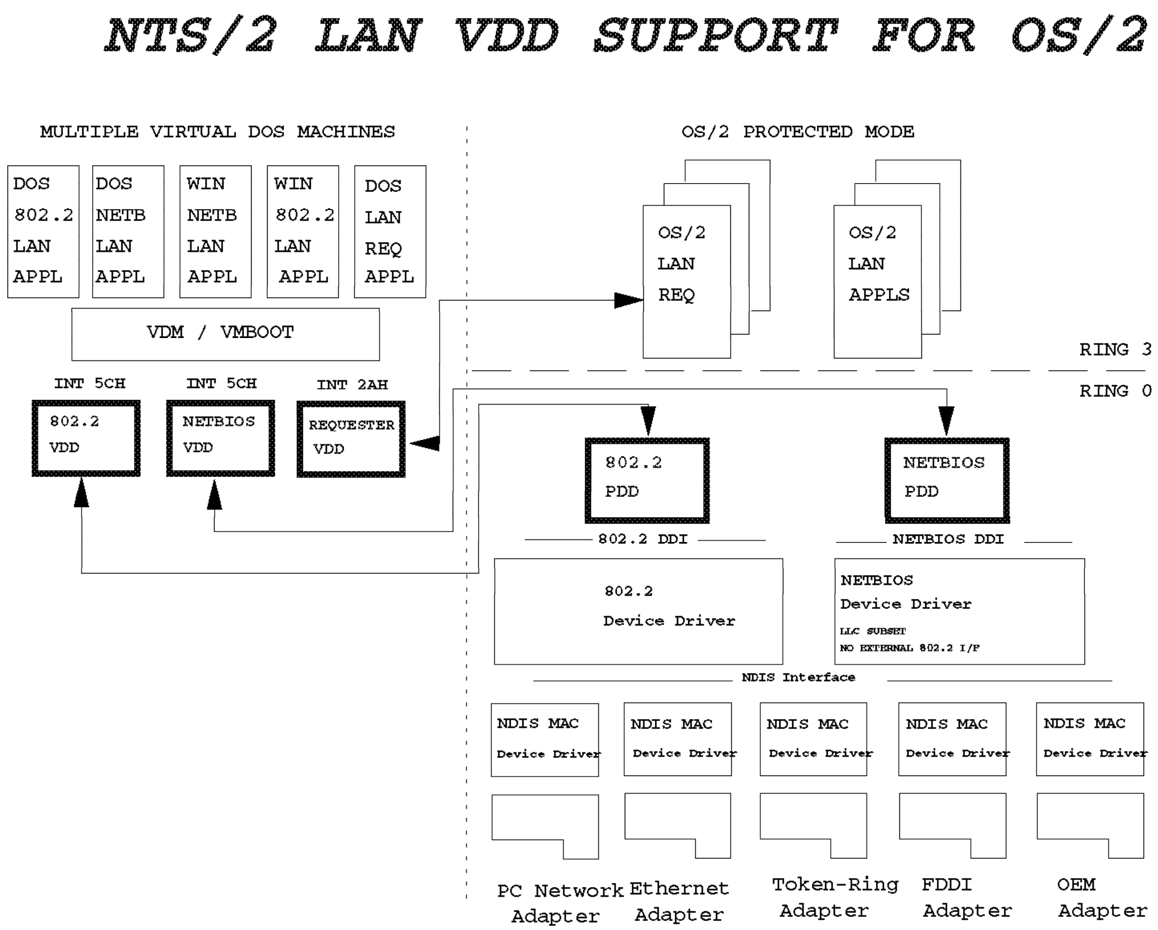


Figure 6. OS/2 NTS/2 Support for DOS LAN Applications

1.8.6 DOS Transport

The DOS transport is the DOS-based code that provides the LAN communication across the particular LAN type. As shown in Figure 7 on page 34, the DOS transport has many pieces. Application examples are shown at the top of the chart. The LAN Support Program is shown inside the dashed line. TCP/IP is shown to the right and the adapters and various NDIS MAC drivers are also shown. Novell environments are not shown in this chart.

The LAN Support Program has a number of different modules with the configuration aid assisting the user in setting up the CONFIG.SYS, AUTOEXEC.BAT, and PROTOCOL.INI of the DOS workstation. Note the notation in the bottom right corner of each LSP module box. This notation directly relates to the actual module name that is shipped with LSP. For example, A0 notes the

DXMA0MOD.SYS module. The following are three different LSP configuration option examples:

- **Native Token-Ring Shared RAM Adapter Support:** The configurator will always configure the Interrupt Arbitrator Module (DXMA0MOD.SYS) for all LSP configurations. This module is used to arbitrate the 5C interrupt issued by applications for the use of the CCB interface (for IEEE 802.2 services) or for the use of the NCB interface (for NetBIOS services). The arbitration is the management of the control given to different software in the machine that uses the 5C interrupt. For the native support the C0 module is configured. It provides the CCB interface that is used to access the IEEE 802.2 support that resides in the adapter microcode. The user is given a choice to load the NetBIOS support (T0 module). In most LSP cases this module does get loaded.
- **Shallow Adapter Support:** The shallow adapter support is similar for token-ring, Ethernet, FDDI and OEM adapters. It is an NDIS environment with the A0 module once again being configured. The E0 module is then loaded and this provides the CCB interface for the IEEE 802.2 code and also the IEEE 802.2 code support itself. Once again the NetBIOS support (T0 module) is optional. The particular NDIS MAC driver is not shipped with LSP but should be supplied with the LAN adapter.
- **High Performance NetBIOS:** If the user requires only the NetBIOS interface (that is, does not have IEEE 802.2 applications) an option is given during the LSP install to just install the A0 module and the J0 module. This configuration is only supported in the NDIS environment but it does provide a higher performing NetBIOS support than the A0, E0, and T0 configuration. Note that the J0 module does not provide an IEEE 802.2 interface for applications to use.

The DOS TCP/IP support also provides a DOS transport for the IBM LAN adapters. This support uses the NDIS Interface.

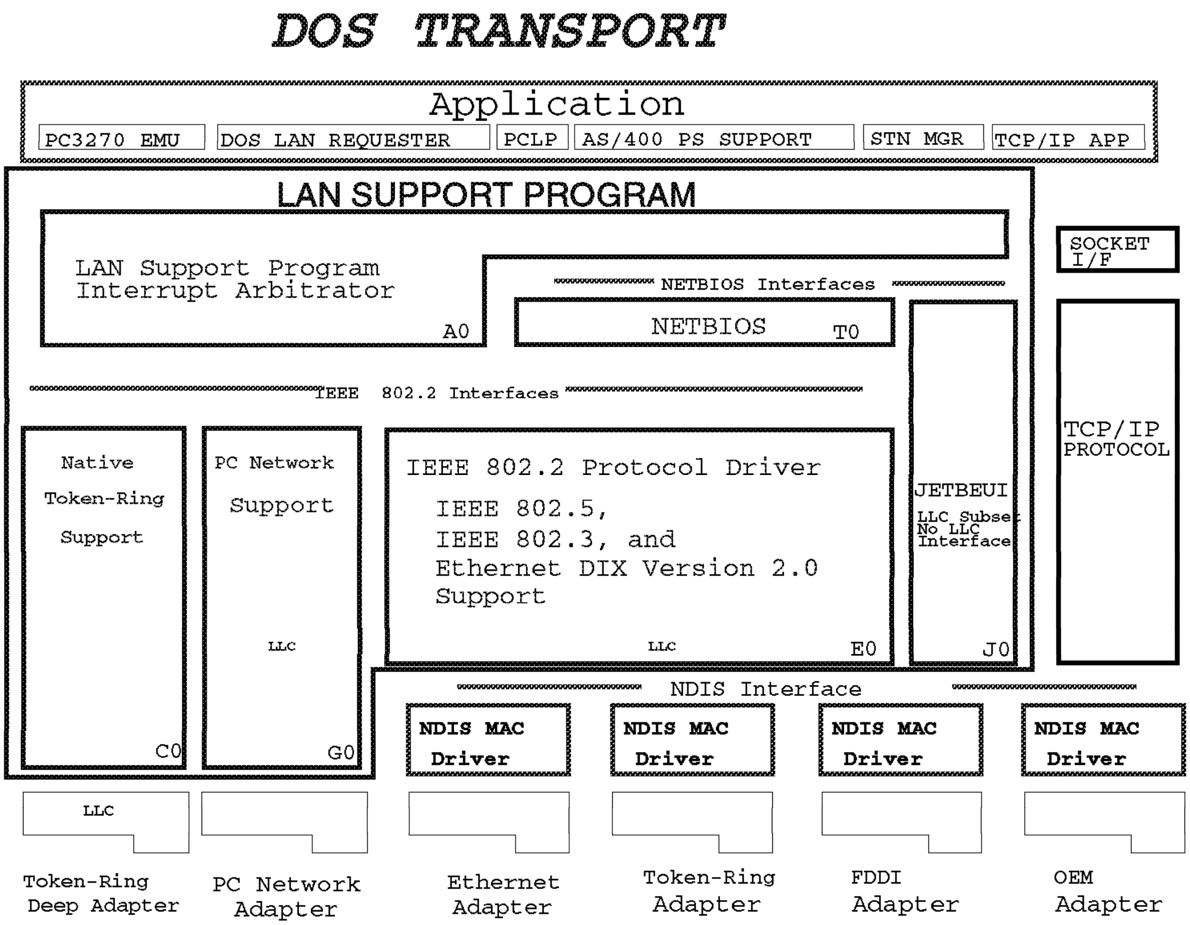


Figure 7. DOS Transport for IBM LAN Adapters

1.8.7 IBM Local Area Network Support Program (LSP) Version 1.3.4

The Local Area Network (LAN) Support Program Version 1.3.4 for DOS (PTF UR39824) has been extended in conjunction with the previous release of LSP (1.3.3) to support the following adapters:

- IBM LANStreamer MC 32 Adapter
- IBM FDDI Fiber Base Adapter/A
- IBM FDDI Copper Base Adapter/A
- IBM FDDI Fiber Extender Adapter/A
- IBM FDDI Copper Extender Adapter/A
- IBM Token-Ring Network 16/4 Adapter II
- IBM Token-Ring 16/4 Credit Card Adapter

- IBM Credit Card Adapter for Ethernet
- IBM LAN Adapter for Ethernet
- IBM LAN Adapter/A for Ethernet
- IBM 3278/3279 Emulation Adapter (with peer communication)
- IBM 3270 Connection Card (with peer communication)

As LSP 1.3.4 is basically a PTF, the major enhancements described below are for LSP 1.3.3. Basically, there are two changes associated with 1.3.4, as follows:

1. DXMJOMOD.SYS and DXMEOMOD.SYS are now supported in some environments. However you still can′t use these two modules if you want to use a NetBIOS application and an 802.2 application at the same time. You must use DXMEOMOD.SYS and DXMT0MOD.SYS when both interfaces are required. DXMJ0MOD.SYS amd DXME0MOD.SYS are supported in the following configurations:

   - 80386 and higher microprocessors
   - Both protocol stacks supporting only one adapter

   Note

   More memory is required if you use DXME0MOD.SYS with DXMJ0MOD.SYS.

2. The LSP Installation Utility has been changed to support installation of DXMJ0MOD.SYS with DXME0MOD.SYS as well as some improved usability enhancements.

Support of the multiple group address function has been added for IBM FDDI adapters, Ethernet adapters, and any other NDIS adapters that support multiple group addresses. Up to 256 multiple group addresses can be set using the direct command DIR.SET.MULT.GROUP.ADDRESS.

Network Driver Interface Specification (NDIS) adapters can use the new protocol driver, DXMJ0MOD.SYS, to provide the NetBIOS interface. The use of DXMJ0MOD.SYS may result in improved performance as compared with the use of DXME0MOD.SYS and DXMT0MOD.SYS. However, DXMJ0MOD.SYS cannot be used if 802.2 support is required because it is not compatible with DXME0MOD.SYS.

Support has been added for application programs running in Microsoft Windows or with memory managers. Most of the LAN Support Program files can be loaded into upper memory blocks to save low memory for other uses. The LAN Support Program has been tested with Windows and memory managers only under DOS 5.0 and DOS J5.0. Please refer to the LSP user′s guide for processor requirements.

When the device drivers DXC0MOD.SYS and DXMG0MOD.SYS are used together, both the PC network adapter and the token-ring network adapter can be set up as primary in the computer hardware. This configuration was not supported in earlier versions.

The Installation Aid has been redesigned to provide easier NDIS adapter configuration and does not disturb existing configuration information for other protocol drivers in the PROTOCOL.INI file. It also preserves statements in

CONFIG.SYS that load device drivers and other programs into upper memory (such as DEVICEHIGH=).

1.8.8 IBM LAN Client

IBM LAN Client provides program interfaces to support network application programs using selected IBM token-ring adapters. It allows a client workstation to communicate with an IBM LAN server at Version 3.0 and 4.0, or with a Novell NetWare server at Version 2.15c or higher, or to use TCP/IP applications. (The IBM and Novell client code is included with this package, with the exception of PING TCP/IP applications.) In addition, support is provided for programs written to the NetBIOS or IEEE 802.2 application programming interfaces.

1.8.8.1 IBM LAN Client Features

- As little as 2 KB of conventional memory required. (See below for more detail.)
- One common environment for concurrent multiple protocols.
  - One or more of NetBIOS, IPX, TCP/IP, and IEEE 802.2.
  - Shim modules, such as ODINSUP and LANSUP, are not needed.
- Includes client software for attachment to Novell NetWare servers and IBM LAN servers.
  - Supports DOS LAN Services 4.0
  - New Novell NetWare Client-32 for DOS/Windows (Beta version)
  - Provides full access to essential NetWare services such as NetWare Directory Services (NDS)
  - Provides improved connection reliability, including the ability to automatically reconnect open files
  - Provides enhanced Large Internet Packet (LIP) and Packet Burst support
- Includes an installation tool with a graphical user interface (GUI) for easy installation of client software.
- Includes a command line version of the installation tool for use by network administrators installing on a large number of workstations.
- Allows the same adapter device driver to be used for client workstations and for Novell NetWare servers, reducing support complexity.

1.8.8.2 DOS Conventional Memory Usage - Reduction

IBM LAN Client minimizes the use of DOS conventional memory for network communications. With IBM LAN Client, IBM LAN adapter drivers and protocol stacks no longer require large amounts of DOS memory below 1 MB. The tables in this section show how little memory is required for IBM LAN Client, compared to existing implementations. There is one table for ISA and Micro Channel adapters, and one for the PCI adapter.

These tables show how much DOS conventional memory is used by IBM LAN Client for three popular communication protocols, compared with current usage.

Table 3 (Page 1 of 2). IBM Auto 16/4 and MC Adapters Memory Reduction Table

Protocol	Before IBM LAN Client	With IBM LAN Client
IPX	32 KB	5 KB

Table 3 (Page 2 of 2). IBM Auto 16/4 and MC Adapters Memory Reduction Table		
Protocol	**Before IBM LAN Client**	**With IBM LAN Client**
IEEE 802.2	9 KB	4 KB
NetBIOS	32 KB	29 KB

Note: The NetBIOS figure is correct for this release; it will be considerably lower in a later release.

Table 4. IBM Auto LANStreamer PCI Adapters Memory Reduction Table		
Protocol	**Before IBM LAN Client**	**With IBM LAN Client**
IPX	59 KB	5 KB
IEEE 802.2	95 KB	4 KB
NetBIOS	95 KB	29 KB

Note: The NetBIOS figure is correct for this release; it will be considerably lower in a later release.

1.8.8.3 Supported IBM LAN Adapters

IBM LAN Client provides support for the following adapters:

- IBM Auto LANStreamer PCI Adapter
- IBM Auto 16/4 Token-Ring ISA Adapter
- IBM Token-Ring 16/4 ISA-16 Adapter
- IBM Auto 16/4 Token-Ring MC Adapter
- IBM Token-Ring 16/4 Adapter/A

1.8.8.4 Supported Software

IBM LAN Client provides support for the following protocols and client applications:

- For DOS 5.0 or higher:
  - IEEE 802.2
  - NetBIOS
  - DOS LAN Services 4.x (with IBM LAN Server 4.0)
  - DOS LAN Services 4.x Peer-to-Peer
  - DOS LAN Requester 3.x (with IBM LAN Server 3.0 and higher)
  - NetWare Client-32 (IPX/SPX) (with Novell NetWare 2.15c and higher)
  - PC3270 Version 4.x
  - Artisoft LANtastic (Version 6.0)
  - Attachmate 3270 Emulation
  - Client Access/400
- For Windows 3.1, Windows 3.11, and Windows for Workgroups 3.11:
  - IEEE 802.2
  - NetBIOS
  - DOS LAN Services 4.x (with IBM LAN Server 4.0)

- DOS LAN Services 4.x Peer-to-Peer
- DOS LAN Requester 3.x (with IBM LAN Server 3.0 and higher)
- NetWare Client-32 (IPX/SPX) (with Novell NetWare 4.0)
- TCP/IP using Winsock 1.1
- PC3270/Windows Version 4.x
- AS/400 for Windows (Version 4.0)
- DCAF (Version 1.3 + CSDs)
- Artisoft LANtastic Version 6.0
- APPC/Windows

Note: You cannot run DOS LAN services and NetWare Client-32 at the same time in a Windows environment.

IBM LAN Station Manager cannot be run in the same workstation as IBM LAN Client.

1.8.8.5 Supported Operating Systems

IBM LAN Client supports the following desktop operating systems:

- MS-DOS 5.x and 6.x
- PC-DOS 5.x, 6.x, and 7.0
- Windows 3.1 and 3.11, in enhanced mode
- Windows for Workgroups 3.11

Note: IBM LAN Client will only operate with one adapter.

You cannot use remote program load (RPL) to download IBM LAN Client from either a Novell NetWare server or an IBM LAN server.

1.8.9 Mixed IBM and Novell Requester Workstation Support

In today′s LAN environment many customer configurations involve both IBM and Novell software for client/requester and emulation support. Only one driver (either native, NDIS, or ODI) can control the adapter. The chart shown in Figure 8 on page 40, describes four different situations that can all provide emulation support, IBM LAN Server/Requester support, and Novell NetWare requester support. The four configurations are as follows:

- **Native Driver Support:** This is a configuration with an IBM token-ring shared RAM adapter that is using the adapter handler driver (DXMC0MOD.SYS) from the LAN support program. The interface presented by this module is the CCB interface. The emulators (both 3270 and 5250 both use this interface, along with NetBIOS (non-NDIS)). Novell provide a module called LANSUP that will allow IPX to use the CCB interface to access the IBM token-ring adapter.
- **NDIS Driver with LANSUP:** In the NDIS environment the 802.2 NDIS protocol (DXME0MOD.SYS for LSP) provides the CCB interface that LANSUP will utilize for Novell requester support. Novell also provides an OS/2 version of LANSUP.
- **IBM′s NDIS Support of ODI Protocols:** IBM has developed a module to support Novell ODI protocols in an environment where NDIS MAC drivers are being used. The module is called ODI2NDI and its function is to map ODI requests to NDIS. This module is currently available for OS/2 via NTS/2 and

is planned to be shipped with DOS NDIS support for the token-ring LANStreamer adapter.

- Novell has developed a mapper module that will support NDIS protocols on top of ODI. The module is called ODINSUP and is also available for DOS and OS/2.

In each of these four configurations the ability to support the IBM and Novell software is preserved, presuming that there are no memory constraints for the configurations that are DOS workstations.

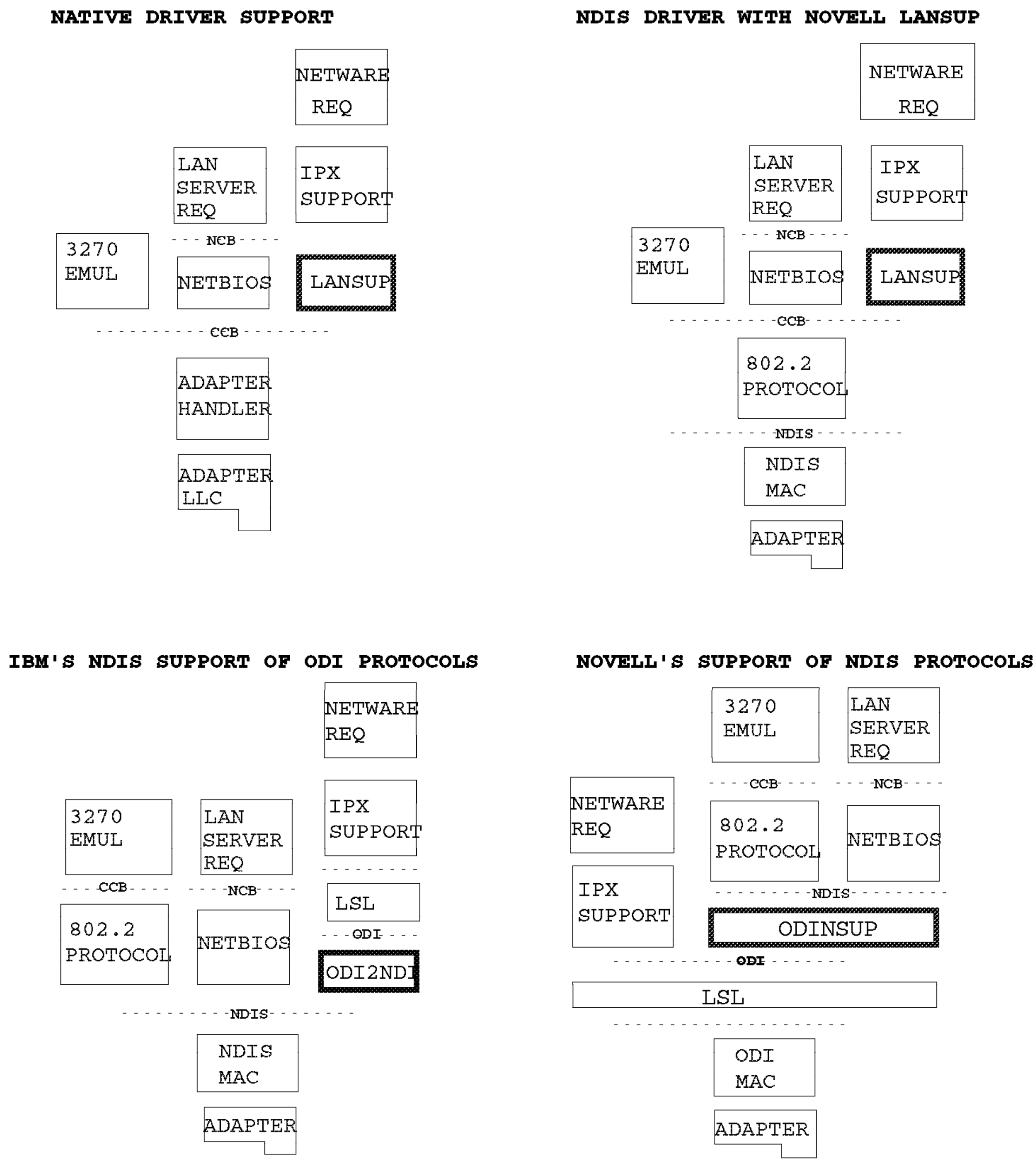


Figure 8. Mixed IBM and Novell Workstation Environments

1.8.10 Memory Overview

For DOS workstations, memory consumption becomes very critical. Figure 9 shows the DOS PS/2 memory map. The area from 0 KB to 640 KB is called conventional memory. The area from 640 KB to 1 MB is called upper memory. The area from 1 MB to 16 MB is called extended memory. The first 64 KB of extended memory is called high memory. Inside the upper memory area an Expanded Memory Specification (EMS) area can be defined so that expanded memory can be *paged* in and out of the defined EMS area.

In Figure 10 on page 42, a more detailed chart is shown of the upper memory area. The area typically reserved for video/display adapters, communication and I/O adapters, system ROM, and machine BIOS are shown. In a typical workstation, portions of this area are not used, which provides the user the option to load things like LAN protocol stack drivers in upper memory. This is all under the assumption that there is sufficient room and that the driver set supports code loaded in upper memory.

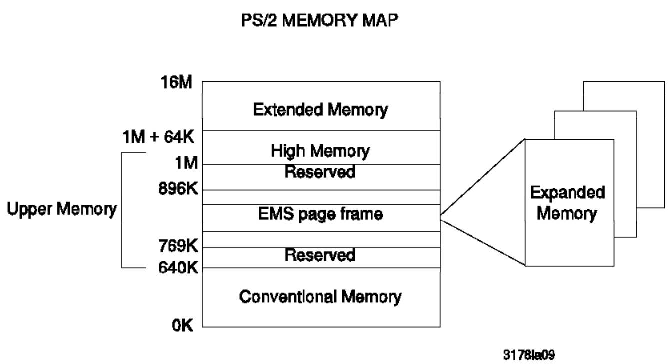


Figure 9. Memory MAP for DOS PS/2 Environments

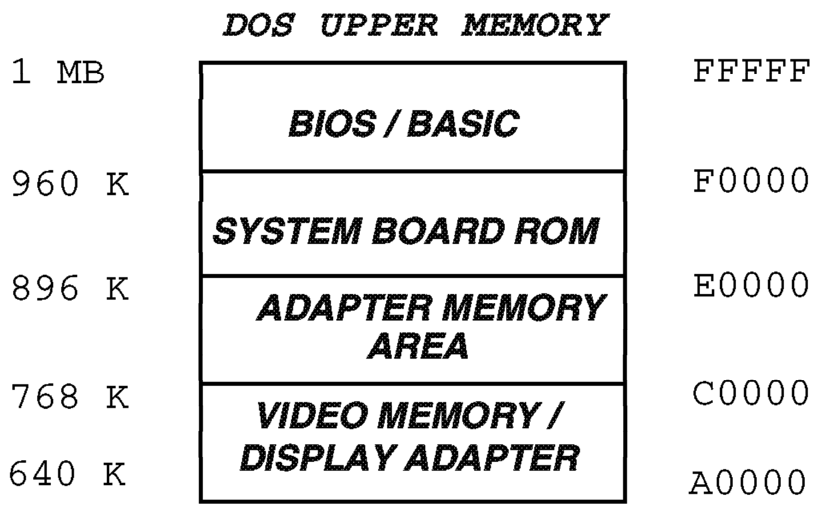


Figure 10. Upper Memory MAP Definition

1.8.11 LAN Support Program (LSP) Memory Consumption

The following charts are to illustrate the memory used in a DOS environment by LSP. Figure 11 on page 43 shows the conventional memory usage for an IBM shared RAM token-ring adapter and a shallow adapter with NDIS MAC driver support. Note that the 40 KB total for the shared RAM adapter does not include the 16 KB RAM and 8 KB ROM that are used in upper memory by these adapters. The point is that since the shallow adapters are used in an NDIS environment and the IEEE 802.2 support is executed in the host memory along with the NDIS MAC driver, the DOS memory utilization is much higher. Figure 12 on page 44 is very similar, but it shows the estimated memory used with the NetBIOS-only option of DXMJ0MOD.SYS. Figure 13 on page 45, estimates LSP DOS memory usage if the modules are loaded in upper memory via a memory manager. This, once again, assumes there is available space for the modules to be loaded high. The following are examples of memory managers:

- DOS 5.0 EMM386
- QEMM from Quarterdeck
- 386MAX from Qualitas

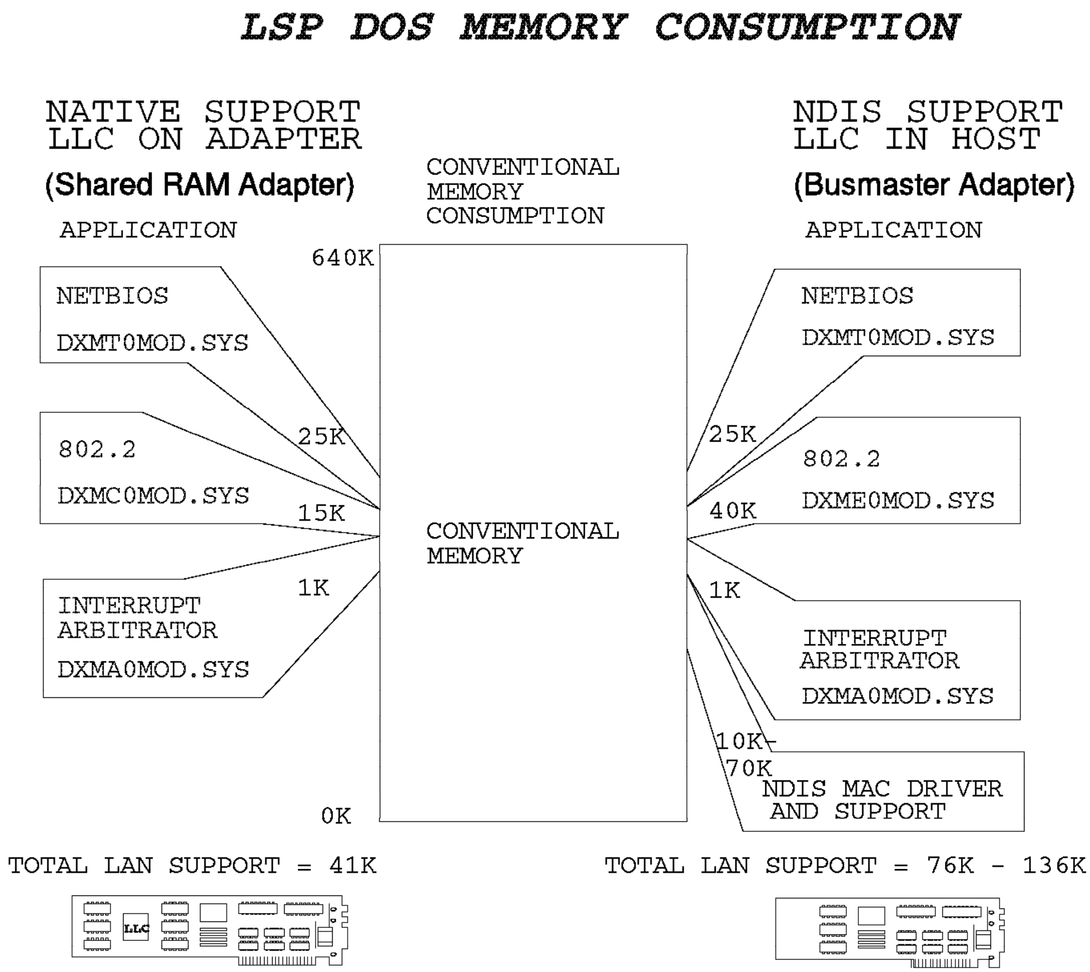


Figure 11. LSP DOS Memory Consumption

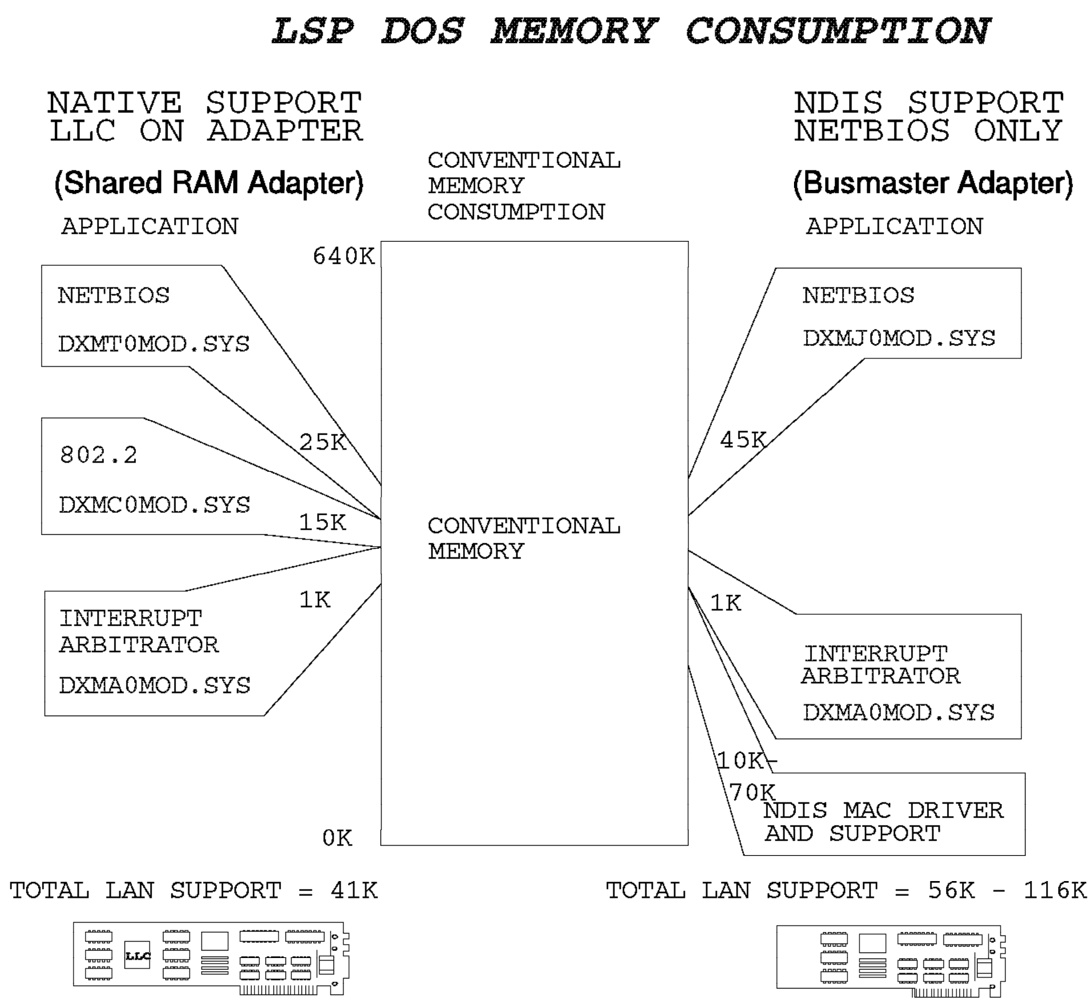


Figure 12. LSP DOS Memory Consumption with J0 Module

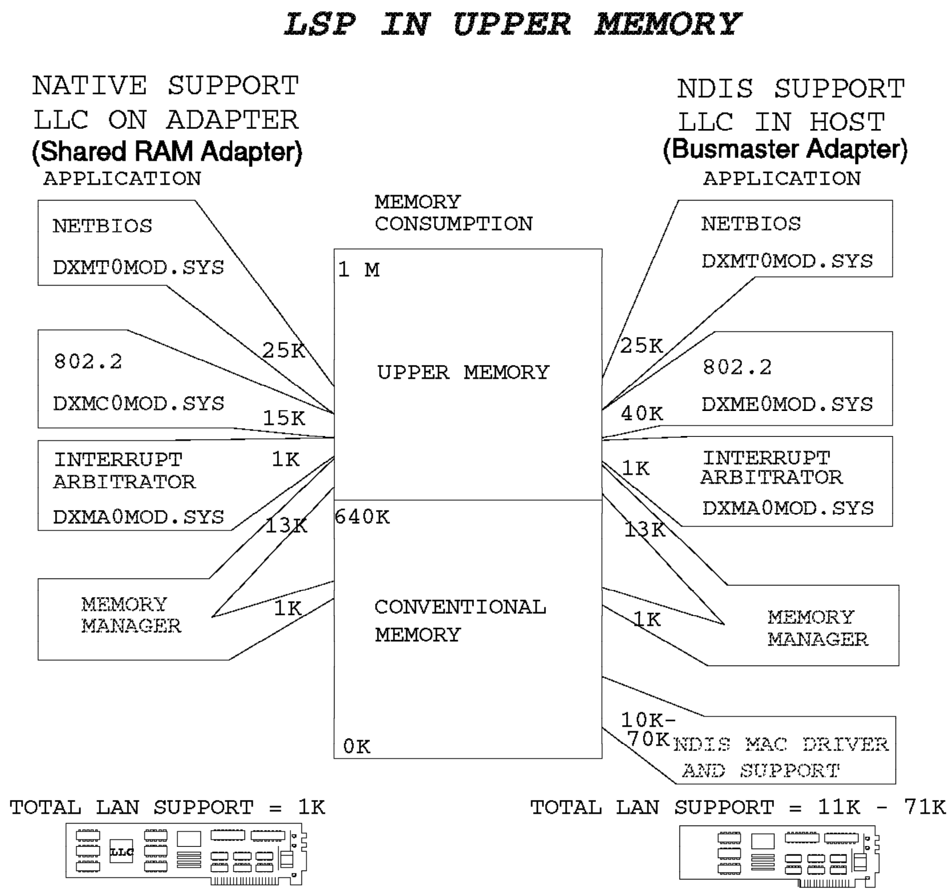


Figure 13. LSP DOS Memory Consumption Utilizing Upper Memory

1.8.12 Memory Considerations

For DOS workstations, memory usage is a major concern. OS/2 workstations usually do not have memory constraints assuming the machine has sufficient memory hardware. The following are some key points to consider:

- DOS LAN workstations that are experiencing memory constraints should try a memory manager such as QEMM or 386MAX.
- Windows workstations that use old DOS applications may continue to experience memory problems because the memory used in the conventional memory area is unavailable in the 640 KB DOS partitions.
- If the applications are true Windows applications (Windows Virtual Device Drivers) the memory problem does not exist since each of these applications has the entire address (virtual) space for execution.
- Normally requester code, spreadsheets, word processors and emulators take up more memory that the LAN Support Program drivers.

1.9 LAN Adapters for the RISC System/6000

This section details the range of adapter features and functions that allow a RISC System/6000 to participate in LAN services.

Token-Ring High-Performance Network Adapter (#2970)

The Token-Ring High-Performance Network Adapter is designed to allow a RISC System/6000 system to attach to 4 Mbps or 16 Mbps token-ring local area networks. This token-ring adapter is cable and network compatible with all IBM PS/2 Token-Ring adapters; no new cables or network components are required. The required cable is included with the adapter and is 3 meters (9.8 feet) in length.

Characteristics:

- 4 Mbps or 16 Mbps
- Compatible with IEEE 802.5 specifications
- Micro Channel interface
- 2-byte bus master
- Streaming data mode
- Up to four adapters per Micro Channel may be installed
- Standard Micro Channel form factor card

Ethernet High-Performance LAN Adapter (#2980)

The Ethernet High-Performance LAN Adapter is a high performance Micro Channel architecture bus master adapter that attaches the system to Ethernet networks. This adapter is designed to provide connection to a 10 megabit Carrier Sense Multiple Access/Collision Detection (CSMA/CD) Ethernet network and is compatible with IEEE 802.3 and Ethernet external interfaces. To attach the system to the network, the customer must supply the appropriate cable for connection to the standard 50 ohm or RG-58A/U coaxial cables. When using the RG-58A/U coaxial cable, an external transceiver is required.

Characteristics:

- Micro Channel interface
- 32-bit bus master
- Compatible with IEEE 802.3 or Ethernet Version 2 interfaces
- Transmission speed of 10 Mbps
- 16 KB of high-speed RAM for data buffering
- Up to four adapters per Micro Channel may be installed
- Standard Micro Channel form factor card
- Thick (DIX) or thin (BNC) cable support

Ethernet 10Base-T Transceiver (Twisted Pair) (#4224)

The Ethernet 10Base-T Transceiver provides the complete attachment unit interface (AUI) to a twisted pair LAN connection. It is connected to a 15-pin DIX Ethernet connection via a transceiver (AUI) cable and converts the signal to 10Base-T. The medium connection is made through an RJ-45 receptacle.

Features include:

- Selectable link test via external toggle switch
- Selectable SQE signal via internal jumper
- LEDs

  - Transmit
  - Receive/Link
  - Collision
  - Jabber
- Dimensions: 2 7/8″ x 2 1/8″

Fiber Distributed Data Interface Adapter (#2720)

The Fiber Distributed Data Interface Adapter uses FDDI, a LAN communications technology that uses optical cabling designed for a line speed of up to 100 Mbps.

FDDI is designed to support the TCP/IP protocol, and supports NFS over TCP/IP. The FDDI implementation supports ANSI standard X3T9.5, with the exception that station management (SMT) function is limited to agent support only. A programming interface (API) is provided for the device driver.

Fiber optic cable is designed to be immune to electromagnetic interference (EMI). Therefore, using fiber technology may prevent jamming by high power emissions. Additionally, fiber optics do not emit electromagnetic radiation (EMR). This feature enhances security, since it helps prevent eavesdropping.

The RISC System/6000 Fiber Distributed Data Interface Single Ring Adapter provides a single attach station (SAS) option and attaches to the FDDI network′s primary ring directly or via an external FDDI concentrator. Connection via an external FDDI concentrator isolates the workstations from the primary ring and protects the network from routine station on/off cycles and individual station failures. Each FDDI adapter requires one Micro Channel card slot. A maximum of six Micro Channel card slots may be used for FC 2720 and FC 2722 adapters, in any combination. The FDDI card requires multimode (62.5/125 micron) FDDI optical fiber jumper cables. The FDDI jumper cables are available in five standard lengths of 4 meters (12 feet), 7 meters (20 feet), 15 meters (50 feet), 31 meters (100 feet) and 61 meters (200 feet) or custom lengths in one foot increments. They are available with MIC, FC, ST, or SC connectors.

For more information about the jumper cables, planning, design, and installation of optical fiber cabling systems, refer to *IBM Cabling System Optical Fiber Installation and Planning Guide.*, GA27-3943.

Jumper cables are the responsibility of the customer and may be ordered from your local authorized IBM cabling distributor or by calling 1-800-IBM-2468 in the United States. For EMEA customers, cables are available from Montpellier through CE offerings.

Fiber Distributed Data Interface Dual Ring Upgrade Kit (#2722)

This feature consists of an upgrade kit to be applied to a system with an existing RISC System/6000 FDDI Adapter (FC 2720).

The RISC System/6000 Fiber Distributed Data Interface Dual Ring Upgrade Kit provides a dual attaching station (DAS) option and attaches to both the FDDI network′s primary and secondary ring. In the event of failure, this type of attachment allows the wrapping of the primary to the secondary ring for high network availability and problem isolation. This dual attach station (DAS) option can also attach to concentrator ports as a single attached station or a dual-homing station.

Each FC 2722 FDDI adapter kit requires one Micro Channel card slot adjacent to the 2720 adapter. A maximum of three FC 2722 adapters per system is supported.

FDDI - Fiber Dual-Ring Upgrade (#2723)

Dual attaching stations (DAS) using the RISC System/6000 FDDI Fiber Single-Ring Adapter and FDDI Fiber Dual-Ring Upgrade will allow customers to attach to both the primary and secondary FDDI rings. In the event of a failure, this type of attachment allows the wrapping of the primary and the secondary ring for high network availability and problem isolation. The dual-ring upgrade can also attach to concentrator ports as a single-attached station or a dual-homing station. A dual-homing station attaches to two different concentrators with the second concentrator acting as a backup or a standby for the station in the event of a concentrator or port failure.

Characteristics:

- Supports dual-ring FDDI attachment at 100 Mbps
- Requires two Micro Channel slots (including the single slot required for the FDDI single-ring adapter)
- Maximum of three FDDI dual-ring adapters supported on each RISC System/6000 machine (depending upon slot availability per machine type)
- Fiber optic cables are required for adapter connectivity, and are the responsibility of the customer

FDDI - Fiber Single-Ring Adapter (#2724)

Single attaching stations (SAS) using the RISC System/6000 FDDI Fiber Single-Ring Adapter will allow customers to attach the workstation directly to an FDDI primary ring of 100 Mbps via an FDDI 100 Mbps concentrator. The concentrator option offers additional protection by isolating the network from routine on/off activity and individual workstation failures.

Characteristics:

- Supports single-ring FDDI attachment at 100 Mbps
- Requires one Micro Channel slot
- Maximum of six FDDI single-ring adapters supported on each RISC System/6000 machine (depending upon slot availability on each machine type)
- Fiber optic cable is required for adapter connectivity, and is the responsibility of the customer

FDDI - STP Single-Ring Adapter (#2725)

Single attaching stations (SAS) using the RISC System/6000 FDDI-STP Single-Ring Adapter will allow customers to attach the workstation directly to an FDDI primary ring of 100 Mbps via an FDDI 100 Mbps concentrator. The concentrator option offers additional protection by isolating the network from routine on/off activity and individual workstation failures.

Characteristics:

- Supports single-ring FDDI attachment at 100 Mbps
- Requires one Micro Channel slot
- Maximum of six FDDI-STP single-ring adapters supported on each RISC System/6000 machine (depending upon slot availability per machine type)

- Shielded twisted pair wire is required for adapter connectivity, and is the responsibility of the customer

FDDI-STP Dual-Ring Upgrade (#2726)

Dual attaching stations (DAS) using the RISC System/6000 FDDI-STP Single-Ring Adapter and FDDI-STP Dual-Ring Upgrade will allow customers to attach to both the primary and secondary FDDI rings. In the event of a failure, this type of attachment allows the wrapping of the primary and the secondary rings for high network availability and problem isolation. The dual-ring upgrade can also attach to concentrator ports as a single-attached station or a dual-homing station. A dual-homing station attaches to two different concentrators with the second concentrator acting as a backup or a standby for the station in the event of a concentrator or port failure.

Characteristics:

- Supports dual-ring FDDI attachment at 100 Mbps
- Requires two Micro Channel slots (including the single slot required for the FDDI-STP single-ring adapter)
- Maximum of three FDDI-STP dual-ring adapters supported on each RISC System/6000 machine (depending upon slot availability per machine type)
- Shielded twisted pair wiring is required for adapter connectivity, and is the responsibility of the customer

1.10 3172 LAN Adapters

This section details the features and functions available to the 3172 for LAN connectivity.

Auto LANStreamer MC 32 (F/C 2235)

This adapter attaches to a 16 or 4 Mbps token-ring network that conforms to the IEEE 802.5 architecture. This adapter has one RJ-45 connector. The adapter is shipped with a conversion cable (RJ-45 to shielded twisted pair cable) that plugs into the RJ-45 connector on the adapter and into which the standard token-ring adapter cable (IBM P/N 6339098 or equivalent) plugs. The standard token-ring adapter cable must be ordered separately. A single cable (IBM P/N 60G1063 or equivalent) may be ordered separately to replace the combination of the conversion cable and standard token-ring adapter cable. This adapter also supports the use of token-ring shielded or unshielded twisted pair cable containing two pairs of wires. This twisted pair cable can have either an RJ-45 connector on each end or an RJ-45 connector on one end and an RJ-11 connector on the other end and must be ordered separately. Limitations: F/C 2235 is not supported with F/C 3000, or 3010. Field installable: Yes. Maximum: 4.

EtherStreamer MC 32 (F/C 2245)

This adapter provides attachment to 10 Mbps Ethernet LANs and conforms to the IEEE 802.3 architecture. Connections to 10Base-T (RJ-45), 10Base5 (mini AUI), and 10Base2 (coax) Ethernet LANs are supported. A conversion cable (P/N 59G9004), which converts from mini AUI to AUI, is shipped with each EtherStreamer adapter. Full-duplex (20 Mbps) mode is only supported through the 10Base-T (RJ-45) connection and this mode requires an Ethernet switch (such as the IBM 8271 EtherStreamer Switch). The 10Base-T (RJ-45) connection supports the use of a category 3, 4, or 5 shielded or unshielded twisted-pair cable with an RJ-45 connector on each end. Attachment cables and hardware to the external (AUI) transceiver are not provided by IBM. To support Ethernet coaxial cable, a BNC T-connector is required to connect to the 10Base2 (coax) connector on the adapter. Limitations: F/C 2245 is not supported with F/C 3000, or 3010. Field installable: Yes. Maximum: 4.

FDDI Adapter (F/C 2300)

This adapter provides attachment to a 100 Mbps FDDI local area network (LAN) that conforms to the American National Standard Institute X3T9.5 (ANSI) and the International Standards Organization 9314 (ISO) architectures. Two feature slots are required to implement the dual ring station that is supported in the 3172-003. Two multimode (62.5/125 micron) FDDI jumper cables are required to connect the adapter into the FDDI ring. These jumper cables are not provided with this feature and must be ordered separately. Refer to the *IBM Cabling System Optical Fiber Planning and Installation Guide,* GA27-3943, and *IBM FDDI Network Introduction and Planning Guide,* GA27-3892, for more information about the jumper cables, planning, design and installation of optical fiber cabling systems. Jumper cables are the responsibility of the customer and may be ordered from your local authorized IBM cabling distributor or by calling 1-800-IBM-2468 in the United States and 1-800-465-1234 in Canada. For EMEA customers, cables are available from Montpellier through CE offerings. The prerequisites are: Rack Mount Assembly (F/C 2500) is mandatory as well as installation in an IBM 9309-002 Rack Enclosure. The limitations are if an FDDI adapter is used with the 3172-003, the 3172-003 must be installed in 9309-002 rack and in a computer room (Class A2 Environment). It is field installable. The maximum number is 1.

TURBOWAYS 100 ATM Adapter (F/C 2310) The TURBOWAYS 100 ATM Adapter provides OS/2-based 3172-003s direct and transparent access to an ATM environment using IBM prestandard token-ring and Ethernet LAN emulation. The ATM adapter provides dedicated 100 Mbps, full-duplex connectivity and uses an i960 RISC processor and a specialized chip set to provide high throughput and minimal use of the 3172 processor. The adapter supports AAL-5 adaptation layer interface and up to 255 active virtual connections. The adapter provides NDIS 2.0.1 support and switched virtual circuit (SVC) support conforming to the ATM Forum UNI version 3.0 specification. Cables are not included with the TURBOWAYS 100 ATM adapter feature and must be ordered separately. Cables may be ordered through your IBM Marketing Representative or can be placed through IBM Optical Link Products, Endicott, N.Y. 1-800-426-6786 (International Call Access Number 01-607-755-9935).

Parallel Channel Adapter (F/C 2501) This feature interfaces with IBM′s Parallel Channel as if it is an IBM 3088 and supports speeds up to 4.5 Mbps. This feature includes the adapter, adapter cable, and the channel cable adapter plate. Channel cables (group 0185) must be ordered separately. The limitation is that F/C 2501 is mutually exclusive with F/C 2800 and F/C 2801. It is field installable and the maximum number is 2.

1.11 3174 LAN Adapters

The 3174 is an establishment controller that provides a broad range of connectivity options, workstation and host attachment possibilities, network asset management capabilities, and expandability features. In addition to options that allow host connections via both local channel and remote communication link connections, the 3174 can connect to the IBM Token-Ring network or Ethernet LAN networks (IEEE 802.3 and Ethernet DIX Version 2). This section details the features and functions available for the 3174 for LAN attachment.

IBM 16/4 Mbps Token-Ring Network Gateway (#3026) (Models 11L, 11R, 12R, 61R, 62R)

Note: An alternative to this feature is Configuration Support-B or Configuration Support-C with the Type 3A adapter (#3044). This feature should not be ordered when Configuration Support-B or Configuration Support-C is ordered to provide the gateway support.

This feature provides the capability of up to 140 token-ring attached devices, as PU 2.0 devices (that is, DSPUs), to communicate with an IBM host. It includes a Type 3A Dual Speed (16/4) Communication Adapter which operates at 16 or 4 Mbps, a 2.4 m (8 ft) communication cable, and Configuration Support-S, Release 5 Licensed Internal Code. Any combination of the following downstream token-ring attached PU T2.0 devices is supported by this feature:

- 3174 Models 13R, 23R or 63R
- System/36 with the LAN Attachment Feature, and using 3270 emulation or APPC (as a PU 2.0 node supported at 4 Mbps only)
- IBM PS/2 or PC using IBM Operating System/2 Extended Edition Version 1.1 (or later)
- IBM PS/2, PC or 3270 PC using 3270 Workstation Program Version 1.1 with maintenance Release 1.1.2 or later
- IBM PS/2 or PC using IBM 3270 Emulation Version 3 with maintenance Release 3.04 or later
- IBM PS/2 or PC using APPC/PC (as a PU 2.0 node at 4 Mbps only)
- IBM 9370 using DPPX/370 (as a PU 2.0 node)
- AS/400 3270 DE Mode or APPC (as a PU 2.0 node)

Type 3A Dual Speed (16/4) - Alternate IML/Gateway (#3044) (Models 11L, 11R, 12L, 12R, 14R, 21H, 21L, 21R, 22R (EMEA), 22L, 24R, 61R, 62R, 64R)

This feature provides a Type 3A Dual Speed Communication Adapter and a 2.4 m (8 ft) communication cable for attachment to an IBM Token-Ring network operating at either 16 or 4 Mbps. This feature may be used for two different functions: (1) Alternate IML configuration (2) IBM 16/4 Mbps Token-Ring gateway when using Configuration Support-B or Configuration Support-C.

(1) When used for the alternate IML function, this feature and the appropriately configured Licensed Internal Code, allows the 3174 Models 11L, 11R, 12L, 12R, 14R, 21H, 21L, 21R, 22R (EMEA), 22L, 24R, 61R, 62R, or 64R to operate in an alternate configuration on an IBM Token-Ring as a model 13R, 23R or 63R. Licensed Internal Code customization and host definition for operation with this feature are the same as a model 13R, 23R or 63R.

(2) When used for the IBM 16/4 Mbps token-ring gateway function, this feature with Configuration Support-B, Releases 1 or 2, provides for data passage between a single IBM host and 16/4 Mbps token-ring network. This feature with

Configuration Support-B, Release 3 or later or Configuration Support-C and a Model 12L or 22L (with ESCON Director) or a Model 11L, 11R, 12R, 21H, 21L, or 21R with concurrent communication adapter(s) provides for data passage between multiple IBM hosts and a 16/4 Mbps token-ring network.

Ethernet Adapter (#3045) (Models 11L, 11R, 12L, 12R, 13R, 21H, 21L, 21R, 22L, 22R (EMEA only), 23R, 61R, 62R, 63R)

The Ethernet adapter provides IEEE 802.3 and Ethernet DIX Version 2 network support. The feature ships with an Ethernet adapter, diagnostic wrap plugs, installation and maintenance manuals, and Configuration Support-C Release 4 LIC. A Configuration Support-C License (feature 6010, 6015, 6060, 6065, or 4710) is a prerequisite.

The Ethernet adapter provides the interface to attach to 10Base5, 10Base2, and 10Base-T networks.

The Ethernet adapter has a standard female attachment unit interface (AUI) connector. An AUI cable and a medium attachment unit (MAU) are required to attach to the 10Base5 network. Both the AUI cable and MAU are customer provided.

The Ethernet adapter has a BNC connector for attachment to the 10Base2 network. A BNC T connector is also provided. The cable to attach to the 10Base2 network is customer provided.

The Ethernet adapter has an RJ-45 connector for attachment to the 10Base-T network. The cable to attach to the 10Base-T network is customer provided.

The Ethernet adapter and properly configured Configuration Support-C Release 4.0 Licensed Internal Code may be used for three different functions: (1) alternate IML configuration; (2) SNA gateway; (3) additional TCP/IP host access.

Note: Configuration Support-C Release 4 is intended only for 3174s with Ethernet capability (that is, feature code 3045 is installed or the 3174 is a Model 14R, 24R or 64R). Configuration Support-C Release 3 provides the same functions as Release 4 for 3174s without Ethernet capability. Release 4 is not available for 3174s that do not have Ethernet capability.

(1) When used for the Alternate IML function, 3174 models 11L, 11R, 12L, 12R, 13R, 21H, 21L, 21R, 22L, 22R (EMEA only), 23R, 61R, 62R, or 63R can operate in an alternate configuration as can models 14R, 24R, or 64R. Dependent 3270 CUT and ASCII terminals can access multiple hosts (TCP/IP Telnet, 3270 SNA) via the Ethernet LAN.

(2) When used for the SNA gateway, SNA traffic is passed between local and remote SNA hosts and Ethernet LAN-attached terminals (for example, 3174 DSPU-attached workstations and intelligent workstations). A PU-to-PU session is made between the SNA host and the Ethernet LAN-attached terminal. Dependent 3270 CUT and ASCII terminals attached to the SNA Gateway can access both upstream SNA hosts and Ethernet LAN-attached TCP/IP Telnet hosts.

(3) When used for the additional TCP/IP host access, dependent 3270 CUT and ASCII terminals attached to the 3174 can access SNA hosts via upstream local or remote 3174 host links and TCP/IP Telnet hosts via the downstream Ethernet LAN.

Maximum: One Ethernet adapter per 3174.

1.12 3745 LAN Adapters

This section specifies the current LAN adapter features available for the 3745 and 3746 Model 900 Communications Controller.

A new feature for the 3746-900 is that TIC3 couplers equipped with an IBM Token-Ring UTP Media Filter, allow the 3746-900 to be used as a LAN gateway for token-ring networks using low cost UTP cabling. (An IBM 8250 must be used as the hub for the UTP connections to the token-ring stations and the 3746-900.)

Ethernet LAN Adapter (#4780)

The ELA using Carrier Sense Multiple Access/Collision Detection (CSMA/CD) provides the attachment to Ethernet V.2 or IEEE 802.3 LAN through OEM AUI transceivers not provided by IBM. The AUI transceivers should meet the IEEE 802.3 recommendation, and support the signal quality error (SQE) test signal enabling. The ELA is plug compatible with the High-Speed Scanner (# 4740). The physical ELA interface to the external cabling is made through IEEE 802.3 15-pin D-type female AUI connectors on the tailgate. There are two LAN ports per ELA which can be active at the same time.

Cables: The attachment cables to the AUI transceivers are not provided by IBM and must meet the IEEE 802.3 specifications.

3745 Token-Ring Adapter (TRA) Type 2 (#4770)

The TRA Type 2 is a microprocessor-based device providing two attachment ports to the 4 Mbps or 16 Mbps IBM Token-Ring Network using standard protocols. It supports software ring speed selection per port, the use of larger frame sizes up to 4 KB at 4 Mbps and up to 16 KB at 16 Mbps, the early token release option at 16 Mbps and the mixture of INN and BNN traffic on the same TRA Type 2 port. TRA Type 1 (#4760) and TRA Type 2 (#4770) can coexist in the 3745 configuration.

3746 Token-Ring Processor (TRP) (#5600)

The TRP performs the logical link control function of a token-ring adapter for the 3746 Model 900. It controls one or two TIC3s, that is, one or two 16/4 Mbps IBM Token-Ring LANs. Two TIC3s on the same TRP can operate at different speeds. Up to 2000 physical units (PUs) can be active at the same time on a TRP, with any ratio of PU-sharing between the two driven TIC2. For the 3745 Model 41A and 61A, a TRP is required to couple the 3746 Model 900 to the CCU-B via a controller bus coupler (#5602). This TRP is placed at a fixed location (H), next to the basic controller bus and service processor, and drives the CBC and optionally a TIC3 that connects up to 500 active PUs. Maximum: Four, in combination with the ESCON Processors (#5500).

3745 Token-Ring Coupler Type 3 (TIC3) (#5601)

This feature provides attachment to one 16/4 Mbps IBM Token-Ring LAN. The TIC3 provides the MAC support of the token-ring adapter. In a 3745 Model 41A or 61A with two active ACF/NCPs, a TIC3 can be activated by one of the two ACF/NCPs and the second TIC3 associated with the same TRP can be activated by the second ACF/NCP. Maximum: Two per Token-Ring Processor (#5600), one for the TRP position H (SC 9604) of a 3746 Model 900 attached to a 3745 Model 41A or 61A. In this case, the TIC3 is in coupler position H,SC 8627.

1.13 AS/400 LAN Adapters

This section explains the features and functions currently available that allow the AS/400 to participate in a LAN environment. The AS/400 provides token-ring, Ethernet and FDDI attachment.

AS/400 16/4 Mbps Token-Ring Network Adapter/HP (#2619)

The 16/4 Mbps Token-Ring Network Adapter/HP feature provides a single attachment to either a 16 Mbps or a 4 Mbps IBM token-ring network. The feature consists of an adapter card, internal code which supplies IEEE 802.5 media access control (MAC) and IEEE 802.2 logical link control (LLC) functions, and an external 2.5 meter (8 foot) cable. The standard IBM cabling system patch cables can increase the length where necessary.

OS/400 configuration parameters are used to select either the 16 or 4 Mbps rate. Early token release can be enabled or disabled when the 16 Mbps rate is selected. These controls allow the customer to easily migrate from a 4 to a 16 Mbps token-ring network.

Feature #2619 is functionally equivalent to feature #2626. Feature #2619 is based on a faster microprocessor, providing up to three times the throughput of feature #2626. A maximum frame size of up to 16 KB is supported. Support of OS/400 Version 2 Release 2 is required.

I/O Card Slots Used: One

Maximum: Four per system on all supported models except the Models E80, E90, E95, F80, F90 and F95, which have a maximum of six. Refer to the 9406 LAN Feature Summary Chart in Table 5 on page 56.

Cables: One token-ring network attachment 2.5 meter (8 foot) cable is included with each token-ring adapter.

AS/400 16/4 Mbps Token-Ring Network Adapter/A (#2626)

The 16/4 Mbps Token-Ring Network Adapter/A feature provides a single attachment to either a 16 Mbps or a 4 Mbps IBM Token-Ring network. The feature consists of an adapter card, internal code, which supplies IEEE 802.5 media access control (MAC) and IEEE 802.2 logical link control (LLC) functions, and an external 2.5 meter (8 foot) cable. The standard IBM cabling system patch cables can increase the length where necessary.

OS/400 configuration parameters are used to select either the 16 or 4 Mbps rate. Early token release can be enabled or disabled when the 16 Mbps rate is selected. These controls allow the customer to easily migrate from a 4 to a 16 Mbps token-ring network.

Feature #2626 is functionally equivalent to feature #2636. Feature #2626 is based on a faster microprocessor, providing up to two times the throughput of feature #2636. A maximum frame size of up to 16 KB is supported.

I/O Card Slots Used: One

Maximum: For Models D35-D80, E35-E70 and F35-F70 - Four. Fpr Models E80-E95 and F80-F95 - Six. Refer to the 9406 LAN Feature Summary Chart in Table 5 on page 56.

Cables: One token-ring network attachment 2.5 meter (8 foot) cable

AS/400 16/4 Mbps Token-Ring Network Adapter (#2636)

The 16/4 Mbps Token-Ring Network Adapter feature provides a single attachment to a 16 Mbps or a 4 Mbps IBM Token-Ring network. The feature consists of an adapter card, internal code which supplies IEEE 802.5 media access control (MAC) and IEEE 802.2 logical link control (LLC) functions, and an external 2.5 meter (8 foot) cable. The standard IBM cabling system can increase the length where necessary.

OS/400 configuration parameters are used to select either the 16 Mbps or 4 Mbps rate. Early token release can be enabled or disabled when the 16 Mbps rate is selected. These controls allow the customer to easily migrate from a 4 to a 16 Mbps token-ring network.

Feature #2636 is based on the same microprocessor as feature #6240. The adapter (#2636) supports a maximum frame size of up to 8 KB. This increased frame size, along with other changes to the licensed internal code, provide improved performance during large file transfer operations. Short interactive workstation exchanges will see little response time improvement over the 4 Mbps IBM Token-Ring network subsystem (#6240).

I/O Card Slots Used: One

Maximum: For Models D35-D80, E35-E70, and F35-F60 - Four. For Models E80-E95 and F70-F95 - Six. Refer to the 9406 LAN Feature Summary Chart in Table 5 on page 56.

Cables: One token-ring network attachment 2.5 meter (8 foot) cable

AS/400 Ethernet/IEEE 802.3 Adapter/HP (#2617)

The Ethernet/IEEE 802.3 Adapter/HP provides a single attachment to one Carrier Sense Multiple Access/Collision Detect LAN. Feature #2617 offers enhanced performance when compared to feature #2625. This high-performance adapter uses a faster microprocessor and additional memory to provide up to six times the throughput of feature #2625. Support of OS/400 Version 2 Release 2 or later is required.

A 15-pin ″D″ connector provides a standard AUI for connection through an external transceiver. Transceivers which attach to 10Base-T (unshielded twisted pair), 10Base2 (Thin Ethernet), and standard Ethernet coaxial media can be obtained from an Ethernet supplier.

The feature consists of an adapter card and internal code which supplies Ethernet Version 2 and IEEE 802.3 media access control (MAC) plus IEEE 802.2 logical link control (LLC) functions. This adapter offers the customer a connection to Ethernet/IEEE 802.3 LANs, which support communications with both IBM and non-IBM products. Concurrent sessions with both Ethernet Version 2 and IEEE 802.3 stations are possible. These two CSMA/CD protocols are able to coexist on the same LAN but they cannot communicate with each other. This concurrent session capability of feature #2617 allows the 9406 to support a customer's staged migration from Ethernet Version 2 to the newer IEEE/802.3 LAN.

I/O Card Slots Used: One

Maximum: Four per system on all supported models except the Models E80, E90, E95, F80, F90 and F95, which have a maximum of six. Refer to the 9406 LAN Feature Summary Chart in Table 5.

Cables: The customer must procure the AUI cable which connects between the adapter and the Ethernet/IEEE 802.3 transceiver. This cable and the transceiver are not available from IBM, but can be obtained from an Ethernet supplier.

AS/400 Ethernet/IEEE 802.3 CSMA/CD LAN Adapter (#2625)

The Ethernet/IEEE 802.3 CSMA/CD LAN Adapter feature, available on 9406 D, E and F Models, provides a single attachment to one Ethernet Version 2 or one IEEE 802.3 Carrier Sense Multiple Access/Collision Detect LAN. The feature consists of an adapter card and internal code which supplies Ethernet Version 2 and IEEE 802.3 media access control (MAC) plus IEEE 802.2 logical link control (LLC) functions. The customer must procure the AUI cable which connects feature #2625 and the Ethernet/IEEE 802.3 transceiver. This feature offers the customer a direct connection to Ethernet/IEEE 802.3 LANs, which support communications with both IBM and non-IBM products. Concurrent sessions with both Ethernet Version 2 and IEEE 802.3 stations are possible. These two CSMA/CD protocols are able to coexist on the same LAN but they cannot communicate with each other. This concurrent session capability of feature #2625 allows the AS/400 system to support a customer's staged migration from Ethernet Version 2 to the newer IEEE/802.3 LAN.

I/O Card Slots Used: One

Maximum: For Models D35-D80, E35-E70 and F35-F70 - Four. For Models E80-E95 and F80-F95 - Six. Refer to the 9406 LAN Feature Summary Chart in Table 5.

Table 5 (Page 1 of 2). 9406 LAN Feature Summary Chart

System Model	#2619	#2626	#2636	#6240	#6242	#2617	#2625	#6250	MAX LANs
D35	F	F	F	S	S	F	F	S	4
E35	F	F	S	S	S	F	F	S	4
F35	F	F	S	S	S	F	S	S	4
D45	F	F	F	S	S	F	F	S	4
E45	F	F	S	S	S	F	F	S	4
F45	F	F	S	S	S	F	S	S	4
D50	F	F	F	S	S	F	F	S	4
E50	F	F	S	S	S	F	F	S	4
F50	F	F	S	S	S	F	S	S	4
D60	F	F	F	S	S	F	F	S	4
E60	F	F	S	S	S	F	F	S	4
F60	F	F	S	S	S	F	S	S	4

Table 5 (Page 2 of 2). 9406 LAN Feature Summary Chart									
System Model	**#2619**	**#2626**	**#2636**	**#6240**	**#6242**	**#2617**	**#2625**	**#6250**	**MAX LANs**
D70	F	F	F	S	S	F	F	S	4
E70	F	F	S	S	S	F	F	S	4
F70	F	F	S	S	S	F	S	S	6
D80	F	F	F	S	S	F	F	S	4
E80	F	F	S	S	S	F	F	S	6
F80	F	F	S	S	S	F	S	S	6
E90	F	F	S	S	S	F	F	S	6
F90	F	F	S	S	S	F	S	S	6
E95	F	F	S	S	S	F	F	S	6
F95	F	F	S	S	S	F	S	S	6

Notes:

- The maximum number of LANs for each system model reflects the total of all LAN features which can be installed on that model.
- F = Available as an orderable feature on these system models.
- S = Supported; not an orderable feature on this system model but may be brought along if upgrading from a previous model.
- All of the token-ring network features for the AS/400 system use the same 2.5 meter cable for connection to the token-ring. The standard IBM cabling system patch cables can increase the length where necessary.
- The High-Performance Token-Ring Adapter (#2619) should be ordered where 9406 system LAN bandwidth demand is expected to exceed 1-4 Mbps. This range assumes a random transaction mix consisting of both short interactive exchanges and large file transfers. The low end of the range applies when short exchanges represent most of the LAN traffic. Below these thresholds, feature #2626 should offer acceptable performance at a lower price.
- The high-performance Ethernet adapter (#2617) should be ordered when 9406 system LAN bandwidth demand is expected to exceed .3-1 Mbps. This range assumes a random transaction mix consisting of both short interactive exchanges and large file transfers. The low end of the range applies when short exchanges represent most of the LAN traffic. Below these thresholds feature #2625 should offer acceptable performance at a lower price.

AS/400 Fiber Distributed Data Interface Adapter (#2618)

This feature provides one interface to connect an AS/400 system to an FDDI LAN which complies with ANSI X3T9.5 and ISO 9314 standards. Feature #2618 consists of a card, a wrap connector and Licensed Internal Code which supplies IEEE 802.2 logical link control (LLC), ANSI X3T9.5/ISO 9314 MAC functions, and ANSI X3T9.5 station management (SMT) functions (draft Version 7.2 level which is compatible with Version 6.2). OS/400 configuration parameters are used to select whether the adapter operates as a SAS, a DAS or a dual-homing station. An interface is provided which can be used to connect through and control an optical bypass switch. A maximum frame size of 4 KB is supported. OS/400 Version 2 Release 3 or later is required, which provides support for SNA communications.

Refer to *IBM FDDI Network Introduction and Planning Guide*, GA27-3892 for an introduction to FDDI concepts, descriptions of IBM FDDI components and information for planning and installing IBM FDDI networks on optical fiber media.

I/O Card Slots Used: One

Maximum: For Models D35, D45, E35, E45, F35 and F45 - One. For Models D50-D80, E50-E95, F50-F95 - Two. Refer to 9406 LAN Feature Summary Chart in Table 5 on page 56.

Cables: The FDDI adapter requires multimode (62.5/125 micron) FDDI optical fiber jumper cables to connect the adapter into the FDDI ring. These jumper cables are not provided with this feature. Jumper cables are the responsibility of the customer and may be ordered from your local authorized IBM cabling distributor or by calling 1-800-IBM-2468 in the United States. For EMEA customers, cables are available from Montpellier through CE offerings. For more information about the jumper cables, planning, design and installation of optical fiber cabling systems, refer to the IBM publication *IBM Cabling System Optical Fiber Installation and Planning Guide,* GA27-3943.

AS/400 Shielded Twisted-Pair Distributed Data Interface Adapter (#2665)

This feature provides one interface to connect an AS/400 system to an FDDI LAN which is constructed of IBM cabling system Type 1, 2, 6, or 9 shielded twisted pair wiring. Feature #2665 consists of a card, a wrap connector and licensed internal code which supplies IEEE 802.2 logical link control (LLC), ANSI X3T9.5/ISO 9314 media access control (MAC) functions, and ANSI X3T9.5 station management (SMT) functions (draft Version 7.2 level which is compatible with Version 6.2). OS/400 configuration parameters are used to select whether the adapter operates as a single attaching station (SAS), a dual attaching station (DAS) or a dual-homing station. A maximum frame size of 4 KB bytes is supported. OS/400 Version 2 Release 3 or later is required, which provides support for SNA communications.

Refer to the IBM publication GA27-3892, *IBM FDDI Network Introduction and Planning Guide*, GA27-3892, for an introduction to FDDI concepts, descriptions of IBM FDDI components and information for planning and installing IBM FDDI networks on shielded twisted pair copper media.

1.13.1 6611 Communication Adapter Features

The following are the six different types of communication adapter features available for the IBM 6611 Network Processor:

- Multi-Interface Serial Adapter, feature #2640
- 6611 2-Port V.35/V.36 Compatible Serial Adapter, feature #2650
- IBM 6611 Token-Ring Network 16/4 Adapter, feature #2660
- 6611 Ethernet Adapter, feature #2680
- 6611 4-Port SDLC Adapter, feature #2720
- 6611 X.25 Adapter, feature #2730
- 4-port multi-interface serial adapter
- 2-port token-ring network 16/4 adapter
- 2-port Ethernet adapter

- Multi-interface serial/token-ring combination adapter
- Multi-interface serial/Ethernet combination adapter
- 2-port multi-interface serial adapter
- 1-port token-ring network 16/4 adapter
- 1-port Ethernet adapter

The first four communication adapter features listed (#2640, #2650, #2660, #2680) share a similar design which incorporates a RISC processor with memory on each adapter. These adapters are able to perform adapter-to-adapter transfers without direct intervention of the system processor through the exploitation of the IBM Micro Channel architecture. Additionally, these adapters are able to process network layer and data link layer protocols within the adapter using the RISC processor and memory contained on each adapter.

The combination of these two features (adapter-to-adapter transfers, and protocol processing within the adapter) enable high levels of performance to be achieved. This is because the processing of routing and bridging functions is distributed between, potentially, many RISC processors.

The remaining two communication adapter features (#2720, #2730) are *shallow* adapters which require interaction with the system processor for most functions. This is consistent with the relatively low-speed (up to 64 Kbps) communication interfaces provided by these adapters.

Multiple instances of each type of communication adapter feature can be used up to the maximums listed in Table 6. However, the total number of communication adapter features (all types) cannot exceed four for the 6611 Network Processor Model 140 or seven for the 6611 Network Processor Model 170.

Table 6. Maximum Communication Adapters and Interfaces by Type

Adapter Type	**6611-140**		**6611-170**	
	Adapters	**Interfaces**	**Adapters**	**Interfaces**
Multi-Interface Serial Adapter	4	8	7	14
6611 2-Port V.35/V.36 Compatible Serial Adapter	4	8	7	14
IBM 6611 Token-Ring Network 16/4 Adapter	4	4	7	7
6611 Ethernet Adapter	4	4	7	7
6611 X.25 Adapter	4	4	4	4
6611 4-Port SDLC Adapter	3	12	6	24

Each of the IBM 6611 Network Processor communication adapter features are described in more detail in the following sections.

Multi-Interface Serial Adapter (#2640)

The Multi-Interface Serial Adapter provides two independent synchronous serial communication interfaces. These interfaces are supported at speeds between 19.2 Kbps and 2.048 Mbps, with a maximum aggregate speed of 3.072 Mbps across both interfaces. Each interface can attach to DCEs that provide either an

EIA RS-422/RS-449 or a CCITT X.21 physical interface with a continuous clock. Except for the types of DCE physical interfaces supported, the Multi-Interface Serial Adapter is identical in function to the 6611 2-Port V.35/V.36 Compatible Serial Adapter.

Note: The RS-422/RS-449 interface provided by the Multi-Interface Serial Adapter does not provide the Request To Send signal, nor does it monitor the Clear To Send signal. This may cause problems when using DCEs that require a valid Request To Send signal. These problems can usually be solved by providing a valid Request To Send signal via some other means.

In countries where T1 common carrier services are available, a DSU/CSU (Data Services Unit/Channel Services Unit) is normally used as the DCE. The DSU/CSU must generate the additional framing bits needed to utilize the 1.544 Mbps interface used with T1 services, while providing a continuous clock to the IBM 6611 Network Processor at 1.536 Mbps. Both interfaces of the Multi-Interface Serial Adapter can be used concurrently at such speeds as the aggregate speed across both interfaces does not exceed 3.072 Mbps (2 x 1 .536 Mbps).

In some countries where E1 common carrier services are available, IBM has announced the IBM 6629 RS449/G.703 2.048 Mbps Interface Converter, which can be used as the DCE. It provides conversion between a CCITT G.703 clear channel inter′ face used with the E1 service and the EIA RS-422/RS-449 interface that can be used by the IBM 6611 Network Processor. If one interface of the Multi-Interface Serial Adapter is used at 2.048 Mbps, the other interface must be used at a lower speed so that the aggregate speed across both interfaces does not exceed 3.072 Mbps.

Each interface of the Multi-Interface Serial Adapter can support one of three data link protocols:

- PPP (Point-to-Point Protocol)
- Frame Relay (permanent virtual circuits only)
- The protocol implemented by the IBM Token-Ring Network Bridge Program Version 2.2 when used as one-half of a remote bridge

Each Multi-Interface Serial Adapter requires up to two DCE interface cables appropriate to the type of DCE interface in use. The available DCE interface cables are:

6611 Serial Adapter Cable, feature #2645 (EIA RS-422/RS-449 DCE Interface)
6611 SDLC Adapter CCITT X.21 Cable, feature #2729

6611 2-Port V.35/V.36 Compatible Serial Adapter (#2650)

The 6611 2-Port V.35/V.36 Compatible Serial Adapter provides two independent synchronous serial communication interfaces. These interfaces are supported at speeds between 19.2 Kbps and 2.048 Mbps, with a maximum aggregate speed of 3.072 Mbps across both interfaces. Each interface can attach to DCEs that provide either a CCITT V.35 or a CCITT V.36 physical interface with a continuous clock. Except for the types of DCE physical interfaces supported, the 6611 2-Port V.35/V.36 Compatible Serial Adapter is identical in function to the Multi-Interface Serial Adapter.

Note: The 6611 2-Port V.35/V.36 Compatible Serial Adapter is only available in some countries. An IBM representative should be consulted to determine the availability of the 6611 2-Port V.35/V.36 Compatible Serial Adapter in a particular country.

Each interface of the 6611 2-Port V.35/V.36 Compatible Serial Adapter can support one of three data link protocols:

- PPP (Point-to-Point Protocol)
- Frame Relay (permanent virtual circuits only)
- The protocol implemented by the IBM Token-Ring Network Bridge Program Version 2.2 when used as one half of a remote bridge

Each 6611 2-Port V.35/V.36 Compatible Serial Adapter requires up to two DCE interface cables appropriate to the type of DCE interface in use. The available DCE interface cables are the following:

6611 V.35 Compatible Serial Adapter Cable, feature #2655
6611 V.36 Compatible Serial Adapter Cable, feature #2657

IBM 6611 Token-Ring Network 16/4 Adapter (#2660)

The IBM 6611 Token-Ring Network 16/4 Adapter provides a single interface to either a 4 Mbps or 16 Mbps IBM Token-Ring Network.

Each IBM 6611 Token-Ring Network 16/4 Adapter requires one 6611 Token-Ring Network Adapter Cable, feature #2665.

6611 Ethernet Adapter (#2680)

The 6611 Ethernet Adapter provides a single interface to a 10 Mbps CSMA/CD (Carrier Sense Multiple Access/Collision Detection) local area network using either IEEE 802.3 or DIX Ethernet V2 frame formats.

Each 6611 Ethernet Adapter requires an AUI (Attachment Unit Interface) cable, and a transceiver suitable for the type of Ethernet cabling in use.

6611 4-Port SDLC Adapter (#2720)

The 6611 4-Port SDLC Adapter provides four independent synchronous serial communication interfaces that only support the use of SDLC data link protocols.

Each port of the 6611 4-Port SDLC Adapter provides the following different DCE physical interface attachment capabilities:

Port 0 Supports EIA RS-232D/CCITT V.24, CCITT V.35 or CCITT X .21
Port 1 Supports EIA RS-232D/CCITT V.24 or CCITT V.35
Port 2 Supports EIA RS-232D/CCITT V.24
Port 3 Supports EIA RS-232D/CCITT V.24

DCEs providing a CCITT V.35 or CCITT X.21 physical interface are supported at speeds up to 64 Kbps. DCEs providing an EIA RS-232D/CCITT V.24 physical interface are supported at speeds up to 19.2 Kbps.

Each 6611 4-Port SDLC Adapter requires one 6611 SDLC Adapter Interface Cable, feature #2723, and up to four DCE interface cables appropriate to the DCE interfaces in use. The available DCE interface cables are :

6611 SDLC Adapter EIA RS-232D/CCITT V.24 Cable, feature #2725
6611 SDLC Adapter CCITT V.35 Cable, feature #2727

6611 SDLC Adapter CCITT X.21 Cable, feature #2729

6611 X.25 Adapter (#2730)

The 6611 X.25 Adapter provides a single serial communication interface that supports the use of CCITT X.25 protocols using either permanent or switched virtual circuits. The interface can attach to DCEs that provide either an EIA RS-232D/CCITT V.24, CCITT V.35 or CCITT X.21 physical interface.

DCEs, providing CCITT V.35 or CCITT X.21 physical interface , are supported at speeds up to 64 Kbps. DCEs providing an EIA RS-232D/CCITT V.24 interface are supported at speeds up to 19.2 Kbps.

Each 6611 X.25 Adapter requires one DCE interface cable appropriate to the DCE interface in use, which can be any one of the following:

6611 X.25 adapter EIA RS-232D/CCITT V.24 Cable - 3 Meter, feature #2977
6611 X.25 Adapter EIA RS-232D/CCITT V.24 Cable - 6 Meter, feature #2978
6611 X.25 Adapter CCITT V.35 Cable - 3 Meter, feature #2987
6611 X.25 Adapter CCITT V.35 Cable - 6 Meter, feature #2988
6611 X.25 Adapter CCITT X.21 Cable - 3 Meter, feature #2975
6611 X.25 Adapter CCITT X.21 Cable - 6 Meter, feature #2976

Chapter 2. Hubs

Industry trends show a dramatic increase in the use of intelligent workstations such as notebooks, portable computers, and desktop computers. Important information is being moved from mainframes to these machines to provide efficient and cost-effective client/server functions.

This changing information infrastructure requires faster and more reliable access to data, which in turn drives new applications based on multimedia, incorporating voice, data, and video. Local area networks are part of this emerging technology.

2.1 What Are Hubs?

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 several LAN types such as Ethernet, token-ring, FDDI, ATM, and the newer 100Base-T and 100VG-AnyLAN technologies.

Typically, the hub acts as a multiport repeater with the total bandwidth being limited by the transport protocol: Ethernet at 10 Mbps, token-ring at 4 and 16 Mbps, FDDI at 100 Mbps, and ATM at 25, 52, 100 and 155 Mbps.

Hubs interface with universal cabling systems, which offer a blend of flexibility and reliability for today′s growing interconnection needs. Support is generally provided for all types of cabling, including thin and thick coaxial, optical-fiber, shielded twisted pair (STP), and unshielded twisted pair (UTP).

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.

Many communications equipment vendors offer hub distribution systems which fall into two major categories; multiprotocol hubs and workgroup hubs.

Multiprotocol Hubs: Multiprotocol hubs usually accommodate extra features like 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 less capabilities than multiprotocol hubs. Many of the hubs described in this book can, for example, perform error detection and recovery and provide flexible configuration options.

The latest interconnection strategies incorporate the intelligent wiring closet concept, which extends the reach of network management down to the port level. Each vendor supports its own proprietary network management system to control and monitor these hubs from the network control center. 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.

2.2 IBM′s Workgroup Hubs

The focus of this book, as indicated by its title, is on workgroup hubs and switches. The following chapters will describe in detail IBM′s offerings in workgroup hubs and switches.

At the time of writing, the following workgroup hubs are available from, or announced by, IBM:

- 8222 Nways Ethernet Workgroup Hub
- 8224 Ethernet Stackable Hub
- 8226 Token-Ring RJ-45 Connection
- 8228 Token-Ring Multistation Access Unit (MAU)
- 8230 Token-Ring Controlled Access Unit (CAU)
- 8238 Token-Ring Stackable Hub
- 8240 FDDI Concentrator
- 8244 FDDI Workgroup Concentrator
- 8250 Multiprotocol Intelligent Hub
- 8260 Multiprotocol Intelligent Switching Hub
- 8281 ATM LAN Bridge
- 8282 Turboways ATM Concentrator

This wide range of hub products represent IBM′s commitment to the workgroup interconnectivity arena. IBM′s introduction of these standards-based products demonstrates the company′s commitment to supporting technologies other than its own; a necessity in today′s enterprise networks that consist of a variety of multivendor communications hardware and software.

Table 7 on page 65 compares IBM′s hubs with each other to help you position and place them in a network environment.

Table 7 (Page 1 of 2). Comparison of IBM's Hubs

Model	Token-Ring	Ethernet	FDDI	ATM	Nr. of Lobe Ports		Unmanaged	Managed		Graphical Management Platforms
					Min.	Max.		SNMP	CMOL	
8222-008		X			6	7	X			
8222-016		X			16	18	X			
8224-001		X			16	17	X but manageable			Windows, NV for Windows, Novell NMS, NV for AIX
8224-002		X			16	17		X		Windows, NV for Windows, Novell NMS, NV for AIX
8226	X				8	8	X			
8228	X				8	8	X			
8230-001	X				20	80			X	LNM for OS/2, LNM for AIX
8230-002	X				20	80			X	LNM for OS/2, LNM for AIX
8230-003/013	X				0	80		X	X	NV for Windows, LNM for OS/2, LNM for AIX
8244-12F/12S/12U			X		12	12		X		LNM for AIX
8250	X	X	X		2	384		X		Windows, NV for Windows, NV for AIX

Table 7 (Page 2 of 2). Comparison of IBM's Hubs

Model	**Token-Ring**	**Ethernet**	**FDDI**	**ATM**	**Nr. of Lobe Ports**		**Unmanaged**	**Managed**		**Graphical Management Platforms**
					Min.	**Max.**		**SNMP**	**CMOL**	
8260	X	X	X	X	2	600		X		Windows, NV for Windows, NV for AIX
8282-001				X	8	12		X		Windows, NV for Windows, NV for AIX

The following sections deal with each of IBM′s workgroup hubs in turn, except the 8250 and 8260 multiprotocol hubs.

2.3 IBM Nways 8222 Ethernet Workgroup Hub

The IBM Nways 8222 Ethernet Workgroup Hubs are a family of unmanaged IEEE 802.3 (Ethernet) low-end, low-cost concentrators. The IBM Nways 8222 family of hubs is intended for installations that do not require SNMP network management. These hubs are available in two models: 8222-008, containing eight 10Base-T ports, and 8222-016, containing sixteen 10Base-T ports. The 8222 6-Port 10Base-T Workgroup Hub has been withdrawn by IBM, and will therefore not be discussed in this document.

The primary function of the Nways hubs is to provide an economical means for devices to be connected over unshielded twisted pair cabling and 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 via cascading over a variety of media (10Base-T, 10Base2 thin coax, 10Base5 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.

2.3.1 Technical Description

The IBM Nways 8222 is designed as a customer setup (CSU) product. It consists of logic circuit board(s) and an internal modular power supply mounted in a protective metal enclosure. The unit is connected to the power source via a standard, detachable three-conductor power attachment cord. The 8222 has the following features:

- Cascadable for large networks through AUI, BNC or 10Base-T ports
- Port auto-partitioning capability

  The IBM Nways 8222 will partition (disable) a port (AUI, BNC or 10Base-T) from further transmissions to the network if either of the following conditions occur:

  – 32 consecutive collision-causing frames are received
  – Collision conditions existing continuously for a time between 1024 and 2048 bit-times

  While the port is disabled, transmissions *from* the network *to* that device are maintained. The port is re-enabled when a clean (non-colliding) transmission is received from or sent to that port.

- Jabber protection

  – The IBM Nways 8222 disables transmission when a node transmits continuously for 65.5 milliseconds (65536 bit-times).
  – Transmission is re-enabled and normal operation resumes after 96 bit-times.

- Automatic polarity reversal detection and correction on 10Base-T ports (hub receive pair only)
- Status information LEDs

- Internal auto-ranging power supply (the internal DC power supply will operate over the expected world-wide range of utility voltages and frequencies).

2.3.1.1 8222 Models 008 and 016

Model	Number of Stations Attached	Number of 10Base-T Ports	AUI Port	BNC Port	Uplink Port
008	Up to 9	8	Yes	Yes	Yes
016	Up to 18	16	Yes	Yes	Yes

Note: With the 8222 Model 008, you cannot use both the AUI port and the BNC port at the same time.

Figure 14 and Figure 15 on page 69 show the front panel of the IBM Nways 8222 Model 008 and Model 016 Ethernet Workgroup Hubs.

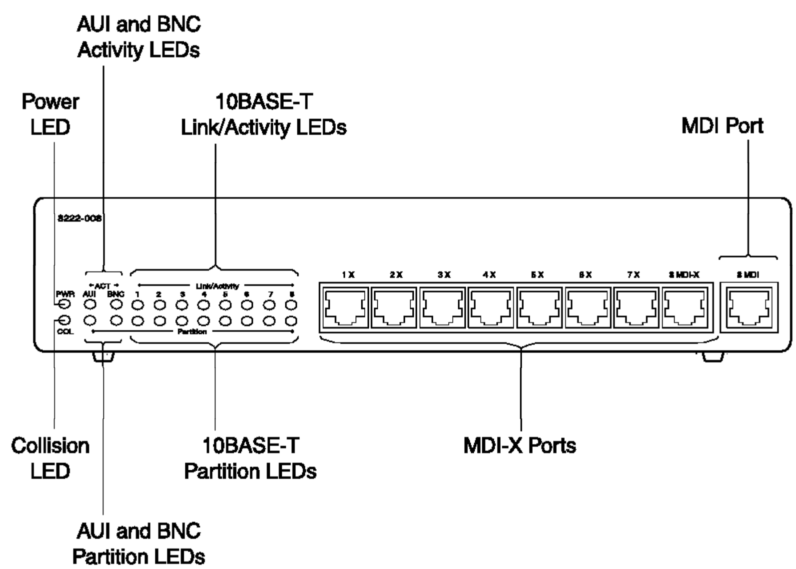


Figure 14. 8222 Model 008 Ethernet Workgroup Hub

The Model 008 consists of the following:

1. Eight MDI-X (Media Dependent Interface-Crossed) 10Base-T network ports
2. One MDI 10Base-T port
   - Alternate to port 8; does not have receive/transmit pair reversal
   - Useful for cascading without the need for crossover cables
3. One AUI port
4. One 10Base2 (BNC) Port
   - The AUI and BNC ports cannot be used concurrently.
5. AUI/BNC Switch
   - Determines which port is active

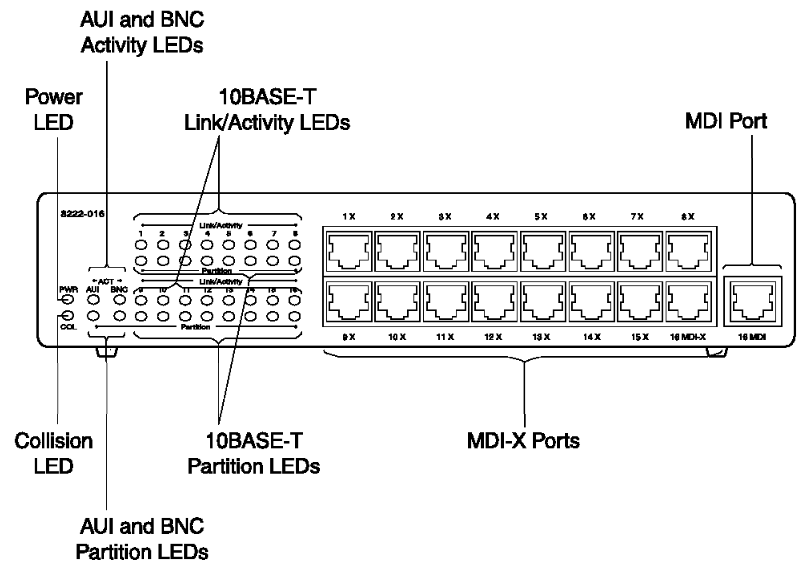


Figure 15. 8222 Model 016 Ethernet Workgroup Hub

The Model 016 consists of the following:

1. Sixteen MDI-X 10Base-T network ports
2. One MDI 10Base-T port
   - Alternate to port 16; does not have receive/transmit pair reversal
   - Useful for cascading without the need for crossover cables
3. One AUI port
4. One 10Base2 (BNC) port
   - Both the AUI and BNC ports can be used at the same time.

Figure 16 shows the 8222's rear interface panel.

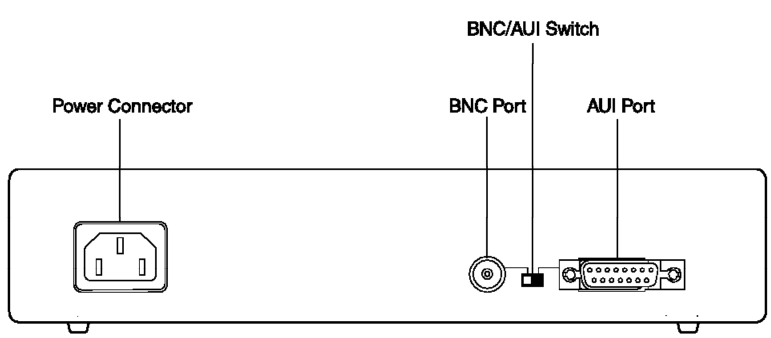


Figure 16. 8222 Rear Interface

2.3.1.2 Operation Interface

The operation features of the Nways 8222 hubs consist of port indicators, unit indicators, and an AUI/BNC selector switch.

Port and Unit Status LEDs

• Per 10Base-T port	Link/Activity Partition
• AUI port	Activity Partition
• BNC port	Activity Partition
• Hub	Power Collision

AUI/BNC Selector Switch (Model 008 only): The slide switch on the rear of the 8222-008 unit selects which port, AUI or BNC, will be active.

2.3.1.3 Cable Interface

The cable interface of the IBM Nways 8222 Workgroup Hub includes the following items:

1. The power inlet connector is a standard appliance inlet, 250 Volt, 6 Ampere (CEE 22).
2. 10Base-T port connectors are standard eight-position RJ-45 modular interface receptacles as described in FCC Rules 68.5, Subpart J, non-keyed.
3. AUI Port - A 15-pin D-Shell socket connector is as specified in IEC 807-2.
4. BNC Port - A standard BNC connector as specified in IEC 169-8.

2.3.2 Configuration

Installation of the 8222 Hub requires the following steps:

1. Preparation
   - Read the information in Chapter 1 of the *8222 Nways Ethernet Workgroup Hubs Installation and Planning Guide*, GA27-4079.
   - Collect the necessary cables. In most cases, only straight-through cables will be needed.
   - Review documentation of the network topology to become familiar with the hub′s position in the network.
2. Connect devices (such as personal computers) to the hub by following the instructions in ″Connecting Devices to the Nways Workgroup Hub″ on page 2-4 of the *8222 Nways Ethernet Workgroup Hubs Installation and Planning Guide*, GA27-4079.
3. If the hub will be connected to another Nways workgroup hub or another type of 10Base-T hub, follow the instructions under ″Connecting the Nways Workgroup Hub to Another 10Base-T Hub″ on page 2-8 of the *8222 Nways Ethernet Workgroup Hubs Installation and Planning Guide*, GA27-4079.

2.3.3 Cabling Examples and Specifications

The IBM Nways 8222 10Base-T ports support the IEEE standard drive distances for transmission of IEEE 802.3 10Base-T signals over UTP, STP, and FTP cabling.

The 8222 supports the following drive distances:

- The 10Base-T ports will drive up to 100 meters over 100-Ohm UTP EIA 568 Category 3, 4, or 5 cables, 100-Ohm or 120-Ohm FTP Category 5 media, or 150-Ohm STP type 1, 6, 9, 1A, 6A, or 9A cables. The 150-Ohm cabling requires impedance matching baluns at each end of the 150-Ohm portion of the link.
- The AUI port will drive up to 50 meters over AUI cable. At the end of the AUI cable, an AUI transceiver is required to connect to network media such as thick coax or optical fiber.
- The BNC port will drive up to 185 meters over coax cable. This port requires a T-connector (provided with the 8222) to connect to coax cabling.

Note: The Nways workgroup hub supports outdoor cable runs only over optical fiber cabling. Ethernet connections over copper cables are restricted to indoor wiring only.

Figure 17 shows the IBM Nways 8222 Workgroup Hub in a typical network configuration of two small workgroups, located closely to each other via UTP cabling.

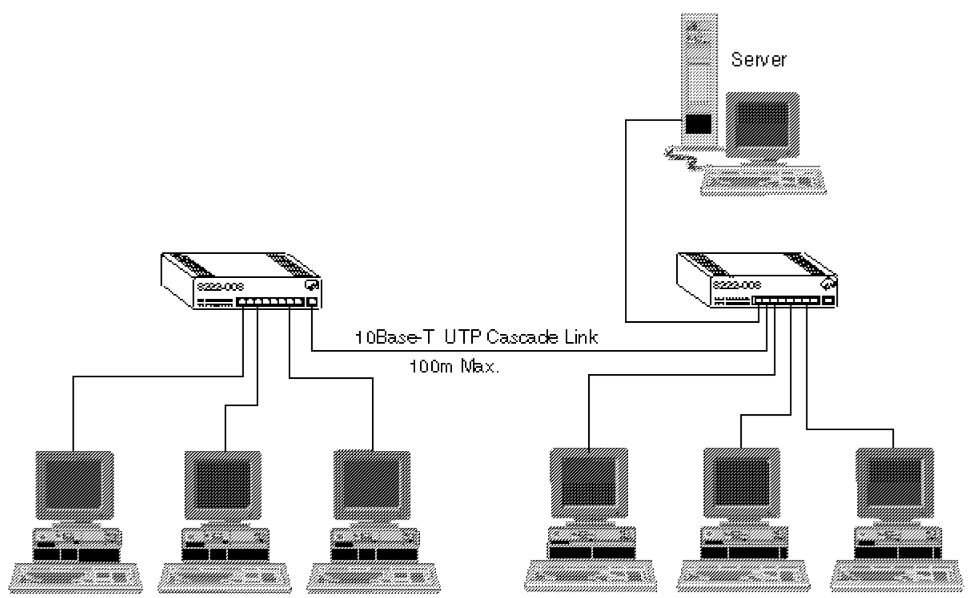


Figure 17. 8222 in a Typical IEEE 802.3 Network

2.3.3.1 Using Nways Workgroup Hubs in 10Base-T Networks

Using a single Nways Workgroup Hub Model 008, you can build a 10Base-T network that consists of 2 to 9 devices.

A single Nways Workgroup Hub Model 016 can be used to build a network that consists of 2 to 18 devices.

An Nways workgroup hub can be connected to other Nways workgroup hubs and other types of 10Base-T hubs through its 10Base-T ports, which is known as *cascading*. Figure 18 on page 72 illustrates a cascaded configuration.

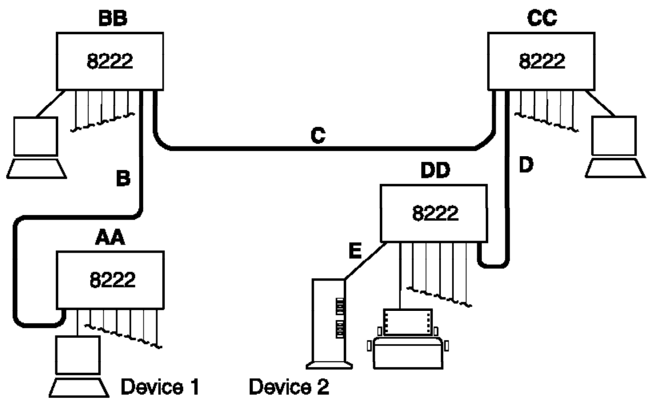


Figure 18. Building a 10Base-T Network with Cascaded 8222 Workgroup Hubs

You can build cascaded 10Base-T networks larger than the one illustrated in Figure 18. For example, instead of connecting devices (such as personal computers) to BB and CC, you could connect additional Nways workgroup hubs, AA and DD. However, remember that no more than four hubs can be in a path between devices.

Note: The UTP connections, B, C, and D between the hubs can have a maximum distance of 100 meters.

If the number of devices that will be connected to the 10Base-T network exceeds the number that you can accommodate using cascaded Nways workgroup hubs, consider dividing the network into two or more collision domains and connecting the domains with bridges, switches, or routers.

2.3.3.2 Using Nways Workgroup Hubs in Mixed Networks

As discussed earlier, an Nways workgroup hub can be attached to other types of networks through its AUI and BNC ports. In Figure 19 on page 73, the Nways workgroup hubs are connected to either a 10Base5 or 10Base2 segment.

Note: The maximum segment length of the 10Base5 cable is 50 meters, and 185 meters for the 10Base2 cable.

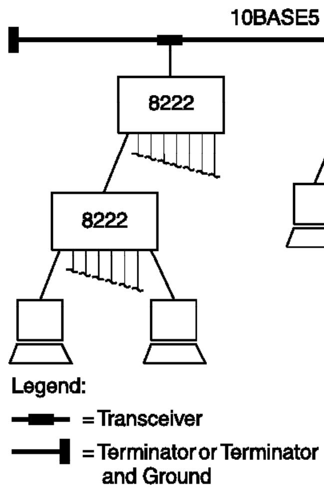


Figure 19. 8222 Hubs in a Network with Coaxial Segments

The workstations are attached to the 8222 hubs via UTP, in the above scenario.

In Figure 20, the Nways workgroup hubs are connected to 10Base5 segments, B and D, and fiber is used to interconnect those segments. The maximum segment length of this fiber connection, C, is two kilometers.

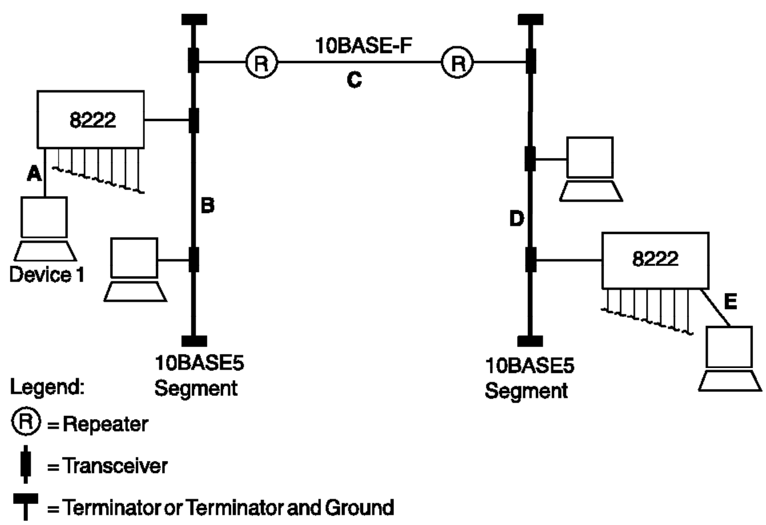


Figure 20. 8222 Hubs in a 10Base5 and Fiber Network

In Figure 21 on page 74, the Nways workgroup hubs are connected via fiber. The maximum segment length of this fiber connection is two kilometers.

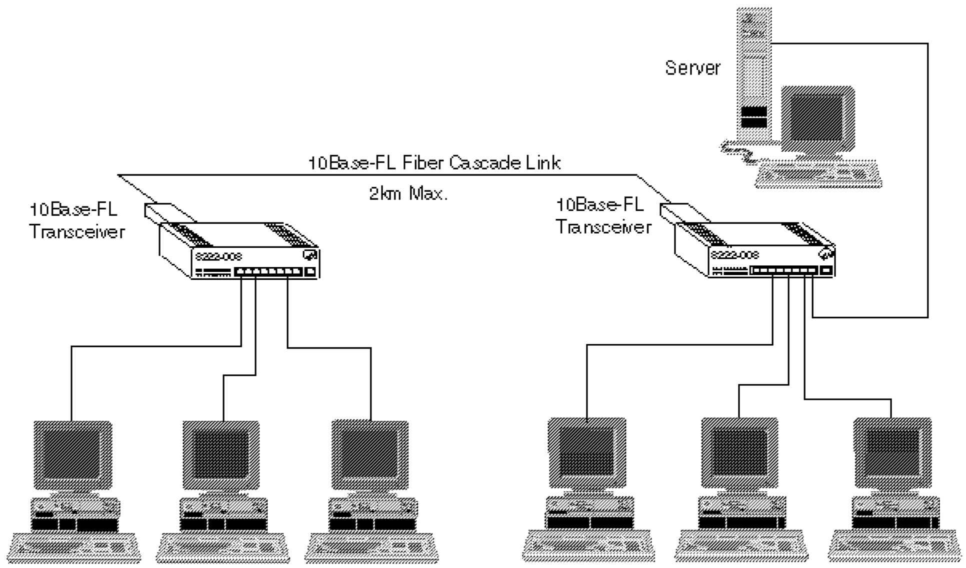


Figure 21. 8222 Hubs Connected with Fiber

The workstations are attached to the 8222 hubs with UTP, in the figure above.

Remember the following guidelines when using Nways workgroup hubs in networks that contain different cabling types:

- Adhere to any network constraints described in your 10Base5, 10Base2, or 10Base-F product documentation.
- Ensure that adding an Nways workgroup hub to a coaxial or optical fiber segment will not cause the maximum device limit to be exceeded.
- A path between two devices should not contain a 10Base2 segment between two 10Base5 segments.

2.3.3.3 Cabling Requirements

Problems with LANs are frequently due to incorrect cabling. So that your Ethernet network will operate as intended, take care in selecting the cabling and ensure that it is correctly installed.

10Base-T Cabling Specifications: Refer to pages 4-9 to 4-19 of the *IBM 8222 Nways Ethernet Workgroup Hubs Installation and Planning Guide*, GA27-4079, which details the specifications for cables and connectors used in 10Base-T link segments.

2.3.4 Management

The IBM Nways Ethernet Workgroup Hub provides limited network management and troubleshooting capability. The 8222 provides for automatic partitioning (disabling) of any of its ports connected to a device that generates repeated collisions, re-enabling that port when the condition clears. The 8222 also automatically detects and corrects for polarity reversals on cables connected to its 10Base-T ports (repeater receive pair).

The 8222 contains status LEDs for power (of the 8222), collision and activity on the Ethernet network.

Troubleshooting tips are provided in the *IBM 8222 10Base-T Workgroup Hub Installation Instructions and Planning Guide*, GA27-4079, shipped with every 8222.

2.3.5 Positioning

The IBM Nways 8222 Ethernet Workgroup Hubs provide an ideal Ethernet networking solution for those requiring a low-cost, unmanaged hub. The 8222 provides connection for up to eighteen workstations in an Ethernet network and provides limited network management capability. Some examples where small Ethernet LANs are useful include classrooms, small businesses (grocery stores, travel agencies, doctors′ offices, etc.), branch offices (of savings and loans, banks, and insurance companies), and departmental workgroups.

The IBM Nways 8222 has an unusually rich set of features which puts it in the highest tier of these small workgroup hubs. These are:

1. Integral auto-ranging power supply.
   - Supports world-wide voltage/frequency needs
   - No external brick power transformer
2. Provides both AUI and 10Base2 BNC ports. On the 16-port version these can be used concurrently, making it an 18-port hub.
3. A separate MDI port (wired in parallel with the last 10Base-T port).
   - Makes cascading between hubs easy. No need for special crossover cables.
4. Clean operator interface.
   - LEDs and 10Base-T ports are both on front side.
5. Full complement of LED indicators for all ports, including AUI and BNC ports.

The IBM Nways 8222 Ethernet Workgroup Hubs can be used to connect department or workgroup LANs to corporate enterprise networks. For those customers desiring to connect a larger number of workstations to the Ethernet network, or for those customers that desire more extensive network management capability, the IBM 8250 Multiprotocol Intelligent Hub or the IBM 8260 Multiprotocol Intelligent Switching Hub should be used for Ethernet concentration. The IBM Nways 8222 Ethernet Workgroup Hubs can be used with the IBM 8260 or 8250 hubs and the IBM 6611 Router to provide enterprise-wide connectivity for corporations.

The structure of IBM′s Ethernet hub family, with the 8222, is compared in Table 8.

Table 8. IBM Ethernet Hub Comparison

Customer Requirement	Ethernet Hub
Unmanaged and unmanageable	8222 Models 008, 016
Unmanaged but manageable	8224 Model 001
Managed single protocol	8224 Model 002
Managed multiple protocol	8250, 8260

2.4 IBM 8224 Ethernet Stackable Hub

The 8224 provides a flexible and comprehensive Ethernet network connectivity and management tool for a wide range of environments. Each 8224 provides up to 17 ports of Ethernet connectivity: sixteen 10Base-T ports and one optional media expansion port for connecting to an existing 10Base2, 10Base5, or fiber Ethernet network.

The 8224 is available in two models; Model 001 and 002. Model 001 is an unmanaged unit that can be managed by an 8224 Model 002 in a stack. Model 002 is an SNMP management unit that can manage up to nine Model 001s in a stack. Up to ten 8224s can be stacked together, for a total port count of 170. Stacked units can be separated by a distance of up to 250 feet.

In addition to the stackable function, the 8224 does the following:

- Supports segmentation. The 8224 stack can be divided into several segments (collision domains). Stacked 8224s can be segmented while maintaining management capability through a single management unit (Model 002). The minimum segment size is one hub as a single hub cannot be segmented.
- Supports 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. IS managers can dial up a remote site or branch office and receive the management information from the 8224 at that site.
- Supports MIB-II (RFC 1213), the hub repeater MIB (RFC 1516), and the Novell Repeater MIB through the SNMP agent. These MIBs are open and can be managed by most DOS or AIX network management applications, including NetView for AIX.
- Supports SNMP over IP and IPX. The 8224 can be managed by an SNMP network management station running in a TCP/IP network or via Novell′s NetWare Management Station.
- Provides for redundant links between 10Base-T port pairs via the IBM MIB extensions.
- Provides for redundant management units (Model 002s) in the stack.

2.4.1 Technical Description

This section provides a technical overview of the 8224 Ethernet Stackable Hub.

Figure 22 on page 77 shows the front panel of both 8224 models. The hardware features include an operator panel indicating the following:

- Sixteen 10Base-T Ports
- Media Expansion Port
- Communications Port
- Hub Expansion Port
- Port and Machine status LEDs
- Uplink Switch
- Power On/Off Switch

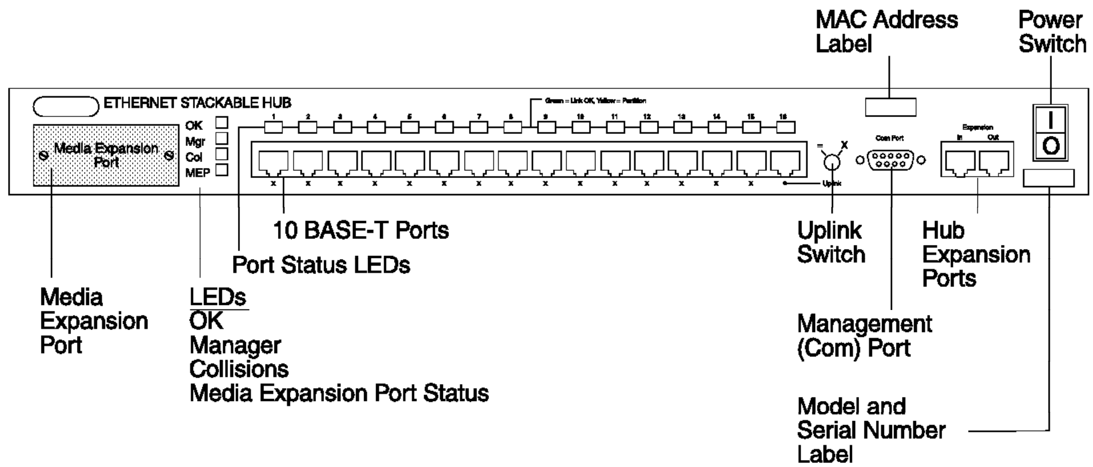


Figure 22. IBM 8224 Model 001 and 002 Front Panel

2.4.1.1 Connectivity Features

Below is a description of the 8224′s connectivity features:

- Media Expansion Port (MEP)

  This port can be used as the 17th port or for cascading to another Ethernet network. The available pluggable expansion port module options are:

  – IBM 8224 AUI Media Expansion Port Module (f/c 9730) provides a standard DB-15 connector for an AUI cable or transceiver.

  – IBM 8224 10Base2 Media Expansion Port Module (f/c 9731) provides a standard BNC connector for coax (ThinNet).

  – IBM 8224 Optical Fiber Media Expansion Port Module (f/c 9732) provides standard ST connectors to support both FOIRL and 10Base-FL over fiber media (50/125µm, 62.5/125µm, 100/140µm).

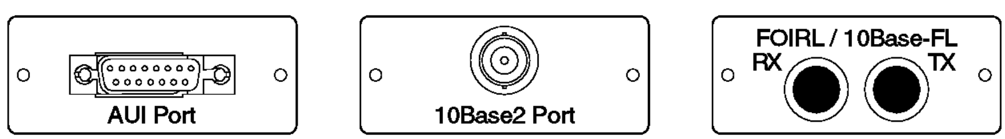


Figure 23. Front Views of 8224 Media Expansion Port Modules

- 10Base-T Ports

  Sixteen ports with shielded RJ-45 connectors are standard per unit. Category 3, 4, 5 UTP or STP cable is supported. The 16th port has selectable pair reversal for easy cascading without the need for crossover cables.

- Uplink switch

  When set to the equals symbol (=), this switch reverses the internal crossover of the receive and transmit signal pairs in port 16 of every hub, allowing standard, straight-through, 10Base-T cables to be used for cascading through those ports.

- Communications Port

  This is a standard DB-9 connector for an EIA 232-C interface. The following functions are provided:

  - Out-of-Band Management (SNMP over SLIP)
  - Configuration (via XMODEM)
  - Microcode Upgrade (via XMODEM or via TFTP over SLIP)

- Hub Expansion Port (HEP)

  This port connects individual units into a stack that acts as a single repeater. It contains an Ethernet bus and bi-directional serial control bus and uses standard 4-pair UTP cable (category 3 minimum) with RJ-45 connectors. The hub expansion port allows up to 76.2 meters (250 feet) end-to-end distance between units in the stack.

2.4.1.2 Display Features

The IBM 8224 provides LED indicators for comprehensive machine and port status. These are detailed below.

- 10Base-T Port LED Indications
  - Link OK
  - Activity
  - Auto-Partitioned
  - Management Disabled
- Media Expansion Port LED Indications
  - Link OK (Fiber Only)
  - Activity
  - Auto-Partitioned
  - Management Disabled
- Unit Status Indications
  - Power On, Diagnostics Complete
  - Management Agent Present
  - Collision

2.4.1.3 Inter-8224 Communications in Managed Stacks

In a stack with one or more 8224 Model 002s, an inter-hub control bus is activated inside the hub expansion cables in addition to the Ethernet bus. The control bus is used to pass stack control information from 8224 to 8224. Figure 24 on page 79 gives a logical view of the inside of the hub expansion cable for a managed stack.

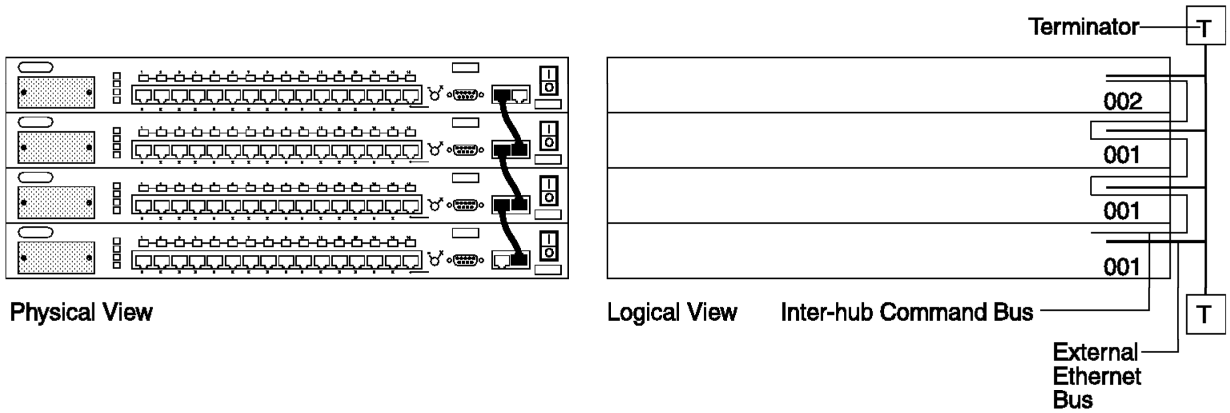


Figure 24. A Managed Stack of 8224s

Using an SNMP-based management application, you can get the following information about all 8224s in a stack while attached to any 8224 in a stack:

- Model number and media expansion port module type
- MAC address
- IP address
- IP subnet mask
- IP default gateway
- Whether the 8224 is segmented from the external Ethernet bus

Using an SNMP-based network manager, you can perform any of the following actions on any 8224 in a stack while attached to any 8224 in a stack:

- Set the IP address
- Set the IP subnet mask
- Set the IP default gateway
- Segment the 8224 from the external Ethernet bus or rejoin the 8224 to the bus
- Set the write community name
- Enable or disable write protect
- Reset the 8224 to make the new settings take effect

Even if 8224s have been segmented from the Ethernet bus, the inter-hub control bus allows you to set IP information and segment 8224s from a stack.

2.4.1.4 Why Segment 8224s from a Stack?

Three major uses of segmentation are to improve performance, to troubleshoot, and to isolate groups of users. This section details those uses.

1. **Improving Performance**

   An unsegmented stack is a single collision domain. All devices attached anywhere to an unsegmented stack see all the Ethernet frames generated anywhere else in the stack.

   As network traffic increases, excessive collisions can cause network performance to slow. You can improve performance by segmenting any number of 8224s from the other 8224s in a managed stack. Each segmented 8224 is in its own collision domain as long as it is not linked to any other 8224s.

To enable segmented 8224s to communicate with the rest of the stack, you can interconnect them using a bridge, router, or Ethernet switch.

2. **Troubleshooting**

   Segmentation can help you isolate areas of your network that are experiencing problems. You can segment 8224s one at a time from the rest of the stack while monitoring stack performance. This technique can help you localize a problem area to the devices attached to one 8224.

3. **Isolating User Groups**

   You may have users in your network who have no need for connectivity outside their department or workgroup. By connecting their workstations to one or more segmented 8224s, you can limit their network access while keeping control of the 8224s.

2.4.2 Configuration

Refer to Chapter 2 of the *8224 Ethernet Stackable Hub Installation and User's Guide*, GA27-4024, for step-by-step instructions for installing the 8224 and the optional media expansion port modules.

2.4.3 Cabling Examples and Specifications

When planning an Ethernet network, the size of each Ethernet collision domain you create is restricted by these factors:

- The limit of four repeaters between any two devices in one collision domain
- The cable length restrictions unique to each type of segment (that is, for 10Base-T, 10Base2, and so on)
- If you make use of optical fiber links:
  - The limit of 4200 meters (13780 feet) between any two devices in one collision domain
  - The optical fiber power budget

2.4.3.1 Four-Repeater Limit

IEEE 802.3 Ethernet standard specifies that a maximum of four repeaters can be placed in the path between any two devices in one collision domain.

Count a stack as one repeater hop as long as the total hub expansion cable length is less than 45.7 meters (150 feet). If the total hub expansion cable length is between 45.7 meters (150 feet) and 76.2 meters (250 feet), count a stack as one and one-half repeater hops.

Note: There may be more than four repeaters within a collision domain, as long as there are no more than four repeaters in the path between any two devices in the collision domain.

2.4.3.2 Maximum Segment Lengths

An Ethernet segment is the total length of cable between either two repeaters or between a repeater and an attached device. The different types of Ethernet supported by the 8224 place different limitations on segment lengths.

Table 9. Maximum 8224 Segment Lengths for the Supported Ethernet Types	
Ethernet Type	**Maximum Segment Length**
10Base-T	100 meters (328 feet)
10Base2	185 meters (607 feet)
AUI	50 meters (164 feet)
FOIRL	1000 meters (3281 feet)
10Base-FL	2000 meters (6562 feet)

Note

The 8224 does *not* support 10Base-FB. It is therefore incompatible with the existing 8250 and 8260 Ethernet 10Base-FB modules (f/c 1110, 1210, and 1310) and cannot be connected to them without the use of a 10Base-FL / FOIRL to 10Base-FB converter.

The 8224 will connect directly to the 10Base-FL modules (f/c 5895, 5896 and 5897) and FOIRL modules (f/c 3814, 3815 and 3816) that can be used in the 8250 and 8260 chassis.

For additional information on maximum distance limits, equivalent distance for signals passing through an 8224, and power loss budgeting, refer to pages 1-10 to 1-14 of the *8224 Ethernet Stackable Hub Installation and User's Guide*, GA27-4024.

2.4.3.3 Cabling Requirements for the 8224

Cable and connector requirements differ depending on the port to which each cable connects.

Cabling Requirements for the 10Base-T Ports: The sixteen 10Base-T ports in the 8224 accept either 100-ohm UTP category 3, 4 or 5 cables, 100 or 120-ohm FTP category 5 cables, or 150-ohm IBM STP type 1, 6, 9, 1A, 6A, or 9A cables. UTP and FTP cables must use RJ-45 connectors; STP cables must use cable adapters to convert to RJ-45 connectors.

Token-ring STP cables will not work as-is in Ethernet environments, because the wires pin out to the connectors differently. However, you can adapt the connectors for the correct pinout for Ethernet; see Figure B-3 on page B-1 of the *8224 Ethernet Stackable Hub Installation and User's Guide*, GA27-4024, for the correct pinout.

At end stations and at the 8224, you will also need impedance-matching devices to change the impedance of 150-ohm STP and 120-ohm FTP to 100 ohms. Changing the impedance does not reduce maximum drive distances.

Whether UTP, FTP, or STP, all cables and connectors you use should meet specifications of TIA/EIA Standards Proposal 2840-A, a revision of the Commercial Building Telecommunications Cabling Standard.

Straight-Through or Crossover Cables?: Use *straight-through cables* to make 10Base-T connections to devices such as workstations and servers.

Crossover cables are typically required when making 10Base-T connections to other hubs. The 8224, however, offers a way to bypass this requirement. If connection is to a different hub, use 8224 port 16 and turn the uplink switch beside it to "=" (straight-through). This action permits the use of a straight-through cable for connections that usually require crossover cables.

Note: If you are connecting port 16 on one 8224 hub to port 16 on another 8224, only one of these ports need to be set to "=" when using a straight-through cable.

If you find that you need a crossover cable, you can make one yourself from a straight-through cable. Pinout diagrams are given in ″Crossover 10Base-T Cables″ on page B-2 of the *8224 Ethernet Stackable Hub Installation and User's Guide*, GA27-4024.

Cabling Requirements for Media Expansion Ports: Cable and connector requirements differ depending on the media expansion port module you use.

- **AUI Port Module**

  The AUI port is a standard DB-15 female connector. You can connect either an AUI cable or a transceiver to it.

- **10Base2 Port Module**

  Use standard thin coaxial cable with a BNC connector.

- **FOIRL/10Base-FL Port Module**

  Use either 62.5/125 micron, 50/125 micron, or 100/140 micron optical fiber cable with ST connectors.

Cabling Requirements for Hub Expansion Ports (HEPs): Use standard four-pair cables, such as UTP category 3, 4, or 5, to interconnect 8224s through their HEPs. All HEP cables must have RJ-45 connectors.

One 152.4 millimeter (6 inch) hub expansion cable is shipped with every 8224. If you need longer cables to interconnect your 8224s, remember that the total cable length from the first 8224 to the last 8224 in the stack must not exceed 76.2 meters (250 feet).

Cabling Requirements for the Com Port: The com port is a standard DB-9 male connector, which provides a standard EIA/TIA 232-E (RS-232) serial interface. You can connect locally, with a null modem cable, or remotely, using a serial cable and a modem at each end and telephone lines in between. Once connected, you can manage the 8224 and upgrade microcode through this port.

You can make a null modem cable by connecting a null modem adapter to a standard serial cable.

2.4.3.4 Connecting Multiple 8224s Together

You can maximize the number of ports available to end stations by interconnecting 8224s using their HEPs. Up to ten 8224s can be linked through HEPs, and the total hub expansion cable length from the first to the last 8224 in a stack can be 76.2 meters (250 feet).

An example of interconnected Model 001s in a stack is shown in Figure 25 on page 83. In this example no Model 002 is present; therefore, only the Ethernet bus is active inside the hub expansion cables.

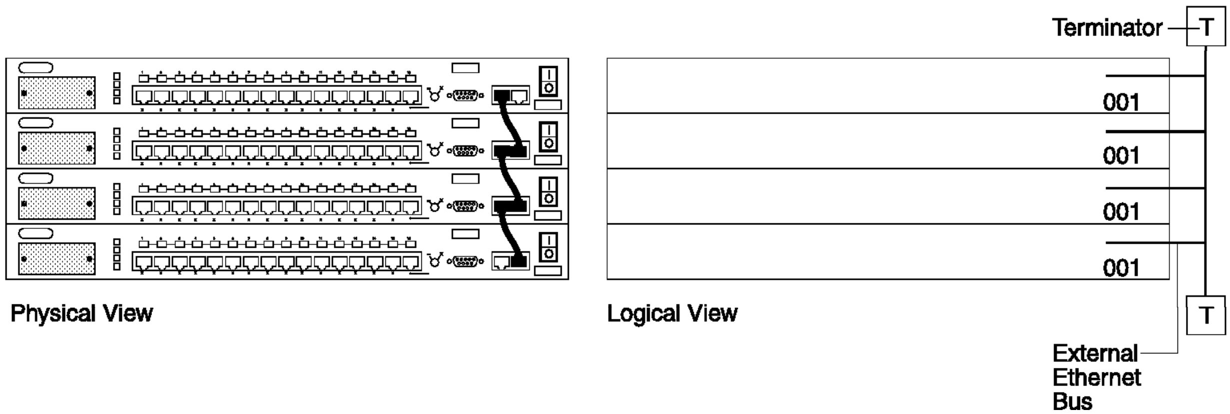


Figure 25. A Stack of Four 8224 Model 001s

The following are the two benefits to using the hub expansion ports to interconnect 8224s:

1. The maximum number of hops between any two workstations directly connected to 8224s is kept at one (or one and one-half, depending on distance).

2. Ports intended for connecting workstations are not being used for interconnecting 8224s.

Figure 26 shows an example of interconnecting two 8224 hubs with UTP via the HEPs.

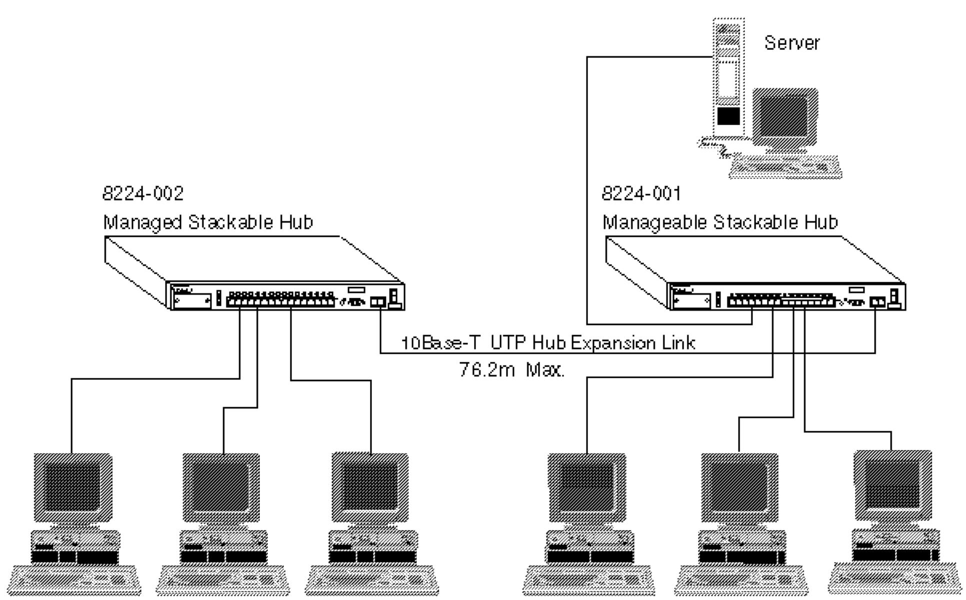


Figure 26. Interconnecting 8224 Hubs via the Hub Expansion Ports

A single 8224 Ethernet Stackable Hub allows the connection of up to sixteen stations to an existing IEEE 802.3 Ethernet network. As the number of workstations on the network increases, more 8224s can be added to the network to meet the demand. The added 8224s can be connected in three ways:

1. Stacking the 8224s on top of another.

   A 6-inch unshielded twisted pair cable (the HEP cable) is included with every 8224 to connect 8224s together through the stacking expansion ports. Up to ten 8224s can be stacked together, for a total port count of 170 (including MEP). The 8224s can also be connected together via the stacking expansion ports by a standard category 3 UTP cable. The cable may be any length from 15.24 centimeters (6 inches) to 76.2 meters (250 feet) long. The overall sum of the lengths of the expansion cables may not exceed 76.2 meters.

2. Cascading through the optional media expansion port to connect 8224s together via 10Base2, 10Base5, or fiber wiring.

   Figure 27 is an example of cascading two 8224 hubs via fiber expansion ports.

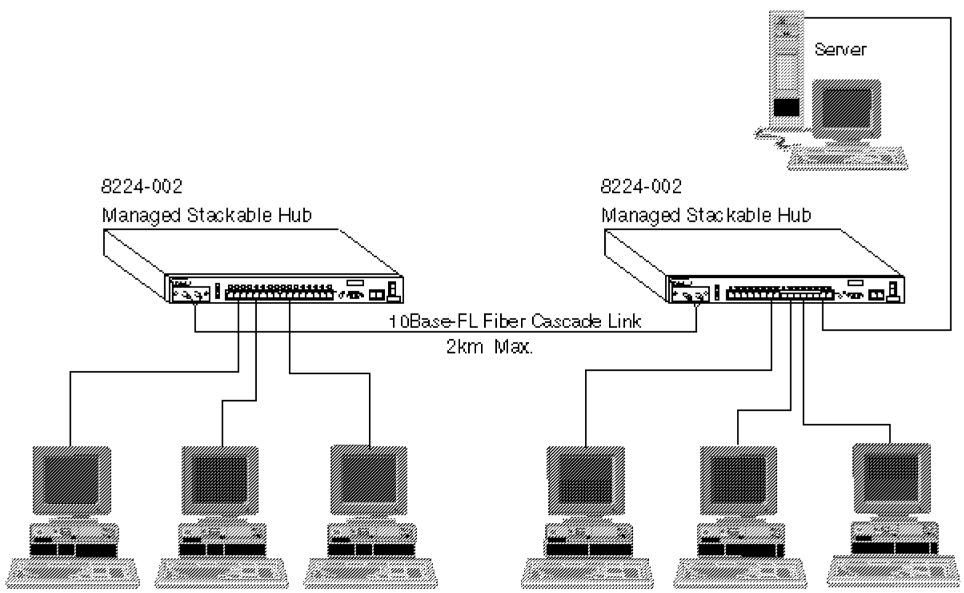


Figure 27. Cascading 8224 Hubs via Fiber Media Expansion Ports

3. Cascading through a 10Base-T port of the 8224 to connect to another 8224.

   A crossover cable is required to cascade through the 10Base-T ports unless you use the 16th 10Base-T port of the hub, for which a regular twisted-pair cable is required. An uplink switch is provided for the 16th port which can be set in the crossover state when cascading. Only four 8224s can be cascaded together using this method because each 8224 will count as a repeater hop. The IEEE 802.3 specification limits the maximum number of repeater hops between stations to four.

2.4.3.5 Segmentation and the 8224

As traffic on the network grows, the 8224 can divide the network into several segments (collision domains) to alleviate congestion in the network. Stacked 8224s can be segmented while maintaining management capability through a single management unit (Model 002). Servers or workstations that generate a lot of traffic on the network can be placed in their own segment to split the 10 Mbps Ethernet bandwidth between fewer stations. In addition, the remaining stations on the network will enjoy better performance with the high-traffic stations off their segment. The maximum number of Ethernet segments available per stack of 8224s is the number of hubs in the stack. In addition, if communication between isolated segments is required, a bridge, switch, or router is required to connect each segmented collision domain of the stack.

Usage Notes for Segmentation:

1. The first step in 8224 stack segmentation is to issue an SNMP command to write to the IBM 8224 MIB ibm8224BkplNum object in each hub in the stack to be segmented.
2. Cascading can then be used to form larger collision domains out of the individually segmented hubs. This cascading is only required when it is necessary to join more than one hub in a second segment within the stack.
3. If the segments in the stack are connected via bridges or routers, full management capability can be maintained over the entire stack through any port in the stack. The 8224 Model 001s remain manageable after segmentation because they can still send and receive stack control information to/from one or more 8224 Model 002s via the inter-hub serial bus in the hub expansion cabling.
4. Because management applications must communicate individually to the SNMP agents in each hub, any management tool must have network connectivity to all hubs that are to be managed.
5. With the use of the Uplink switch, the need for special crossover cables to connect the hubs together for cascading is avoided.
6. When cascading, each hub layer adds an additional repeater hop.
7. The total distance between the first and last units in the stack may be as much as 76.2 meters (250 feet).
8. If the combined length of all of the hub expansion cables within a segment exceeds 45.7 meters (150 feet), then the hub stack for that segment must be considered as 1.5 repeater hops for the purposes planning the network topology.

The Hub Expansion Port in a Segmented Stack: Figure 28 on page 86 illustrates the interconnection within an IBM 8224 hub stack with one hub segmented.

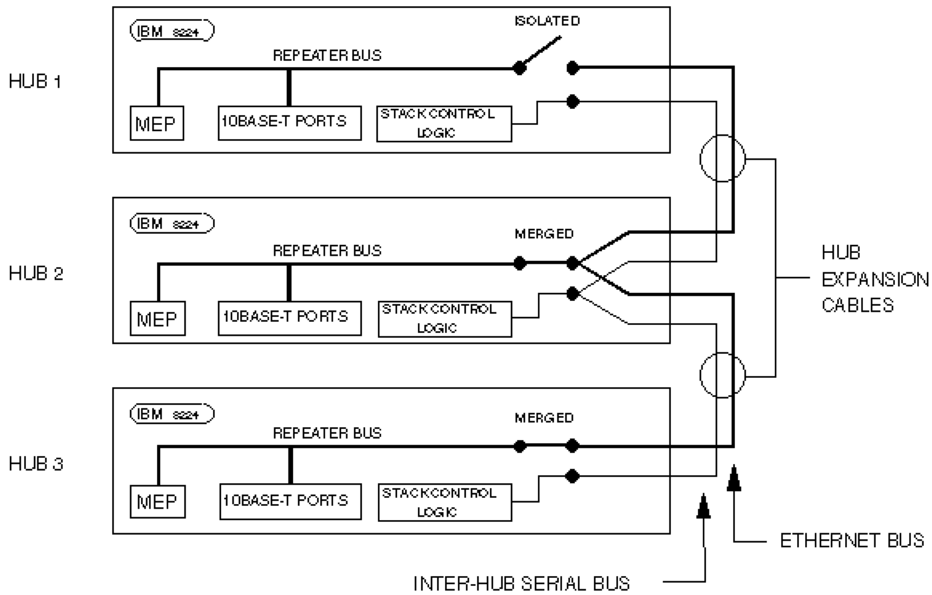


Figure 28. IBM 8224 Hub Expansion Port Interconnection. This example shows a stack of three hubs, one of which is segmented. Hub 1 is isolated (segmented) from the Ethernet bus in the hub expansion port cables via an SNMP command. Note that after segmentation the inter-hub serial control bus remains connected to the stack control logic in each of the hubs.

Figure 29 on page 87, Figure 30 on page 87, and Figure 31 on page 88 show examples of IBM 8224 hub stacks using the segmentation and cascade capabilities.

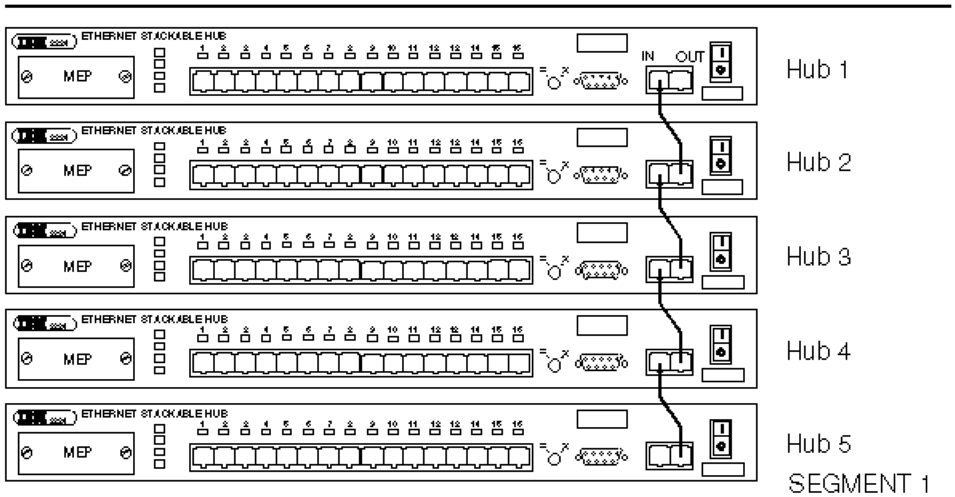


Figure 29. An IBM 8224 Stack - Unsegmented. This example shows a stack of five hubs, none of which are segmented. Thus, all are connected together in one segment or collision domain through the Ethernet bus in the hub expansion port cables.

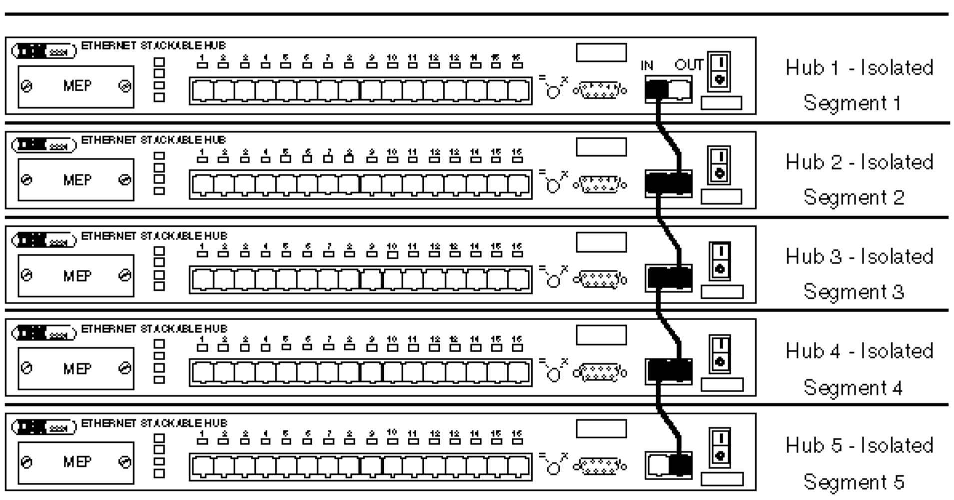


Figure 30. An IBM 8224 Stack - Fully Segmented. This example shows a stack of five hubs. Each hub has been segmented out of the network with an SNMP command to the IBM 8224 MIB. Thus, there are five segments and five collision domains now in the stack.

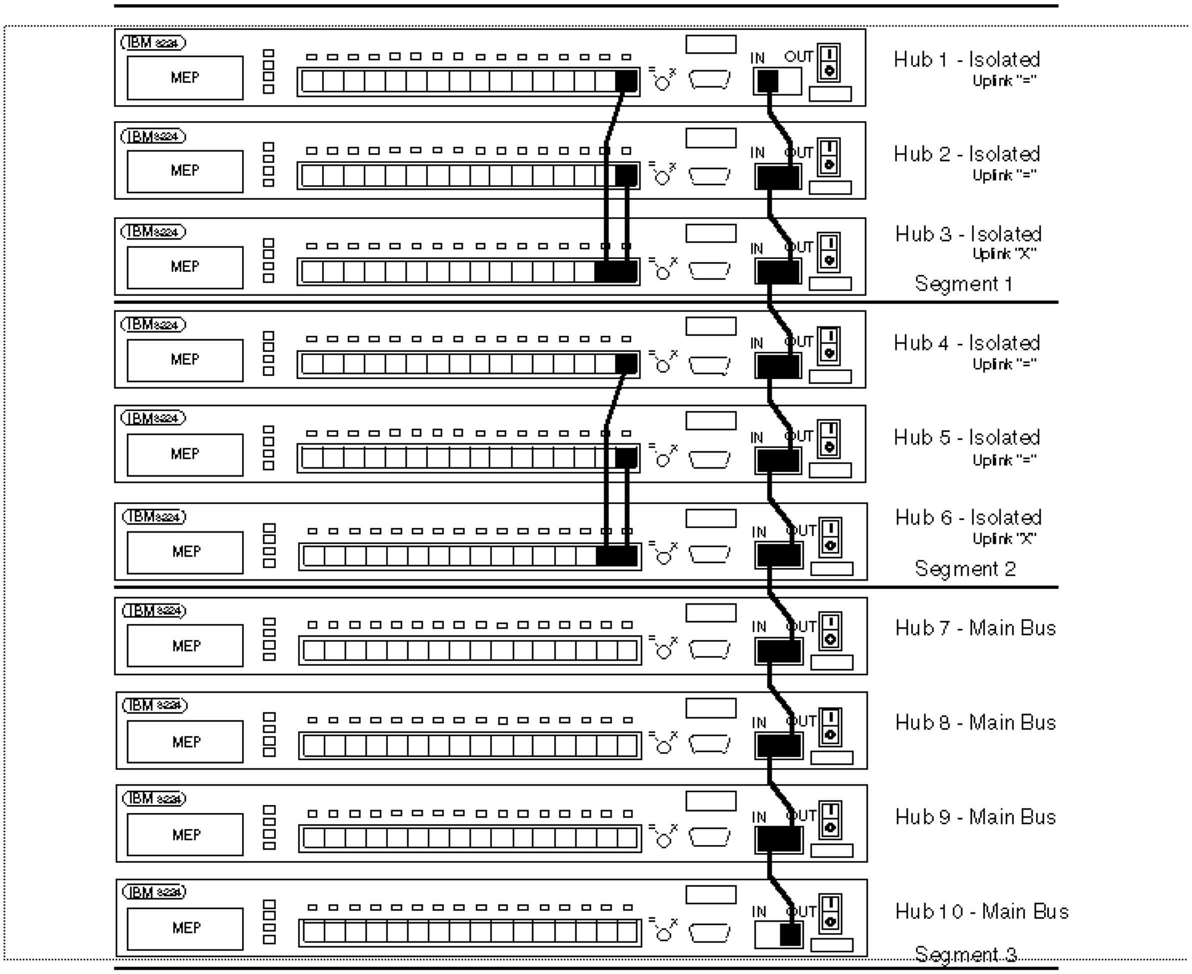


Figure 31. A Stack of Ten IBM 8224 Hubs - Configured for Three Segments, Using Cascading. This example shows a stack of ten 8224 hubs separated into three network segments.

Explanation for Figure 31 - Hubs 1 through 6 have each been segmented (isolated) out of the network by SNMP commands written to the IBM 8224 MIB in each of the six hubs. This leaves hubs 7 through 10 still connected to one collision domain (Segment 3) through the Ethernet bus in the Hub Expansion Ports and their associated cables.

Then, using UTP cables between 10Base-T ports, hubs 1, 2 and 3 have been cascaded together to form Segment 1. In the same manner, hubs 4, 5 and 6 have been cascaded together to form Segment 2. In this way, three collision domains have been formed from the stack of ten hubs.

On hubs 1, 2, 4 and 5, the uplink switch has been set to "=." This setting reverses the internal crossover of the receive and transmit signal pairs in port 16 of each of those hubs, allowing standard, straight-through, 10Base-T cables to be used for cascading through those ports.

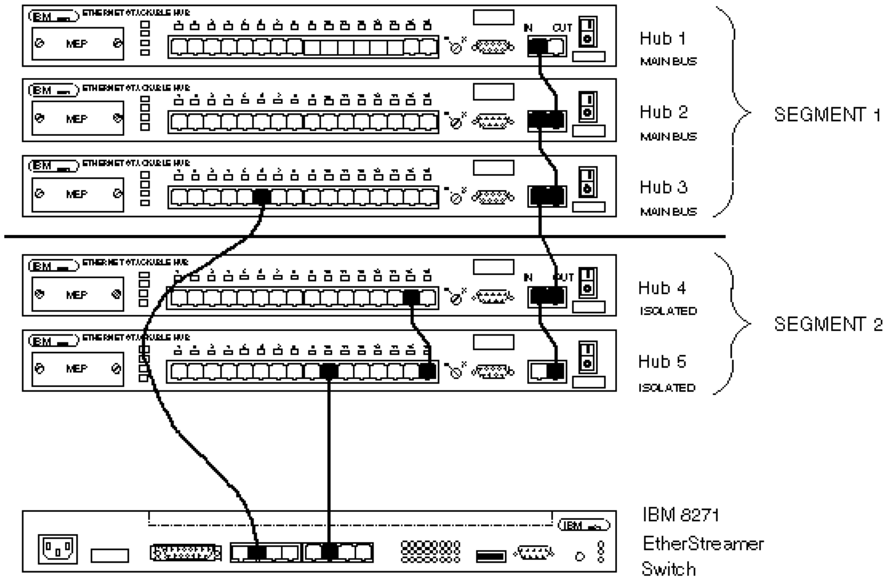


Figure 32. A Stack of IBM 8224 Hubs - Configured for Two Segments Joined with an IBM 8271 Switch. This example shows a segmented stack of 8224 hubs. Connectivity between the two collision domains is provided by an IBM 8271 EtherStreamer Switch.

Explanation for Figure 32 - Hubs 4 and 5 have both been segmented (isolated) out of the network by SNMP commands written to the IBM 8224 MIB in both hubs. This leaves hubs 1 through 3 still connected to one collision domain (Segment 1) through the Ethernet bus in the hub expansion ports.

Then, using UTP cables between 10Base-T ports, hubs 4 and 5 have been cascaded together to form Segment 2.

Connectivity between the two segments for end-user communication and management information flow has been accomplished by connecting each segment to an IBM 8271 EtherStreamer Switch. Here the 8271 switch is operating in half-duplex mode to match the hubs.

The result of this topology is connectivity for 76 devices spread over two separate 10 Mbps collision domains. Four ports remain available on the 8271 switch for connecting servers or other high bandwidth devices to the network in full-duplex mode.

Segmenting 8224s from a Stack: You can use any SNMP management application to segment an 8224 from a managed stack. Figure 33 on page 90 shows physical and logical views of a stack from which one 8224 has been segmented. Notice that even though hub B has been logically removed from the Ethernet bus, the inter-hub control bus remains, permitting the management information described in 2.4.1.3, “Inter-8224 Communications in Managed Stacks” on page 78, to reach the 8224.

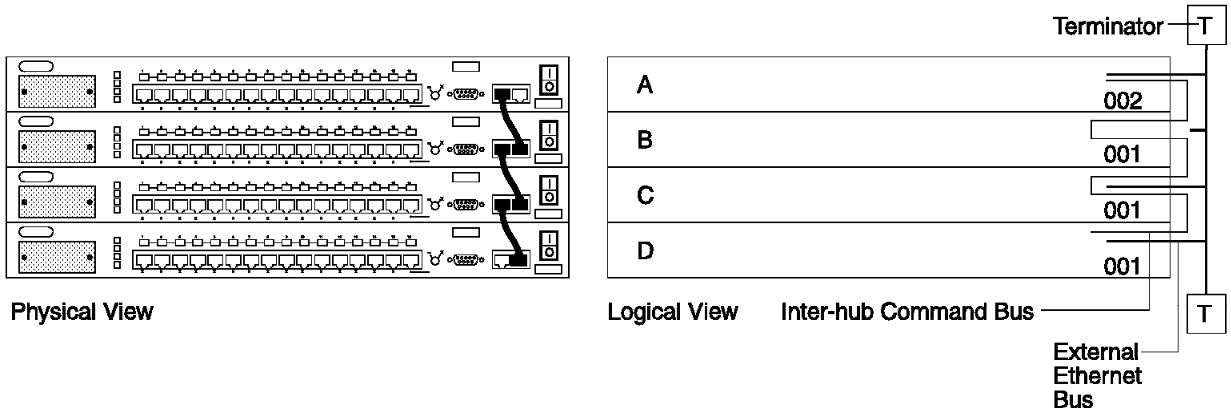


Figure 33. 8224 Hub B - Segmented from the External Ethernet Bus

Linking Segmented 8224s: In order to manage a stack of 8224s:

- The 8224 you want to manage must either be a Model 002 or be connected in a stack with a Model 002.
- There must be an Ethernet link between the 8224 to which your management workstation is attached and the 8224 you want to manage.

  When you segment an 8224 from a stack, you break either the Ethernet link to that 8224, or, if your management workstation is attached to that 8224, to the rest of the stack. You have two choices for re-linking segmented 8224s: cascading or interconnecting using a bridge, router, or Ethernet switch.

  To cascade, two or more 8224s must be segmented. When you cascade 8224s, they can communicate with one another in one collision domain, but not with the rest of the stack.

  If you interconnect the segmented 8224 or 8224s with the rest of the stack using a bridge, router, or Ethernet switch, they can communicate with the other 8224s and remain independent collision domains. The next sections explains these options in detail.

Cascading Segmented 8224s: If more than one 8224 has been segmented, you can cascade them. Figure 34 on page 91 shows a stack in which hubs B and C have been segmented from the external Ethernet bus. Hub C is cascaded from port 16 of hub B, and hub B′s uplink switch is set to "=" (straight-through). Hubs B and C make up one collision domain, and hubs A and D make up another.

Within each collision domain, all devices attached to either hub see all the frames generated by stations attached to the other hub. However, hubs B and C have no path to enable them to communicate with hubs A and D.

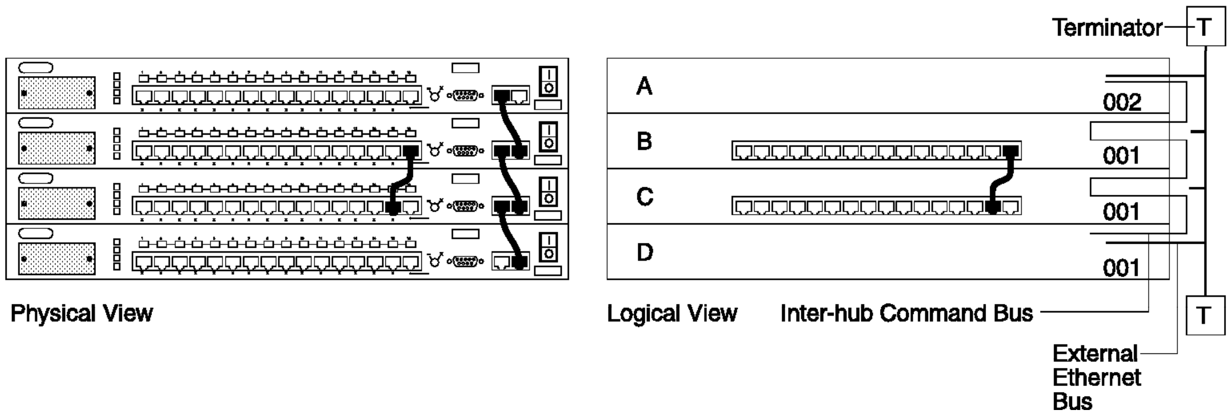


Figure 34. 8224 Hub C - Cascaded from Hub B

If you want to cascade, the 8224 provides a convenient way to do so with no need for special crossover cables. You can turn the switch beside port 16 to the equals symbol (=) (straight-through), and then use a standard Ethernet (straight-through) cable to interconnect the hubs.

2.4.3.6 8224 in a Campus Network

Figure 35 on page 92 is an example of a number of 8224 Model 001 and Model 002 hubs cabled together. The hubs in the warehouse, manufacturing, and administration buildings are connected to an 8271 switch for separate collision domains in the network. Fiber is used between buildings to overcome the distance limitations of copper cabling and so fiber expansion ports in the 8224s are required.

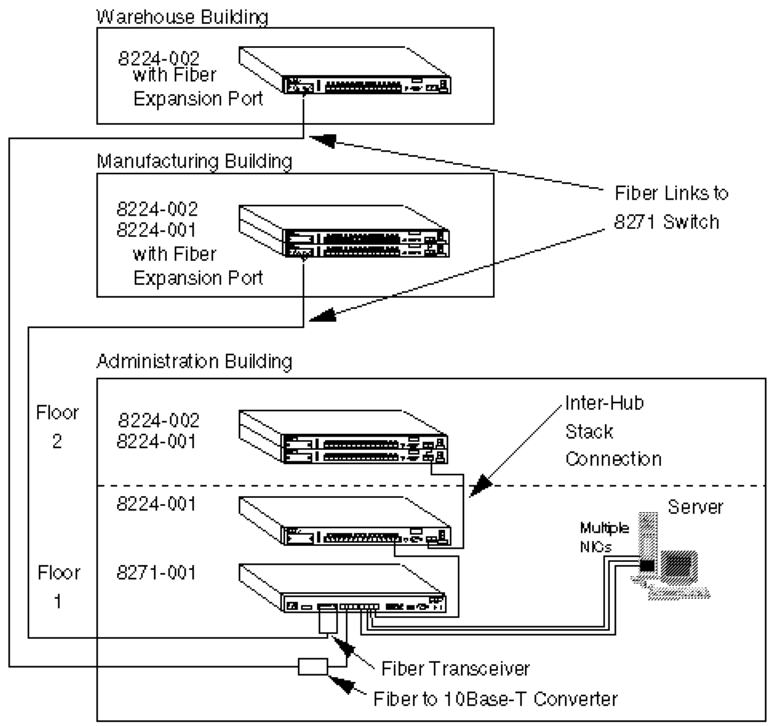


Figure 35. 8224s in a Campus Network

2.4.4 Management

The 8224 provides for automatic disablement (partitioning) of any of its ports connected to a device that generates repeated collisions, re-enabling that port when the condition clears. The 8224 also automatically detects and corrects for polarity reversals on cables connected to its 10Base-T ports (repeater receive pair).

The 8224 contains status LEDs for ″at-a-glance″ network monitoring. The 8224 contains status LEDs for power (of the 8224), collision (on the Ethernet network), and identifying if the hub is a managing unit or not. A link OK/disabled (partitioned) LED is provided for the media expansion port and for every 10Base-T port.

The 8224 provides centralized management of remote sites and branch offices through its out-of-band management support via the SLIP protocol. IS managers can dial up a remote site or branch office and receive the management information from the 8224 at that site.

The 8224 supports BOOTP (BOOTstrap protocol) for effortless power-on configuration. Configuration information like the IP address needs to be entered the first time the managed 8224 units are used. Every time the managed units are powered on, the hub will send a BOOTP request to the network manager and the network manager will provide the configuration information to the hub.

The 8224 supports SNMP over IP and IPX. Thus, the 8224 can be managed by an SNMP network management station running in a TCP/IP network or via Novell′s NetWare Management System.

2.4.4.1 Management Features

The SNMP hardware assist circuitry utilized in the IBM 8224 allows management access to the SNMP agent and the associated MIBs even with full bandwidth utilization. With at least one IBM 8224 Model 002 in the stack, the following management capabilities are provided:

- Full SNMP Management
  - In-Band and Out-of-Band (via SLIP)
  - Over IP and IPX Protocols
- Novell NMS HMI Compliant
  - Supports Novell HUBNVLE.MIB and IPX Autodiscovery
- Management Frame Formats Supported
  - IP Ethernet Version 2
  - IPX Ethernet Version 2, IEEE 802.3
- MIBs Supported
  - MIB II RFC 1213
  - Ethernet Repeater MIB RFC 1516
  - Novell Repeater MIB HUBNVLE
  - IBM 8224 MIB
- Segmentation

  Each unit can be segmented out of the network by setting IBM 8224 MIB variables. Segmentation only affects the connection of a hub to the Ethernet bus in the hub expansion port cabling. The interhub serial bus is unaffected.

  To maintain intersegment Ethernet communication, including SNMP management flows, segments must be connected by bridges, routers or switches.

  All stack control commands, including segment or unsegment commands, pass through the interhub serial bus and are unaffected by segmentation. Thus, they do not require bridges, switches or router presence.
- Back-up Ports

  Within any single unit in a managed stack, up to eight primary/backup port pairs can be designated via the IBM 8224 MIB.

  By writing to the ibm8224BkUpPortBackupPort object in the IBM 8224 MIB, any IBM 8224 hub can be configured to provide up to eight sets of primary/backup port pairs. This feature is useful in applications such as file servers where redundant connections are required to help assure reliable network connections. Examples of this topology are shown in Figure 36 on page 94 and Figure 37 on page 94.

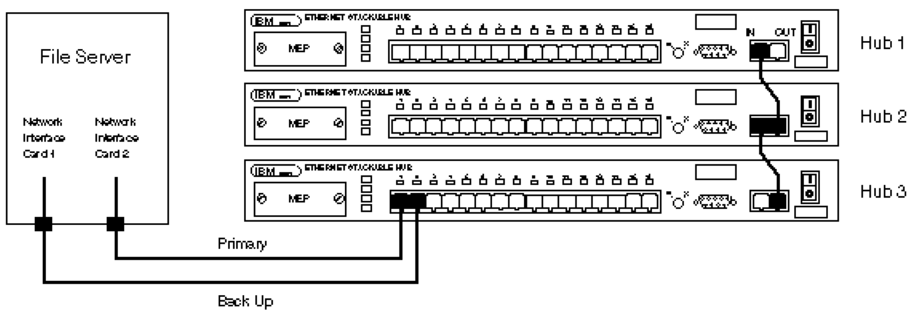


Figure 36. An IBM 8224 Stack - With Backup Port Enabled - Server Application. This example shows a hub stack connected to a server with 2 NICs. Port 1 is the primary connection. Port 2 is the secondary connection or backup port. The server must be rebooted after the transfer to the backup port to reset to the new node address in the backup server NIC.

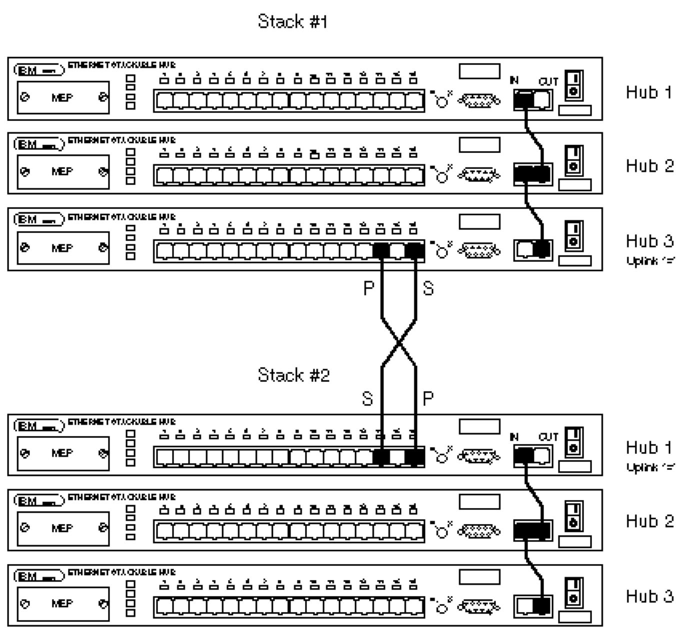


Figure 37. Two IBM 8224 Stacks - With Backup Ports Enabled - Cascading Application. This example shows multiple hub stacks connected via cascading over a backed-up 10Base-T link. The link between port 14 on hub 3 on stack 1 to port 16 on hub 1 of stack 2 is the primary (P) connection. The link between port 16 on hub 3 on stack 1 to port 14 on hub 1 of stack 2 is the secondary (S) or backup connection.

Backup Port Operation:

1. Primary/Backup port designations are defined in the IBM 8224 MIB via standard SNMP commands.

2. As long as the primary port is the active connection, the backup port is disabled to prevent a redundant active connection.

3. In the event of loss of the link OK on the primary port or an autopartition of that port, the backup port will automatically become the primary port and the designated primary port will be disabled. When this occurs, a health state trap will be sent to each device whose address is located in the 8224 IP and IPX trap tables.

4. To reset the designated primary port as the active port, the 8224 MIB must be used.

5. When the backup port is active, its LED will be green and the primary port will be disabled, with its status LED orange.

6. The primary and backup ports cannot be set up for load-sharing.

7. Both ports within a primary/backup pair must be on the same hub.

2.4.4.2 Management in a Stack

Each hub, either Model 001 or Model 002 has an SNMP agent and an IP address and therefore is managed directly. The agent in the 8224-001 is viable only when it is in the same stack as an 8224-002. The 8224-002 enables the management capability in each of the 8224-001s connected to it through the serial bus on the hub expansion cable. This means that, in a stack containing at least one 8224-002, management is distributed throughout the stack. Thus, the relationship between the 8224 Model 002 and the attached 8224 Model 001s is a community of peers rather than the traditional master/slave hierarchical relationship of its competitors.

Setting IP Addresses: This can be done in the following three ways:

1. XMODEM Text Configuration File

   The 8224 hub IP address, the net mask, the IP default gateway and the write community string can be set by downloading a text configuration file using the XMODEM protocol. This requires a PC with a serial port, a text editor (to change the parameters), an XMODEM file transfer program and either a null modem cable for local configuration or a pair of modems for remote configuration.

2. BOOTP Server or Reverse ARP Server

   A BOOTP server can be used to set the 8224 hub configuration parameters. Each time that the 8224 completes the power-on self-test, it will make two BOOTP requests and then two Reverse Address Resolution Protocol (RARP) requests. These contain the MAC address of the 8224. This process will be repeated every five minutes until a valid IP address is received. Using the IBM 8224 MIB, this process can be disabled where it is not desired, for example, in an IPX network.

   See your BOOTP or RARP server's documentation for specific instructions.

3. Using SNMP (over IP and IPX)

   Once one of the hubs in the stack has a valid IP address, the IP addresses of the remaining hubs in the stack can be set using SNMP over IP requests. An SNMP network manager can set/update the IP address (and other configuration parameters) for each of the hubs in a stack by modifying the ibm8224StackTable MIB object.

SNMP over IPX can be used to set the IP address of each hub in the stack even if none of the hubs has a valid IP address.

Refer to the documentation included with your management program for complete instructions.

2.4.4.3 Preparing for SNMP Management

In order to perform any of the management actions, you must run an SNMP management application, such as IBM StackWatch for Windows or IBM StackWatch for NMS, on your workstation. In addition, the stack you plan to manage must contain an 8224 Model 002.

SNMP commands are sent over IP or IPX networks. If you plan to use SNMP over an IP network, you will first need to set the IP addresses of the hubs in your stack; begin with ″Getting Started: SNMP over IP.″ If you plan to use SNMP over an IPX network, go to “Special Considerations for SNMP Over IPX.”

2.4.4.4 Getting Started: SNMP over IP

To manage a stack using SNMP over IP, you must first set the IP address of an 8224 Model 002 using one of the following methods:

- By sending a configuration file using the XMODEM protocol
- By configuring a BOOTP or RARP server to send the IP address to the 8224
- By using an IPX-based network management application to discover the Model 002, and then sending the IP address over IPX.

Assign IP addresses with care, especially if you plan to communicate on the Internet. Duplicate addresses may cause misrouting of frames and data loss.

Special Considerations for SNMP Over IPX: BOOTP requests disrupt SNMP activity for six seconds every five minutes as long as an 8224 has no IP address, so you may want to disable this if you do not plan to use the IP protocol. You can disable BOOTP and RARP requests by setting the IBM 8224 MIB object ibm8224BootpRarpRequests to 2, noBootpRarp.

2.4.4.5 Managing 8224s Using SNMP

For detailed information on this topic, please refer to pages 3-11 to 3-13 of the *8224 Ethernet Stackable Hub Installation and User′s Guide*, GA27-4024.

2.4.4.6 IP Management through the Com Port

For detailed information on this topic, please refer to pages 3-14 to 3-16 of the *8224 Ethernet Stackable Hub Installation and User′s Guide*, GA27-4024.

2.4.4.7 IBM 8224 Graphical Management Applications

All 8224 network management applications provide a graphical representation of how your networks are interconnected and enable you to view real-time statistics of the 8224 hubs and ports. The applications communicate with the 8224 hubs via the Simple Network Management Protocol over an Ethernet network and allow you to point-and-click on various managed graphical elements for immediate statistic displays.

Four network management applications are currently available for the 8224 Ethernet Stackable Hubs.

StackWatch for Windows is a stand-alone low-cost Windows network management application for the 8224 only. It is the ideal solution for customers with only 8224 Ethernet hubs in their network or for those customers that desire the most inexpensive 8224 network management application. It runs on Microsoft Windows operating system and can be used on any PC either attached to or in a stack with an 8224 Model 002 (SNMP management model).

StackWatch for NetWare Management System is an application which runs on top of Novell′s NetWare Management System (NMS). StackWatch for NMS should be used by customers with multiple SNMP-managed devices (bridges, routers, hubs) in their network and when they are using Novell′s NetWare Management System V2.0 platform.

8224 NetView for Windows Program is the product specific module (PSM) for the 8224 that runs on IBM′s NetView for Windows management platform. The 8224 NetView for Windows Application like StackWatch for NMS, should be used by customers with multiple SNMP managed devices on their network and by customers with several IBM hub products in their network. NetView for Windows will eventually manage all IBM hub products. In addition to the 8224 Ethernet Stackable Hubs, NetView for Windows also supports the IBM 8230 Token-Ring concentrator, the 8271 and 8272 switches, and the 8250 Hub.

8224 NetView for AIX Program is the PSM for the 8224 that runs on the IBM NetView for AIX management platform. In conjunction with the facilities provided by NetView for AIX, this application lets you perform point-and-click management of your 8224 hubs via hot spots on realistic graphical representations. You can also perform a number of configuration, performance, management, and monitoring tasks.

All these graphical management applications allow you to easily do the following:

- Graphically define network topologies using a library of bit-mapped geographic maps and network elements.
- Point-and-click on various managed graphical elements for immediate statistical displays.
- Obtain real-time event information, including time-stamped alarm information.
- Establish and invoke redundant link connections for critical network devices.
- Automatically download microcode to the 8224.

2.4.5 Positioning

The 8224 Ethernet Stackable Hubs round out IBM′s Ethernet hub offerings. At the low-end of the Ethernet hub line, IBM has the Nways 8222 Ethernet Workgroup Hub for very small networks not requiring management. One step up from the 8222 is the 8224 Model 001, which provides an unmanaged but manageable solution for small and medium-sized companies. The 8224 Model 002 is for companies that desire SNMP network management capability. The 8250 Multiprotocol Intelligent Hub and the 8260 Multiprotocol Intelligent Switching Hub round out the IBM Ethernet hub line, providing network connectivity and management capability for large companies with multiple LAN media types and protocols in their enterprise networks.

There are different customer sets for the 8224 Ethernet Stackable Hub.

2.4.5.1 Small Companies

One customer set for the 8224 Ethernet Stackable Hub is the small-to-medium sized companies that wish to connect their PCs and other resources in a single 10Base-T Ethernet network. They buy the unmanaged model initially with the capability of upgrading their network with management as their networking needs grow. The 8224 Model 001 will satisfy these customers with its low per-port price. In addition, due to the hub′s stackable feature, customers will not have to throw away their investment in previously-purchased Model 001s when upgrading their networks with management. The customer can purchase a Model 002 to manage up to nine Model 001s in an Ethernet segment.

2.4.5.2 Corporate Environment

The second customer set of the 8224 is the large companies that have multiple segments (many or all of which are Ethernet) combined with bridges, routers, or intelligent hubs. In these environments, the 8224 is used to connect departments, workgroups, and branch offices to the corporate network. Network management is a critical requirement. Thus, customers in these environments will purchase a combination of 8224 Model 001 and Model 002 units. Price, network management, remote management capability, and the ability to centralize management on a recognized platform will be key factors in this market.

The structure of IBM′s Ethernet hub family, with the 8224, is compared in Table 10.

Table 10. IBM Ethernet Hub Comparison

Customer Requirement	**IBM Ethernet Hub**
Unmanaged and unmanageable	8222 Models 008, 016
Unmanaged but manageable	8224 Model 001
Managed single protocol	8224 Model 002
Managed multiple protocol	8250, 8260

The network management applications available for the 8224 are the first results of IBM′s effort to provide widespread management support for the 8224. In order to help IBM sales representatives sell the 8224 hubs into existing Ethernet environments, it is important that the 8224 can be managed in the customer′s chosen network operating system environment.

2.4.5.3 Management for Small Companies

For small-to-medium sized companies requiring single 10Base-T Ethernet networks, StackWatch for Windows is the solution for customers with only 8224 Ethernet hubs in their network or for those customers that desire the most inexpensive 8224 network management application. It runs on the Microsoft Windows operating system and can be used on any PC either attached to or in a stack with an 8224 Model 002 SNMP management model.

2.4.5.4 Management for Large Companies

For corporate environments, with multiple SNMP-managed devices (bridges, routers, hubs) on the networks, either StackWatch for NMS, or the 8224 NetView for Windows and AIX Applications will provide a quality solution.

The 8224 NetView for Windows and AIX programs are the graphical management applications for the 8224 on the NetView for Windows and AIX platforms respectively. The NetView for Windows application provides network management support for many products, including the IBM 8271, 8230, and several non-IBM products. These applications should be used when other IBM and non-IBM devices are used in the network and the customer is using the IBM NetView for Windows or AIX platform.

StackWatch for NMS is the 8224 graphical management application for Novell′s NetWare Management System V2.0 platform. As with NetView for Windows, NMS provides network management support for many network products like hubs, routers and bridges through applications like StackWatch. StackWatch for NMS should be used when several non-IBM devices are used in the network and when the customer is using Novell′s NetWare Management System V2.0 platform. The StackWatch for NMS product provides 8224 management support for 10% of all existing Ethernet installations.

IBM′s 8224 NetView for AIX Program is the latest result of a continuing effort to provide widespread support for the 8224. (NetView for AIX is a full-function network management platform supporting many IBM and non-IBM network products.)

2.5 IBM 8226 Token-Ring RJ-45 Connection

The IBM 8226 Model 001 provides eight RJ-45 port attachments to a 4 or 16 Mbps token-ring LAN. It offers a splitter function that exceeds the capabilities of the IBM 8228. While offering increased function, the IBM 8226 is not a replacement for the IBM 8228, but an addition to the product line.

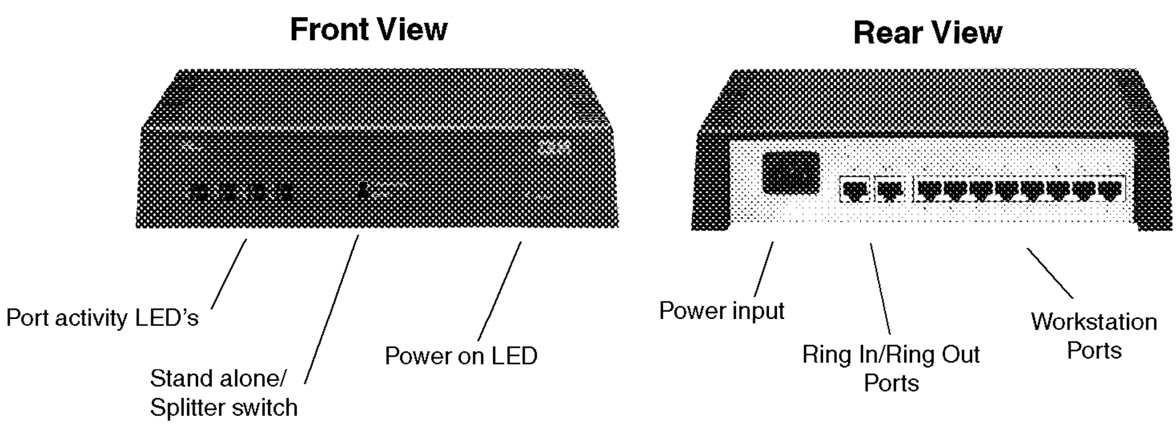


Figure 38. 8226

2.5.1 Technical Description

The 8226 is a very simple plug-and-play box that has the following characteristics:

- Powered by an integrated auto-ranging power supply.
- Has eight shielded RJ-45 connectors for workstation attachments.
- Has shielded RJ-45 ring-in and ring-out connectors to expand the ring segment.

- Supports 150 ohm STP cables.
- Supports 100/120 ohm UTP/FTP cables.
- No lobe filters required for any type of cables for FCC and CISPR22-A certification.
- Has a switch to operate either as a concentrator (like an 8228) or as a splitter.
- When set to operate in splitter mode, the 8226 can connect up to eight devices off a lobe port of another hub, MAU (Multistation Acess Unit), or concentrator.
- In splitter mode, the 8226 provides the phantom current to its upstream lobe port when any of its workstation ports become active.
- Has one LED for each of the eight workstation ports to indicate when active workstation is attached.
- Does not require a setup or initialization tool.
- Comes with two wrap plugs for the RI and RO port whenever they are not in use.
- The 8226 coexists with all other IBM token-ring concentrators and hubs.

2.5.2 Cabling Requirements

The 8226 supports all different types of commonly used STP, category 4, 5 UTP and FTP cables and follow the same basic token-ring hub cabling rules. Refer to the *8226 Planning and Installation Guide*, GA27-4981 and *Token-Ring Network Introduction and Planning Guide*, GA27-3677 for restrictions on lobe length, RI/RO drive distance and number of workstations allowed in the ring segment.

You can also refer to the 8230 chapter of this book to find out, as an example, the cabling limitation of an 8226 when used as a splitter off an 8230 lobe port.

2.5.3 8226 Positioning

The 8226 is very suitable for small workgroup environments, especially where laying UTP cables is more convenient than STP. With the splitter function, the 8226 is also a good solution to extend an established token-ring network to a small workgroup area, by using a single lobe cable from the existing hub.

The major difference between an 8226 and an 8228 is that an 8226 can provide the phantom current. It enables an 8226 to be used as a splitter for all token-ring MAUs, hubs and concentrators, not just from lobe insertion unit (LIU) ports of an 8230-003/013, like the 8228 requires.

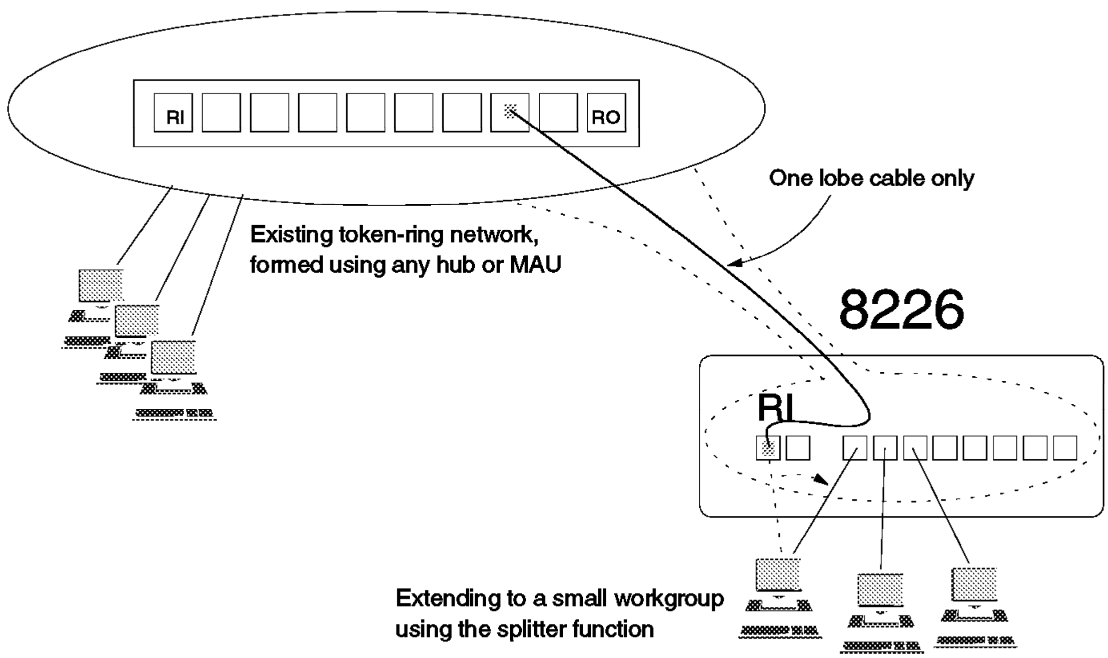


Figure 39. 8226 Splitter Mode. Instead of attaching to a workstation, the lobe cable can go into the RI port of an 8226 set in splitter mode. You then have eight ports to tie a small workgroup to the main ring.

See 2.7, "IBM 8230 Token-Ring Controlled Access Unit" on page 102 for more information about using the 8226 as a splitter.

2.6 IBM 8228 Multistation Access Unit (MAU)

The IBM 8228 is a passive concentrator hub, very easy to use, and with a good cost-benefit price.

It permits the interconnection of multiple 8228 access units via ring-in/ring-out ports.

2.6.1 Technical Description

The IBM 8228 is an unintelligent, unpowered token-ring Multistation Access Unit (MAU). It can attach up to eight devices in a 4 Mbps or 16 Mbps token-ring network. Using IBM Cabling System Connectors (ICS), cables from the workstations or devices are simply plugged into the unit. The IBM 8228 supports STP cabling as well as UTP cabling when used with appropriate connectors/filters.

Figure 40 on page 102 shows the front panel of the IBM 8228.

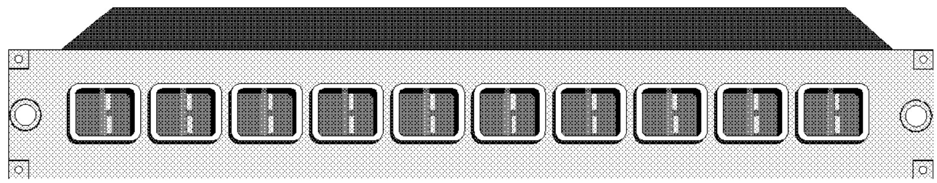


Figure 40. IBM 8228 Multistation Access Unit

2.6.2 Positioning

The IBM 8228 is a simple, unintelligent, unpowered token-ring hub targeted at small workgroup LANs that use IBM Cabling System Connectors (ICS).

2.6.3 Functions

The IBM 8228 offers the following features:

- Up to thirty-two 8228s can be joined together using the ring-in/ring-out ports.
- Devices are simply plugged in to form a network. The 8228 will detect the presence of a signal for each of the eight connections and will configure the ring.
- Allows up to 1,263 feet of maximum length with IBM Cabling System (330 feet with UTP). Easily fits in a standard wiring closet.
- Fits on a 19 inch rack, shelf or is wall-mountable.

2.7 IBM 8230 Token-Ring Controlled Access Unit

Although comparisons and discussions on the compatibility of all the 8230 models exist, this section focuses on the 8230 Controlled Access Unit Model 3 and 13. For information about 8230 Model 1 and Model 2, refer to *LNM 1.0, IBM 8230 CAU and LMU/2*, GG24-3754.

The 8230 Model 3 is an intelligent token-ring network wiring concentrator, similar in form and function to the IBM 8230 Models 1 and 2, intended to provide enhanced levels of control and reliability for attaching workstations to the IBM token-ring local area network (IEEE 802.5). The Model 3 control unit serves as the host for all optional features, providing intelligence, status displays, power, one token-ring MAC function (PO), and appropriate interfaces for all installable options. The RI/RO modules provide the main ring path connection to the controlled access unit while the port lobe insertion units (LIUs) provide from two to four connections for network devices. The lobe attachment modules (LAMs) allow up to 20 passive STP or UTP station attachments.

2.7.1 Technical Description

The following subsections describe highlights of the IBM 8230 Controlled Access Unit Model 3.

Granularity

Granularity and modularity down to zero ports (purely repeater), and up to more than 100 port configurations, allow for a more tailored approach to upgrading as requirements arise. Also, the MAC daughter card, which is not required in a single 8230 (no RI/RO) configuration, has been made an optional feature to provide a lower entry price.

Management

The option of management via either SNMP or CMOL. SNMP agent support has been available for the 8230 Model 3 since its general availability date. Any MIB browser that conforms to industry standards can be used to manage (read, monitor and update) MIB variables inside an 8230-003, thus providing management functions. A more effective approach is to use tailored SNMP applications that provide a graphical interface. The 8230 Device Management for Windows that comes with the hardware and runs on top of IBM NetView for Windows is an example. In larger installations, IBM LAN Network Manager for AIX which runs on top of IBM NetView for AIX is another choice.

As for CMOL support, the code is not available at the time of writing. LNM for OS/2 V2.0, with application of certain PTFs should provide management functions graphically using CMOL by the time this book is published.

Remote LAM

The remote LIU and remote LAM both contain their own microprocessors and communicate to each other over a control wire (using category 5 UTP) that can be up to 100 meters long. Parallel to it is a data cable which provides transport of data on the ring. Lobe cables that attach workstations to the RLAM are governed by its cabling rules.

Mixed Wiring

Mixing and matching of different wiring types makes the IBM 8230 Controlled Access Unit Model 3 the most versatile work group concentrator available.

- Any combination of active or passive devices can be connected.
- 150 ohm or 100/120 ohm balanced cable, shielded or unshielded, can be mixed in one base unit with a combination of different LIUs and LAMs.
- RI and RO connections can either be made with ICS data connectors, RJ-45 connectors, or optical fiber ST connectors.
- Support of category 3 UTP cable via an active LIU or active RLAM.

LAMs

Ability to attach up to three LAMs to the IBM 8230 base unit. Each LAM that is available now has 20 ports.

Fan-Out Devices

Ability to attach 8228s or 8226s directly to the IBM 8230 Controlled Access Unit Model 003 via any LIU. This improves port density of the concentrator in the lowest cost manner and provides a migration path for existing 8228 users.

Speed Detection

Speed detection before ring insertion. This function, available only on LIU ports, avoids any beaconing condition (recovery cycle not necessary) if a workstation attempts to insert into the ring at the wrong speed.

Enhanced Error and Status Displays

Four digit display for error and status indication. Light-emitting diodes (LEDs) for LAM status are also available on the base unit.

Backup Path

With the MAC feature installed, three internal adapters monitor the main and backup ring path to provide not only problem detection but also recovery monitoring. RI/RO ports wrap and unwrap accordingly to minimize impact to the network.

Differences between 8230-001, 002 and 003, 013: The IBM 8230-003 and 013 have base functions similar to the 8230-001 and 002 with the following enhancements:

- More granular and modular design using LIUs
- Better price performance of all configurations
- Option of management via either SNMP or CMOL
- A new RLAM, with RJ-45 connectors that can be up to 100 meters from the base unit
- Mixing and matching of active and passive LIUs, STP and UTP cables from the same base unit
- Ring speed detect before insertion
- Enhanced error and status displays
- EIA-232 serial port for out-of-band SNMP initialization and port control and configuration

Active RJ-45 LAM

The Active RJ-45 UTP LAM that is supported on 8230-002 is not supported on Model 003 or 013.

2.7.1.1 Base Unit

The following figures show the front view and back view of an 8230-003/013 base unit. You can familiarize yourself with the locations of all the LEDs, receptacles, switches and recesses for labels.

Slot Numbering

Note that slots for inserting LIUs or RI/RO modules are numbered from right to left.

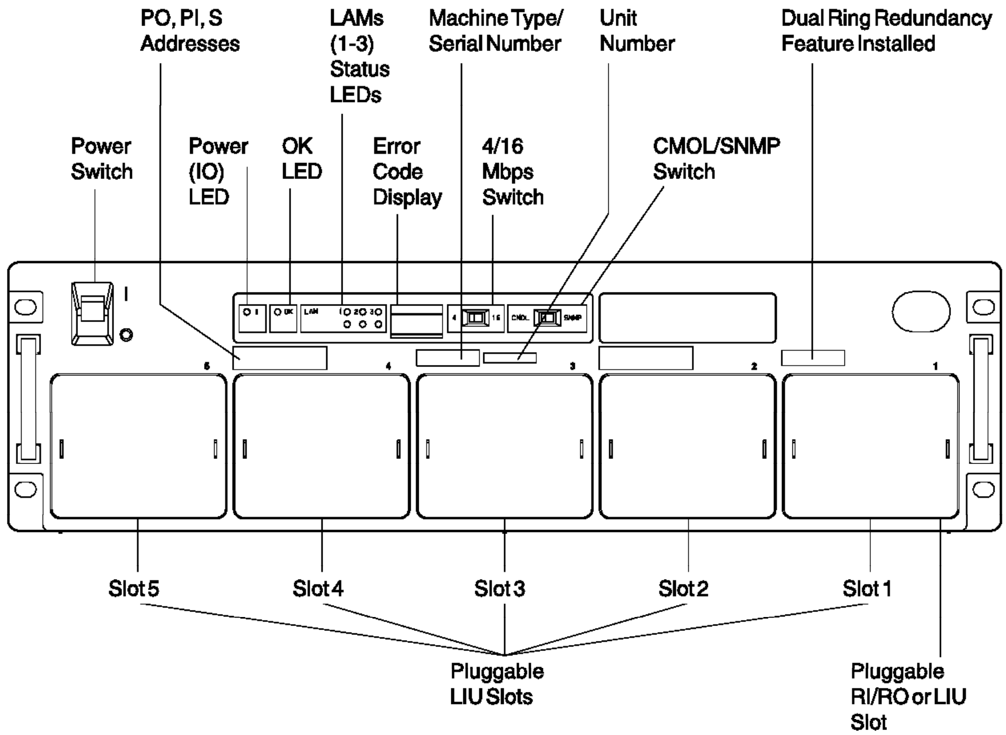


Figure 41. Front View of an 8230-003/013

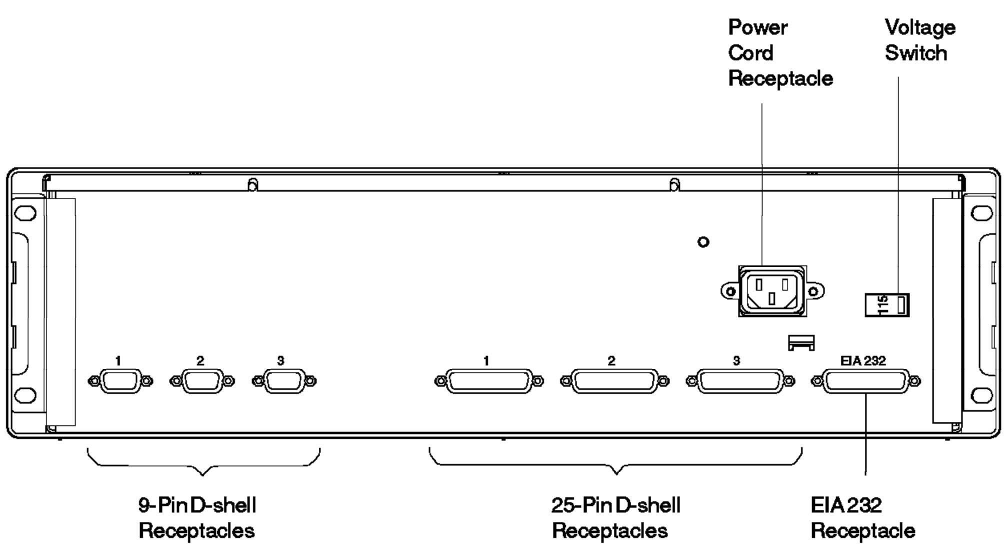


Figure 42. Rear View of an 8230-003/013

LED Status: When the Model 3 is powered on, all LEDs should light while the words Lamp then Test appear on the error code display (matrix display LEDs). They then turn on and off and blink while the error code display shows different numbers during the diagnostic cycle. For a detailed explanation of each LED′s status and interpretation of the numbers shown on the Error Code Display, refer to the *8230 Customer Setup Instruction and Service Guide* that comes with the hardware. Table 11 on page 106 gives you a rule of thumb of what the status is.

Table 11. General LED Status		
LED	**Status**	**Meaning**
Green	On	OK, ready, and operational
	Off	Not ready, no power, ready but workstation not active (lobe ports only)
	Blinking	Disabled, by management software or internal code
Yellow	On	Error, malfunction
	Off	No error
	Blinking	Defective hardware

Exception

Because LIUs do not have a separate status LED for the module as a whole, if all LEDs of a LIU are not lit, the meaning could be:

- Ready, but no active workstation connected.
- LIU installed improperly and has no physical connection with the base unit.
- LIU is completely dead.

Switches: There are four switches on the base unit. See Figure 41 on page 105, Figure 42 on page 105 and Table 12 for reference.

Table 12. Switches Position and Function		
Location	**Switch**	**Function**
Front	Power	Turning power on or off to the 8230
	4/16	Ring speed selection between 4 Mbps and 16 Mbps. Unit restarts if switch position changes.
	CMOL/SNMP	Management protocol selection, CMOL position does not work at the time of writing. Need CMOL code update in future.
Rear	Voltage Select	Select either 115V or 230V

Receptacles: Apart from the power receptacle, there are three 9-pin and four 25-pin D-shell receptacles at the rear of the 8230 base unit. The 9-pin D-shell and the left-most three 25-pin D-shell are for communication with LAMs. They are labeled 1, 2 and 3, respectively.

The right-most 25-pin D-shell receptacle (female) is for connection to a modem via an RS-232 cable or to an ASCII terminal via a null modem cable. It is labeled EIA-232. This port provides out-of-band management functions.

2.7.1.2 Attachable Modules

Attachable modules come in the following two types:

- Actually insert into the base unit compartment
- Attach to the base unit via two cables plugged into the 9-pin and the 25-pin D-shells

The former can be RI/RO modules or lobe insertion unit modules. The latter are lobe attachment modules. This section shows these modules in drawings and provide descriptions to their functions and usage.

RI/RO Modules: RI/RO modules extend the main ring path of an 8230 to a second 8230 or other devices that have RI/RO interfaces with matching cabling characteristics.

Co-Requisite

The MAC daughter card (dual ring redundancy feature) is a co-requisite for installing any RI/RO module (f/c 2029 for Model 3, pre-installed for Model 13).

- One, and only one, RI/RO module can be installed in an 8230-003 or 013. It fits *only* in slot 1 (far right) of the base unit.
- All RI/RO ports are fully repeated for longer drive distance and better signal conditions.
- The following are the five choices of RI/RO modules:
  1. STP (IBM cabling system connector) RI and RO (f/c 7737)
  2. Optical fiber (ST connector) RI and RO (f/c 2010)
  3. Shielded RJ-45 RI and RO (f/c 2007)
  4. Fiber RI and STP/ICS RO (f/c 7754)
  5. STP/ICS RI and Fiber RO (f/c 7751)
- The fiber ports provide the interface to the main ring path via 50/125, 62.5/125, 85/125 or 100/140 multimode optical fiber cables, terminated with ST connectors and operated at a wavelength of 850 nanometers.

  Optical fiber

  If you are not familiar with optical fiber cables, multimode means the cables are for a light source that is generated by LEDs rather than by laser devices. The above numbers are the sizes of the core fibers and their cladding in microns.

- Fiber RI/RO ports are compatible with other 8230s, the 8250 Fiber Repeater Module (f/c 3822) or the 8260 Dual Fiber Repeater Module (f/c 3010). The 8250 module requires a setting called 8230 compatibility mode enabled. Read *IBM 8250, 8260 Planning and Site Preparation Guide*, GA33-0285 for references.
- As fully repeated pairs, the copper RI/RO ports are compatible with other 8230s, the 8250 Copper Repeater Module (f/c 7386), the 8260 Token-Ring 18-Port Active PPS and PMS Modules (f/c 3018 and 3118) when two of their ports are configured for RI/RO. Note that a jitter attenuator daughter card (f/c 8914) is required for the 8260 module.

  Copper RI/RO Without Repeater

  An 8230 copper RI/RO port is also compatible to the RI/RO ports of an 8228, the 8250 Fiber Repeater Module (copper RI/RO), the 8250 MAU module (f/c 3820) and the token-ring management modules. Since these devices contain no repeaters, drive distances are reduced according to normal token-ring cabling rules (depending on lobe length). Our conclusion is that such a connection is not recommended because it does not take advantage of the benefits of the 8230 repeater function.

- 8230 RI/RO modules are *not* compatible with 8218, 8219 or 8220 to act as half of the repeaters.
- The ICS and RJ-45 RI/RO ports interface with both 150 ohm STP cables or 100/120 ohm FTP/UTP category 4/5 cables. 100 ohm cables require impedance matching devices.

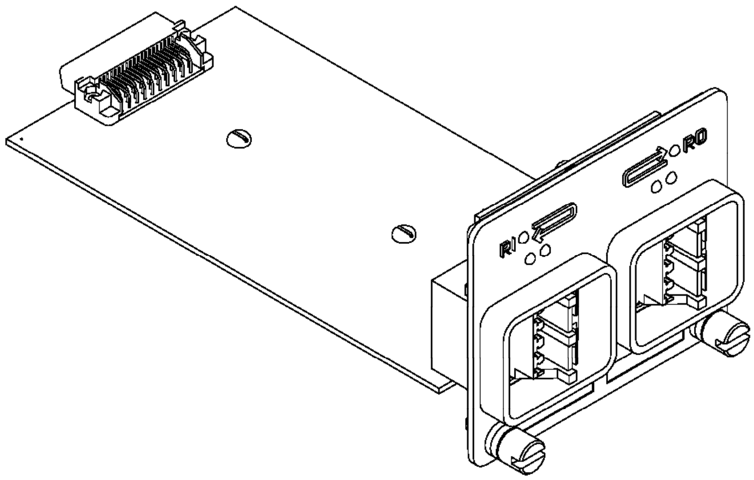


Figure 43. IBM Cabling System (ICS) Ring In/Ring Out Module

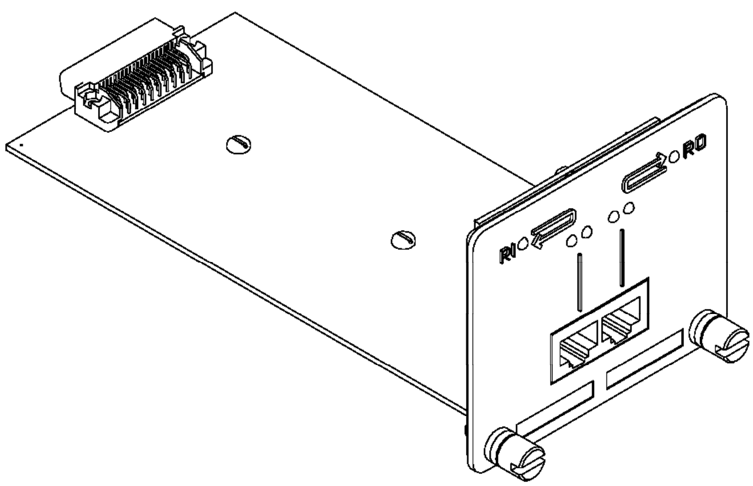


Figure 44. RJ-45 Ring In/Ring Out Module

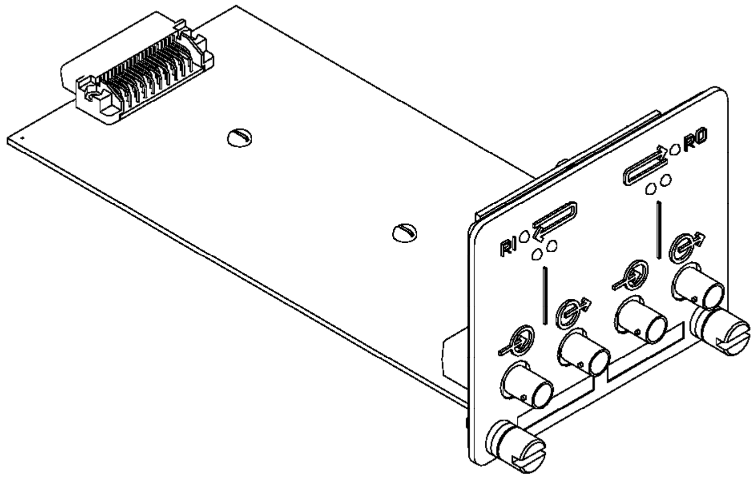


Figure 45. Fiber Optics (ST) Ring In/Ring Out Module

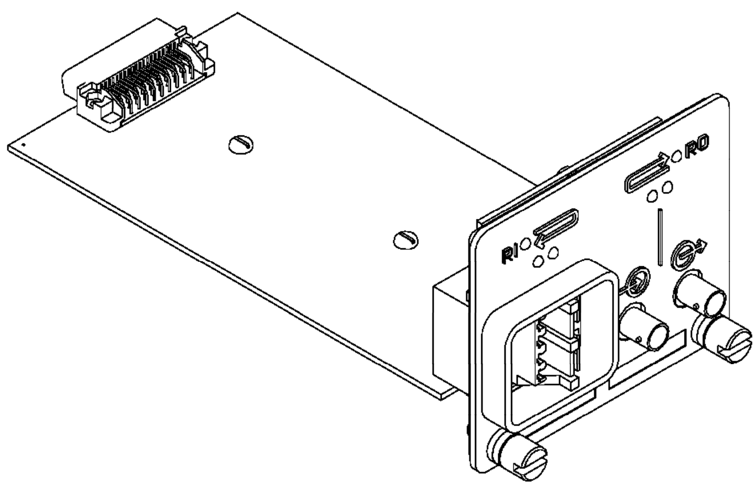


Figure 46. ICS Ring In/Fiber Ring Out Module

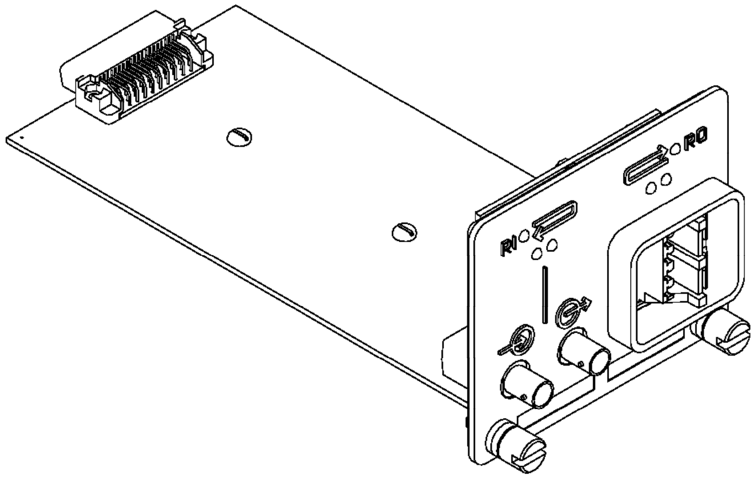


Figure 47. Fiber Ring In/ICS Ring Out Module

LIU Modules: LIUs are for lobes, the cables that run from a concentrator to workstations. One special type of LIU is a remote LIU. It provides attachment for a remote LAM which in turn provides lobes for workstations.

- There are five slots and each accepts LIUs of any kind (including RLIU). However, with a RI/RO module in slot 1, you can install a maximum of four LIUs.
- The four types of LIUs are:
  1. 2-Port ICS STP Passive LIU (f/c 2011)
  2. 3-Port RJ-45 Active LIU (f/c 2008)
  3. 4-Port RJ-45 Passive LIU (f/c 2009)
  4. Remote LIU (f/c 8230)
- Current support is one remote LIU per 8230.
- All LIUs are hot-pluggable, meaning that without powering off the 8230, plugging in or removing LIUs does not affect the main ring operation or workstations attached to other LIUs or LAMs.
- The 3-Port RJ-45 Active LIU provides active retiming and regenerates electrical signals on the ring path. This results in less stringent cabling requirements than passive LIUs.
- The ICS STP LIU provides an interface to 150 ohm IBM shielded twisted pair cables (Type 1, 2, 8 or 9) terminated with an IBM cabling system (ICS) data connector.
- The two RJ-45 LIUs provide interface to 100/120 ohm balanced cables (UTP or FTP), category 3, 4, 5 for active LIU and category 4, 5 for passive LIU.
- Like the slot numbering of the base unit, port 1 on LIUs starts from the right-most position.
- The 8230 internal code supports the presence of eight MAC addresses at each lobe port. Provided cabling considerations are made, each lobe port on the LIU can be used with an 8228 or similar device to fan-out to a maximum of eight ports.
- All ports on the LIU can be enabled for speed detection. The speed of an inserting workstation is compared to the 8230′s current ring speed and

allows insertion only if they match. This capability avoids a beaconing condition and, hence, any recovery cycle. The result is a higher availability level than other implementations.

- The Remote LIU is treated differently. It has two ports, providing a control and data path to the remote LAM.

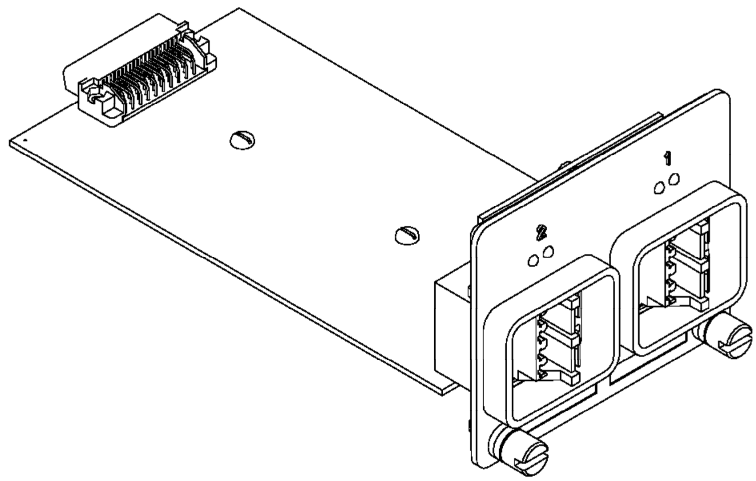


Figure 48. ICS Lobe Insertion Unit (LIU) Module

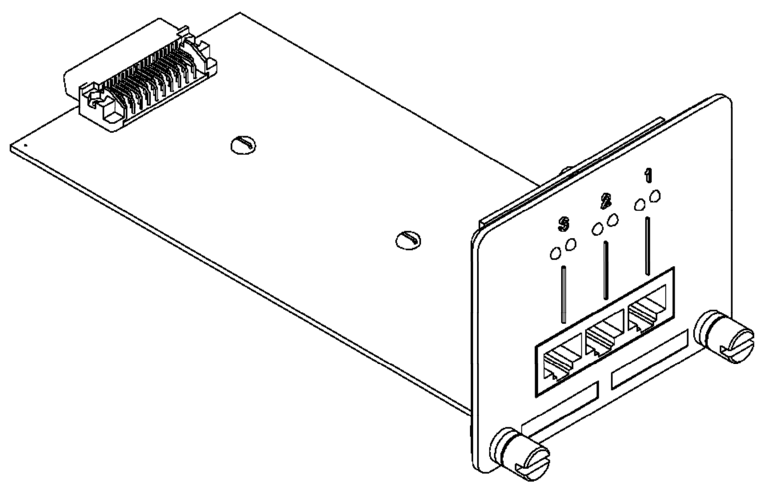


Figure 49. 3-Port RJ-45 Active Lobe Insertion Unit (LIU) Module

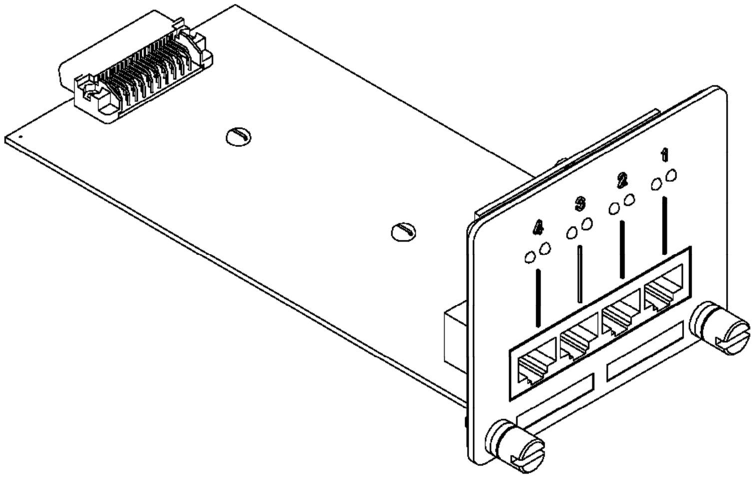


Figure 50. 4-Port RJ-45 Passive Lobe Insertion Unit (LIU) Module

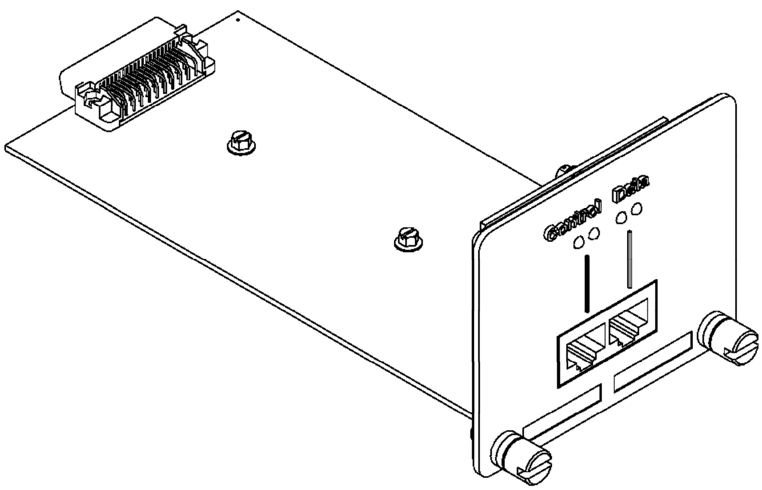


Figure 51. Remote LAM Lobe Insertion Unit (RLIU) Module

LAMs: Lobe attachment modules (LAMs) are also used for extending lobes to workstations. They do not fit inside the 8230 base unit but can be mounted above or below it on a standard 19 inch rack. Signals and data flow in and out of the 8230 base unit via 2 custom cables. These cables run out of the LAM and are terminated with a 9-pin D-shell and a 25-pin D-shell and are plugged into the corresponding receptacle of the base unit.

- Three types of LAMs are available:
  1. IBM Cabling System LAM (f/c 5501)
  2. RJ-45 LAM (f/c 5502)
  3. Shielded RJ-45 LAM (f/c 6738)
- Both RJ-45 LAMs takes up two units of rack space while the ICS LAM takes up three units.
- All of these LAMs have 20 ports.

- All these LAMs are passive. They do not contain circuits to do retiming and regeneration of electrical signals.
- The shielded RJ-45 LAM and the RJ-45 LAM (unshielded) are basically the same except for the RJ-45 connectors. The shielded connectors allow for connection using 150 ohm RJ-45 STP cables. Before the announcement of this feature, 150 ohm STP cables had to be terminated with ICS data connectors and connected to the ICS LAMs which take up more rack space.

Latest IEEE Recommendations

Because of the latest changes in IEEE 802.5 recommendations, a mix of all supported LAM types in one 8230 base unit is now supported by IBM. This is significantly different from the original 8230-003 announcement. The Model 3 becomes even more flexible in supporting different cabling needs. In mixed LAM environments, the most stringent cabling rules prevail (concerning lobe length and number of attached stations in one ring segment).

- In a mixed LAM environment (within one 8230), place any RJ-45 LAM with unshielded media first, starting with LAM position 1, followed by any shielded RJ-45 LAMs with shielded media, followed by any ICS LAMs.

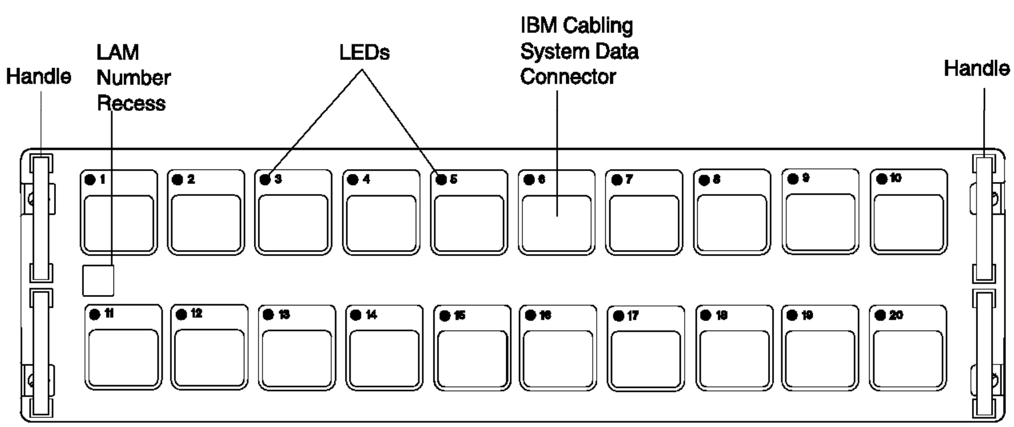


Figure 52. Front View, ICS Lobe Attachment Module (LAM)

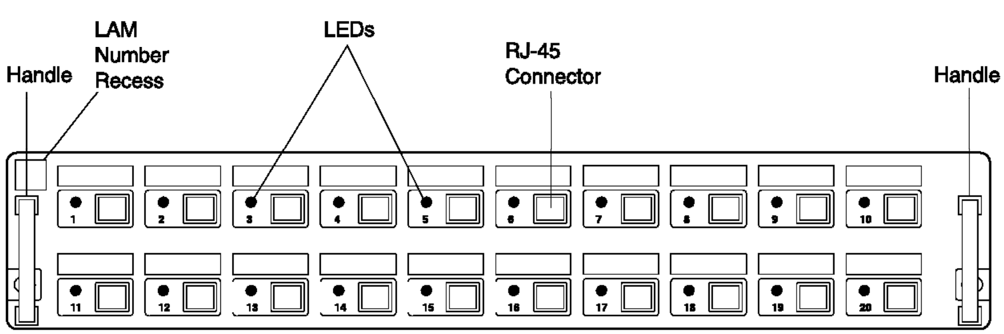


Figure 53. Front View, RJ-45 Lobe Attachment Module (LAM)

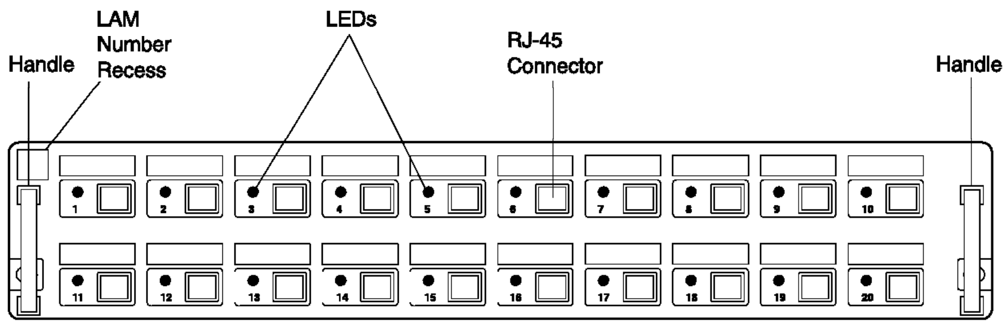


Figure 54. Front View, Shielded RJ-45 Lobe Attachment Module (LAM)

Shielded and Unshielded RJ-45 LAM

Note that these two LAMs are very similar in appearance except that the shielded one has silvery metal around the RJ-45 sockets while the unshielded ones are surrounded with black plastic.

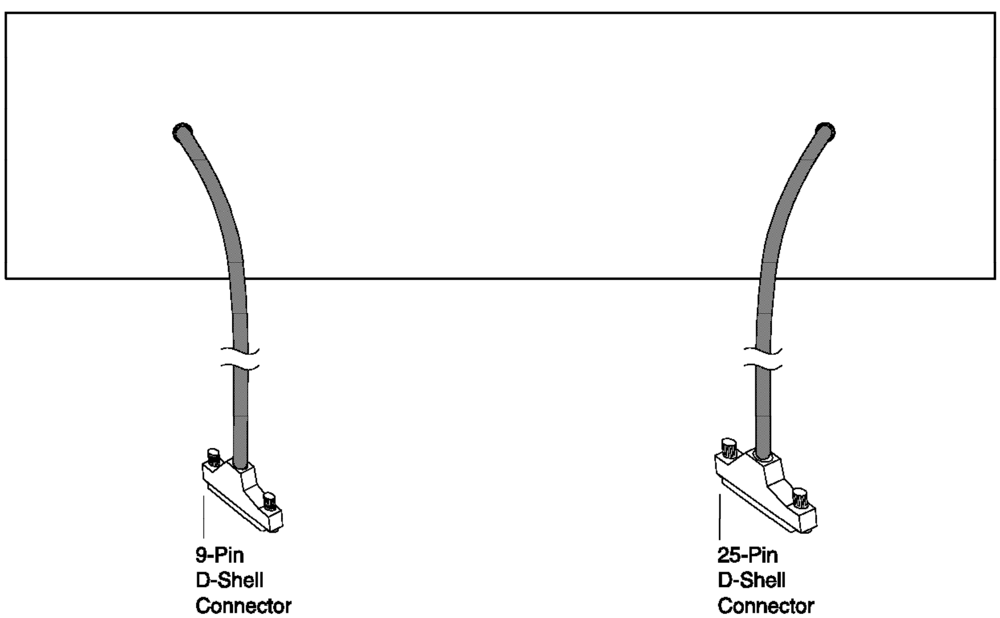


Figure 55. Rear View, Lobe Attachment Module (LAM)

Remote LAM: A remote LAM is a separate rack-mountable device that has 16 ports for workstation attachment. It is connected to an 8230 base unit with a remote LIU via two category 5 UTP cables that provide signals and data flow.

- Two models:
  1. Active RLAM (f/c 8225)
  2. Passive RLAM (f/c 8710)
- When attached to the 8230 base unit, workstations on the RLAM join the same segment as other workstations attached to the 8230 via different modules (LIUs or LAMs).

- Active RLAMs can drive category 3 cables for 16 Mbps ring speed.
- Data and control cables need to be UTP category 5 with a 100 meter length limit.
- Lobe ports from RLAMs conform to usual cabling rules.
- Active RLAMs accept 150 ohm STP in addition to 100/120 ohm UTP/FTP.

Be Independent!

Remote LAMs can work independently if no connection is made to the base unit. They then become active or passive non-manageable 16-port token-ring hubs.

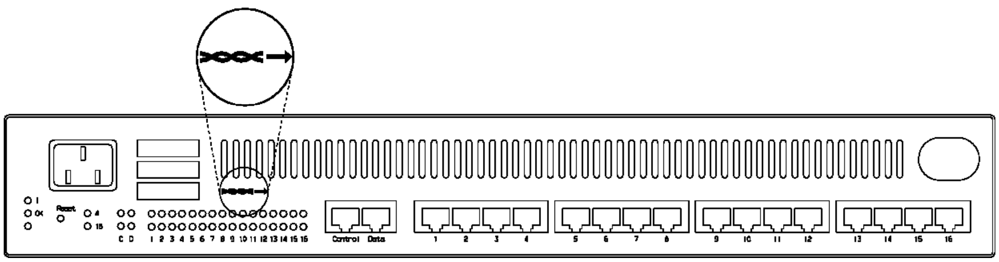


Figure 56. Front View, Remote LAM. Note that the magnified symbol in the diagram (of a piece twisted wire) appears only on the active RLAM.

2.7.1.3 Dual Ring Redundancy Feature (f/c 2029)

The Dual Ring Redundancy feature, sometimes referred to as the MAC daughter card for the 8230-003 is a field installable feature. Customer engineers perform the installation. It provides dual-ring error recovery for the IBM 8230-003/013 when other devices are attached to the segment via ring in and ring out and is co-requisite for any of the five RI/RO modules.

Without the MAC daughter card, the 8230 Model 3 has only one MAC appearance (PO adapter) on the ring path. With only the PO adapter to monitor a single point on the main ring path you will be able to recover only internal beacon scenarios.

With this optional card you get two more MAC presences, the PI and S adapters. These three adapters (PO, PI and S) monitor ring signals on different points of the main and backup ring path and report to the 8230 central microprocessor on error and recovery conditions they detect. Internal code then gives commands to the circuits that open or close relays that wrap or unwrap RI/RO ports in various manners.

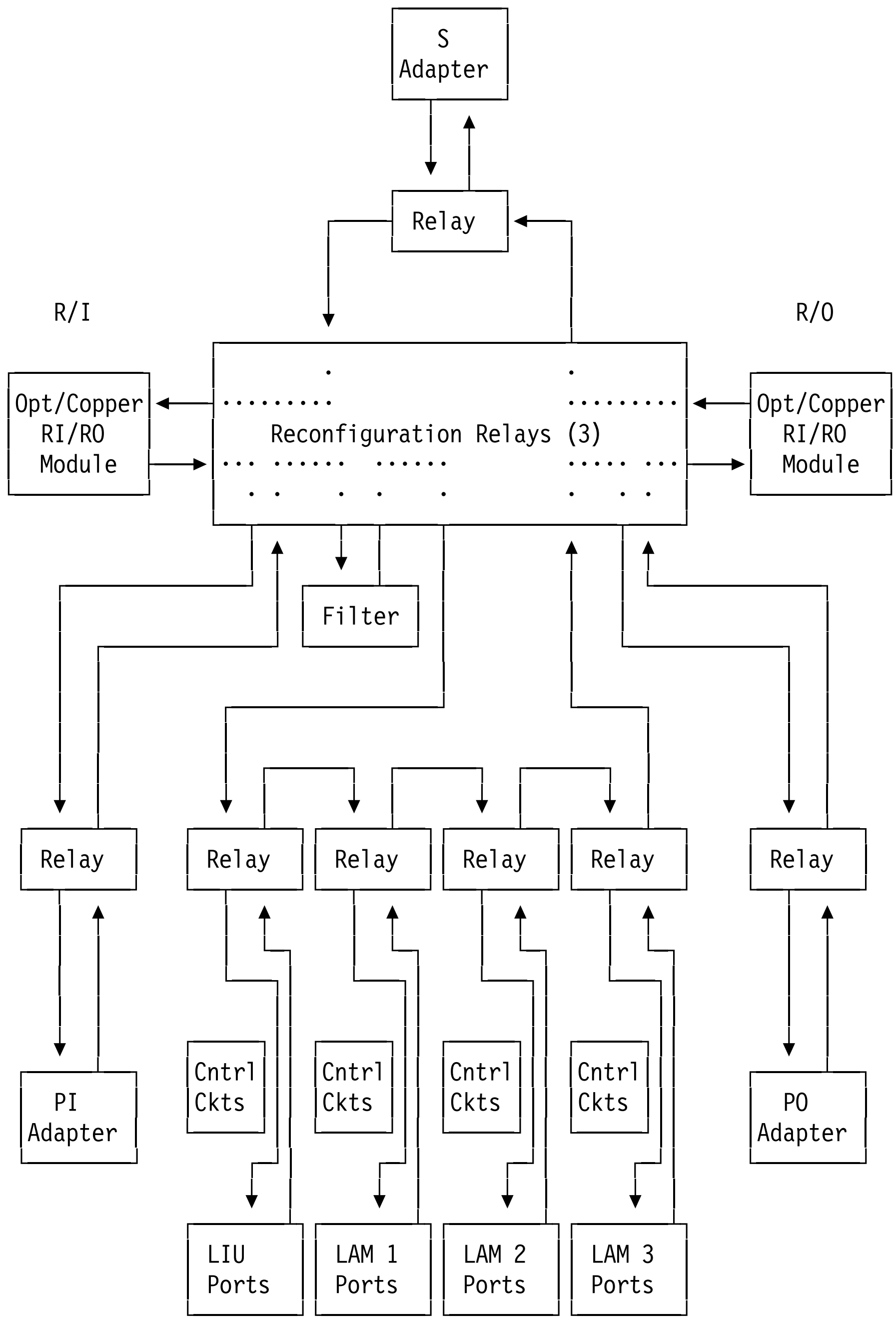
All three adapters will reclock and retransmit data as any typical station on the token-ring and, therefore, take away three counts from the maximum number of workstations allowed for any token-ring cabling topology.

Wrong speed attempted insertion will be recovered as a function of the control unit and is not dependent on the presence of the MAC daughter card.

MAC Addresses

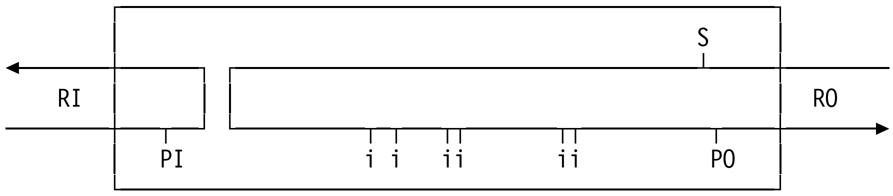
The burned-in UAA addresses for the adapters are in sequence, starting with PO, then PI, then S. This is true whether the daughter card comes pre-installed (Model 13) or as an option (for Model 3).

The following figures show the data flow (physical electrical signal) within an 8230-003/013 during normal condition and under various wrap states. Note that PI and S attach to RI and RO ports even under fault conditions to trigger an unwrap should signals become normal again.



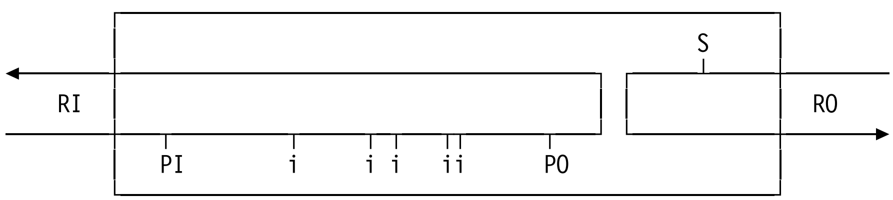
IBM 8230 Data Flow

Figure 57. IBM 8230 Data Flow



RI Fault

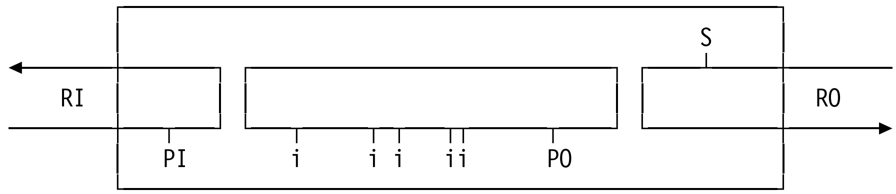
Figure 58. Wrap RI



RO Fault

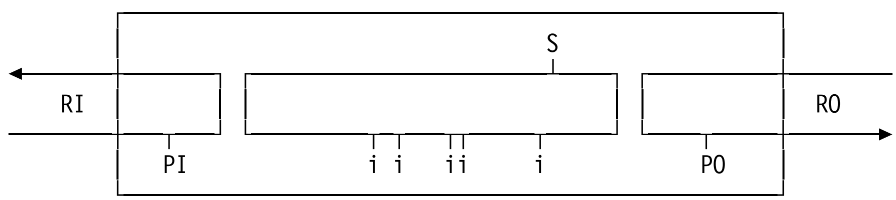
S = IBM 8230 station on back-up ring
PI = IBM 8230 station on primary ring (RI side)
PO = IBM 8230 station on primary ring (RO side)
i = ring station inserted on IBM 8230

Figure 59. Wrap RO



External Fault

Figure 60. Wrap RI/RO



Internal Fault

S = IBM 8230 station on back-up ring
PI = IBM 8230 station on primary ring (RI side)
PO = IBM 8230 station on primary ring (RO side)
i = ring station inserted on IBM 8230

Figure 61. Wrap RI/RO - Top External Fault, Bottom Internal Fault

2.7.1.4 Current EC and Internal Code Level

The 8230s are intelligent boxes that contain a combination of hardware components and internal code (software). It is therefore important to check for the latest engineering changes (EC) and internal code updates before adding new modules to the base unit. If ECs involve hardware, customer engineering should be involved. For software updates:

- IBM SEs and internal users should check out the LANCSD tool disk using the `TOOLCAT` command.
- Customers should contact their local IBM branch office.

Latest Code Level

The latest internal code level 2.1.0 which is the minimum level to support RLIUs and RLAMs will be posted on LANCSD. For customers who have existing 8230-003s, 013s installed and want to add these features, refresh the 8230s with this level of code before installation. See 2.7.4, "Management" on page 127 for using CCMF on how to verify the existing code level.

2.7.1.5 Compatibility

The 8230s operate a token-ring network according to the IEEE 802.5 standard, regarding connectors, cabling rules and signaling. As the standard evolves, IBM′s recommendation will be fully compatible with the IEEE and take advantage of any new flexibility offered. See 2.7.3, "Cabling Requirements and Limitations" on page 124 regarding some newly updated changes (which are quite different from existing documentation).

Concerning connectivity with other IBM products, here is list of products and some comments about their connectivity.

Table 13. 8230 Connectivity with Other IBM Products

Product	Connected from (8230 side)	To (Other products′ side)	Comments
8228/8226 or MAU blade on 8250/60	RI/RO	RI/RO	Drive distances conform to normal token-ring cabling rules.
8228/8226	LIU lobe ports	RI	As splitter for 8 devices.
8226 (splitter mode)	LAM lobe ports	RI	As splitter for 8 devices.
8230-001, 002	RI/RO	RI/RO	Full drive distance as between 8230-003s.
8218/8219/8220	RI/RO	RI/RO	Cannot be half repeater of these devices.
8250 TR Fiber Repeater module	RI/RO	RI/RO	Fiber connection is fully repeated, copper is not.
8260 18-Port Active PPS and PMS modules	RI/RO	RI/RO	Fully repeated drive distance (need jitter attenuator card on 8260).

2.7.2 Configuration

Configuration of an IBM 8230-003/013 can be a very straightforward task. In fact, it is designed as a customer setup (CSU) machine and will operate properly right out of the shipping boxes without any configuration procedures. We have included below a few usage scenarios and the basic setup procedures required.

Read This!

We must point out here that understanding of token-ring network design rules is of prime importance for successful implementation of a token-ring network using the 8230, or in fact, any other hubs. *The IBM Token-Ring Network Introduction and Planning Guide*, GA27-3677, *-05 or above* and the *8230-003 Supplement to the Token-Ring Network Introduction and Planning Guide*, GD21-0055, (shipped with 8230 hardware) are recommended.

2.7.2.1 Configuration Scenarios

In each of the following scenarios, we will point out what the most simple configuration procedures are, if any are required at all.

Single 8230 (Without RI/RO LIU): No configuration is required. Simply plug and play.

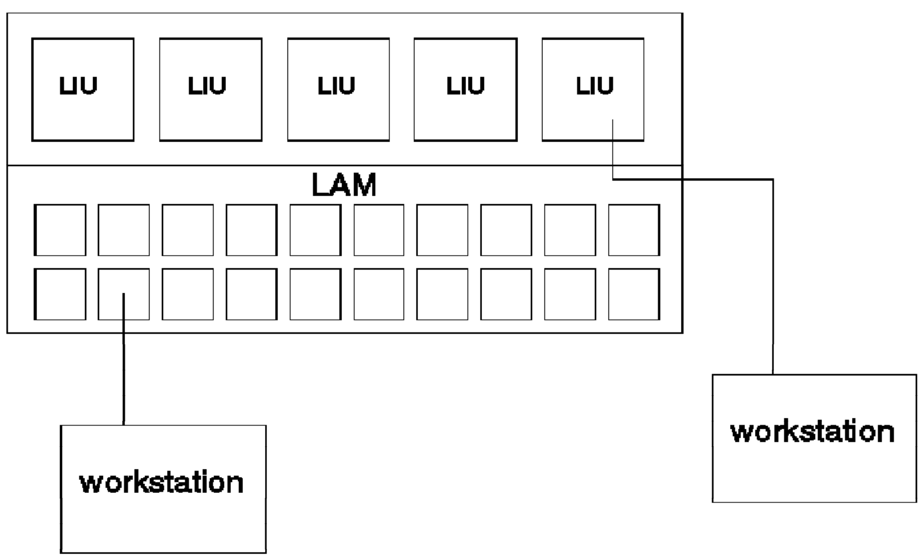


Figure 62. Single 8230 Configuration

Multiple 8230s (With RI/RO Module Installed): No configuration is required. Again, plug and play. Pay attention to drive distance limitation.

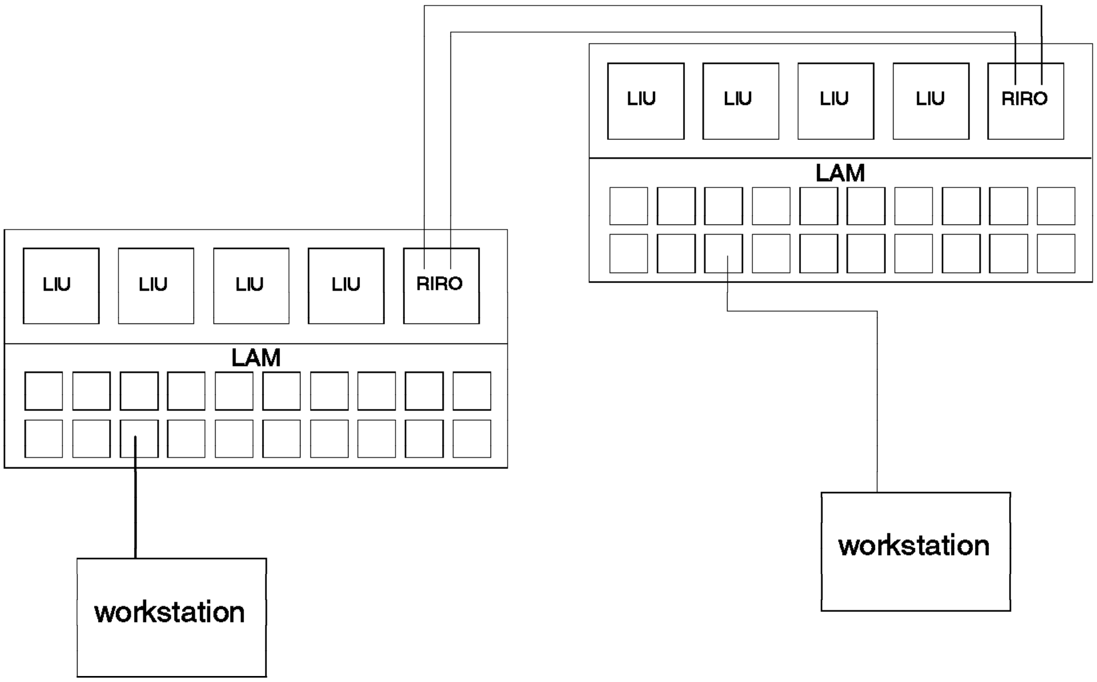


Figure 63. Multiple 8230 Configuration

Using Fan-Out Devices: The splitter can be an IBM 8228 or an IBM 8226. MAUs that are fully compatible with the 8228 or 8226 may also be used, but note that the 8230 is designed to manage up to eight MAC addresses at every fan-out lobe port. Do not attach more than eight workstations to a 10-port OEM MAU, for example, even if this is proven to be compatible to an 8228 when set up in stand-alone mode.

All LIU ports supported!

In the original 8230-003/013 announcement, only the ICS LIU was supported to attach splitters. Now, all lobe ports in all LIUs are supported for splitter attachment as long as cabling rules are taken into consideration.

Using IBM 8228s: Connect 8228 RI ports to LIU ports or ports on RLAMs (not local LAM ports). You need to enable passive concentrator attachment privileges (PCAP) through the EIA 232 port. Concentrator configuration maintenance facility (CCMF) is activated via the EIA 232 port on the 8230-003/013 with a PC running an ASCII terminal emulation program.

Phantom Current

Phantom current is the electrical signal that a normal token-ring adaptor uses to ″open″ the relay in a port (ports on LIUs, in this case) for connection. An 8228 contains no active components and cannot supply this signal. It is therefore necessary to manually open the port through management software, by enabling PCAP.

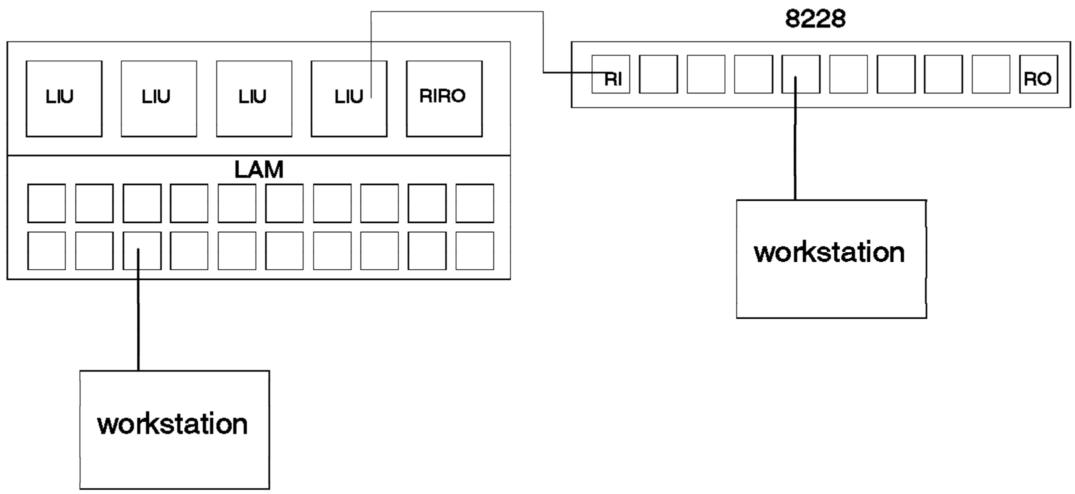


Figure 64. Fan-Out Using 8228s

Using IBM 8226s: Connect 8226 RI ports to LIU ports, LAM ports or ports on RLAMs. No configuration is required if the 8226s are switched to splitter mode. Otherwise, treat it as an 8228.

8226 Advantage

8226 is an active device and when set in splitter mode, provides the phantom current through its RI port whenever any workstation on its ports requests insertion. It provides fan-out to LAM ports as well as LIU ports.

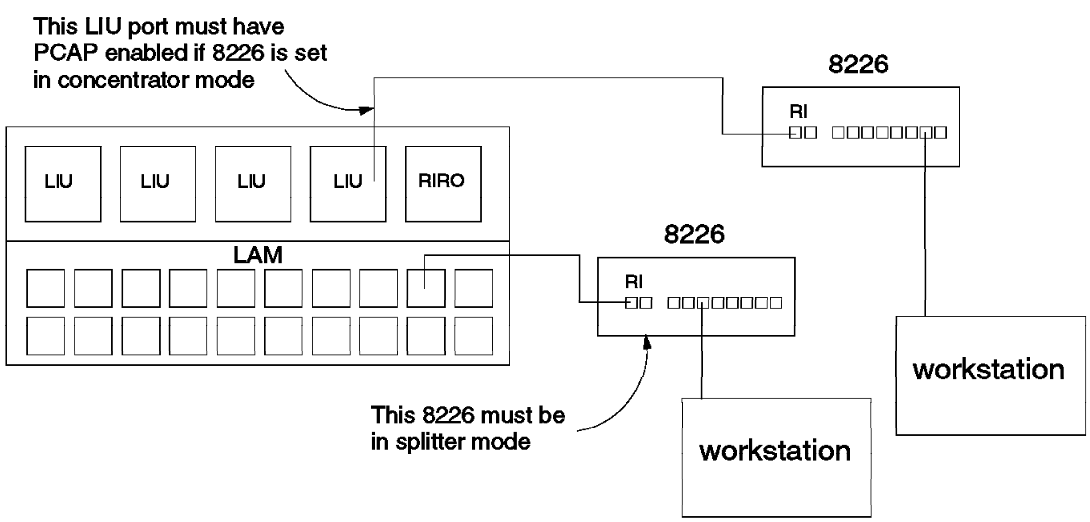


Figure 65. Fan-Out Using 8226s

2.7.2.2 Summary of Configuration

In summary, configuring an 8230 can be a very simple task. It is more important to put effort in cabling planning. If any setup is required, the simplest way to perform configuration is to attach an ASCII terminal (or a PC running an ASCII emulation program), local or via modems, to the EIA port, to run CCMF. A glimpse of the CCMF main menu is shown in Figure 66 and explanation of its options is discussed in the section on management.

```
Main Menu - Concentrator Configuration/Management Facility
Type the number of the desired option, and then press Enter.
--------------------------------------------------------------------------------

 1.  IP Configuration
 2.  Concentrator MIB Parameters
 3.  MIB-II System Parameters
 4.  Community Parameters
 5.  Trap Parameters
 6.  Set Password
 7.  Load Operating Code
 8.  Restart Concentrator
 9.  Exit Concentrator Configuration/Management Facility


Notes: To configure the Concentrator initially, you must set at least the
       IP configuration and community parameters.

An * marks changeable parameters on panels that also display read-only values.


Option number >1
```

Figure 66. CCMF Main Menu. This menu is accessed via the EIA 232 port with an ASCII terminal or a PC running a terminal emulation program.

More sophisticated methods of configuration include using an SNMP manager, like NetView for AIX or NetView for Windows, when the 8230 is set to run in SNMP mode. When the 8230 is set to run in CMOL mode, LNM for OS/2 V2 will serve the purpose.

2.7.3 Cabling Requirements and Limitations

Must Read!

Once again, the two most useful books for this task are:

- *Token-Ring Network Introduction and Planning Guide*, GA27-3677, -05 or above
- *8230 Model 3 Supplement for the Token-Ring Network Introduction and Planning Guide*, GD21-0055, -01 or above

Although most detailed information about token-ring cabling requirements and limitations are documented in the above two references, we have included below a summary which serves as a general rule of thumb. We assume a data rate of 16 Mbps in all cases because this is more common today.

2.7.3.1 Lobe Length

This is the length of cable running from an 8230 lobe port (on LIU or LAM) to the workstation. This is sometimes referred to as drop length. For an all-8230 ring, which means NO 8228s or other passive MAUs in any RI/RO path, see Table 14.

Table 14. Lobe Length

LIU/LAM Type	Commonly Used Cables and Lobe Length
ICS LAMs, ICS LIUs	150 ohm Type 1 STP, 145 meters
Active RJ-45 LIUs	100/120 ohm category 5, 180 meters
Passive RJ-45 LIUs, Shielded/Unshielded RJ-45 LAMs	100/120 ohm category 5, 100 meters
Shielded RJ-45 LAMs	150 ohm Type 1 STP, 145 meters

For other combinations of cables and modules, please refer to the above references.

2.7.3.2 8230 RI/RO Drive Distance

This is the distance between two 8230s (any models) connected together via the RI/RO ports.

If there is no mixed media type on lobes:

- Using 150 ohm Type 1 STP: 200 meters
- Using 100/120 ohm balanced category 5: 100 meters
- Using 62.5µm multimode optical fiber: 2 km

If there is mixed media type on lobes:

- Using 150 ohm Type 1 STP: 140 meters
- Using 100/120 ohm balanced category 5: 100 meters
- Using 62.5µm multimode optical fiber: 2 km

2.7.3.3 RI/RO between 8230 and IBM 8250/60 Token-Ring Modules

Some of the 8250/60 token-ring modules may have better drive distances when used by themselves. You need to follow the most restrictive rules when connecting to 8230s. Therefore:

- 8250 Fiber Repeater, 8260 Dual Fiber Repeater: 2 km using multimode optical fiber
- 8260 18-Port Active PPS/PMS Module:
  - Follow 8230-only rules
- Other non-repeated 8250/60 Modules:
  - Follow normal token-ring cabling rules

2.7.3.4 Using 8228 As a Splitter

A cable runs from an LIU port of an 8230-003/013 to the RI port of an 8228.

- Lobe cables are Type 1 STP, from 2-Port ICS LIUs:

  For every 8228 connected as a fanout device, use the following formula:

  `Maximum Lobe Length = 290m - {M + 2 x (a + b + c + ... + j) + 5 x Q}`

  where:

  – M is the longest lobe length connected directly to 8230 LIUs.

  – a, b, c,... are the distances between the 8230 LIU and the 8228 RI port.

  – Q is the total number of 8228s used in this single 8230.

- Lobe cables are 100 ohm category 4,5, from 4-Port RJ-45 LIUs:

  Same formula as above but subtract from 200 meters instead:

  `Maximum Lobe Length = 200m - {M + 2 x (a + b + c + ... + j) + 5 x Q}`

- Lobe cables are 100 ohm category 4,5, from 3-Port Active RJ-45 LIUs:

  Same formula as above but subtract from 360 meters:

  `Maximum Lobe Length = 360m - {M + 2 x (a + b + c + ... + j) + 5 x Q}`

2.7.3.5 Using 8226 As a Splitter

If the 8226 is set to concentrator mode, follow the calculation as if it were an 8228. If it is set to splitter mode, the calculation is much simpler:

`M = m + a`

where:

- M is the maximum allowable lobe length for that particular LIU/LAM.
- m is lobe length from 8226 to workstation.
- a is the length of cable between LIU/LAM lobe port to 8226 RI.

2.7.3.6 RLAM Cabling

Two category 5 UTP cables are required to connect a Remote LAM to a Remote LIU: one for control signals and the other for data flow. Control signals are the commands and responses between the microprocessors in the RLIU and RLAM.

- From RLIU to RLAM (active or passive): 100 meters

- From Active RLAM to workstation:

  – Using 150 ohm Type 1 STP: 350 meters

  – Using 100 ohm category 3: 100 meters

  – Using 100/120 ohm category 4: 200 meters

  – Using 100/120 ohm category 5: 225 meters

- From passive RLAM to workstation:

  – Using 100/120 ohm category 4/5: 100 meters

  – UTP category 3 is not supported for 16 Mbps (100 meters for 4 Mbps)

  – 150 ohm Type 1 STP is not supported

2.7.3.7 Overall Recommendation

Be Safe!

- Limit horizontal cabling length (from wiring closets where 8230s, MAUs or RLAMs are installed to work area) to 90 meters. This provides allowance for patch cables on both ends, and would most likely survive future upgrade of the network to use higher speed equipments.
- Use category 5 cables whenever possible.
- Patch cables, patch panels, and wall plate modules should be of the same grade as installed cables.
- Consider using optical fiber if wiring closets are more than 100 meters apart, or cable path is exposed outdoors.

Lobe Filters: If any unshielded media is used, ensure the proper use of lobe filters (A for ICS connectors, B for RJ-45) to meet FCC Class A, CISPRA or CISPRB standard. Read the *8230 Model 3 Supplement for Token-Ring Network* for different requirements of each LIU and LAM types.

Workstation Filters: Nowadays, most token-ring adapters come with this filter built in (for example, IBM Auto 16/4 Token-Ring Adapter). Otherwise, for connection to any unshielded media, add an external workstation filter.

Impedance Matching: Use Table 15 to determine if impedance matching devices (balun) are required:

Table 15. Impedance Matching Device Requirements

LIU/LAM Type	150 ohm media	100/120 ohm media
3-Port, 4-Port LIUs, Passive RLAMs	Required	Not required
2-Port ICS LIUs, ICS & RJ-45 RI/ROs	Not required	Required
ICS LAMs, Shielded/Unshielded RJ-45 LAMs	Not required (See Note)	Not required (See Note)
Active RLAM	Not required	Not required

Note

Only if one type of media (either 150 ohm or 100/120 ohm) is used within one LAM.

2.7.4 Management

The following are the four ways of managing an 8230-003, 013:

- Leave it unmanaged. It works!
- Limited management function using the RS-232 management program (CCMF).
- Manage it using TCP/IP Simple Network Management Protocol (SNMP).
- Manage it using OSI Common Management Information Protocol over LLC (CMOL).

2.7.4.1 Unmanaged

The 8230-003, 013 can operate without any management software or settings. Install the hardware and connect to it all the cables that you have planned for (during your planning stage) and it should work. There are, of course, some default settings that you should be aware of:

- Speed verification before insertion at the LIU ports is *not* enabled by default.
- You are not able to use 8228s as splitters on any of the lobe ports. (You can use 8226s set in splitter mode.)
- All ports are enabled by default.
- RI/RO ports are in wrap or unwrap state depending on signals they received.

2.7.4.2 Management Through the EIA 232 Port

Internal code inside the 8230 can interact with the outside world with its EIA 232 port. It is called the RS 232 program and is also referred to as Concentrator Configuration / Management Facility (CCMF) in the *8230 Model 3 Token-Ring Network Controlled Access Unit Customer Setup Instructions*, GA27-4061. A chapter in this setup manual is dedicated to CCMF and explains in detail the functions and usage of every menu item. You will find that, except for performance statistics, almost anything that can be done using an SNMP manager can be done here.

2.7.4.3 SNMP Managers

Two examples of SNMP managers are discussed here: NetView for Windows and NetView for AIX. Both of them are platforms on which you run specific applications for different purposes. To manage 8230-003 and 013, you need:

- For NetView for Windows: 8230 NetView for Windows Program (no charge, shipped with 8230 hardware)
- For NetView for AIX: LAN Network Manager (LNM) for AIX

Both applications provide realistic displays of the 8230 base unit, LIUs and LAMs, with their LED status and switches. By clicking on a port, the status of that particular port comes up as a separate window. A few screens of these two applications follow.

SNMP Setup

In order to manage an 8230 using any SNMP manager, you need to set up its IP address and community parameters using the RS 232 program (CCMF).

8230 Device Management for Windows

Latest PTF

The latest PTF for 8230 Device Management for Windows is UR43376. It is required for the program to recognize remote LIUs and remote LAMs correctly. The PTF is UR43376 PACKAGE on LANCSD.

NetView for Windows Interfaces

NetView for Windows is a platform that has consistent interfaces across different product specific modules (PSMs) that run on top of it.

More detailed information about the usage of this application can be found in *8230 Device Management for Windows User's Guide*, part number 04H7256, it is also in softcopy format on a diskette that comes with the 8230.

LNM for AIX: The LAN Network Manager for AIX program works with the NetView for AIX to enable you to manage the LAN resources of your network and provides topological views of the LAN. The functions of LNM for AIX are integrated into the NetView for AIX graphical interface. Consider LNM for AIX as a super application that has various components in it to interact with different agents which collect and manage information in different environments.

To manage an 8230-003, 013 in an SNMP environment, the agent that talks to LNM for AIX runs inside the 8230. This means, you do not need a separate workstation to run additional programs. On the other hand, if the Model 3/13 is set to run in CMOL mode, you need LNM for OS/2 running on a separate PC to act as the agent.

For detailed information on LNM for AIX usage, refer to *Using LAN Network Manager for AIX*, SC31-7110.

2.7.4.4 CMOL

When an 8230-003 is set to CMOL mode with the SNMP/CMOL switch, you can manage it with:

- LAN Network Manager (LNM) for OS/2 V2
- LNM for AIX with the LNM for OS/2 proxy agent (running on a separate PC workstation)

At the time of writing, the code for CMOL is not available. When the code is available, you need to do the following:

1. Upload the new code to the 8230 using the RS 232 program.
2. Apply PTFs to LNM for OS/2 V2. The PTF number is not available yet but will be announced with the 8230 CMOL code.

Procedures to manage 8230-003, 013 in CMOL mode with either LNM for OS/2 or LNM for AIX should be the same as what we are doing today to manage 8230-001, 002. See another ITSO redbook *LNM for OS/2, LNM for AIX and MSM Integration and Scenarios*, SG24-2504 and the user manual *Using LNM for OS/2 V2.0*, SC31-7105 for reference.

2.7.5 Positioning

This topic will position the 8230 with other IBM products.

2.7.5.1 The 8230 Family

The 8230-003/013 are new members to the IBM 8230 family of homogeneous token-ring intelligent wiring concentrators. They have better price-performance than Model 1 and 2 on a cost-per-port basis. Here are some considerations when choosing between Model 1,2 and 3/13:

1. Will you start out with a very small number of ports (less than 10, for example)?
    - If yes, consider Model 3/13.
    - If no, consider Model 1/2 (20 ports minimum).
2. Will SNMP manageability be a major advantage?
    - If yes, consider Model 3/13.
3. Will a large number of active RJ-45 ports be a requirement? (A very common example would be to upgrade a site implemented with 100 ohm category 3 cables from 4 Mbps to 16 Mbps.)
    - If yes, consider Model 2.
    - If no, consider Model 3/13. (Active RJ-45 UTP LAMs are not supported, but active LIUs and active Remote LAMs can be an alternative if the number of ports required is fewer than 20.)

2.7.5.2 8230-003/13 Versus 8250/60

Comparing the IBM 8250/60 multiprotocol hubs with their corresponding token-ring modules, the major considerations are:

1. Will any networking topology other than token-ring play a major role in the network under consideration?
    - If yes, consider 8250/60.
    - If no, consider 8230-003/013.
2. Will multiple segment configuration in the same site, or even micro-segmentation, be a major benefit to your environment?
    - If yes, consider 8250/60.
    - If no, consider 8230-003/013.
3. Will cost-per-port be a major issue? (Especially for environments where token-ring networks are implemented with a large number of 8228s and network management capability becomes a requirement but investment has to be kept to a minimum.)
    - If yes, consider 8230-003/013, using 8228s as splitters.
    - If no, consider 8250/60.
4. 8230s and 8250/60s can be complementary to each other.
    - Use 8250/60s in central sites where multiple protocols and segmentation are most common.
    - Use 8230s in satellite sites where token-ring is the single topology used.
    - Add fiber/copper RI/RO modules in the 8230s. Add repeater modules (fiber or copper) in the 8250/60s.
5. Will the features and advantages of remote LAMs bring major benefit to the network implementation?
    - If yes, consider 8230-003/013.
    - If no, consider 8250/60.

2.7.5.3 Summary

Table 16 summarizes IBM token-ring hubs currently available and their major characteristics.

Table 16. Hub Comparison

Product	Connector types	Number of ports (without splitters)	Can use 8228s as splitters	RI/RO	Management Protocols
8228-001	ICS	8	N/A	Copper	None
8226-001	RJ-45	8	N/A	Copper	None
8230-001	ICS, RJ-45 passive	20 - 80	No	Copper and/or Fiber	CMOL
8230-002	ICS, RJ-45 passive, RJ-45 active	20 - 80	No	Copper and/or Fiber	CMOL
8230-003 013	ICS, RJ-45 passive, RJ-45 active	0 - 80	Yes	Copper and/or Fiber	CMOL or SNMP

2.8 IBM Nways 8238 Token-Ring Stackable Hub

The IBM Nways 8238 Token-Ring Stackable Hub is an affordable, token-ring, super stackable hub with high-end features.

2.8.1 Technical Description

The IBM Nways 8238 Token-Ring Stackable Hub addresses the emerging, higher functionality needs of both main office telecommunications closets and those of mission-critical remote sites.

As networks have grown from department-oriented methods of sharing resources to everyone′s connection point to the enterprise′s vital information, equipment in the telecommunications closet has evolved from unmanaged, passive, multistation access units such as the 8238, to highly manageable, chassis-based, multiprotocol-capable, intelligent hubs such as the IBM 8250 and 8260. More and more frequently, stackable hubs such as the 8238 that combine high-end management with fault-tolerant features and lower cost are considered for telecommunications closet installation where multiprotocol support is not required.

Branch banks, retail stores, medical clinics, insurance offices, and sales agencies are just a few examples of remote sites that are now being connected to the enterprise network.

Enterprise networks often contain hundreds, even thousands of such remote sites that demand the same level of service and support as the networks in the home office because they are performing the same mission-critical tasks. Here again, the 8238′s high fault tolerance and remote manageability make it a superior choice for extending the enterprise network and its mission-critical applications to branch offices.

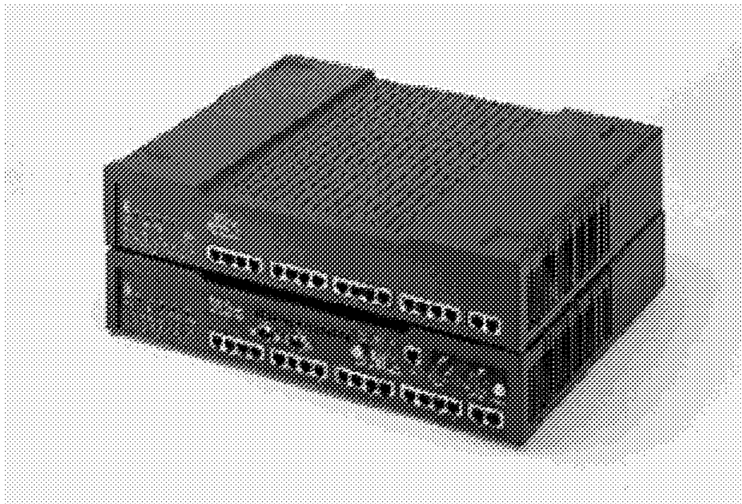


Figure 67. IBM Nways 8238 Token-Ring Stackable Hub

2.8.1.1 Fault Tolerance through Improved Technology

The IBM 8238 delivers state-of-the-art fault tolerance at an affordable price. Our instant beaconing recovery distributes the beaconing recovery to each hub so that beaconing fault detection and recovery occur within moments.

When physical changes are required in the stack of an 8238, either to add an additional component or replace a faulty one, the 8238′s design permits hot swapping. So components can be added or removed without powering down the stack and without interfering with ring activity.

Finally, the 8238′s automatic speed detection feature makes sure that every station entering the ring is operating at the same speed as the ring. Any station that attempts to enter the ring while operating at the wrong speed is prevented from entering and disrupting the operation of the ring.

2.8.1.2 Making the Infrastructure Work for You

A solution that causes you to recable all of your facilities raises the cost of network ownership. So IBM has done all it can to support the most common, standards-recognized, building cabling in the design of the 8238.

Our phase locked loop (PLL) technology is one of the most advanced and reliable features of the 8238. Each lobe port of the active media models is retimed and repeated. The result is that reliable operation is achieved at 16 Mbps on 100-ohm, Category 3 UTP cables with lobe lengths of up to 100 m (328 ft). Up to 225 m (738 ft) of Category 5 UTP and up to 400 m (1312 ft) of 150-ohm, STP type 1 cabling are also supported. The PLL ensures that crosstalk and jitter will not distort signals and hinder the LAN operation even at these extended, non-standard, distances.

For facilities with high-quality building cabling and shorter lobe lengths, passive media models that employ the PLL circuit once for each hub provide a highly reliable, cost-effective solution. Categories 4 and 5 UTP cabling of up to 100 m (328 ft) or 150-ohm STP of up to 200 m (656 ft) are all supported at 16 Mbps. Categories of 120-ohm UTP, ScTP, or FTP cabling are supported at the same distances as 100-ohm cabling for both active and passive modules. For connections between 8238s or to other IBM concentrators or hubs such as 8230s, 8250s, or 8260s, IBM offers both copper and multimode optical fiber RI/RO modules.

2.8.1.3 Network Management

Whether you are using the 8238 in a telecommunications closet down the hall or in a branch office in another state, you need to be able to diagnose and resolve problems without leaving your network management workstation. The 8238′s three levels of upgradable network management software offer the network management you need, where you need it. The bronze level offers configuration management, real-time error monitoring on a per-port basis, and ring traffic statistics. The silver level delivers error and performance monitoring on a per-port basis, user-defined thresholds, and 8 out of 13 of the following groups of remote monitoring (RMON) specification: TR statistics, host, ring station, ring station order, ring station configuration, source routing, event, and alarm groups.

For the most complete suite of network management information, managed base Models AG1 and PG1 (Active Gold 1 and Passive Gold 1) support all 13 RMON groups as well as event logging. The additional RMON groups are: host top N, matrix, history, filter, and packet capture. Upgrades from one level to another can be done via in-band downloads. Using the Code Download kit in combination with your network management workstation, an entire network can be upgraded from your office. The 8238 reduces the cost of keeping your network up-to-date to an absolute minimum.

In addition, the 8238 allows you to keep crucial information such as its serial number, the revision level, date of installation, and service dates in the hub′s memory. This information, which is accessible from the management workstation, can save hours of record-keeping and allows for an efficient, centralized inventory.

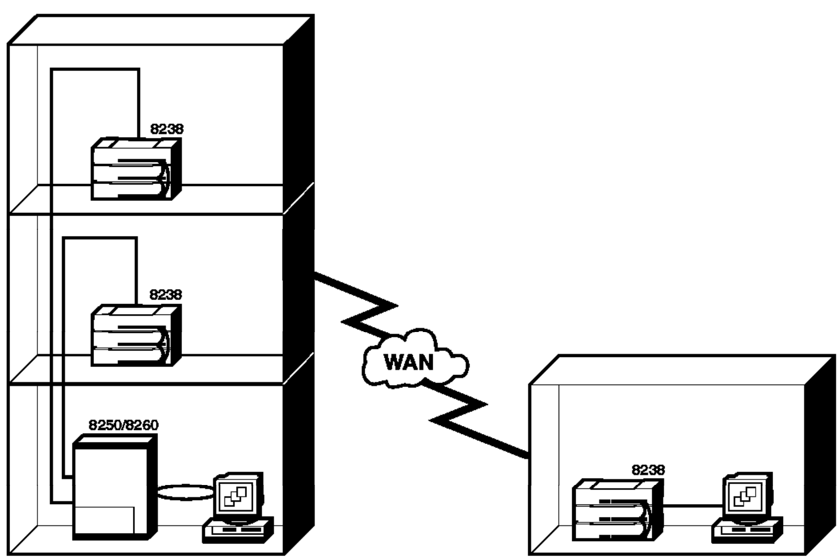


Figure 68. Example of a Corporate Network

2.8.1.4 Future Proofing Your Token-Ring Installations

The 8238 gives you the flexibility to grow and manage your token-ring LANs, wherever they are, with a minimum of fuss and bother. Its flexible, stackable design will not only let you grow, it will accommodate complementary applications like redundant power supplies and remote dial-in access for network users, no matter where they are. Its compatibility with existing IBM token-ring products such as the 8230, 8250, and 8260 concentrators and hubs let the 8238 fit nicely into your long-term networking plans.

2.8.1.5 What You Get

- Power cord
- Manuals - shipped with the product and available separately

Quick Start Guide	GA27-4091
Management Guide	GA27-4092
Quick Reference Guide	GA27-4086
Installation and Operations	GA27-4093
Installation or RI/RO	GA27-4094
Memory Card Installation	GA27-4095

Table 17. Upgradable Network Management Software

	Bronze	**Silver**	**Gold**
SNMP	Yes	Yes	Yes
Configuration	Yes	Yes	Yes
Status	Yes	Yes	Yes
Fault Reporting per Port	Yes	Yes	Yes
Ring Traffic	Yes	Yes	Yes
Per-Port Traffic Monitoring		Yes	Yes
Thresholds		Yes	Yes
RMON		8 groups	13 groups
Event Logging			Yes

Table 18 (Page 1 of 2). IBM Nways 8238 Token-Ring Stackable Hub at a Glance

Machine type	8238 Passive Base - Bronze	PB1	38H6220
	8238 Passive Base - Silver	PS1	38H6225
	8238 Passive Base - Gold	PG1	38H6226
	8238 Active Base - Bronze	AB1	38H6210
	8238 Active Base - Bronze	AS1	38H6215
	8238 Active Base - Bronze	AG1	38H6216
Features	8238 Passive Expansion	6240	38H6240
	8238 Active Expansion	6230	38H6230
	Fiber RI/RO Module	6201	38H6201
	Copper RI/RO Module	6202	38H6202
	4 MB Memory Expansion	6208	38H6208
	8 MB Memory Expansion	6209	38H6209
	Code Download Kit	6200	38H6200

Table 18 (Page 2 of 2). IBM Nways 8238 Token-Ring Stackable Hub at a Glance		
Management upgrades	Bronze to Silver Upgrade	38H6204
	Bronze to Gold Upgrade	38H6205
	Silver to Gold Upgrade	38H6205
Protocol	IEEE 802.5 token-ring at 4-or 16-Mbps management SNMP error and status displays LED indicators for power, unit, and individual port status Hex display for error codes and diagnostic message	
Physical specifications	Width: 434.00 mm (17.1 inches) Depth: 324.00 mm (12.75 inches) Height: 89.00 mm (3.5 inches) Weight: Management Hub: 5 kg (11 lb) Expansion Hub: 4 kg (8.8 lb)	
Operating environment	Temperature: 32° to 122°F (0° to 50°C) Relative humidity: 5% to 95% Electrical V ac 1.5 A 50-60 Hz	
Warranty	One year	
Regulatory compliance	Meets UL, CSA, and TUV safety requirements; FCC/A, VCCI/1, VDE/B, CISPR2/A.	

Table 19 (Page 1 of 2). Hub Architecture Enhancements	
Feature	**Benefits**
Device attachment	• Provides affordable concentration for as few as 16 or as many as 128 users • Each managed module can support up to 7 unmanaged modules in the same stack
Ring-in and ring-out modules	• Provide connection to the main ring path • Support RI/RO via optical fiber or shielded RJ-45
Cable choices	• Support Category 3/4/5 UTP cable and STP cable
Network management	• Three upgradable levels to meet all your requirements • Same MIB as the 8250 and 8260; supported by the NetView family of network management products • Supported by IBM Intelligent Hub Management Program (IHMP) DOS Entry Version 2 or IBM Nways Manager for Windows • AIX support with NWAYS Campus Manager LAN For AIX
EIA 232 communications port	• Two ports provide for simultaneous port consultation between the network administrator and a service provider - both of whom can be remote from the site
Flash Memory	• Lets you update microcode via software download
Error and status displays	• Simplify troubleshooting and performance monitoring
Compatibility with other IBM products	• Preserves your equipment investment in other IBM products • Standardizes network equipment requirements • Compatible with 8230, 8250, and 8260 concentrators and hubs
Automatic speed detection	• Reduces errors and simplifies management • Helps avoid network interrupts

Table 19 (Page 2 of 2). Hub Architecture Enhancements	
Feature	**Benefits**
Service	• Provided by IBM
Code updates	• No annual maintenance fee
Product preview	• IBM intends to enhance the 8238 in the fourth quarter of 1995 by adding redundant power and dial-in access similar to that of the IBM 8235. Announcement and availability of these functions will be based upon IBM's business and technical judgment.

2.9 IBM 8240 FDDI Concentrator

The IBM 8240 FDDI Concentrator is a wiring concentrator for use in an FDDI network. It provides a dual attachment for an FDDI ring. The concentrator itself can provide up to 24 ports for the attachment of FDDI stations and concentrators, connected either via optical fiber cable or via copper cable.

Each IBM 8240 is shipped with a Maintenance Facility Program. It is installed on a PS/2 with an FDDI adapter under the OS/2 operating system. It can be used to communicate with the concentrator, for example, to get status information, to configure the IBM 8240 and to monitor a single FDDI segment.

2.9.1 Hardware Description

The IBM 8240 FDDI Concentrator is a single media access control (MAC) concentrator. The mounted frame has eight slots for different modules. The modules are:

- One required concentrator control module (CC Module)
- One required ring attachment module (RA Module)
- One to six optional device attachment module (DA Module)

The size of the concentrator is 482.6 mm (19 in) wide, 442 mm (17.4 in) deep and 443.7 mm (17.5 in) high. It will therefore fit in a standard EIA (Electronics Industries Association) 19-inch equipment rack. The weight depends on how many modules are installed. It varies from 25 Kg (56 lb) with no modules to 50 Kg (112 lb) with all modules installed. Figure 69 on page 137 shows the IBM 8240 FDDI Concentrator.

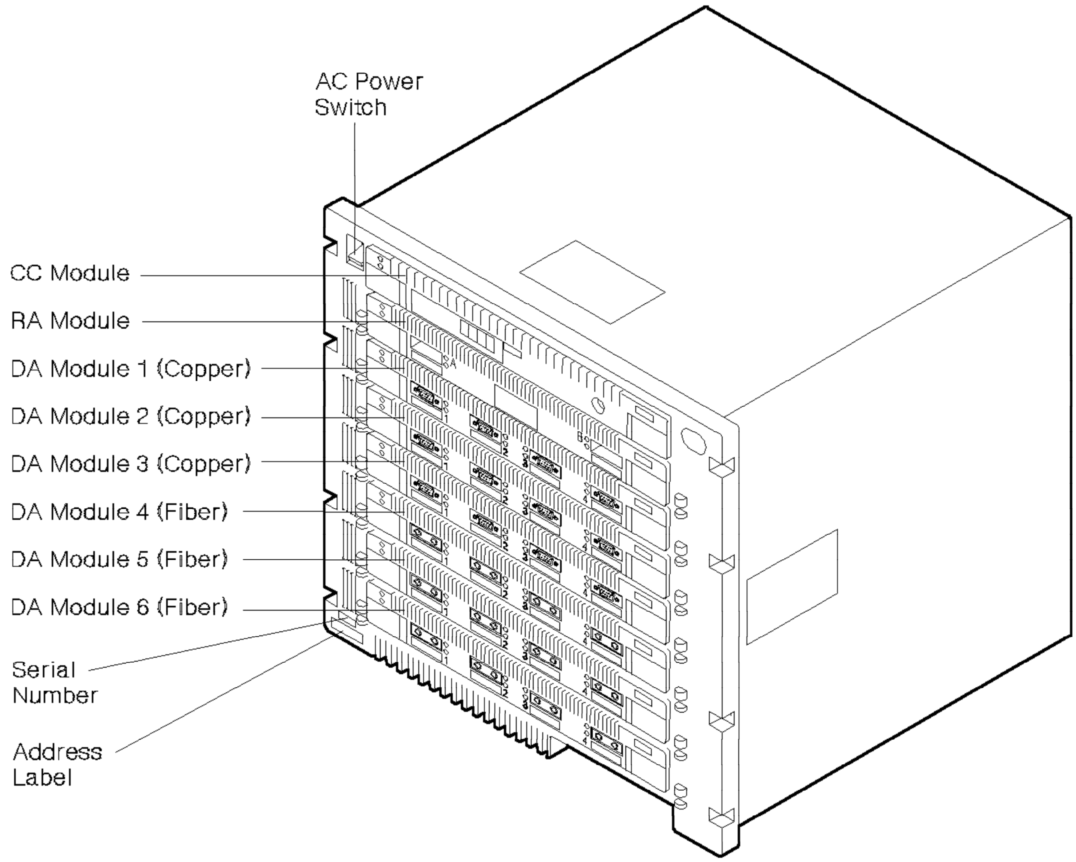


Figure 69. IBM 8240 FDDI Concentrator

Note: The sequence of the DA modules is arbitrary.

2.9.1.1 Concentrator Control Module (CC Module)

The concentrator control module contains the control electronics of the IBM 8240. It maintains the access to the FDDI network for the concentrator and for the FDDI stations which are attached to this concentrator. There is a label at the front cover which shows the universally administered MAC address of the concentrator.

This module also has an interface for an external optical bypass control connector. There are two LEDs (light-emitting diodes), green and amber, and a 4-digit hexadecimal display at the front of the module. They indicate the status and error codes of the concentrator (see 2.9.4, "Problem Determination" on page 141).

The CC Module must always be installed in the first slot of the IBM 8240 (see Figure 70 on page 138).

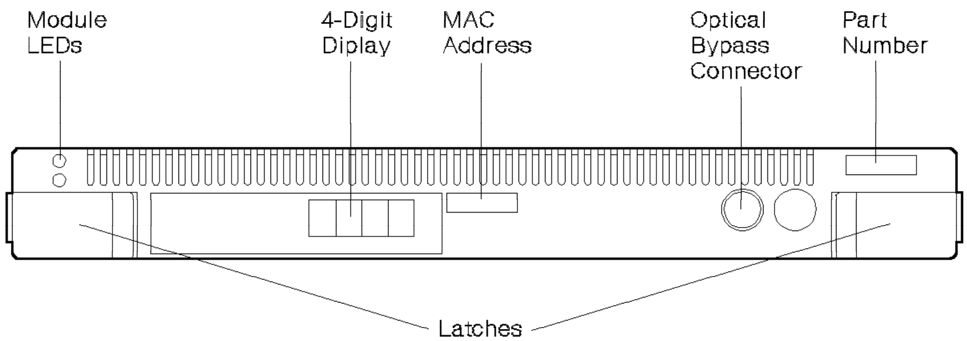


Figure 70. IBM 8240 Concentrator Control Module

2.9.1.2 Ring Attachment Module (RA Module)

The ring attachment module allows you to attach the concentrator as a dual attaching station (DAS) to an FDDI ring. Another possibility is to connect the concentrator as a dual homing concentrator (DHC) or a single attaching concentrator (SAC) to other concentrators. The attachment to the FDDI ring is made via multi-mode optical fiber cables. The left receptacle is coded with a Key "Type A", and the right receptacle is coded with a Key "Type B".

There are LED pairs, green and amber, at the front of the module to indicate the status, one pair for the the RA module, one pair for the A port and one for the B port respectively.

The RA module must always be installed in the second slot of the IBM 8240 below the CC Module (see Figure 71).

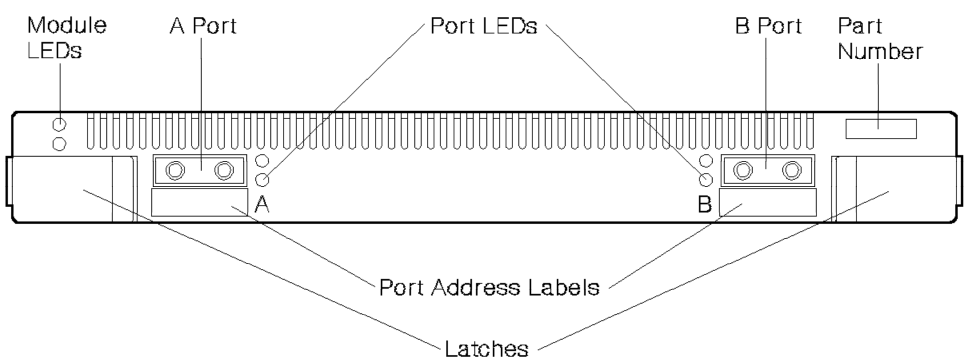


Figure 71. IBM 8240 Ring Attachment Module

2.9.1.3 Device Attachment Modules (DA Modules)

There are two device attachment modules available for the IBM 8240, one for optical fiber connection using multimode optical fiber cable and one for copper connection using IBM cabling system types 1, 2, 6, or 9 shielded twisted pair. Each module has four master ports (M Port) to attach up to four devices, either end stations or concentrators. The receptacles are coded with a Key "Type M".

There are LED pairs, green and amber, at the front of the module to indicate the status, one pair for the the DA module and one pair for each of the four master ports.

The DA modules are installed after the RA module. The IBM 8240 has six slots available for these modules. Any combination of the DA modules can be installed. Figure 72 shows the DA module for optical fiber connections, and Figure 73 shows the DA module for copper connections.

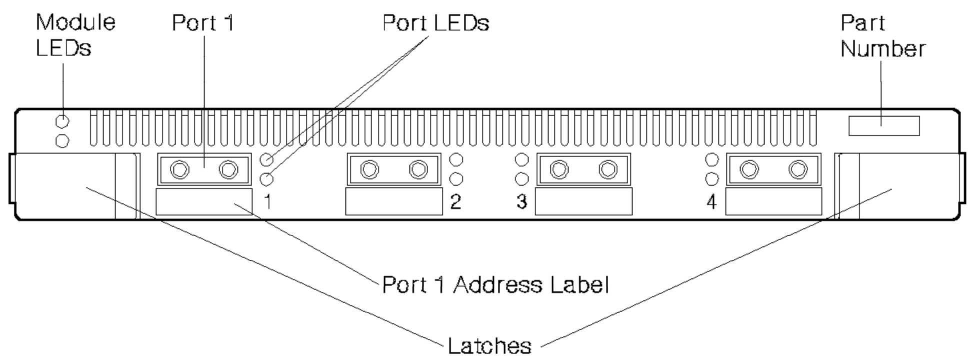


Figure 72. IBM 8240 Device Attachment Module for Optical Fiber

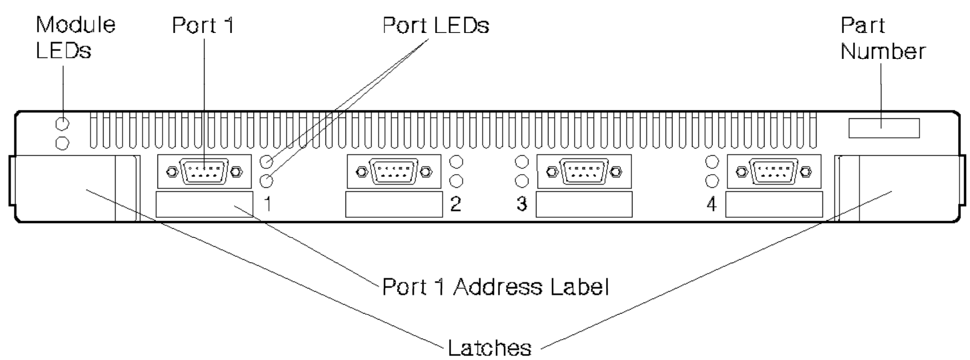


Figure 73. IBM 8240 Device Attachment Module for Copper

2.9.2 Ordering Consideration

The IBM 8240 can be ordered by the following part numbers:

- 02F9799 Concentrator (world trade countries)
- 02F9899 Concentrator (US non-Federal Government)
- 02F9700 Concentrator (US Federal Government only)
- 02F9764 Concentrator Control Module

  The module does not have to be ordered separately. It is shipped together with the IBM 8240. It can be ordered as a customer replaceable unit (CRU).

- 02F9774 Ring Attachment Module

  The module does have to be ordered separately. It is *not* shipped together with the IBM 8240.

- 02F9783 Device Attachment Module for Optical Fiber
- 02F9793 Device Attachment Module for Copper
- 92F9003 FDDI Wrap Plug for Optical cable
- 33G2759 FDDI Wrap Plug for Copper
- 33G2760 IBM Concentrator Copper Attachment Port cable

It is strongly recommended to order wrap plugs to verify the installation of the IBM 8240. They are also needed to test the FDDI adapter cards in other FDDI stations, for example in a PS/2.

2.9.3 Installation Consideration

The shipment of the IBM 8240 will include the following items:

- IBM 8240 housing
- Rack mounting shelf
- Concentrator control module
- Power cord
- Six slot covers installed in the IBM 8240
- Cable management bracket
- Documentation
  - Unpacking instruction
  - *IBM 8240 FDDI Concentrator Customer Setup Instruction,* GA17-0235
  - *IBM 8240 FDDI Concentrator Service Guide,* SY17-0014
  - *IBM 8240 FDDI Concentrator Maintenance Facility User′s Guide,*GA17-0237
- Maintenance Facility Program Diskette

The RA module, which must be ordered with the IBM 8240, is packaged separately. This is also true for all the DA modules which are ordered. In the fiber ports of the RA module and the DA module there are protection plugs installed (the process plug), to protect the optical interfaces of the modules.

The IBM 8240 is shipped without the modules installed, to ease the installation of the concentrator in a 19-inch equipment rack.

> **Note:**
>
> The concentrator must be installed with the rack mounting shelf or other equipment support rails.

After the concentrator frame is mounted in a rack, the CC module is installed in the first slot. The RA module is installed in the second slot directly below the CC module. All other slots, which are for the DA modules, are covered by a slot cover front. Only as many covers should be removed as DA modules are to be installed.

When all modules are installed, a Power-On Self Test (POST) is performed. The test starts automatically when the IBM 8240 is switched on. The green and amber LEDs blink alternately and the 4-digit hexadecimal display on the CC Module presents a series of status codes (see 2.9.4, “Problem Determination” on page 141). After the test has finished successfully, the status code will display 0000 for approximately 60 seconds before it goes blank. The green status LEDs of all modules will be lit, and all port LEDs will be turned off.

After a successful Power-on Self Test the FDDI stations can be connected to the ports of the DA Module. When a station opens its FDDI adapter, the green LED at the IBM 8240 will be lit.

If the FDDI station is a dual homing station, the LED for the primary path, which is the connection between the B port of the station and the concentrator, will be lit, and the LED for the alternate path will blink green. When the primary path fails, the LED for this path goes off and the LED for the alternate path will switch to a steady lit state.

2.9.4 Problem Determination

The IBM 8240 is designed to be installed by the customer and repaired by the customer or by a customer engineer (CE). All modules, the CC module, the RA module and the DA modules are customer replaceable units (CRUs) and can be ordered separately. Field replaceable units (FRUs) are the housing, the power supply, the fan assembly and the backplane. FRUs are replaced by the CE.

On the concentrator control module the 4-digit hexadecimal display presents the different status and error codes of the IBM 8240. The status codes are only displayed for approximately 60 seconds, then the display goes blank. The error code stays on the display.

2.9.4.1 Status and Error Codes

The codes are grouped in the following four categories:

- Status Codes
- Power-On Self-Test (POST) Codes
- Remote Program Update (RPU) Codes
- Error Codes

Status Codes ("0000" to "07FF"): The codes provide information on the cabling configuration and the number and the type of the installed DA modules (copper or fiber). Also displayed is the status of the RA module and other internal setup parameters.

Power-On Self-Test (POST) Codes ("8000" to "8FFF"): These codes are displayed during the IBM 8240 hardware initialization process. The step-by-step progress from the power-on state to the operational state can be followed.

The codes are grouped as follows:

Range	Description
8000 to 80FF	RA Module POST Error
8100 to 81FF	DA Module 1 POST Error
8200 to 82FF	DA Module 2 POST Error
8300 to 83FF	DA Module 3 POST Error
8400 to 84FF	DA Module 4 POST Error
8500 to 85FF	DA Module 5 POST Error
8600 to 86FF	DA Module 6 POST Error
8700 to 87FF	Not used
8800 to 8DFF	CC Module POST Error
8E00 to 8FFF	Status during Initialization

If the POST process ends with one of the above error codes, the relevant module has to be replaced.

Remote Program Update (RPU) Codes ("9000" to "9FFF"): The codes are displayed during the progress of a remote program load process. The 8240 should not be powered off while the process is active.

Error Codes ("B000" to "FFFF"): Codes within this range report any kind of IBM 8240 hardware problems. The error codes are grouped to identify the failing hardware easier.

Range	Description
B000 to CFFF	Ring errors
D000 to D0FF	RA Module suspected errors. The amber LED on the RA is also lit. The problem can be caused by: • An incorrectly installed RA Module • A defective RA Module • A defective power supply • A defective backplane
D100 to D1FF	DA Module 1 suspected errors.The problem can be caused by: • An incorrectly installed DA Module • A defective DA Module • A defective RA Module • A defective CC Module • A defective backplane
D200 to D2FF	DA Module 2 suspected errors, caused by the same problem as for DA Module 1
D300 to D3FF	DA Module 3 suspected errors, caused by the same problem as for DA Module 1
D400 to D4FF	DA Module 4 suspected errors, caused by the same problem as for DA Module 1
D500 to D5FF	DA Module 5 suspected errors, caused by the same problem as for DA Module 1
D600 to D6FF	DA Module 6 suspected errors, caused by the same problem as for DA Module 1
D700 to D7FF	Backplane suspected errors, caused by the same problem as for DA Module 1
D800 to DBFF	Not used
DC00 to DCFF	NP-bus errors, caused by the same problem as for DA Module 1
DD00 to DDFE	Not used
DFFF	Fan failure

2.9.5 Maintenance Facility (MF)

The Maintenance Facility Program for the IBM 8240 FDDI Concentrator has the following main functions which will be described in more detail:

- Configure the IBM 8240
- Load microcode to the IBM 8240
- Display the link quality of the IBM 8240 ports
- Obtain the ring status of the IBM 8240 and its ports
- Build a ring map of the FDDI network
- Send generic Station Management (SMT) frames through the ring
- Obtain help information from the Maintenance Facility panels

The program uses OS/2 Presentation Manager as its user interface. The usage of windows, menus, push buttons and check boxes are the same as for other

Presentation Manager applications. Both the keyboard and the mouse are supported.

2.9.5.1 Installation

To install the Maintenance Facility Program the following minimum hardware and software is required:

- PS/2 Model 70 with:
  - 8 MB memory
  - 3.5-inch diskette drive
  - Video Graphics Array (VGA) monitor
  - IBM Enhanced Keyboard
  - IBM FDDI Adapter
  - Approximately 1 MB hard disk space
- Operating System/2 (OS/2) Version 1.3 or higher
- OS/2 Extended Services Version 1.0 or higher
- OS/2 LAN Services
- IBM FDDI Adapter Network Device Interface Specification (NDIS) device driver

2.9.5.2 Functions

The functions provided by the Maintenance Facility are either applied to the entire FDDI ring or only to a selected IBM 8240.

The following functions related to the IBM 8240 concentrator and other FDDI stations are available:

Link Quality: The link quality function will display the link rate of any port for an IBM 8240 concentrator. The related MIB attributes for the link quality, which are the average link error rate (LER), the LER alarm threshold and the cutoff condition threshold, are also displayed and the latter two can be changed if necessary. Different colors are used for easier recognition of critical conditions (green - yellow - red).

- The average link error rate indicates the current estimated error rate. In normal operation the average LER is in the range of 10^{-15} to 10^{-10}. errors per second.
- The LER alarm generation threshold indicates when the average error rate is in a critical condition and an alarm should be generated. In this case an SRF (status report frame) is sent. The default value is 10^{-8} but can be changed in steps of $10^{\pm 1}$ between 10^{-15} and 10^{-4}. The value cannot be set below the cutoff condition threshold.
- The cutoff condition threshold indicates when a port will be removed from the ring after the link error rate has increased and alarms were generated. The default value is 10^{-7} but can be changed in step of $10^{\pm 1}$ between 10^{-15} and 10^{-4}.
- The link rate is the difference between the average link error rate and the alarm generation threshold. Using the above default and average values, the link rate would be between 10^{-7} to 10^{-2}. The field in the MF menu will only display -7 to -2.

  Note:

  Therefore a value of -2 reflect a worse link quality than a value of -7.

Log Manager: When the Maintenance Facility is activated a log is started to record status report frame (SRF) conditions and parameter management frame (PMF) changes requested by the user. In addition other SMF frames can be selected by a filter provided by MF. The following are examples of frames:

- Neighbor Information Frame (NIF)
- Status Information Frame (SIF)
- Resource Allocation Frame (RAF)
- Echo Frame (ECF)
- Request Denied Frame (RDF)

Another filter is available to select the various fields of these frames. The size of the log file is 64 KB and will be used in a wraparound fashion (oldest log entry will be erased by new entry).

View Mail: With this function the latest status report frames (SRF) which were sent by a IBM 8240 are displayed. Once they are displayed they will be deleted from this function but are still logged by the log manager function. A Mail icon next to a selected concentrator indicates if new mail is available. The following conditions are reported by the IBM 8240 and can be viewed via the View Mail function:

- When the average LER is greater than or equal to the LER alarm generation threshold for a specific port
- When the port elasticity buffer error counter is incremented
- When the MAC frame error threshold has been exceeded
- When the MAC not-copied threshold has been exceeded
- When a duplicate MAC address is detected on the FDDI ring
- When an undesirable or illegal connection is attempted
- When a trace is started, propagated or terminated by the concentrator

Configuration Manager: The Configuration Manager function allows the changing of multiple MIB (management information base) attributes for any node in an FDDI network where the MF is active. The function can create various profiles with different attributes. When the profiles are applied (associated) to an FDDI station the node is configured according to the defined MIB attributes in this profile.

Profiles can be defined by copying a default profile or any other available profile. It is also possible to take the values from the MIB of an IBM 8240 and change them to the chosen values.

View MIB Attributes: This function provides all the MIB attributes for a selected IBM 8240. Some of the attributes can be changed, others are for display only.

Remote Program Update: The IBM 8240 is shipped with microcode already installed, but the microcode diskette is also provided with the shipment. The Remote Program Update function is needed to update the IBM 8240 with a new release of the microcode. The function is also used by a remote concentrator to request a new copy of the microcode in case a microcode checksum error has occurred. This situation is reported to the MF and a load of the 8240 microcode can be started automatically.

The function can be activated for multiple concentrators at the same time if required. After the transmission an automatic configuration with the previously stored configuration files can be started.

SMT Frame Builder: This function is unique for a LAN maintenance tool. It enables a user to issue any kind of SMT frame. Only an experienced network operator or maintenance personnel should use this function.

The FDDI SMT Draft Standard publication or any other documentation which provides detailed information is required to use this function.

There is no checking or verification done for the frames built. This allows a user to test the behavior of stations when an invalid frame is received or to test new SMT implementations.

2.10 IBM 8244 FDDI Workgroup Concentrator

This section first gives a brief overview of fiber distributed data interface (FDDI) concepts that will help you understand the 8244 FDDI Workgroup Concentrator. Because the IBM 8240 FDDI Concentrator is no longer marketed by IBM, it will not be discussed in this document.

2.10.1 FDDI Concepts

Originally envisioned as a standard for high-speed host channels, FDDI rapidly became used as a new generation of LANs that uses optical fiber to provide high-speed communication networks. In many ways, FDDI is similar to the IEEE 802.5 token-ring, although there are some differences. FDDI uses a token-passing protocol in which each station has the chance to transmit data when a token passes. A station can decide how many frames it will transmit using an algorithm, which permits *bandwidth* allocation. FDDI also allows a station to transmit many frames without releasing the token.

An FDDI network consists of a set of devices connected to each other as a serial string by a transmission medium to form a physically closed loop. Information is transmitted sequentially as a stream of suitably encoded symbols, from one active device to the next active one. Each device regenerates and repeats each symbol. The method of actual physical attachment to the FDDI network may vary and is dependent on specific application requirements.

FDDI uses two rings, each ring consisting of a single fiber path equivalent to a pair of copper conductors:

- The *primary ring*, which is similar to the main ring path in token-ring terminology.
- The *secondary ring*, which is similar to the backup ring path of a token-ring.

More detailed information about FDDI topologies can be found in Chapter 2 in *Local Area Network Concepts and Products: Lan Architecture,* SG24-4753.

2.10.2 Technical Description

The IBM 8244 FDDI Workgroup Concentrator is the primary attachment to the FDDI dual ring for attaching workstations to a 100 Mbps network. It is available in six models which provide the following:

- Three models with six attachments (Models 06)

  Model 06s are configured with two ports for ring attachment and four ports for workstations. These 6-port concentrators can be upgraded to either 8, 10, or 12-port concentrators for workstations by ordering 2-port kit features to be installed by an IBM customer engineer. Each feature (fiber multimode, copper STP, or UTP category 5) offers additional connection for two devices.

- Three models with 12 attachments (Models 12)

  Model 12s have two ports for ring attachment and ten ports for workstations.

Devices can be connected to the 8244 via:

- Multimode optical fiber
- IBM cabling system′s shielded twisted pair (STP) copper cable
- Unshielded twisted pair (UTP-5) copper cable

The 8244 can operate as a dual-attached, single-attached, or dual-homed concentrator. As a dual-attached concentrator, it can be attached to a primary and secondary ring. The primary ring transmits the data, while the secondary ring provides backup for the primary ring. FDDI also provides the capability to structure primary and alternate path connections to attaching devices such as the 8244, improving the overall reliability, availability, and serviceability of the network. It allows the construction of hierarchical topologies by ″cascading″ several levels deep and by ″dual homing″ (for example, attaching an 8244 to each of two other 8244s) to provide optimum network availability in case of a bypassed network failure.

The 8244 provides connection for FDDI devices that are based on the ANSI and ISO standards. The 8244 will operate with management entities that support the ANSI Station Management (SMT) 7.3 frame-based protocols.

2.10.2.1 Connectivity Features

The front panel of the 8244 is shown in Figure 74 on page 147.

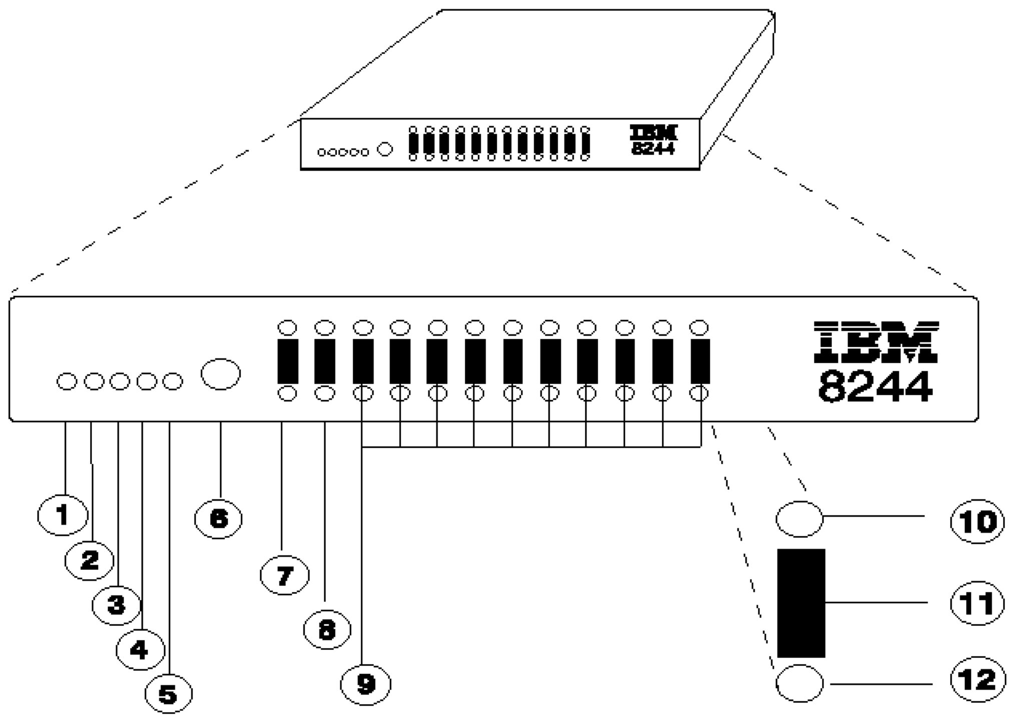


Figure 74. Front View of the 8244 Concentrator

On the front panel the numbers 1 to 5 represent the *general* LEDs:

1. OK (normal operation)
2. Ring operational (ring is operational)
3. Through (ports A and B are active)
4. Receive (receiving packets)
5. Transmit (transmitting packets)

Numbers 6 to 9 on the front panel represent the connections that you attach to the concentrator:

6. Optical bypass (a feature which supplies the necessary signals to inform an optical bypass switch that all is well with the concentrator. If the 8244 loses power then the switch will maintain the main and backup paths of the ring without wrapping the ring. This reduces the chances that the network will wrap in two places and fragment the ring.)
7. Port A
8. Port B
9. Ports M1 to M10 (master ports to connect workstations or additional concentrators)

Numbers 10 to 12 on the front panel represent the *port* LEDs:

10. Yellow LED for each port
11. Port connector:
    - Fiber MIC

- DB-9 for SDDI/STP
- RJ-45 for UTP category 5

12. Green LED for each port

2.10.3 Configuration

This section describes the basic installation of an 8244 concentrator, selecting an operating mode, and performing microcode updates to the flash memory.

2.10.3.1 Installing the 8244

Refer to Chapter 3 of the *IBM 8244 FDDI Workgroup Concentrator User′s Guide*, GA33-0339 for step-by-step instructions for installing the 8244 Concentrator and integrating it into an FDDI network.

After powering on the 8244, wait at least five seconds for the self-test to be performed. During the self-test the green and yellow LEDs on the front panel illuminate. The self-test is complete when the green OK LED remains lit. The colors of the LEDs indicate the current status of the 8244.

2.10.3.2 Customizing the 8244 Concentrator

You can display and change the preconfigured settings in the 8244 or set other options to satisfy your network requirements. The following 8244 parameters can be specified:

- Station management (SMT)
- Port configuration
- Internet Protocol (IP)
- SNMP
- MAC address

Using the DEE.COM program stored on the 8244′s System diskette is one way to customize the 8244′s parameters. The DEE.COM program requires:

- DOS version 2.0 or higher
- Any graphic adapter
- 256 KB RAM
- Serial line interface com1 or com2

You can also use other V.24 terminal emulation programs, such as the Windows and OS/2 Terminal, that are preconfigured as follows:

- Serial line interface com1
- 9600 baud
- 8-bit data transfer
- 1 stop bit
- No parity

Note: The 8244 does not support Telnet.

To display the Configuration Menu, perform the following steps:

1. Connect the 8244 to the com port of your workstation.
2. Insert the System diskette that comes with the 8244 into drive A of the workstation.
3. At the system prompt, type:

   ```
   DEE
   ```

and press Enter.

4. Restart the 8244 by doing one of the following:
   - Switch the 8244 OFF and ON again, or
   - Type

     `reset`

     and press Enter.

   The main menu of the concentrator is displayed as shown in Figure 75.

```
        FDDI Concentrator Boot-Code Main Menu
        =====================================
        The following modules are available:

                 (m1) Software Update Loader
                 (m2) Configuration File Loader
                 (m3) SMT-Code
                 (m4) Configuration Editor
                 (m5) Hardware Diagnostics

        After 5 seconds, the module
                 SMT-Code
        will be started automatically.

        Please select module:
```

Figure 75. FDDI Concentrator Boot-Code Main Menu

5. Select Configuration Editor by typing `m4` and pressing Enter within five seconds. The Configuration Editor menu is displayed as shown in Figure 76.

   Note: If you do not enter a selection within five seconds, the SMT module is automatically started. In order to exit from the SMT module and return to the main menu, type `reset` and press Enter.

```
        Configuration Editor Main Menu
        ==============================

 (0)    Exit
 (1)    Edit Configuration
 (2)    Save Configuration
 (3)    Cancel All Changes

        Please select function  [0] :
```

Figure 76. FDDI Concentrator Boot-Code Main Menu

6. Select Edit Configuration by typing `1` and pressing Enter. The Edit Configuration menu is displayed as in Figure 77.

```
        Edit Configuration Menu
        =======================

 (0)    Exit
 (1)    Edit SMT Configuration
 (2)    Edit Port Configuration
 (3)    Edit IP Configuration
 (4)    Edit SNMP Configuration
 (5)    Display MAC Address

        Please select function  [0] :
```

Figure 77. FDDI Concentrator Boot-Code Main Menu

Use the Edit Configuration menu to customize the 8244 and change preconfigured settings for new options. For detailed information on editing SMT Parameters, Port Configuration Parameters, IP Parameters, SNMP Parameters, and displaying MAC Addresses, refer to the *IBM 8244 FDDI Workgroup Concentrator User's Guide*, GA33-0339.

2.10.3.3 Selecting an Operating Mode

The 8244 ships configured as a dual attachment concentrator, including A and B ports and four or ten master ports. However, each concentrator can be configured to operate in any of the following modes:

- Standard mode - Connecting up to ten single attachment stations to the FDDI ring. This is the default operating mode.
- Cascading mode - Using cascaded concentrators, leaving up to 11 master ports per concentrator for stations.
- Stand-alone mode - Where all 12 ports can be used as master ports.
- Dual homing mode - Allows the use of redundant SAS connections for class A dual attachment stations.

For more details on these operating modes, refer to 2.10.4.1, "8244 Cabling Examples."

2.10.4 Cabling Examples and Specifications

The 8244 FDDI Workgroup Concentrator supports the following cabling specifications:

- Multi Mode Fiber
  - MIC connector
  - Up to 2 kilometers in 62.5µm multimode fiber
  - Cabling will be reusable for ATM
- Shielded Twisted Pair Copper (STP)
  - DB-9 connector
  - Up to 100 meters in ICS STP type 1 or 2 cable
  - Based on SDDI specification
  - Cabling is reusable from token-ring
- Twisted Pair Copper - Either unshielded (UTP) or folded (FTP)
  - 4 twisted pairs
  - 100 ohm impedance
  - RJ-45 connector (must be shielded)
  - 100 meters maximum with UTP category 5 cable
  - Based on TP-PMD standard
  - Cabling is not reusable from token-ring or Ethernet if the impedance of the installed cabling does not match that for UTP or FTP for FDDI, that is, 100 ohms.

2.10.4.1 8244 Cabling Examples

The 8244 can be used in different ways in an FDDI network, as shown in the following sections.

Standard Mode: Figure 78 on page 151 shows how the 8244 can be used to integrate up to ten class B stations to the FDDI ring, converting it into a tree structure. This operating mode uses two different port types:

- Ports A and B are used to connect the concentrator to the FDDI dual ring (the concentrator operates as a class A station in the ring).
- Up to ten M ports connect the concentrator (master) to stations (slaves).

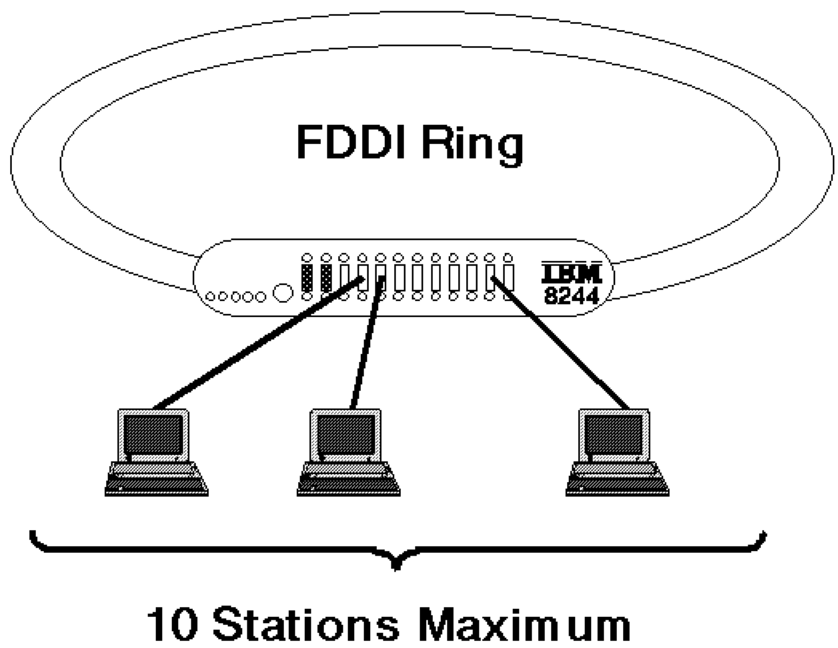


Figure 78. 8244 Standard Mode: Integrating Single Attachment Stations

Cascading Mode: Figure 79 on page 152 shows how the 8244 concentrator supports the use of cascaded concentrators with up to eleven class B ports per concentrator. By using cascaded concentrators, you can configure extensive tree structures of up to 500 stations (depending on the standard).

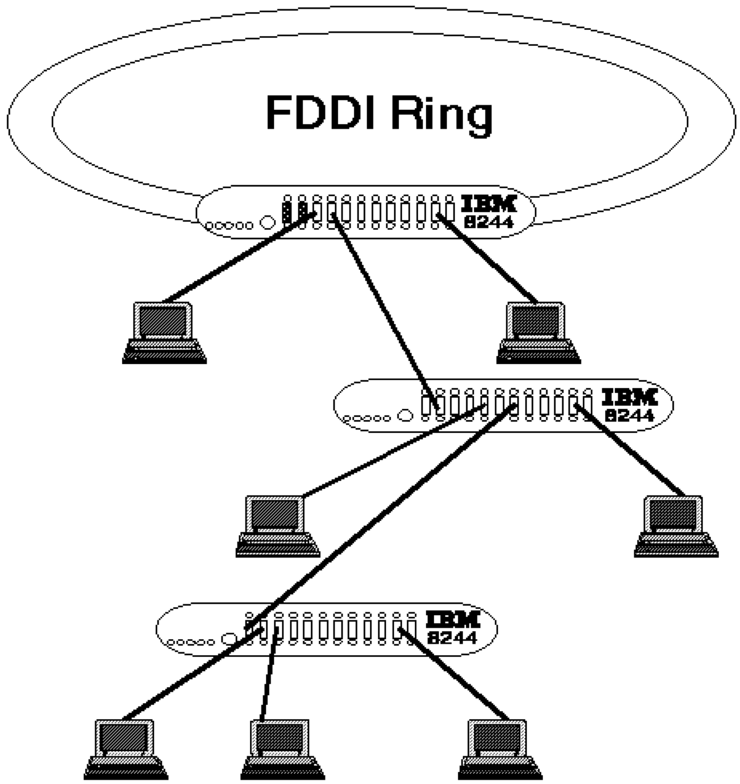


Figure 79. 8244 Cascading Mode: Using Cascaded Concentrators

To use the cascading mode, you must reconfigure the 8244 as described in 2.10.3.2, "Customizing the 8244 Concentrator" on page 148.

Stand-Alone Mode: Figure 80 on page 153 shows how the 8244 concentrator can be used in stand-alone mode to connect up to twelve class B stations to an FDDI ring. When used in stand-alone mode, the FDDI ring is internal to the 8244.

To use the stand-alone mode, you must reconfigure the 8244 as described in 2.10.3.2, "Customizing the 8244 Concentrator" on page 148.

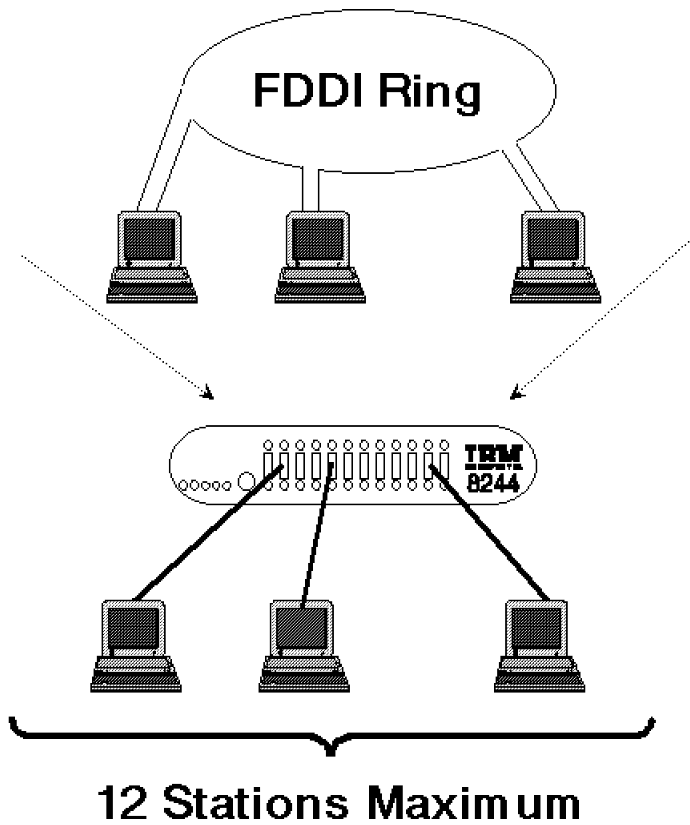


Figure 80. 8244 Stand-Alone Mode

Dual Homing Mode: Figure 81 on page 154 shows how an FDDI workstation can be attached to two concentrator ports at the same time. The two ports can be on the same concentrator, or on different concentrators.

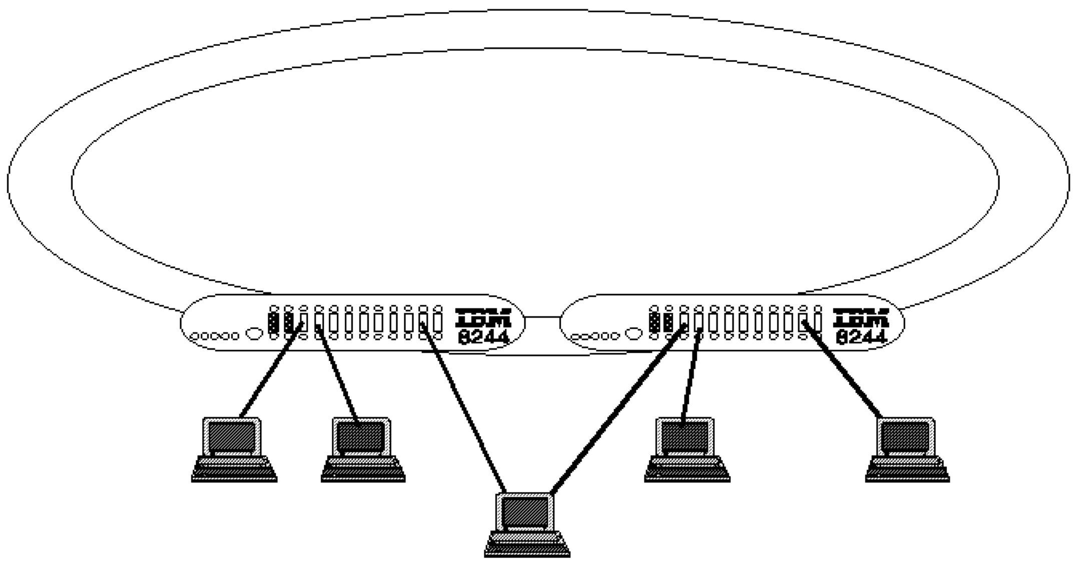


Figure 81. 8244 Dual Homing Mode

The following are the advantages of dual homing:

- Data integrity on the ring is increased and protection against cable failure is provided.
- FDDI stations are protected against the failure of a given concentrator.

Note

Dual homing is possible only for workstations that are class A stations via, for example, an FDDI card with a DAS option.

2.10.4.2 Configuring Optical Fiber Connections

When installing optical fiber connections, you only need one optical fiber cable between the concentrator and a workstation, except when the workstation is attached in dual homing mode.

Figure 82 on page 155 shows an example of how to install fiber cables when attaching SAS stations to an FDDI ring in standard mode.

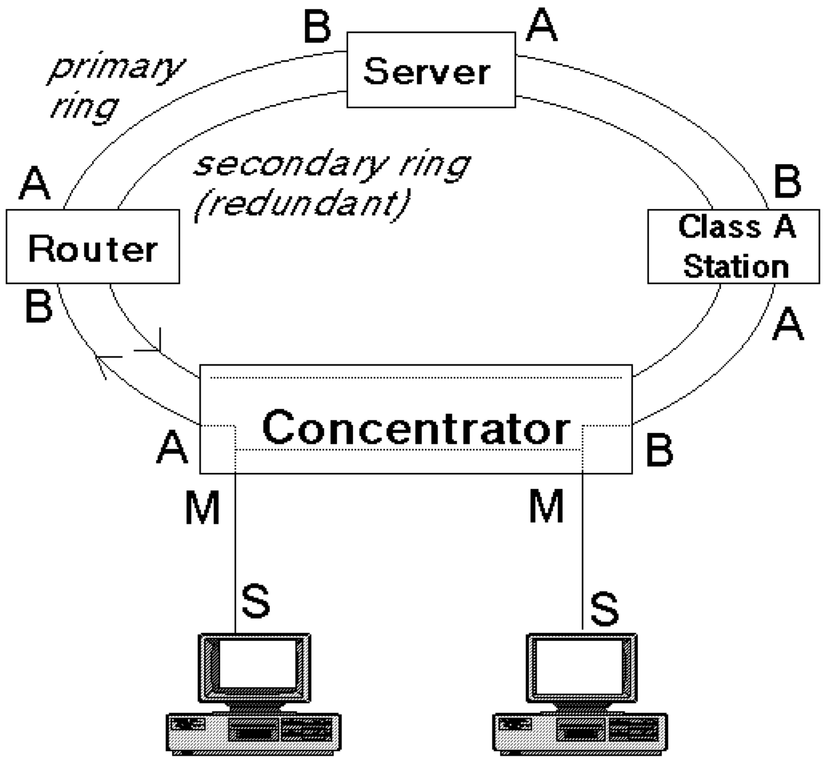


Figure 82. Optical Fiber Connections in 8244 Standard Mode

The appropriate keyed optical fiber (MIC) connectors are labelled (A, B, M, and S) accordingly.

- Key A is used to fit a plug into port A on the concentrator.
- Key B is used to fit a plug into port B on the concentrator.
- Key M is used to fit a plug into ports M1 to M10 on the concentrator.
- Key S is used to fit a plug into the jacket on a workstation's interface card.

Figure 83 on page 156 shows you how to key cable plugs for different operating modes.

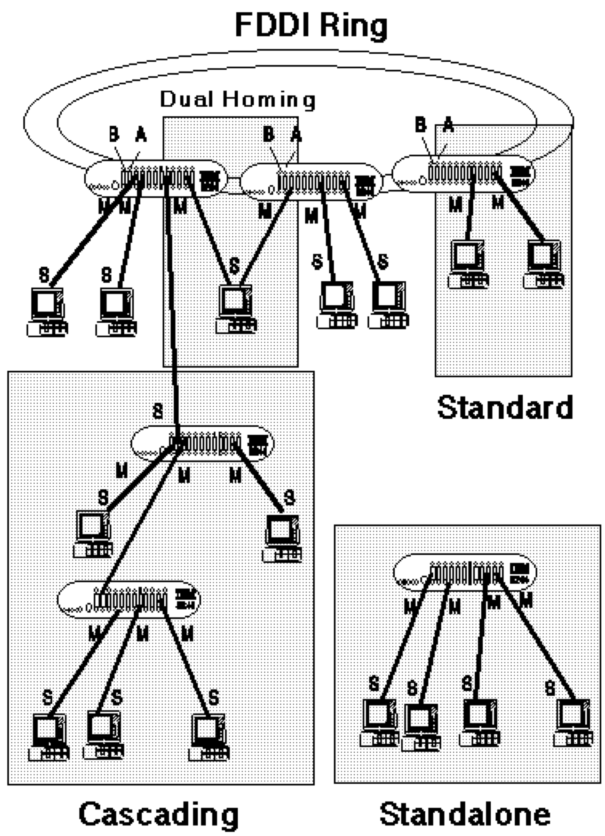


Figure 83. Keying 8244 Cable Plugs in Different Operating Modes

Important

All connections to ports A and B must be fiber. Connections to other ports can be either copper or fiber.

For more information on FDDI standards, planning and implementation of FDDI networks, refer to the *IBM FDDI Introduction and Planning Guide*, GA27-3892 and *FDDI Concepts and Products*, GG24-3865.

2.10.5 Management

The 8244 is delivered as plug and play. The software is preloaded and a typical configuration is preset. Software is flash-based for upgradeability. Modules can be exchanged or updated through a software tool. Upgrades and customization can be done via an attached DOS station. Access to the 8244 is through the serial port which is located on the back panel.

Concentrator management is made possible via the imbedded SNMP agent. This agent will maintain the concentrator's FDDI MIB-II parameters for use by NetView for AIX or any original equipment manufacturer (OEM) SNMP-based network management system.

Network management is further enhanced by using the included FDDI SNMP Proxy Agent. This proxy agent will convert SMT to SNMP protocols and allow

NetView for AIX or any other OEM SNMP-based network management system to manage all stations (SMT level 6.2 or 7.3) connected to the FDDI segment. The Proxy Agent is an OS/2 application and can reside and operate in any OS/2 workstation that runs on the same FDDI segment as the 8244. It is not separately orderable.

The Proxy Agent and system diskette are available through the IBM support organization. .

2.10.5.1 IBM FDDI SNMP Proxy Agent

FDDI includes a station management (SMT) protocol supported by each device attaching to the FDDI ring. A management station on the FDDI ring can use the SMT protocol to monitor and control the FDDI devices residing on that ring. However, since the SMT protocol cannot be sent across bridges or routers, it cannot be used directly to provide off-ring management of FDDI devices.

The Proxy Agent supports these SMT flows to monitor and control each device attached to the ring. To provide off-ring management, the Proxy Agent supports SNMP to communicate to a remote Manager, such as NetView for AIX. Management information bases (MIBs) are included with the Proxy Agent program which allow the SNMP manager to monitor and control the FDDI ring. The Proxy Agent provides unsolicited notification of problems occurring on the ring through the use of SNMP traps. The Proxy Agent runs as an O/2 application and can coexist with other OS/2 applications. The user interface for managing the ring is located at the SNMP manager. Figure 84 on page 158 shows an example of the Proxy Agent in a network environment.

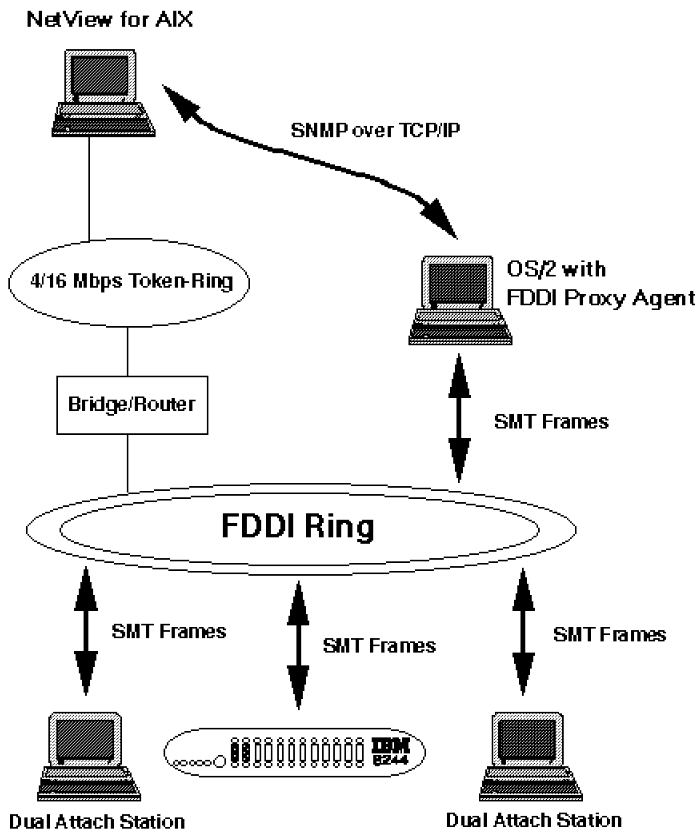


Figure 84. FDDI Proxy Agent in a Network Environment

Note: The AIX for NetView workstation can be located on the local FDDI ring or on a remote token-ring or Ethernet network.

The proxy agent provides a comprehensive MIB definition consisting of the following components:

- RFC 1285 and RFC 1512 MIBs
- IBM extensions for ring configuration
- IBM extensions for comprehensive PMF management
- IBM extensions for IBM 8240 FDDI Concentrator

The proxy agent is designed to work with any SNMP manager. However, the SNMP manager referred to in this document is IBM′s NetView for AIX. NetView for AIX provides the capability of loading the Proxy Agent MIB, displaying MIB information using the MIB Browser capability, displaying trap information, and converting traps to generic alerts to be forwarded to NetView.

2.10.5.2 Things to Check Before Installing the FDDI Proxy Agent

For detailed procedures on how to perform the following, refer to *FDDI Concepts and Products,* GG24-3865.

1. Verify the OS/2 NDIS device driver level. You will need to replace it if the level is prior to the prerequisite level of V2.01. If you have a level higher than V2.01, you do not need to modify your current installation.

2. Install and customize TCP/IP components to support the Proxy Agent.

- Setting up SNMP
- Modifying the CONFIG.SYS file
- Defining trap managers
- Creating a community name file

3. Starting the SNMP daemons.

   - Starting SNMPREQD
   - Starting SNMPD

2.10.5.3 Installing, Starting, and Running the Proxy Agent

For detailed procedures on how to perform the following, refer to *FDDI Concepts and Products,* GG24-3865.

Proxy Agent Modes of Operation: You can operate the Proxy Agent in three modes:

- Customer
- Administrator
- Engineer

The customer mode is the default operation mode and is set whenever the 8244 is started. In this mode of operation you cannot perform any of the actions listed under the Actions pull-down menu (except Exit). You may, however change the operation mode to administrator or engineer.

The administrator mode is used to perform system administrator functions:

- Edit PMF passwords file
- Refresh PMF passwords
- Change profile options

The engineer mode should be used only by an IBM support representative to execute troubleshooting procedures. It provides two debugging facilities:

- Trace
- Debug

When running the Proxy Agent in administrator or engineer mode, a check mark is displayed in the User Mode pull-down menu to identify the operation mode. The absence of a check mark in both operation modes means that the Proxy Agent is running in customer mode (the default).

Both administrator and engineer modes require a password. The administrator password is set by the user while the engineer password is controlled by IBM support personnel.

2.10.5.4 Customizing NetView for AIX Version V1

For detailed procedures on how to customize NetView for AIX Version 1 for use with the Proxy Agent, refer to *FDDI Concepts and Products,* GG24-3865.

2.10.5.5 Customizing NetView for AIX Version 2 and Version 3

For detailed procedures on how to customize NetView for AIX Versions 2 and 3 for use with the Proxy Agent, refer to *FDDI Concepts and Products,* GG24-3865.

2.10.5.6 Using NetView for AIX to Manage the 8244

NetView for AIX includes a MIB browser function to retrieve MIB information and also change attributes which are defined to be read/write. To use the MIB browser to look at FDDI MIB information maintained by the Proxy Agent, enter the IP address and community name used by the Proxy Agent and then choose the MIB information you wish to display. To select the MIB objects, you need to know the full identifiers used to get to the *subtrees* which contain the Proxy Agent MIB information. You can select to see any or all of the MIB information contained in the MIB subtrees supported by the Proxy Agent:

- **RFC 1285 Subtree (Revision 6.2 of SMT)**

  The MIB object identifier used for this subtree is: org.dod.internet.mgmt.mib-2.transmission.fddi

- **IBM Extensions for SMT 6.2**

  The MIB object identifier used for this subtree is: iso.org.dod.internet.private.enterprises.ibm.ibmArchitecture.fddi.fddismt6-2

- **RFC 1512 Subtree (Revision 7.3 of SMT)**

  The MIB object identifier used for this subtree is: iso.org.dod.internet.mgmt.mib-2.transmission.fddi.fddimib

- **IBM Extensions for SMT 7.3**

  The MIB object identifier used for this subtree is: iso.org.dod.internet.private.enterprises.ibm.ibmArchitecture.fddi.fddismt73ext

- **IBM Extensions for 8240 Concentrator**

  The MIB object identifier used for this subree is: iso.org.dod.internet.private.enterprises.ibm.ibmProd.ibm8240

When using MIB browsers over FDDI rings containing a mix of SMT 6.2 and 7.3 stations, be aware that these situations may occur:

- When you browse over SMT 7.3 MIB, for the stations implementing only SMT 6.2, the variables appear with zero value.
- When you browse over SMT 6.2 MIB, for the stations implementing only SMT 7.3, the variables appear with zero value.

This approach was taken so the sequencing of the browser would not be disrupted.

For more detailed information about the traps defined and sent by the SNMP FDDI Proxy Agent, and the traps defined and sent by the SNMP agent of the 8244 concentrator, refer to *FDDI Concepts and Products,* GG24-3865.

2.10.5.7 Using LAN Network Manager for AIX to Manage the 8244

LAN Network Manager (LNM) for AIX works with the FDDI SNMP Proxy Agent and NetView for AIX to pass instructions from LNM for AIX to the managed FDDI segment and to obtain status and change information pertaining to the FDDI resources. Using LNM for AIX you can perform FDDI network management tasks by selecting an FDDI resource (such as the 8244) from a topological view of your network and using menu choices to perform a specific task.

LNM for AIX uses the FDDI SNMP Proxy Agent program as its proxy agent in FDDI networks. The Proxy Agent passes requests from LNM for AIX to the managed FDDI segment and obtains status and change information pertaining to the FDDI devices on the segment by means of status reporting frames (SRFs) from the FDDI segment. These are converted into SNMP traps and passed to LNM for AIX.

For instructions on how to define parameters for LNM for AIX to establish and maintain contact with the Proxy Agent, as well as other resynchronization intervals, refer to Chapter 10 in *Using LAN Network Manager for AIX*, SC31-7110, which deals with managing FDDI networks.

Displaying an FDDI Station Submap: LNM for AIX provides an FDDI Station submap to represent the managed elements of an FDDI station. If you double-click on an FDDI station in an FDDI Segment submap, the FDDI Station submap opens to display a graphical representation of a computer workstation. Icons representing the SMT, attachment, MAC, path, path class, and ports are displayed in the submap.

2.10.6 Positioning

The IBM 8244 FDDI Concentrator should be marketed as the primary attachment to the FDDI dual-ring for attaching workstations, bridges, and routers to the backbone.

Customers can now achieve greater bandwidth than existing LANs such as token-ring and Ethernet by using the 8244 for attachment to the FDDI network. The 8244, therefore, can be used for small, dedicated workgroups or as a backbone unit for LAN extension and total network interoperability.

The 8244 can provide connection for FDDI devices that are based on the ANSI and ISO standards. The 8244 will operate with management entities that support the ANSI Station Management (SMT) 7.3 frame-based protocols.

The 8244 FDDI Work Group Concentrator complements the existing IBM FDDI ring attachment products as a concentrator for up to 12 attached workstations.

The IBM 8250 Multiprotocol Intelligent Hub and the IBM 8260 Multiprotocol Intelligent Switching Hub address the heterogeneous LAN environment, that is, FDDI, token-ring, Ethernet, and ATM attachment.

2.11 IBM Nways 8260 Multiprotocol Intelligent Switching Hub

The 8260 is an intelligent managed hub which provides the platform to build local area networks using various types of cabling systems (such as STP, UTP, fiber and coax) and different types of LAN protocols (such as token-ring, Ethernet, and FDDI). Additionally, the 8260 provides a platform for the implementation of high-speed networks based on Asynchronous Transfer Mode (ATM) technology.

The 8260 is a rack-mountable hub and depending on the model it allows you to install up to 17 payload *modules*. These modules can be a combination of media and management modules providing you with the flexibility to design networks addressing the individual needs of your organization.

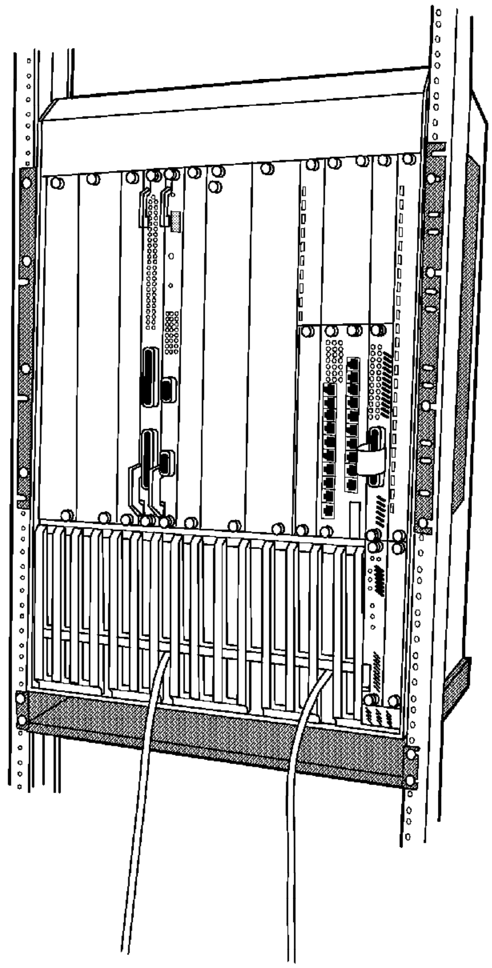


Figure 85. IBM 8260 Model 017. The 8260 has the 4-slot 8250 feature and a second power supply installed.

Media and management modules can be installed or removed from the 8260, while the hub is operational. This allows you to modify the configuration of the network with minimal disruption to the users.

The 8260 provides the room to install up to two controller modules. The second controller module will be used to provide backup for the primary controller module.

In addition to a wide range of 8260 media and management modules which are specifically designed to take advantage of the features offered by the new chassis, the 8260 supports all of the media and management modules from the 8250 (but not its controller module). This provides you with the ability to protect your investment in the 8250 modules. As the 8260 is taller than the 8250, an optional adapter kit is required to install the 8250 modules in an 8260.

The 8260 is designed to be a stand-alone unit or to be mounted in a standard 19 inch rack. There are four models of the 8260:

- 8260-017
- 8260-010
- 8260-A17
- 8260-A10

When you order the 8260, the following components will be included in the 8260 chassis that is shipped to you:

- One controller module
- One power supply
- One power supply bay cover
- One AC power cord
- Three fan units
- One cable tray
- One rack mount kit
- One rubber feet kit
- Six blank dual-slot filler plates
- Three blank single-slot filler plates

Additionally, you can order the following features to be included in your 8260:

- Up to three additional power supplies for 8260 Model 017 and Model A17 or up to two additional power supplies for the 8260 Model 010 or Model A10.
- 8250 adapter kit
- Distributed Management Module (DMM)
- Ethernet Carrier Distributed Management Module (EC-DMM)
- Ethernet Media Access Control (E-MAC) daughter card
- Token-Ring Media Access Control (T-MAC) daughter card
- Ethernet Modules:
  - 8260 Ethernet 36-port 10Base-T module
  - 8260 Ethernet 24-port 10Base-T module
  - 8260 Ethernet 20-port 10Base-T module
  - 8260 Ethernet 40-port 10Base-T module
  - 8260 Ethernet 10-port 10Base-FB module
  - 8260 Ethernet Flexible Concentration Module
    - 8260 2-port FB/FL module
    - 8260 4-port UTP module
    - 8260 3-port BNC module
    - 8260 3-port AUI module
  - 8260 Multiprotocol Interconnect module
  - 8260 Ethernet Security daughter card
- Token-ring Modules:
  - 18-port active per-port switching module
  - 18-port active module-switching module
  - 20-port passive module-switching module
  - Dual fiber repeater module
  - Jitter Attenuator daughter card
- Multiprotocol Interconnect Module
- ATM Modules:
  - Refer to 5.3, “The IBM 8260 Multiprotocol Intelligent Switching Hub” on page 250

The 8260 can be managed out-of-band using an ASCII console attached locally or via modem to the management module. Additionally, you may manage the 8260 via SNMP using the Hub Manager Program for AIX.

For a comprehensive description, see *8260 Multiprotocol Intelligent Switching Hub,* GG24-4370.

2.11.1 8260 Model 017 and Model 010

The 8260 Model 017 is a 17-slot module and the Model 010 is a 10-slot module which allows you to install any combination of 8260 and 8250 modules (except the 8250 Controller module) to set up token-ring, Ethernet and/or FDDI networks. Additionally, it can be upgraded with the ATM backplane to 8260-A17 and 8260-A10 respectively. This allows you to set up an ATM network.

The 8260 chassis is made up of five main areas:

- The backplane
- The payload area
- The Controller module slots
- The intelligent power subsystem
- The intelligent cooling subsystem

Figure 85 on page 162 provides a view of an 8260 Multiprotocol Intelligent Switching Hub with both 8250 and 8260 modules installed with a second power supply.

Table 20 shows a comparison between Model 017 and Model 010:

Table 20. Comparison between 8260 Model 017 and Model 010

Adapter kit Component	Model 017	Model 010
Payload, slots	17	10
Power Supplies, basic	1	1
Power Supplies, additional	3	2
Fan Units	3	3
Controller Module Slots	2	2

By sharing same chassis elements, networks can be built using a mixture of Model 017s and Model 010s without an overhead for managing accessories and spare parts.

2.11.2 8260 Backplane

The 8260 has two standard backplane buses which are used to provide you with the ability to configure token-ring, Ethernet, and/or FDDI network segments.

These two buses are standard features of all the 8260 models and are installed on every 8260 shipped to the customers.

2.11.2.1 LAN Segments on the Backplane

On each backplane bus (both Enhanced TriChannel and ShuntBus) there are 96 *pins* which are used for passing the network traffic between the media modules installed in the hub as well as the control signals between the media modules, fault-tolerant controller module, and distributed management module (DMM). The control signals are used to carry clocking, voltage, status and other information pertinent to the proper operation of the hub and the installed modules.

On the Enhanced TriChannel, 54 pins are available to be used for passing network traffic. The rest of the pins are used for non-data traffic signals. These signals are used for passing control signals between the controller module and the media modules as well as signals between the management module and the media modules.

On the Enhanced TriChannel, the pins used for passing the network traffic are not permanently allocated to a specific type of network. Instead, a pin may be configured to be used for passing either token-ring, Ethernet or FDDI packets at any one time. This enables more efficient utilization of the backplane resources.

The following is the maximum number of permitted LAN segments when a single protocol is used on the Enhanced TriChannel:

- Six Ethernet segments or
- Seven token-ring segments or
- Four FDDI segments

Note that you are allowed to have a mixture of token-ring, Ethernet and FDDI segments on the Enhanced TriChannel. In this case, the exact number of each network type which is allowed in a mixed protocol environment depends on the configuration of your hub. For detailed information about the permitted configurations in a mixed protocol environment please refer to 2.11.2.5, "Network Allocations on the 8260 Backplane" on page 168.

Figure 86 provides an overview of the Enhanced TriChannel bus.

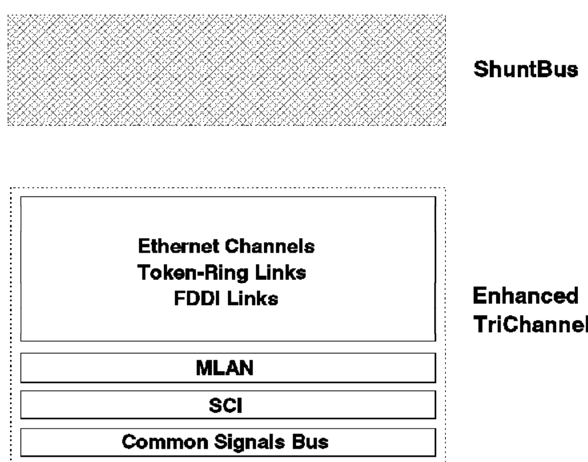


Figure 86. Enhanced TriChannel Bus

The pins available for user traffic on the ShuntBus are used to set up two dedicated Ethernet segments as well as 10 token-ring (or 4 FDDI) segments as shown in Figure 87 on page 166.

On the ShuntBus, eight pins are dedicated to be used by two Ethernet segments. These dedicated pins are not available to be used by other segment types. The remaining 64 pins on the ShuntBus are available to be used by token-ring and/or

FDDI segments. This allows you to have a mixture of token-ring and FDDI segments as well as two Ethernet segments on the ShuntBus.

The following is the permitted maximum number of LAN segments on the ShuntBus:

- Two Ethernet and
- Ten token-ring or four FDDI

Note: At the time of writing this publication, there are no FDDI modules available that can be assigned to the FDDI segments on the ShuntBus. Therefore, practically, the ShuntBus allows you to have two Ethernet segments plus ten token-ring segments.

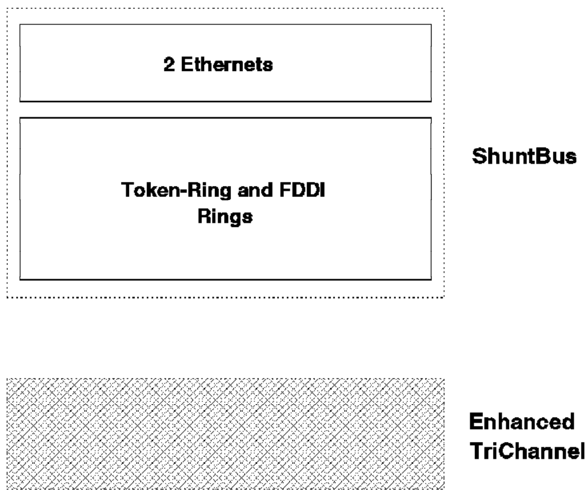


Figure 87. 8260 ShuntBus

2.11.2.2 Ethernet Segments on the Backplane

The 8260 allows you to set up a maximum of six Ethernet segments on the Enhanced TriChannel and two Ethernet segments on the ShuntBus.

Each Ethernet segment on the backplane uses a number of pins on the backplane which is referred to as an *Ethernet path* in this document. There are eight Ethernet paths on an 8260.

The Ethernet segments on the Enhanced TriChannel use the same pins on the backplane as are used by the token-ring and/or FDDI segments. Therefore, simultaneous configuration of other types of networks (such as FDDI and/or token-ring) on your hub′s Enhanced TriChannel will impact the number of Ethernet networks available for use. However, the two Ethernet segments on the ShuntBus have dedicated pins on the backplane and will not be impacted by the configuration of other segment types (that is, token-ring and/or FDDI) on the ShuntBus.

Each Ethernet segment on the 8260 utilizes one of the Ethernet paths on the backplane regardless of the number of Ethernet modules which constitute that segment.

2.11.2.3 Token-Ring Segments on the Backplane

The 8260 allows you to set up a maximum of seven token-ring segments on the Enhanced TriChannel using the 8250 modules. Also, you can set up ten token-ring segments on the ShuntBus using the 8260 token-ring modules.

Each 8250 token-ring module which is assigned to one of the seven token-ring networks on the Enhanced TriChannel uses one of the resources called a *token-ring path*. There are 15 token-ring paths on the Enhanced TriChannel. Each token-ring path utilizes four pins on the Enhanced TriChannel.

When you assign an 8250 token-ring module to one of the token-ring networks on the Enhanced TriChannel the 8260 will automatically allocate one of the available token-ring paths to this module.

The number of token-ring paths used by a single token-ring network on the Enhanced TriChannel equals the number of token-ring modules on that network.

On the ShuntBus, in addition to the two dedicated Ethernet segments, there are ten token-ring segments. Unlike, the Enhanced TriChannel, there is no concept of token-ring paths on the ShuntBus. Instead, there are ten physical rings on the backplane. Each of these rings is a set of six pins which is routed from slot to slot on the backplane and is completed across each slot via a self-shorting connector. At the end of the backplane, the signal path is returned from slot 17 to slot 1. In this manner, a ring is formed. When a module is inserted into the backplane, the self-shorting connector opens and the signal is routed onto the module. Therefore, any installed token-ring module on the ShuntBus has access to any of the ten token-ring segments on the backplane. This design allows the implementation of per-port switching for the token-ring modules so that individual ports on a module can be assigned to different rings on the backplane.

Each token-ring interface on the ShuntBus connector uses three Shunt pairs to form one token-ring network on the backplane. The three Shunt pairs carry a clock and two data signals.

Note that regardless of the number of token-ring modules used in a segment, you always have the ability to set up ten separate token-ring segments on the ShuntBus.

The same pins that are used for token-ring segments on the ShuntBus are designed to be used for FDDI segments as well. Therefore, if you have a mixture of token-ring and FDDI segments on the ShuntBus, the maximum number of token-ring segments would be lower, depending on the number of FDDI segments.

2.11.2.4 FDDI Segments on the Backplane

The 8260 allows you to set up a maximum of four FDDI segments on the Enhanced TriChannel using the 8250 modules. Also, it is possible to set up a maximum of four FDDI segments on the ShuntBus, using the 8260 FDDI modules. However, as there are no 8260 FDDI modules available yet, if you are planning to have FDDI segments on the 8260, you must use the 8250 FDDI modules to set up FDDI segments on the Enhanced TriChannel only.

Each FDDI module which is assigned to one of the four FDDI networks on the Enhanced TriChannel uses one of the resources called *FDDI path*. There are eight FDDI paths on the Enhanced TriChannel.

When you assign an FDDI module to one of the four FDDI networks on the Enhanced TriChannel the 8260 will automatically allocate one of the available FDDI paths to this module.

The number of FDDI paths used by a single FDDI network on the Enhanced TriChannel equals the number of FDDI modules on that network.

The FDDI paths on the Enhanced TriChannel use the same pins on the backplane as are used by the Ethernet and/or token-ring segments.

On the ShuntBus, in addition to the two dedicated Ethernet segments, there can be up to four FDDI segments. Unlike, the Enhanced TriChannel, there is no concept of FDDI paths on the ShuntBus.

2.11.2.5 Network Allocations on the 8260 Backplane

As we now have so many options of switching modules and ports between networks it is perhaps a good time to clarify the rules regarding those allocations.

- 8250 Ethernet ports or modules can be connected to parallel addressed segments (ethernet_1 thru 3 on the Enhanced TriChannel) only.
- 8250 Ethernet ports or modules cannot be connected to serially addressed segments (ethernet_4 thru 8) on either the TriChannel or ShuntBus.
- 8260 Ethernet ports or modules can be connected to any of the segments (ethernet_1 thru 8) on the TriChannel or ShuntBus. When connected to ethernet_1 thru 3, they use parallel addressing and when connected to ethernet_4 thru 8 they use serial addressing.
- 8250 token-ring or FDDI modules can only be connected to the segments on the Enhanced TriChannel. They cannot be connected to the segments on the ShuntBus.
- 8260 token-ring (or future 8260 FDDI) modules cannot be connected to any segment on the Enhanced TriChannel. They can only be connected to the segments on the ShuntBus.
- Any module can plug into any slot and all allocation of modules to networks or channels, regardless of whether they are TriChannel or ShuntBus, is done by electronic switching (via DIP switches on the modules or management module commands).

Figure 88 on page 169 shows the Enhanced TriChannel network allocation and how the mixing of various network types affect the availability of the others.

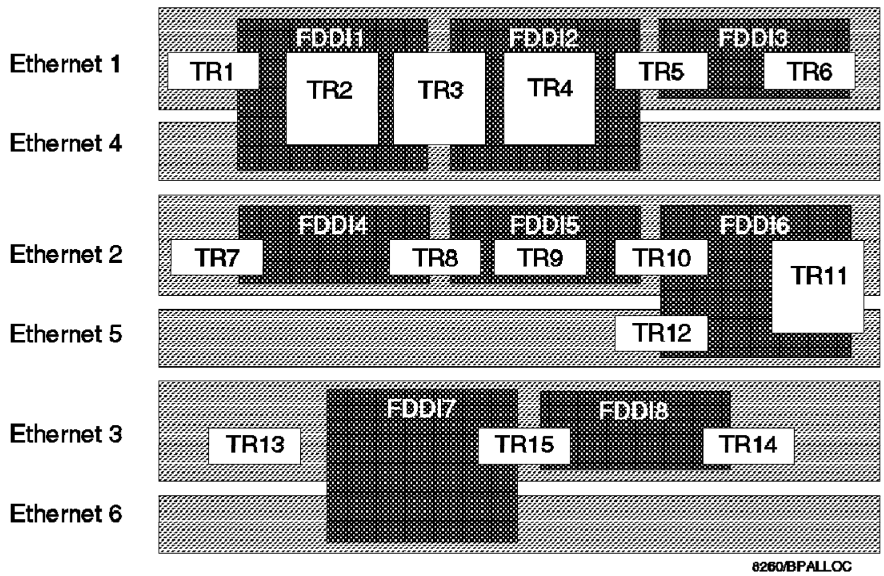


Figure 88. TriChannel Backplane Network Allocation

Using Figure 88, you can see that if, for example, tr_path_8250_3 path is used, it eliminates ethernet_path_1, ethernet_path_4, fddi_path_8250_1 and fddi_path_8250_2. If ethernet_path_5 is used it eliminates tr_path_8250_11, tr_path_8250_2 and fddi_path_8250_6.

Figure 89 on page 170 illustrates the possible combinations of the network segments on the ShuntBus. In this diagram, we have shown the token-ring networks as TR 16 thru 25 and FDDI networks as FDDI9 thru 12. This is to provide a distinction between the segments on the Enhanced TriChannel and the ShuntBus for our discussion in this book. However, when you use the management module commands to assign the token-ring modules to the token-ring segments on the backplane, you will refer to the Enhanced TriChannel segments as token_ring_1 thru 7 and to the ShuntBus segments as token_ring_1 thru 10. In other words, some token-ring segments on the Enhanced TriChannel have identical names to the token-ring segments on the ShuntBus. However, the management module is programmed to realize that when you refer to a token_ring segment number when issuing a command for the 8250 module, that segment is on the Enhanced TriChannel and when the command is issued for an 8260 module, the referenced segment number is on the ShuntBus. This is, of course, due to the fact that 8250 token-ring modules can only be connected to the Enhanced TriChannel, and the 8260 token-ring modules can only be connected to the ShuntBus.

Using Figure 89 on page 170 you can see that if, for example, fddi_1 network on the ShuntBus is used, it eliminates token_ring_1, token_ring_2 and token_ring_3. Also, you can see that the use of Ethernet segments ethernet_7 and ethernet_8 have no affect on the availability of token-ring and FDDI segments.

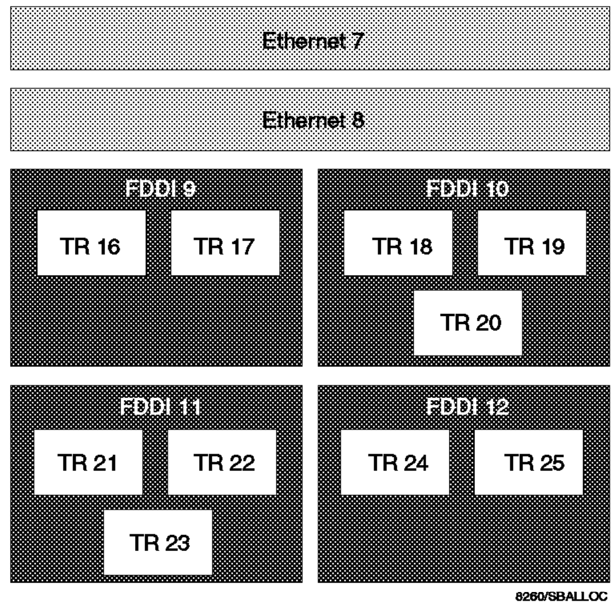


Figure 89. ShuntBus Backplane Network Allocation

In designing your network, if possible, it is recommended that you use the Enhanced TriChannel as well as the two dedicated Ethernet segments on the ShuntBus for the Ethernet segments only and use the ShuntBus for the token-ring segments only.

2.11.2.6 Management Buses

As mentioned earlier pins on the TriChannel backplane are reserved for non-data traffic. Included in these pins are the management LAN (MLAN) and the serial control interface (SCI).

The Management LAN (MLAN): The MLAN is a dedicated 10 Mbps Ethernet bus which connects the DMM (distributed management module) and all the media access control daughter cards (E-MAC or T-MAC). The MAC daughter cards connect to their respective networks, T-MAC to token-ring and E-MAC to Ethernet, and provide statistics about those networks to the DMM via the MLAN. Also, the IP stack provided by the MAC daughter card is accessed by the upper layer protocol stacks within the DMM (SNMP, Telnet) through the MLAN.

The E-MAC can be installed on either the EC-DMM or the 8260 media modules. When installed on the 8260 media modules, E-MAC can collect statistics about all the Ethernet segments on the backplane, but will not be able to collect per-port or per-module statistics for the 8250 modules. However, if the E-MAC is installed on the EC-DMM, it will be able to collect a full range of statistical information about any segment that it is attached to, regardless of whether that segment is using parallel or serial addressing. This is because the EC-DMM provides parallel to serial address translation.

Note that E-MAC is always able to collect full statistics about 8260 modules irrespective of which type of module (EC-DMM or 8260 media modules) the E-MAC is installed on and which networks the 8260 modules are attached to.

The Serial Control Interface (SCI): The SCI is the same as that used in the 8250. All modules, 8250 and 8260 alike, use the SCI to transmit module and port configuration data. The controller module uses the SCI to gather VPD from the modules, and to get power and cooling status. The controller module, in conjunction with the DMM, also uses the SCI as a medium to change the status of power supply to the modules and to remove and add modules in the event of a change in the power or cooling subsystems. Figure 92 on page 178 illustrates the relationship between the MLAN, SCI and the modules.

2.11.3 8260 Payload Area

The payload area provides the housing for media and management modules. In addition to the 8260 module, you may install all the 8250 modules (except the Controller module) in an 8260. Once these modules are installed on the 8260, they will be connected to the backplane.

Certain modules provide you with *per-port switching* capability, which allows you to connect different ports on the same module to different backplane segments. Other modules are *module-switching* modules, which means that all the ports on the module must be connected to the same network segment. The per-port switching capability is available for both Ethernet and token-ring.

Since the 8260 modules are taller than the 8250 modules, when you install one or more 8250 modules in the 8260 Multiprotocol Intelligent Switch, you must use the *8250 Adapter Kit*. Depending on the kit that you order, the 8250 adapter kit enables you to install up to 4, 9 or 16 single-slot 8250 modules or a mixture of single-slot and dual-slot 8250 modules.

The components of the 8250 4-slot adapter kit are shown in Figure 85 on page 162.

The 8250 adapter kit consists of the following:

- Right Boundary Adapter - This adapter is a full length adapter and occupies one slot. Installation of this adapter result in 16 slots remaining available in the 8260 for the installation of media and management modules.
- Left Boundary Adapter - This adapter will be installed on the left boundary of the area occupied by the 8250 modules. The top portion provides a filler plate.
- Dual-Slot Top Filler - This adapter provides the filler plate for two slots.
- Single-Slot Top Filler - This adapter provides the filler plate for one slot. Note that two of these adapters can be used as a dual-slot top filler.

2.11.4 8260 Fault Tolerant Controller Module

The 8260 Fault Tolerant Controller Module is a critical component of the 8260. One active controller module is always required in order to keep the 8260 hub operational and running. The 8260 Fault Tolerant Controller module does not occupy any of the payload slots.

The controller module provides the following functions:

- Clock generating and its distribution across Enhanced TriChannel and ShuntBus

  This provides the clocking to the backplane and synchronizes the operation of all the installed modules.

- Monitoring the hub temperature and taking appropriate action in overheated conditions

  When the hub temperature rises in a particular area, the overheated condition is signaled to the controller module. Then, the controller module may power down 8260 modules within that area according to the power classes assigned to the modules. This will be done to bring down the temperature of the hub to an acceptable limit.

- Inventory and intelligent power management

  Each 8260 module has a serial EEPROM which is used for power management and inventory purposes. The EEPROM is programmed at manufacturing and includes information about how much power the module requires, its serial number, model number, the vendor ID, and its hardware revision level. Upon insertion into the hub, the 8260 modules will send vital product data (VPD) and their power requirements over the control bus (SCI) to the controller module.

  The controller module also has knowledge of how many power supplies are installed in the hub and how much of the power is used by the currently installed modules; therefore, it is able to determine if there is enough power left in the hub to power up the new module. If the answer is yes, the controller module will apply full power to the module allowing it to operate normally. The controller module will also update its internal power tables to take into account the power consumption of the new module. Finally, the controller module informs the DMM of the VPD of the newly inserted module. Via the DMM command, you can also display information about the power supplies installed and the amount of power used by the existing modules.

2.11.4.1 The Controller Module Front Panel

Figure 90 on page 173 shows the front view of the controller module.

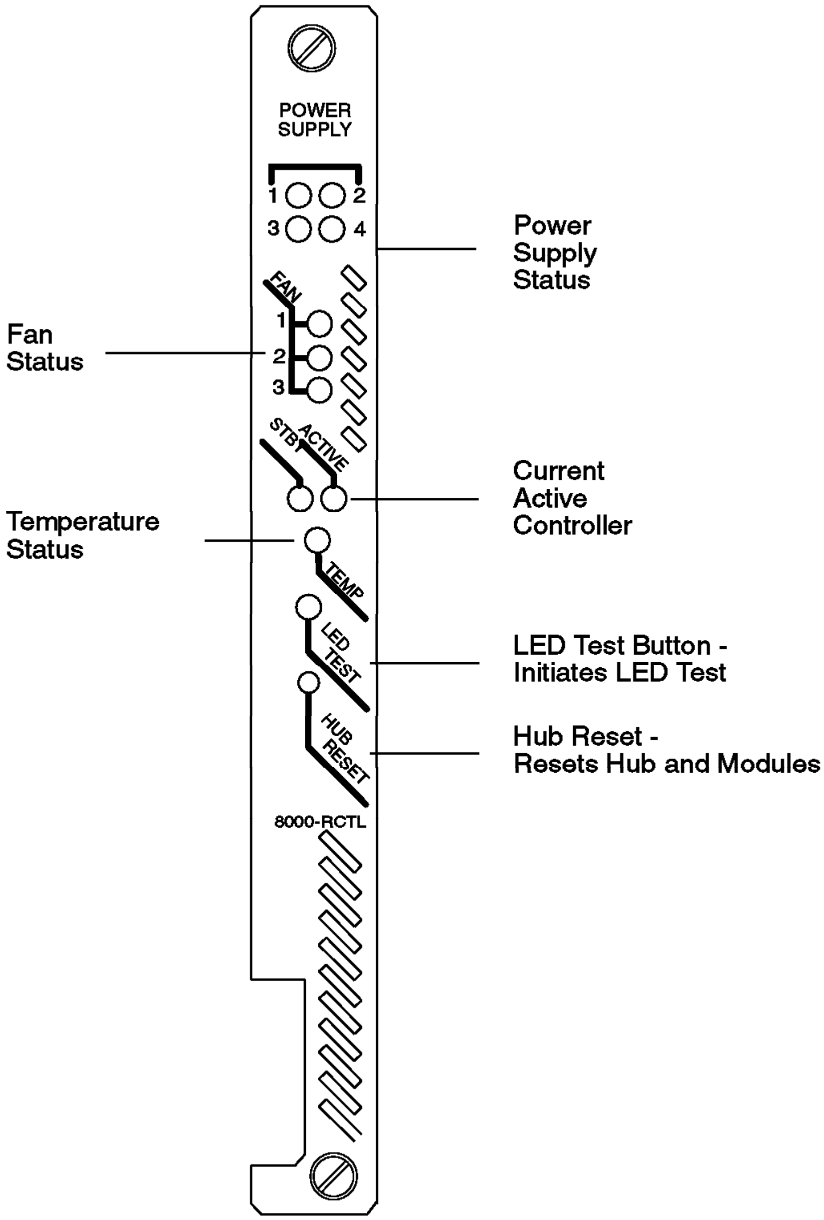


Figure 90. Front View of the Controller Module

Besides the hub reset and the LED test buttons, the controller module has ten LEDs covering the four power supplies, three fans, active or standby mode and temperature on the front panel which indicate the state of the system environment.

Hub Reset Button

Pressing this button, which is active on the active controller module only, resets all installed modules including both active and standby controller modules.

If you issue the reset hub command at the 8260 console, it will give you the same result as using the hub reset button.

Prior to resetting a hub, ensure that all parameters are saved; otherwise, you will have to re-enter them. Also remember that when the hub is reset, the network operation is disrupted.

LED Test Button

The LED test button is used to verify LED operation for all LEDs on all 8250 and 8260 modules installed. When you press the LED test button, every LED on every installed module should light up for approximately five seconds.

After five seconds, the port status LED will blink the number of times representative of the network to which that port is assigned for every port assigned to a backplane network. For every port that is not assigned to a backplane network, the port status LED will turn off and remain off for approximately 25 seconds.

2.11.4.2 Controller Module Fault Tolerance

There are two dedicated slots, 18 and 19, provided for installing the controller module. Once installed, the controller does not need to be configured. Since the controller module is a critical component, it is recommended to have a second controller module installed in the hub for backup purposes.

When two controller modules are installed in the hub, one is active and the other will be a standby. Both the active and standby controller modules monitor and modify the hub operating conditions such as temperature and power. This redundant monitoring and control capability enables the standby controller module to be ready to take over from the active controller module should the active controller module fail.

When the standby controller module takes over from the active controller module, all the installed modules perform a fast reboot. Fast reboot results in all the 8260 modules equipped with on-board memory (NVRAM) to automatically load the configuration stored there. This occurs regardless of the current DIP switch settings on the modules. Fast reboot facilitates immediate resumption of the hub activity following the failure of the active controller module and takeover by the standby controller module.

2.11.5 8260 Intelligent Power Management Subsystem

The 8260 provides extensive power management functions that allow you to take advantage of the modular load-sharing power supply system available on the 8260.

The power subsystem provides an easy access power bay which can support up to four load-sharing, high-capacity, managed power supplies.

The 8260 comes standard with one load-sharing power supply but it allows you to have up to a maximum of four power supplies installed in a single 8260.

Each power supply is hot swappable and is accessible from the front panel of the 8260 hub after removal of the power supply bay cover as shown in Figure 85 on page 162.

The power consumed by the controller, media and management modules currently installed in the 8260 is evenly distributed over all the installed power supplies. With the 8260 intelligent power management function, which is available through the distributed management module and the controller module, you can perform the following functions:

- Assign power class (priority) to each 8260 module.
- Display the power class assigned to each installed module.
- Power up and power down individual slots housing 8260 modules using DMM commands.
- Display the number and status of power supplies installed in the 8260.
- Display the available power budget in your 8260.
- Operate the 8260 in fault-tolerant or non-fault-tolerant mode.
- Display the operational mode (fault-tolerant or non-fault-tolerant) of your 8260.
- Automatically power-down the lower class (priority) 8260 modules if the failure of one or more power supply results in the power requirement of the currently installed modules to exceed the power capacity of the currently operational power supplies.
- Ensure that the newly installed 8260 modules will be powered up only if there is enough available power in the 8260 to operate them.

2.11.5.1 Power Class

Power class can be considered as a power priority which ranges from 1 to 10. 10 is the highest priority and 1 is the lowest priority.

In the event of failure of one or more power supplies which results in power deficit (that is, the available power is less than the power requirements by all the currently installed modules), the controller module will power down a number of 8260 media modules with the lowest power class to bring down the level of power consumption to the level of available power supplied by the remaining operational power supply components.

2.11.6 8260 Intelligent Cooling Subsystem

The 8260 intelligent cooling subsystem is made up of the following components:

- The fans and sensors
- The DMM (distributed management module)
- The controller module
- The SCI (serial control interface)

These components work together to make up the intelligent cooling subsystem.

Each 8260 has three fan units that can be installed or removed while the 8260 hub is operating. These fan units are accessible from the back of the 8260.

Each of the three fan units cools an overlapped area in the hub covering eight slots.

These three areas have their own temperature sensors. Also, integrated into each fan unit is a sensor that detects a stopped or slow fan condition. The controller module continually monitors all the sensors via the SCI.

This is the mechanics of the intelligent cooling subsystem:

- Each of the 8260 modules can be assigned a power class.

- 8250 modules cannot be assigned a power class.
- If an overheat condition is detected there is a one-minute delay and then the DMM is notified.
- DMM will generate an SNMP alert as a result of receiving an over temperature notification.
- If the Over_Heat Power_Down is set to Enable, (default is Disable) then the power subsystem is used to power down 8260 modules according to their power class and slot position within the affected cooling zone as shown in Figure 91.

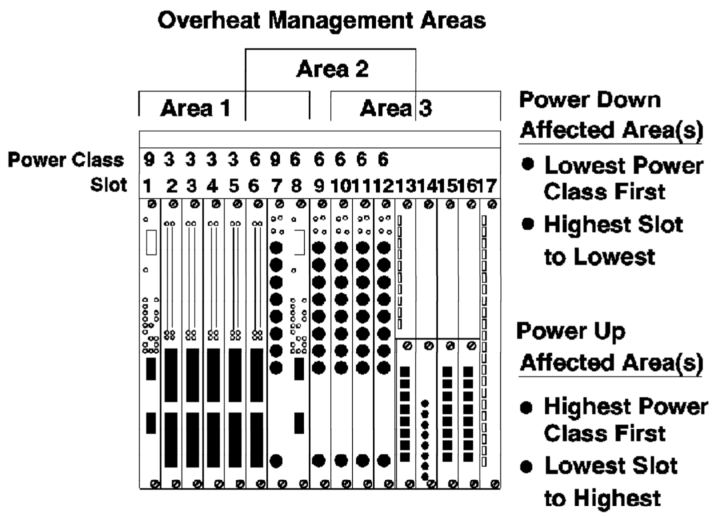


Figure 91. 8260 Cooling Zones and Power Classes

- Modules are powered down until the 5 volt power supply consumption is reduced by 50 watts.
- The temperature is allowed to stabilize for 15 minutes and if the temperature is still too high, all the 8260 modules in the affected zone are powered down.
- When the overheat condition is resolved the modules are powered back up. Modules with the highest priority are powered up first.
- The 8250 modules and the 8260 modules with power class 10 cannot be powered down by the controller module.
- If the Overheat_Auto_Power_Down is disabled, the controller module will not take any action. If the over temperature condition continues, the 8260 may be damaged.

2.11.7 8260 Distributed Management

To fully manage the 8260 and the installed modules, the 8260 uses a distributed management architecture. In this architecture, the various tasks of managing the various elements of the hub are distributed across the following elements:

- Distributed management module
- MAC daughter cards
- Controller module

There are two types of distributed management module (DMM):

- Stand-alone DMM
  - The DMM is called a stand-alone card because it does not have any mounting facility for the daughter cards.
- EC-DMM
  - This module allows you to mount up to six Ethernet Medium Access Carrier (E-MAC) daughter cards on it. At the time of writing there is no carrier DMM available for mounting token-ring MAC (T-MAC) daughter cards.

In terms of management functions, DMM and EC-DMM are identical. The only difference between these two cards is their ability to house Ethernet MAC daughter cards. Therefore, as this section is discussing management in general, the term DMM will be used to refer to both 8260 management modules (stand-alone DMM and EC-DMM).

The DMM, along with the fault tolerant controller module, manages and controls the 8260 hub and its modules. However, to perform certain management functions such as network traffic monitoring, there is a need for a daughter card to assist the DMM. There are two types of daughter cards:

- Ethernet Medium Access Carrier (E-MAC) daughter card
- Token-ring Medium Access Carrier (T-MAC) daughter card

These daughter cards provide the following two functions:

- Interface to the backplane segments

  To be able to communicate with devices attached to any of the backplane segments, DMM requires an interface to that segment. The interface to the Ethernet segments on the backplane is provided to DMM via E-MAC, whereas T-MAC allows DMM to interface with the token-ring segments on the ShuntBus. Note that DMM requires one MAC daughter card for each network on the backplane through which DMM is going to communicate with the other devices.

  DMM will use the interface to the backplane segments to communicate with the devices attached to these segments using IP. For example, to be able to manage the 8260 via an SNMP manager, DMM must have an interface to a network thru which the SNMP manager can be accessed.

- Network monitoring

  Daughter cards attach to the appropriate backplane segment (token-ring or Ethernet) and listen to the traffic flow and pass all the information back to DMM.

Note: Ethernet MAC daughter cards can be installed on EC-DMM or Ethernet media modules, whereas token-ring MAC daughter cards must always be installed on token-ring media modules.

The combination of DMM and daughter cards provide a cost efficient management architecture that consolidates media management into a single card, while distributing network monitoring across a series of protocol-dependent daughter cards. The DMM is a generic (protocol independent) module that can be used for both in-band and out-of-band management. As mentioned above, when used for in-band management, DMM requires a daughter card. The flexibility and reduction in cost is achieved by distributing the network monitoring function to daughter cards that can be mounted on EC-DMM (E-MAC only) or media modules, so they do not use any valuable payload slots. This also means you only need one DMM to manage the entire 8260. If your network grows and you need to invest in more network monitoring function, you can install additional daughter card(s) matching the protocol of your new network(s) by just mounting them on the existing media module or EC-DMM (E-MAC only).

The MAC daughter cards will be assigned to the token-ring or Ethernet backplane using DMM commands. Once assigned to a backplane segment, they will be able to monitor the traffic on that segment and pass the collected information to the DMM. Note that the MAC daughter cards installed on the media modules will communicate with the DMM (or EC-DMM) using the MLAN, as shown in Figure 92. The E-MACs installed on the EC-DMM, however, will use the on board circuitry of the EC-DMM to communicate with DMM.

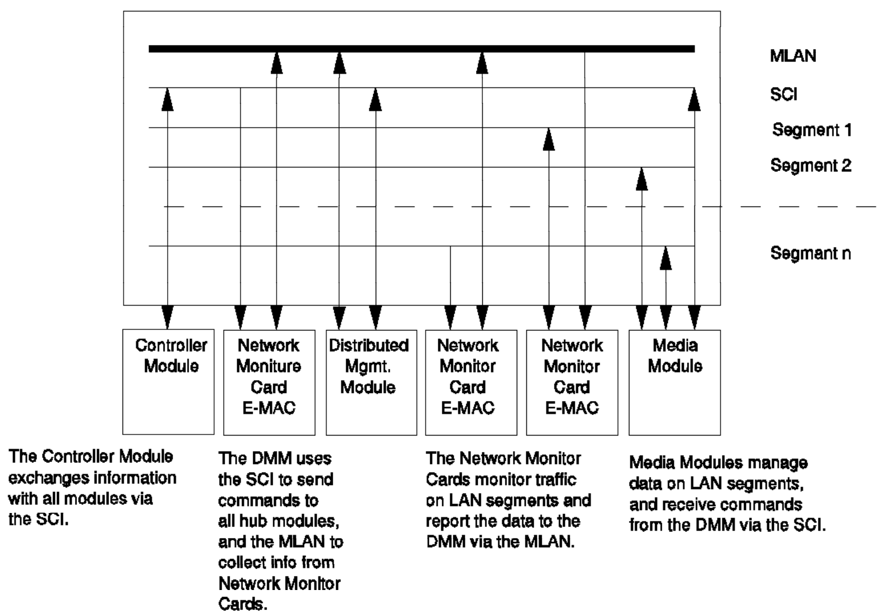


Figure 92. Management Schematic

The DMM (and daughter cards) provide management and control facilities in the following areas:

– **Configuration**

  The DMM, networks, modules, and port settings can be configured through the DMM using DMM commands. The DMM can be used to configure 8250 as well as 8260 modules.

– **Statistics and fault reporting**

  E-MAC and T-MAC provide support for collecting an extensive range of statistics based on RMON.

– **Out-of-band and in-band down-loading**

The DMM provides both in-band and out-of-band download features for down-loading new software to DMM, media modules, and daughter cards. Trivial file transfer protocol (TFTP) is used for in-band downloads. Out-of-band downloads allow you to download software using the Xmodem protocol from a local or modem attached PC (with ASCII emulation software) attached to the RS-232 port on the front panel of the DMM.

– **SNMP support**

  In a Simple Network Management Protocol (SNMP) managed environment the DMM acts as the SNMP agent, responding to SNMP requests and generating SNMP traps.

– **Telnet support**

  Using Telnet you can log in remotely to any DMM on the network and manage it from the remote station. You can also use Telnet from the terminal attached to the DMM to log in to any other device which supports Telnet.

– **Inventory**

  The DMM provides a complete inventory of the hub including power supplies, fans and modules installed in the 8260.

– **Staging**

  The media modules save their configuration information in an on-board non-volatile RAM (NVRAM). This means flexibility for network managers as they can configure the modules at a central site and then send them out to the remote locations for installation.

– **Power management**

  The DMM when used in conjunction with the fault tolerant controller module can be used to manage the power subsystem. For example, it can set power classes for modules and turn power fault tolerance on and off.

– **Mapping**

  DMM allows you to display a detailed topological ring map including address-to-port mapping about the token-ring segments on the network.

2.11.7.1 The Distributed Management Module (DMM)

The stand-alone DMM is a single-slot management module that has no facility for carrying daughter cards.

The DMM has 1 module status LED, a 4-character display with a display control toggle button and 2 serial port connectors and looks like the EC-DMM shown in Figure 93 on page 181 with the exception of the network status LEDs.

The LCD display and display control button are used to:

- Display the current operating state of the module
- Determine the network assignment of ports and 8260 modules in the hub
- Display the version of the DMM microcode

The LCD display normally shows the module operating state.

Console and Auxiliary Ports: There are two DB-9 ports on the face-plate of the DMM. The upper port is called the *console* port and is used for attaching a terminal locally (or via a modem) to the DMM. This terminal is used to provide out-of-band management capability for the 8260.

Three types of users can be used to access DMM:

- *User*

  This type of user can view the configuration of the 8260 and all the installed modules and daughter cards. Additionally, this user can obtain statistics about the various components of the network.

- *Administrator*

  This type of user can perform all the user functions. Additionally, this user can modify the configuration of the hub and all the installed modules and daughter cards.

- *Superuser*

  This type of user can perform all the functions of the administrator. Additionally, this user can create new users and perform maintenance functions such as down-loading new software to the DMM and other modules.

2.11.7.2 The EC-DMM (Ethernet Carrier - Distributed Management Module)

The EC-DMM is a single-slot management module that has the mounting ability to carry up to 6 Ethernet MAC daughter cards.

The EC-DMM has 1 module status LED, a 4-character display with a display control toggle switch, 24 Ethernet network status LEDs and 2 serial port connectors. Figure 93 on page 181 shows the layout of the DMM front panel.

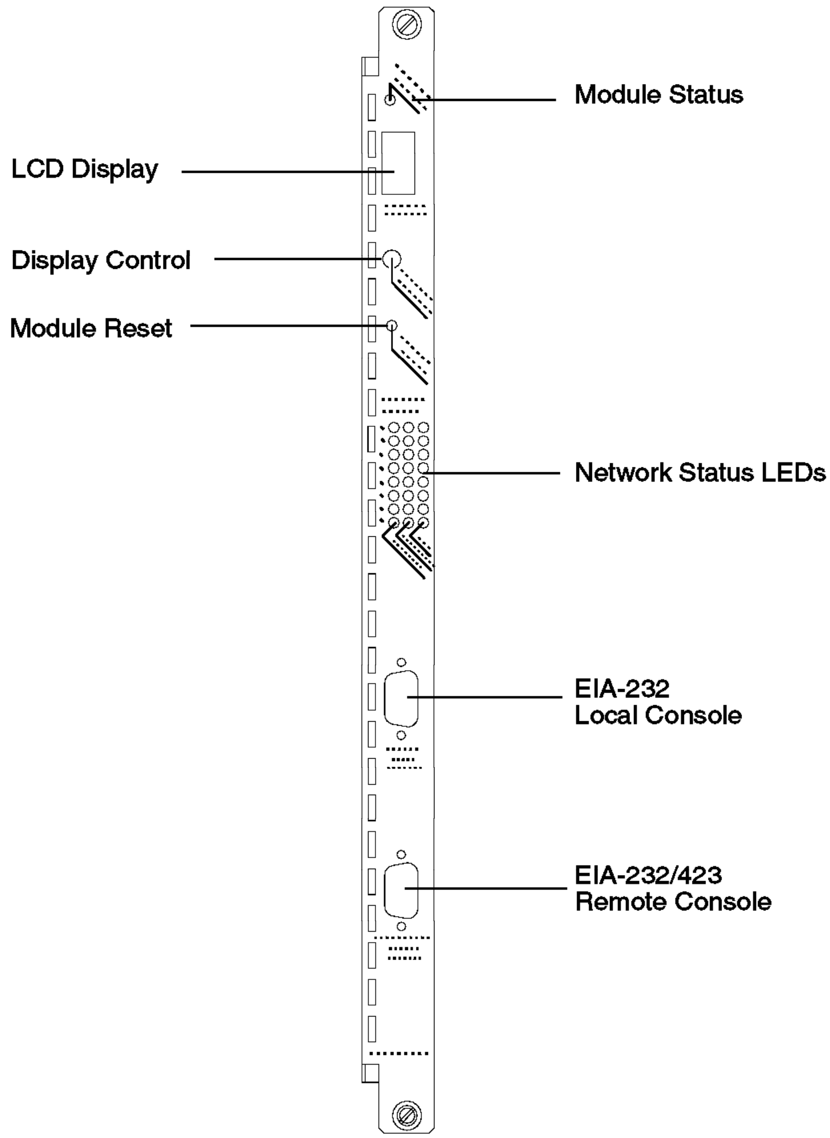


Figure 93. EC-DMM Front Panel

The LCD display normally shows the module operating state. Each time the display control button is pressed the character display cycles through each of the networks. By using the network display LEDs on the EC-DMM and the 8260 media modules it is possible to see which modules and which ports are assigned to a network.

Console and Auxiliary Ports: The ports equals those of the DMM card.

2.11.7.3 MAC Daughter Cards

To be able to monitor the network traffic activity on the backplane segments, as well as to be able to communicate with other stations using IP, DMM requires the services provided by MAC daughter cards.

These daughter cards connect to the networks, listen to the traffic flow and pass traffic information back to the DMM. They also provide the DMM with the interface to the networks on the backplane so that it can communicate with the other stations on that network.

The MAC daughter cards are protocol-specific cards and at the time of writing this book the following two types of MAC daughter cards were available:

- The E-MAC (Ethernet - Media Access Card)
- The T-MAC (Token-ring - Media Access Card)

These daughter cards can be installed on the media modules that use the same protocol. That is, T-MACs can be installed on token-ring media modules, and E-MACs can be installed on Ethernet media modules. Each token-ring or Ethernet media module can accommodate installation of one MAC daughter card (Ethernet 40-port module allows the installation of two MAC daughter cards). Additionally, the E-MACs can be installed on the EC-DMM. Each EC-DMM can accommodate the installation of up to 6 E-MACs.

Regardless of where the MAC daughter cards are installed, they can be assigned to any of the backplane segments. However, to assign a MAC daughter card to an isolated segment on a media module, the MAC daughter card must be installed on that media module.

Ethernet MAC Daughter Card (E-MAC): E-MAC is a MAC daughter card which can be installed on an EC-DMM or Ethernet media modules. Figure 94 shows how you can install up to 6 E-MACs on a single EC-DMM.

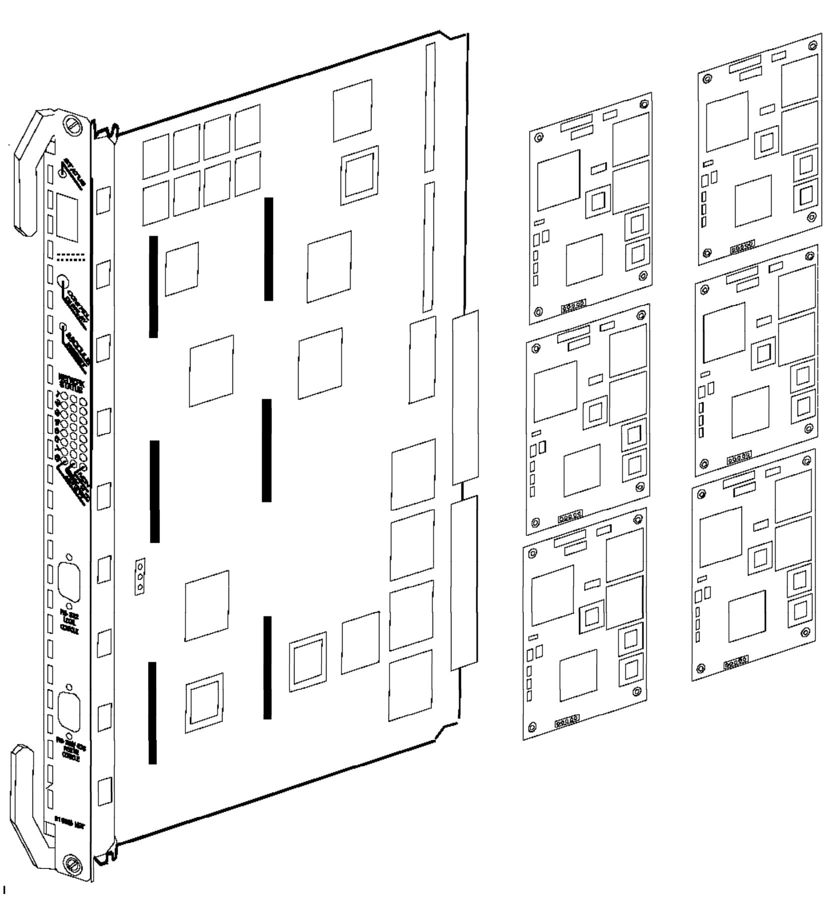


Figure 94. EC-DMM with Up to 6 E-MACs

In addition to the DMM with an interface to the network, E-MAC allows you to collect statistics about the Ethernet segment to which it is attached. The statistics which are collected by E-MAC are passed to DMM which allows you to display them locally or access them (in-band) through an application such as RMonitor for AIX. Note that the communication between DMM and the E-MAC installed on the 8260 media modules is via MLAN.

The E-MAC supports collection of a subset of the RMON statistics.

Token-Ring MAC Daughter Card (T-MAC): The T-MAC must be mounted on an 8260 token-ring media module. This is because at this stage there is no token carrier DMM. The T-MAC performs the same functions for token-ring as the E-MAC does for Ethernet. It gathers network and port statistics and transmits them to the DMM via the MLAN.

Each token-ring media module has the housing to install one T-MAC.

In addition to providing DMM with the interface to the backplane segments, T-MAC allows you to collect statistics about the token-ring segment to which it is attached. The statistics which are collected by T-MAC are passed to DMM (over MLAN) which allows you to access them locally or in-band through an application such as RMonitor for AIX. T-MAC supports collection of a subset of RMON statistics.

2.11.7.4 Overview of Management and Control Commands

Commands used in the 8260 hub can be organized into hierarchical or layer-like structures. When you first log in to the 8260 hub with the *system* user ID, commands in the first layer will be available. Commands may have various parameters or options associated with them. For example, in Figure 95 on page 184, all commands in the second layer are the available options associated with the set command. Default_gateway, ip_address and subnet_mask are the possible options associated with the ip option and the set command in the second and first layers in respectively.

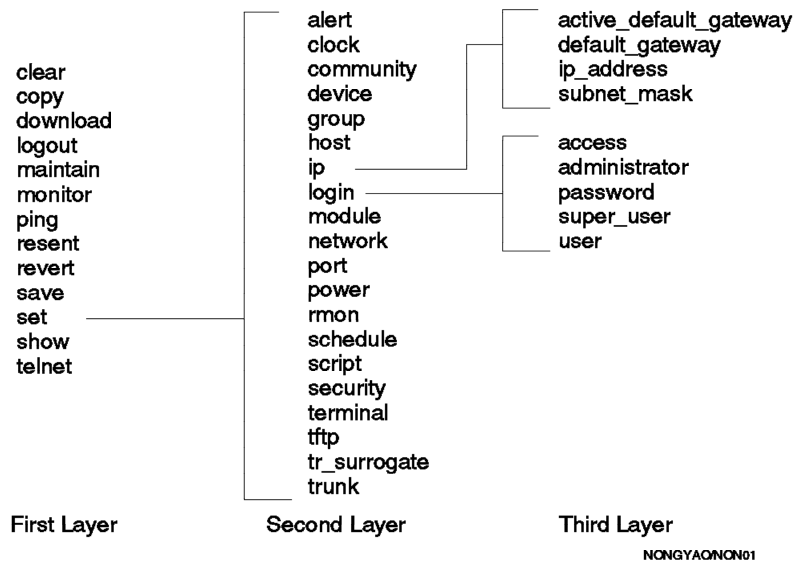


Figure 95. A Sample of Hierarchical Structure Command

In the remainder of this book, the DMM commands will be covered as we discuss various components of the 8260.

2.11.8 8260 Modules and Daughter Cards

This section will give an overview of currently available 8260 modules and daughter cards and a brief description of them.

2.11.8.1 Ethernet Modules

Note that you can install and use any 8250 Ethernet module in the 8260.

8260 Ethernet 36-Port Bank Switching Module: This is a single-slot connector switching module that:

- Supports Telco 50-pin connector-based 10Base-T wiring
- Enables users to assign a backplane segment at the connector level of the module
- Connects up to 36 devices to the hub

The module provides 36 10Base-T compliant ports using 25-pairs 10Base-T cables. The main value add of this module is the integration and the low cost solution for Ethernet networks.

The 36-port 10Base-T module provides the following features:

- Security through the 8260 Ethernet security card that provides continuous eavesdropping and intrusion protection without affecting network performance
- Driver and receiver integrity checking by use of remote diagnostics mode
- Support of scalable network management architecture that enables you to gather Ethernet and remote monitor (RMON) network statistics for any of the 8260 backplane segment

- Support of two daughter cards including a Medium Access Control Card (E-MAC) for in-depth monitoring of the network, or a Security card (E-SEC) for private Ethernet conversations
- Support of three 12-port Telco 50 pin connectors which you can switch (per connector) to any of the eight 8260 backplane channels or eight extended segments in the addition of the eight
- Per-connector switching to all eight of the 8260 backplane segments and eight isolated segments
- IEEE repeater statistic gathering for monitoring of 8260′s security and network management architecture
- Up to 100 meters on 10Base-T compliant unshielded twisted pair (UTP) wiring as well as shielded twisted pair (STP) wiring

8260 Ethernet 24-Port 10Base-T Module: The 8260 Ethernet 24-Port 10Base-T Module is a 24-port IEEE 802.3 repeater module that complies with the 10Base-T standard and supports backbone and to-the-desk connectivity over unshielded twisted pair (UTP) cabling. This module provides two 50-pin Telco-type connectors. Each Telco connector can be connected to an external 12-port *harmonica*. Each port on the harmonica provides an RJ-45 connector for attaching 10Base-T compliant devices using UTP cabling for distances of up to 100 m.

All 24-ports are internally crossed-over which allows you to connect them directly to 10Base-T transceivers without using external crossover adapters.

The module can also be used to provide a UTP backbone connection between the 8260 and other 10Base-T compliant hubs such as another 8260, 8250 or 8224.

The module provides the following features:

- Per-port switching

  Each port can be connected to one of the eight segments on the backplane. Also, the module provides eight isolated segments to which the individual ports on the module can be attached.

- Support for 1 E-MAC

  This module provides the mounting for one E-MAC. The E-MAC can be assigned to any of the Ethernet segments on the backplane, or any of the isolated segments on this module. Note that the E-MAC mounted on this module cannot collect per-port or per-module statistics about the 8250 modules.

- Support for 1 Ethernet Security Card

- Support for port redundancy

  You can set up redundancy between two links on the same module or two different modules.

- Auto-polarity detection

  This feature will automatically detect if you have erroneously reversed polarity of the cable during its assembly and will resolve the problem by reversing the polarity.

- Support for non-10Base-T compliant devices

  This module allows you to disable link integrity which allows connection to some equipment that does not conform to the 10Base-T standard.

8260 Ethernet 20/40-Port 10Base-T Module: These are single-slot 20-port, and two-slot 40-port IEEE 802.3 repeater modules that comply with the 10Base-T standard and support backbone and to-the-desk connectivity over unshielded twisted pair (UTP) as well as shielded twisted pair (STP) cabling. These modules provide 20 or 40 shielded RJ-45 connectors for attaching 10Base-T compliant devices using STP and/or UTP cabling for distances of up to 100 m.

Note: You can mix UTP and STP cabling on a single 20/40-port 10Base-T module.

On the 20/40-port 10Base-T modules, all the ports are internally crossed-over which allows you to connect them directly to 10Base-T transceivers without using external crossover adapters.

These modules can also be used to provide UTP/STP backbone connections between the 8260 and other 10Base-T compliant hubs such as another 8260, 8250 or 8224.

The 24/40-port 10Base-T modules provide the following features:

- Per-port switching

  Each port can be connected to one of the eight segments on the backplane. Also, the module provides eight isolated segments to which the individual ports on the module can be attached. This means that the ports on these modules can be connected to a maximum of eight segments which can be a combination of backplane and isolated segments.

- Support for 2 E-MACs
- Support for 1 Ethernet security card
- Support for port redundancy

  You can set up redundancy between two links on the same module or two different modules. Note that port redundancy is supported between different types of modules.

- Support for non-10Base-T compliant devices

8260 Ethernet 10-Port 10Base-FB Module: This is is a 10-port module that complies with the 10Base-FB standard and supports backbone and to-the-desk connectivity over fiber optic cabling.

This module supports 50/125, 62.5/125, 85/125 or 100/140 micron duplex fiber rated at 150 MHz or better and can be ordered with either ST, FC or SMA-type connectors.

In general, on 62.5 micron cable, you can go up to a maximum of 4000 meters (when the module is set to operate at high power mode) point-to-point using 8250 and/or 8260 10Base-FB modules.

The module provides the following features:

- Per-port switching

  Each port can be connected to one of the eight segments on the backplane. Also, the module provides four isolated segments to which the individual ports on the module can be attached. You have the freedom to assign any of the 10 ports to any of the backplane or isolated segments.

- Support for 1 E-MAC

- Support for 1 Ethernet security card
- Support for port redundancy

  You can set up redundancy between two links on the same module or two different modules.

8260 Ethernet Flexible Concentration Module: This is a single-slot media module with a flexible architecture which allow you to populate the module with various input/output (I/O) cards. This architecture allow you to mix and match front-end card types.

The 8260 Ethernet flexible module supports the ″mix and match″ capability with five types of field-installable I/O cards. This structure authorizes the creation of a customized mixed-media solution to meet individual needs.

When the number of collisions (or duration of collisions) exceeds a threshold, the I/O card automatically disables the port. The card also enables the port when it detects good data.

The module supports the following field-installable I/O cards:

- Two-ports FB/FL with ST connectors
- Two-ports FB/FL with FC connectors
- Two-ports FB/FL with SMA connectors
  - FB or FL networks can be mixed on the same I/O card. The module supports eight fiber ports (four I/O cards).
- Four-port UTP with RJ-45 connectors
  - Maximum ports per module is 16 (four I/O cards).
- Three ports BNC
  - Maximum ports per module is 12 (four I/O cards).
- Three ports AUI Male
- Three ports AUI female
  - Maximum ports per module is six (two I/O cards).

The Ethernet flexible concentration module is per port switchable to all eight Ethernet backplane segments and supports:

- Up to eight isolated networks.
- Security through the Ethernet Security Card (E-SEC). The E-SEC provides continuous eavesdropping and intrusion protection without affecting network performance. Up to two Ethernet security cards may be connected.
- Allows you to connect up to two Ethernet medium access control cards (E-MAC) for network management.
- IEEE Repeater Statistics-gathering for basic network monitoring through the 8260 security and network management architecture.
- Offers high port density at a low cost per port.
- Maintains its own inventory and power management information in non-volatile RAM (NVRAM).
- Automatic portioning.

8260 Ethernet Security Daughter Card: The 8260 Ethernet Security Card (E-SEC) is a daughter card that allows you to provide security on any Ethernet network to which this card is attached. You can install this card on any Ethernet media module or the 8260 DMM with Ethernet Carrier (EC-DMM).

Security features provided by this card are only applicable to the Ethernet ports on the 8260 modules.

Once assigned to an Ethernet network, the E-SEC card can be used to provide the following security features for that network:

- Intrusion protection

  This feature allows only the authorized users for each port to transmit data on that port. If an unauthorized user is detected on a port, the E-SEC card may be configured to perform one or more of the following:

  – Report the time and port on which the intrusion took place along with the MAC address of the intruder.

  – Jam the intruder′s port so that the intruder is not able to exchange data with the other stations on the network.

  – Disable the port to which the intruder is connected.

  Authorized users on each port are known to the E-SEC card via the *network security address table*. The contents of this table can be created and/or modified using *manual* and/or *auto-learning* procedures.

  Each entry in the network security address table contains the 8260 slot and port number as well as the MAC address of the station authorized to transmit data on that port. You may configure the E-SEC card to either check only the MAC address of the sending adapter, or both the MAC address and the port to which the sending station is attached.

- Eavesdropping protection

  This feature prevents unauthorized users from examining the contents of packets destined for another port by preventing all the nodes except the intended recipient from receiving the packets transmitted on the network.

Eavesdropping and intrusion protection functions can be enabled or disabled separately for each port. Various ports on a single network may have different security settings.

2.11.8.2 Token-Ring Modules

The 8260 token-ring modules can only be connected to the token-ring segments on the ShuntBus. The 8250 token-ring modules can only be connected to the token-ring segments on the Enhanced TriChannel.

8260 18-Port Active Per-Port Switching Module: This module is a single-slot module that supports 18 active ports. The main features of this module are:

- 18 ports with shielded RJ-45 connectors.
- Each port has its own DPLL, which actively retimes and regenerates the signal on that port. This provides longer lobe distances on both UTP and STP.
- Each port can be connected to one of the 10 token-ring segments on the ShuntBus or one of the 11 isolated segments on the module. All the ports can be connected to a maximum of 11 segments consisting of backplane and isolated segments.
- Simultaneous UTP and STP cabling is supported on the module. Also, UTP and STP attached stations can be connected to the same segment.

- Ports 17 and 18 can optionally be configured to be used as RI/RO ports for connection to another hub.
- Support for beacon recovery using the recovery ASIC which is implemented on the module.
- Support for address-to-port mapping using the recovery ASIC.
- Support for fan-out devices and splitters for attaching up to eight stations to each port.
- Support for connection of MAC-less stations (such as token-ring tracing tools) to all ports except port 18.
- Automatic speed detection of the attached stations so that only the stations with the correct ring speed settings can attach to the network.
- Support for simultaneous 4 and 16 Mbps token-ring networks on the module.
- When ports 17 and 18 are configured as RI/RO ports, they are fully compliant with the IEEE 802.5C (dual-ring recovery) standard.
- Support for installation of one T-MAC.
- Support for installation of one Jitter Attenuator daughter card.

8260 18-Port Active Module Switching Module: This module is identical to the 18-port active per-port switching module with the exception that it does not support the per-port switching feature. This means that all the ports on this module can only be assigned to the same segment on the backplane or can all be isolated.

8260 20-Port Passive Module Switching Module: This is a single slot module that supports 20 passive ports. This is a module switching module, which means that all the ports must be attached to the same segment. The following are the main features of this module:

- 20 ports with shielded RJ-45 connectors.
- A single DPLL which is implemented on the module will remove the jitter before passing the signal to the 8260 backplane.
- The module can be assigned to any of the 10 token-ring segments on the ShuntBus or can be isolated.
- Support for both UTP and STP cabling. However, you cannot mix both cabling types on the same module simultaneously.
- Support for beacon recovery using the recovery ASIC which is implemented on the module.
- Support for address-to-port mapping using the recovery ASIC.
- Support for fan-out devices and splitters for attaching up to eight stations to each port.
- Support for connection of MAC-less stations (such as token-ring tracing tools).
- Software-based speed detection so that only the stations with the correct ring speed settings can attach to the network.
- Support for 4 or 16 Mbps token-ring networks.
- Support for installation of one T-MAC.
- Built-in Jitter Attenuator daughter card.

8260 Dual Fiber Repeater Module: This is a single slot module that supports ten active lobe ports and two sets of fully repeated fiber RI/RO trunk ports. This is a per-port switching module, which means that any of the lobe ports or and trunk port sets can be assigned to any of the backplane segments. The following are the main features of this module:

- 10 lobe ports with shielded RJ-45 connectors.
- Each lobe port has its own DPLL, which actively retimes and regenerates the signal on that port. This provides longer lobe distances on both UTP and STP.
- Each lobe port can be connected to one of the 10 token-ring segments on the ShuntBus or one of the 11 isolated segments on the module.
- Two sets of fully repeated fiber RI/RO trunk ports with ST connectors.
- Each trunk port is fully repeated and supports multimode fiber connections for 62.5/125 fiber at distances up to 2 km.
- Each set of trunk ports can be assigned to one of the 10 token-ring segments on the ShuntBus or one of the 11 isolated segments on the module.
- Simultaneous UTP and STP cabling is supported on the lobe ports attached to the same or different segments.
- Support for beacon recovery on both lobe and trunk ports using the recovery ASIC which is implemented on the module.
- Support for address-to-port mapping using the recovery ASIC.
- Support for fan-out devices and splitters for attaching up to eight stations to each port.
- Support for connection of MAC-less stations (such as token-ring tracing tools) to all the lobe ports.
- Automatic speed detection of the attached stations to the lobe ports, so that only the stations with the correct ring speed settings can attach to the network.
- Simultaneous support of 4 and 16 Mbps token-ring networks on the lobe and trunk ports.
- Compliant with the 802.5C (dual-ring recovery) on the trunk ports.
- Support for installation of one T-MAC.
- Support for installation of two Jitter Attenuator daughter cards.

8260 Jitter Attenuator Daughter Card: The 8260 Jitter Attenuator daughter card allows you to filter excessive amounts of jitter that may have accumulated in other equipment, before passing the signal to the 8260 backplane. The Jitter Attenuator daughter card can be mounted on any 8260 token-ring media module.

2.11.8.3 Management and Controller Modules

8260 Distributed Management Module (DMM): The distributed management module is an independent management module which allows you to fully manage and control the 8260 Multiprotocol Intelligent Hub and all the 8250/8260 modules. The DMM provides you with flexibility in handling the management of network segments with different protocols and media modules via a single management module using a single slot in the 8260 payload area. There are two different versions of DMM:

- **A Distributed Management Module with Ethernet Carrier - (DMM with Ethernet Carrier)** The DMM with Ethernet carrier module is a management module which is capable of housing up to 6 Ethernet MAC daughter cards.
- **A Stand-Alone Distributed Management Module (Stand-Alone DMM)** The stand-alone DDM module is a management module which is not capable of housing any Ethernet MAC daughter cards.

8260 Fault-Tolerant Controller Module: The 8260 Fault-Tolerant Controller Module synchronizes the operations of all installed media and management modules by providing clocking and timing to the 8260 Multiprotocol Intelligent Hub backplane. The controller module is also responsible for managing the power and cooling subsystems.

Ethernet Media Access Daughter Card (E-MAC): The E-MAC daughter card allows you to gather statistics for the network to which it is attached. It can be physically mounted to either an 8260 Ethernet media module or the 8260 EC-DMM.

8260 Token-Ring Media Access Daughter Card (T-MAC): The T-MAC daughter card allows you to gather statistics for the network to which it is assigned. It can be mounted on any 8260 token-ring media module.

2.11.8.4 8260 Multiprotocol Interconnect Module

The 8260 Multiprotocol Interconnect Module is a one or two-slot module for the 8260 which allows you to interconnect Ethernet, 802.3, and token-ring networks using bridging and/or routing functions. These modules provide 6 ports for backplane attachments to the Ethernet segments on the ShuntBus or TriChannel. Additionally, the two-slot module provides you with the capability to install two additional I/O cards for providing connection to external token-ring and/or Ethernet networks. These additional I/O cards will provide the seventh and eighth port on the module. At the time of writing this book, the following I/O cards are available:

- Token-ring 4/16 I/O card
- Ethernet 10Base-T I/O card
- Ethernet 10Base2 I/O card
- Ethernet 10Base5 I/O card

Note that the I/O cards for the two-slot module only provide attachment capability to the external networks. For example, installation of the token-ring I/O card does not provide the ability to connect the module to the token-ring segments on the backplane.

The one-slot module can perform the following functions:

- Transparent bridging between Ethernet/802.3 segments
- IP routing between Ethernet/802.3 segments
- IPX routing between Ethernet/802.3 segments
- DECnet Phase IV routing between Ethernet/802.3 segments

The two-slot module can perform the following functions:

- Transparent bridging between Ethernet/802.3 segments
- Transparent bridging between token-ring segments operating at 4 and/or 16 Mbps
- Source-route transparent bridging between token-ring segments operating at 4 and/or 16 Mbps

- Translational bridging between token-ring and Ethernet or 802.3 segments when both sides use transparent bridging
- IP routing between Ethernet/802.3 and/or token-ring segments
- IPX routing between Ethernet/802.3 and/or token-ring segments
- DECnet Phase IV routing between Ethernet/802.3 segments

Note: DECnet Phase IV routing is not supported on token-ring ports.

The Multiprotocol Interconnect Module uses a 32-bit RISC processor (80960FA) for high performance, allowing you to forward up to 45,000 packets per second when bridging and up to 30,000 packets per second when routing IP. The performance of the module will vary depending on the number of routing protocols running in the module as well the size of the packets.

This module can be managed using a local ASCII terminal (VT100/VT220) connected to the module through an RS-232 port (locally or via a dial-up modem operating at speeds up to 9600 bps). It can also be managed remotely using Telnet.

The Multiprotocol Interconnect Module, also supports SNMP allowing it to be managed using an SNMP manager.

New software can be downloaded to the Multiprotocol Interconnect Module using BOOTP, TFTP, or X-Modem. This can be done:

1. Out-of-band - Using a local or modem attached PC to the RS-232 port on the module.
2. Inband - Using an IP network.

The management facilities of the Interconnect Module allow you to do the following:

- Configure the module for bridging and/or routing functions
- Monitor traffic counters
- Monitor diagnostics information
- Monitor address table information for routing and bridging functions

The Multiprotocol Interconnect Module consists of:

1. Backplane Interface Module (BIM):

   This module provides the following functions:

   - Connection to the ShuntBus and Enhanced TriChannel Ethernet/802.3 segments
   - A DB-9 connector for local management
   - Housing for two additional I/O cards (2-slot module only)

2. Router Engine Module (REM):

   This module is installed on the BIM and provides housing for an i960 processor.

3. I/O cards (available on the two-slot module):

   Up to two I/O cards (in any combination) can be installed on the BIM to provide connections for up to two external token-ring and/or Ethernet segments.

Note: The connectors on the token-ring I/O modules are via DB-9 connectors.

Figure 96 on page 193 shows the front view of the 1-slot and 2-slot Multiprotocol Interconnect Modules.

There are a number of activity and status LED displays on the front panel of the Multiprotocol Interconnect Module that are used to show the information.

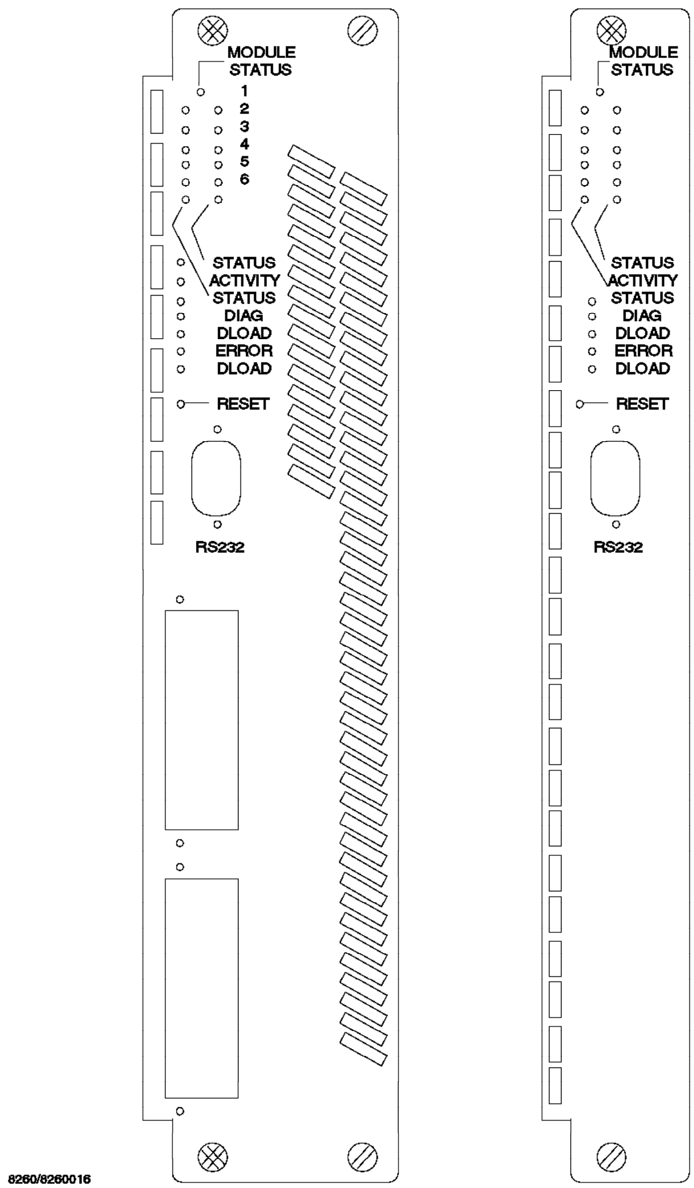


Figure 96. Front View of the Multiprotocol Interconnect Modules

Bridging Functions: This module can perform transparent bridging (TB) between Ethernet or 802.3 segments as well as between token-ring segments. Also, it can be configured to perform source-route transparent (SRT) bridging between token-ring networks. Finally, it can perform translational bridging between token-ring and Ethernet (or 802.3) networks when both the token-ring and Ethernet (or 802.3) segments are using transparent bridging.

Note: This module cannot perform source-route to transparent (SR-TB) bridging like the IBM 8209 and 8229.

This module supports the spanning tree protocol and can coexist and interoperate with other transparent and source-route transparent bridges that support the spanning tree protocol.

Note: This module cannot use the spanning tree protocol to interoperate with source-route (SR) bridges.

When performing transparent bridging functions, it dynamically learns the addresses of all the nodes on the subnetworks. To do so, the module looks at the source address of each packet and creates a database containing these addresses. You can also configure the filtering database with permanent entries to build a customized bridging environment. When a packet is received by the module, its destination is compared with the addresses in the database entries for that subnetwork. If it is found, the station is considered to be local and the packet will not be forwarded. If the address is not found, the station is considered to be in a subnetwork other than the source subnetwork and the packet will be forwarded on some or all the ports depending on how you have configured your bridge.

As a source-route transparent bridge, this module will use the routing information field (RIF) in the frame to forward the packet towards its destination.

This module can also be configured to bridge the traffic between token-ring and Ethernet (or 802.3) networks. In bridging traffic between token-ring and Ethernet (or 802.3) it also supports IPX traffic.

Routing Functions: The Multiprotocol Interconnect Module supports the following routing protocols:

- IP
- IPX
- DECnet Phase IV

IP Routing Support: When acting as an IP router, the Multiprotocol Interconnect Module provides support for:

- Directed broadcast
- ICMP
- Proxy ARP
- Ethernet or 802.3 (not both) encapsulation on LAN interface
- Datagram fragmentation/reassembly support
- IP security
- Boothelper
- Static routes
- Dynamic routes
  - RIP
  - OSPF

RIP Implementation: The following is a summary of the RIP implementation in the Multiprotocol Interconnect Module:

- Routing messages are broadcast every 30 seconds.
- Triggered updates are sent.
- Split horizon with poison reverse is always used.
- Host level routing is supported (with future WAN I/O cards).

- RIP can be enabled/disabled on a per logical port basis.
- RIP can be enabled/disabled globally.
- Path cost can be configured on each logical port.
- Routing table entries are aged-out to ensure validity of routes.
- Can pass or block datagrams according to user-defined security access list.

OSPF Implementation: The following is a summary of the OSPF implementation in the Multiprotocol Interconnect Module:

- Only topology changes are broadcast as per OSPF Specification Version 2 (RFC 1247).
- Supports alternate routes based on IP Type Of Service (TOS).
- Supports multiple paths with equal costs.
- Supports authentication between routers.
- Importation of RIP routes and static routes to an OSPF domain may be enabled or disabled.
- Filters may be configured to import or discard specific RIP and static routes to OSPF.
- Supports hop count to OSPF metric conversion when importing RIP and static routes.
- Does not support non-broadcasting multiaccess networks (such as X.25).

IPX Routing Support: The following is a summary of the IPX implementation in the Multiprotocol Interconnect Module:

- Supports RIP (routing information protocol) and SAP (service advertising protocol).
- Supports split horizon.
- Does not support poison reverse.
- Does not support split path routing.
- Does not support static RIP or SAP entries.
- Does not support equal cost paths.
- Can pass or block datagrams according to user-defined security access list.

DECnet Phase IV Routing Support: The Multiprotocol Interconnect Module in a DECnet environment is always a level 2 router. It implements the DECnet routing layer and provides network management and security, including the following:

- Supports configurable circuit cost.
- Supports designated router priority.
- Supports designated router priority.
- Can pass or block datagrams according to a user-defined security access list.

Configuring Multiprotocol Interconnect Module: Both one-slot and two-slot Multiprotocol Interconnect Modules provide six ports that can be attached to any of the Ethernet segments on the ShuntBus or Enhanced TriChannel. These ports are referred to as ports 1 thru 6. Additionally, the two-slot module provides the housing for two I/O cards that can be used to provide connections to external token-ring and/or Ethernet segments. These ports are referred to as ports 7 and 8.

To configure the 8260 Multiprotocol Interconnect Module, you must use the Local Management Systems (LMS) accessed via the local (or remote) console.

2.12 IBM Workgroup Hubs at a Glance

This section provides at-a-glance details for each hub which have not necessarily been included in the preceding sections.

2.12.1 8222 Models 008 and 016

- **Physical Specifications**

  Width 225.7 mm (8.90 inches)

  Depth 168.7 mm (6.70 inches)

  Height 51.7 mm (2.0 inches)

  Weight 1.24 kg (2.8 lbs) - Model 008

  Weight 1.35 kg (3.0 lbs) - Model 016

- **Installation**
  - Tabletop
  - Wall mount
- **Power Selection**
  - Auto-ranging; 100 to 240 Volts, 50 or 60 Hertz
- **Cabling Types**
  - 10Base-T ports - 100-ohm UTP category 3, 4 or 5, 100- or 120-ohm FTP category 5, or 150-ohm IBM STP type 1, 6, 9, 1A, 6A, or 9A
  - AUI port - thick Ethernet cable (10Base5) or AUI transceiver
  - BNC port - standard thin coaxial cable (10Base2)
- **Connector Types**
  - 10Base-T ports - RJ-45; STP cables must use baluns to convert to RJ-45 connectors.
  - AUI port - DB-15 connector.
  - BNC port - BNC connector.
- **Shipping Group**
  - 8222 Ethernet Workgroup Hub
  - BNC T-connector
  - Power cord
  - Safety manual
  - Wall mount bracket
  - Warranty and support information
  - *8222 Nways Ethernet Workgroup Hubs Installation and Planning Guide*
- **Graphical Management Applications Available**
  - None. The 8222 Nways hubs are not manageable.

2.12.2 8224 Models 001 and 002

- **Physical Specifications**

  Width 432 mm (17.0 inches)

  Depth 292 mm (11.5 inches)

  Height 44.5 mm (1.75 inches)

  Weight 3.14 kg (6.90 lbs)

- **Installation**
  - Tabletop.
  - Rack mount. Do not attach rubber feet to 8224′s underside if you are planning to rack mount the hub, or it will exceed standard height.
- **Power Selection**
  - Auto-ranging; 100 to 240 Volts, 50 or 60 Hertz
- **Cabling Types**
  - 10Base-T ports - 100-ohm UTP category 3, 4 or 5, 100- or 120-ohm FTP category 5, or 150-ohm IBM STP type 1, 6, 9, 1A, 6A, or 9A
  - AUI port - thick Ethernet cable (10Base5) or AUI transceiver
  - BNC port - standard thin coaxial cable (10Base2)
  - FOIRL/10Base-FL port - 50/125µm, 62.5/125µm, or 100/140µm optical fiber cable
  - EIA 232 port - EIA 232 cable
- **Connector Types**
  - 10Base-T ports - RJ-45; STP cables must use baluns to convert to RJ-45 connectors.
  - AUI port - DB-15 connector.
  - BNC port - BNC connector.
  - Optical fiber - ST connector.
  - EIA 232 port - DB-9 connector.
- **Shipping Group**
  - 8224 Ethernet Stackable Hub
  - Power cord
  - Cable management bracket
  - Hub expansion cable
  - Self-adhesive rubber feet
  - *8224 Ethernet Stackable Hub Installation and User′s Guide*
- **Graphical Management Applications Available**
  - StackWatch for Windows
  - StackWatch for Novell NMS
  - 8224 Application for NetView for Windows
  - 8224 Application for NetView for AIX

2.12.3 8226 Model 001

- **Physical Specifications**

  Width 263 mm (10.4 inches)

  Depth 141 mm (5.5 inches)

  Height 54 mm (2.1 inches)

  Weight 0.975 kg (2.15 lbs)

- **Installation**
  - Tabletop
- **Power Selection**
  - Auto-sensing
- **Cabling Types**
  - Category 4 or 5 UTP or FTP and STP for both lobe and main ring paths
- **Connector Types**
  - RJ-45
- **Shipping Group**
  - 8226 Base Unit
  - *IBM 8226 Token-Ring RJ45 Connection Model 001 Planning and Installation Guide*
  - Safety manual
  - Two RJ-45 wrap plugs
- **Graphical Management Applications Available**
  - None. The 8226 is not a manageable hub.

2.12.4 8228 Model 001

- **Physical Specifications** (approx.)

  Width 46.9 mm (18.5 inches)

  Depth 17.3 mm (6.8 inches)

  Height 6.6 mm (2.6 inches)

- **Installation**
  - Wall mount (separate bracket required)
  - Rack mount
- **Power Selection**
  - Not applicable, the 8228 does not use power to operate.
- **Cabling Types**
  - STP Type 1, UTP category 3, 4, 5
- **Connector Types**
  - IBM Cabling System (ICS)
- **Shipping Group**
  - 8228 MAU

- Lobe port initialization tool
- Cable management bracket

- **Graphical Management Applications Available**
  - None. The 8228 is not a manageable hub.

2.12.5 8230 Models 001, 002, 003, and 013

- **Physical Specifications**
  - Base Unit - Model 001

    Width 483 mm (19.0 inches)

    Depth 362 mm (14.25 inches) front of unit to rear of unit (with wrap plug installed)

    Depth 330 mm (13.13 inches) front of mounting surface to rear of unit (with wrap plug installed)

    Height 133 mm (5.25 inches)

    Weight 6.8 kg (15 lbs)

  - Base Unit - Model 002

    Width 451 mm (17.75 inches)

    Depth 371 mm (12.1 inches)

    Height 133 mm (5.25 inches)

    Weight 9.6 kg (21.25 lbs)

  - Base Unit - Model 003, 013

    Width 483.0 mm (19.0 inches)

    Depth 362.0 mm (14.25inches)

    Height 133.0 mm (5.25 inches)

    Weight 9.07 kg (20.0 lbs)

  - Lobe Attachment Module (ICS)

    Width 483 mm (19.0 inches)

    Depth 190 mm (7.48 inches)

    Height 133 mm (5.23 inches)

    Weight 3.6 kg (7.9 lbs)

  - Lobe Attachment Module (RJ-45)

    Width 483 mm (19.0 inches)

    Depth 190 mm (7.48 inches)

    Height 89 mm (3.50 inches)

    Weight 3.2 kg (7.0 lbs)

  - 16/4 Unshielded Media LAM

    Width 451 mm (17.75 inches)

    Depth 305 mm (12.0 inches)

    Height 89 mm (3.50 inches)

Weight 5.8 kg (12.7 lbs)

- Lobe Attachment Module - Passive and Active Remote LAM

  Width 438.5 mm (17.25 inches)

  Depth 254.0 mm (10.0 inches)

  Height 66.0 mm (2.6 inches)

  Weight 3.85 kg (8.5 lbs)

- **Installation**
  - Tabletop
  - Rack mount
- **Power Selection**
  - 100 or 240 Volts, 50 or 60 Hertz, switch selectable
- **Cabling Types**
  - STP type 1
  - Category 3, 4, 5 balanced cables
  - Optical fiber
  - EIA 232 port - EIA 232 cable
- **Connector Types**
  - ICS (IBM Cabling System data connector)
  - RJ-45
  - Optical fiber: mini-BNC for 001/002, ST connector for 003/013
  - EIA 232 port - DB-25 female (Model 003/013 only)
- **Shipping Group**
  - Controlled Access Unit Base - Model 001, 002
    - Base unit
    - Labels
    - Service guide
    - Maintenance Facility on 3.5″ diskette
    - Maintenance Facility User′s Guide
    - Customer Setup (CSU) instructions
    - Wrap Plug
    - German RFI statement
    - Warranty information sheet
  - Controlled Access Unit Base - Model 003, 013
    - Base unit
    - Cable guides
    - CSU instructions
    - Service guide
    - Service Facility User′s Guide

        - Instructions German RFI sheet
        - Three diskettes:
          1. Service Facility
          2. Device Management for Windows (required NetView for Windows)
          3. Online publication for Device Management for Windows
        - Power cord
    – Lobe Attachment Module (ICS)
        - Base ICS LAM
        - CSU instructions
        - Four number labels
        - Two cable brackets
        - Warranty information sheet
    – Lobe Attachment Module (RJ-45)
        - RJ-45 Lobe Attachment Module
        - CSU instructions
        - Four number labels
        - Warranty statement
    – 16/4 Unshielded Media LAM
        - Lobe Attachment Module
        - CSU instructions
        - Four number labels
        - Warranty statement
- **Graphical Management Applications Available**
    – 8230 PSM for NetView for Windows
    – LAN Network Manager for OS/2
    – LAN Network Manager for AIX

2.12.6 8244 Models 006 and 012

- **Physical Specifications**

  Width 443.0 mm (17.4 inches)

  Depth 69.0 mm (2.70 inches)

  Height 232.0 mm (9.11 inches)

  Weight 6.3 kg (12.6 lbs) fully configured

- **Installation**
    – Tabletop - Ensure there is sufficient space around the unit for air to circulate.
    – Rack mount.
- **Power Selection**
    – Preset to 220V-50 Hertz. Can support 110 to 220 Volts, 50 or 60 Hertz.
- **Cabling Types**

- Copper ports - 150-ohm STP, 100-ohm UTP and FTP
- Fiber ports - 62.5µm multimode fiber
- EIA 232 port - EIA 232 cable

- **Connector Types**
  - Copper ports - DB-9 for STP, shielded RJ-45 for UTP
  - Fiber ports - MIC connector
  - Optical Bypass - Mini Din 6 plug
  - EIA 232 port - DB-15 connector
- **Shipping Group**
  - 8244 FDDI Workgroup Concentrator
  - Power cord (by country)
  - Side plates for 19-inch rack assembly
  - V.24 null modem interposer
  - Keying bag for fiber transceivers
  - Safety manual
  - System diskette with diagnostics and backup copy of the preloaded software
  - Diskette with Proxy Agent program
  - Diskette with 8244 customization program for NetView for AIX
  - *IBM 8244 FDDI Workgroup Concentrator User's Guide*
  - *IBM 8244 FDDI Workgroup Concentrator Maintenance Guide*
  - *IBM SNMP FDDI Proxy Agent User's Guide*
- **Graphical Management Applications Available**
  - LAN Network Manager for AIX

2.12.7 8282 Model 001

- **Physical Specifications**

  Width 483 mm (19 inches)

  Depth 508 mm (20 inches)

  Height 133 mm (5.25 inches)

  Weight 13 kg (30 lbs)

- **Installation**
  - Tabletop
  - Rack mount
- **Power Selection**
  - 100 to 250 Volts (auto-sensing)
- **Cabling Types**
  - ATM ports - 100-ohm UTP category 3, 4, or 5, and 150-ohm STP Types 1, 1A, 9, and 9A
  - ATM switch - 62.5µm multimode fiber

  - EIA 232 port - EIA 232 cable
- **Connector Types**
  - ATM ports - RJ-45 connectors
  - ATM switch - SC connector
  - EIA 232 port - DB-25 connector
- **Shipping Group**
  - ATM Workgroup Concentrator Base Unit
  - Mounting brackets
  - Cable management bracket
  - Power Cord
  - 8282 Configuration and Management Utility diskette
  - 8282 microcode diskette
  - *IBM Turboways 8282 Concentrator Installation and Service Manual*
  - *IBM Turboways 8282 Concentrator Reference Information*
  - *IBM Turboways 8282 Concentrator Introduction and Planning Guide*
- **Graphical Management Applications Available**
  - Configuration and Management Utility (Windows)

Chapter 3. Switches

This chapter discusses the functions and features of the latest series of IBM switches. Please consult the installation and planning manuals for each of these devices for further information.

3.1 IBM 8271 EtherStreamer Switch

The 8271 EtherStreamer Switch provides the ability to forward Ethernet frames among up to eight shared Ethernet LAN segments via Ethernet 10Base-T or attachment unit interface (AUI) connections. Similar in function to a multiport Ethernet transparent bridge, the 8271 EtherStreamer Switch forwards Ethernet frames from one of the eight ports to another based on Ethernet MAC addresses. The 8271 is able to forward Ethernet frames at media speeds. With a highly parallel internal design optimized for performance, the 8271 is able to maintain media-speed frame transfer between each of the possible four distinct pairs of ports simultaneously. This feature allows the 8271 to provide an aggregate bandwidth of up to 40 Mbps.

Networks with traffic patterns able to take full advantage of the 8271 could sustain throughput equivalent to four 10 Mbps Ethernet. Additionally, the 8271 uses a switching technique sometimes referred to as *on-the-fly* switching, which provides for extremely low latency or delay (less than 50 microseconds), as frames traverse the switch. Figure 97 shows the 8271 model 108.

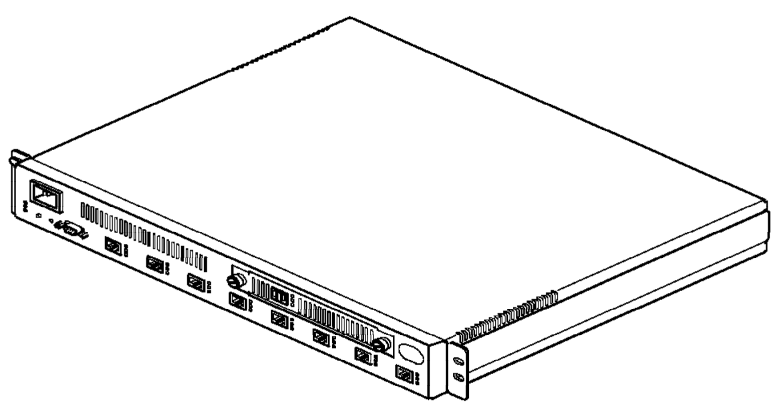


Figure 97. IBM 8271 Model 108

The operation of the 8271 is very similar to the operation of a transparent bridge.

Like a bridge, the 8271 has filter/forward tables. Each 8271 is able to support 6000 MAC addresses. This is the limit of the master address table. Each port can support up to 1700 addresses.

The 8271 can be mounted in a standard 19 inch rack or to a wall or similar surface. The 8271 can also be placed on a flat surface such as a desk or tabletop.

The 8271 has the following categories of LEDs:

- Status LEDs
- Individual port LEDs

The status LEDs indicate the activity of the switch, whereas the port LEDs indicate the activity at each individual port.

You can see a brief description of each LED in Table 21.

Table 21. 8271 Status LEDs

Status LEDs	Color (lit)	Meaning
I (Power)	Green	Indicates whether or not the 8271 is receiving DC power.
OK	Green	Indicates whether or not the switch is working correctly.
Unlabeled (Fault)	Amber	Indicates whether or not the switch performed diagnostics correctly.

Table 22. 8271 Port LEDs

Port LEDs	Color (lit)	Meaning
Link	Green	Indicates whether or not the port is receiving link pulses from an attached device.
Rcv	Green	Indicates whether or not the port is receiving data.
Xmit	Green	Indicates whether or not the port is transmitting data.

3.1.1 Full-Duplex Ethernet

In addition to those features that make the 8271 a cost-effective, high-performance alternative LAN interconnection solution, the 8271 EtherStreamer Switch provides another feature that is unique to the 8271: full-duplex Ethernet.

As users segment their LAN populations to relieve network congestion, they often extend this segmentation to a point where they have placed a single station on a dedicated LAN segment, such as a high-traffic file server. This may reveal congestion of another sort, congestion at the network access point or adapter within the server. To increase the bandwidth available to the server, dedicated LAN segments connected to any or all of the 8271′s eight ports can be configured to operate in full-duplex mode. Full-duplex Ethernet, an emerging extension to the existing IEEE 802.3 standard, provides for simultaneous, two-way transmission between the 8271 and the server.

Full-duplex Ethernet provides two independent data paths between the 8271 and the LAN station on the dedicated LAN segment, each with a bandwidth of 10 Mbps, for a total of 20 Mbps per full-duplex Ethernet switch port. In fact, these independent, parallel, full-duplex paths are extended throughout the internal design of the 8271 so that each of the two 10 Mbps paths that are part of a full-duplex Ethernet connection can be switched to different half-duplex ports on the 8271, or can be switched to half-duplex halves of other full-duplex Ethernet connections on the 8271. When all of the ports on the 8271 are configured for full-duplex operation, the 8271 could achieve an aggregate bandwidth of up to 80

Mbps, performance not often found in products in this price range. Each port on the 8271 is configured for full-duplex Ethernet operation via switches on the front panel of the 8271.

Note:

Full-duplex communication is available between the 8271 and dedicated media LAN segments only (single workstation).

Full-duplex Ethernet requires a full-duplex capable Ethernet adapter, such as the IBM EtherStreamer MC 32 Adapter. While existing servers may not be currently equipped with adapters capable of full-duplex Ethernet, upgrading to adapters capable of full-duplex Ethernet may be the most cost-effective way to double network access bandwidth, given server slot constraints and the re-usability of non full-duplex adapters elsewhere in the user′s network.

3.1.2 Compatibility

The 8271 EtherStreamer Switch is compatible with and can forward frames between existing Ethernet 10 Mbps LAN segments, whether the segments consist of IBM or non-IBM machines, whether the machines contain IBM or non-IBM Ethernet adapters, and whether the Ethernet LAN segment is formed using IBM or non-IBM concentrators, as long as these network components conform to the specifications listed in the IEEE 802.3 standard. The IBM 8271 is compatible with all current IBM Ethernet adapters and concentrators, including the following:

- IBM LAN Adapter for Ethernet
- IBM LAN Adapter/A for Ethernet
- IBM LAN Adapter for Ethernet TP
- IBM LAN Adapter for Ethernet CX
- IBM EtherStreamer MC 32 Adapter
- IBM 8222 10Base-T Workgroup Hub
- IBM 8224 Ethernet Stackable Hub
- IBM 8250 Multiprotocol Intelligent Hub
- IBM 8260 Multiprotocol Intelligent Switching Hub
- RISC System/6000 Ethernet High-Performance LAN Adapter

3.1.3 IBM EtherStreamer Switch Release 1.1 Microcode

Release 1.1 of the IBM EtherStreamer Switch microcode is available at no additional charge to existing IBM EtherStreamer Switch customers.

The IBM EtherStreamer Switch is being improved with a number of significant functions that enhance customers′ ability to manage the traffic that flows through their IBM EtherStreamer Switches, extend their flexibility in constructing switched local area networks, and make it easier to remotely manage their IBM EtherStreamer Switches from a central location. These new functions are included in Release 1.1 of the IBM EtherStreamer Switch microcode.

- **Address Filters**

  Often, for either security or traffic load management reasons, it may be desirable to control the traffic that flows through the IBM EtherStreamer Switch.

  Address filtering on the IBM EtherStreamer Switch provides the ability to filter or inhibit frame flow at port of entry. The IBM EtherStreamer Switch can be configured with a filter table consisting of LAN (MAC) addresses and a related switch port number. Ethernet frames destined for any of the specified addresses sent from any station on the associated switch port will not be forwarded to any other switch port. These addresses may be unicast, multicast, or broadcast addresses.

- **Virtual Switch Support**

  It may sometimes be desirable to construct a switch network of less than eight ports. That is, again for security or traffic load management reasons, it may be desirable to group switch ports so that no traffic (including broadcasts) flows between the ports within the group and any other switch ports outside the group. This capability may sometimes be referred to as broadcast domains.

  Virtual switch support on the IBM EtherStreamer Switch allows a single physical switch to be divided into two to four virtual switches, each consisting of a non-overlapping set of two to four switch ports.

  In Figure 98 you can see the switch logically divided in two switches.

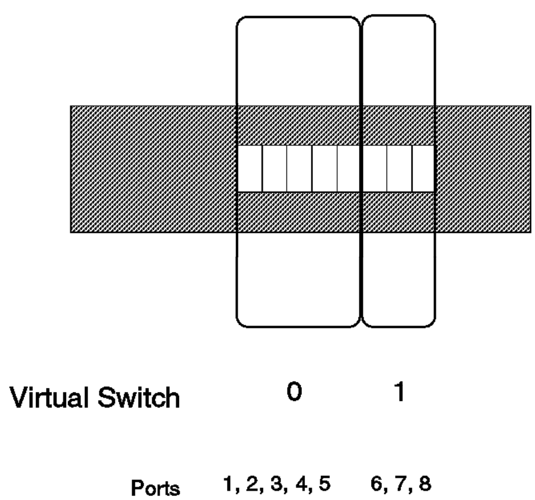


Figure 98. Example of Virtual Switch Configuration

- **EtherPipe Support**

  To construct switch networks consisting of more than eight LAN segments, users of the IBM EtherStreamer Switches with Release 1.0 of the microcode may interconnect two IBM EtherStreamer Switches by connecting a single port on one switch to a single port on the other, for a maximum bandwidth of 20 Mbps between the switches. With EtherPipe support in Release 1.1 of the microcode, this interconnection capability is expanded so two IBM EtherStreamer Switches can be interconnected using up to four links in parallel. Each of these inter-switch links is a full-duplex Ethernet connection that provides up to 20 Mbps of bandwidth between switches, or a maximum of 80 Mbps of bandwidth (using four lines) between switches. With Multilink EtherPipes, traffic is automatically distributed on each of these links using destination address so that traffic load can be more evenly balanced across each of the parallel links between the switches in a manner consistent with any spanning tree features configured at the time. EtherPipe support provides the ability to grow and tune the bandwidth required between IBM EtherStreamer Switches.

In Figure 99 you can see a connection between two switches using EtherPipe.

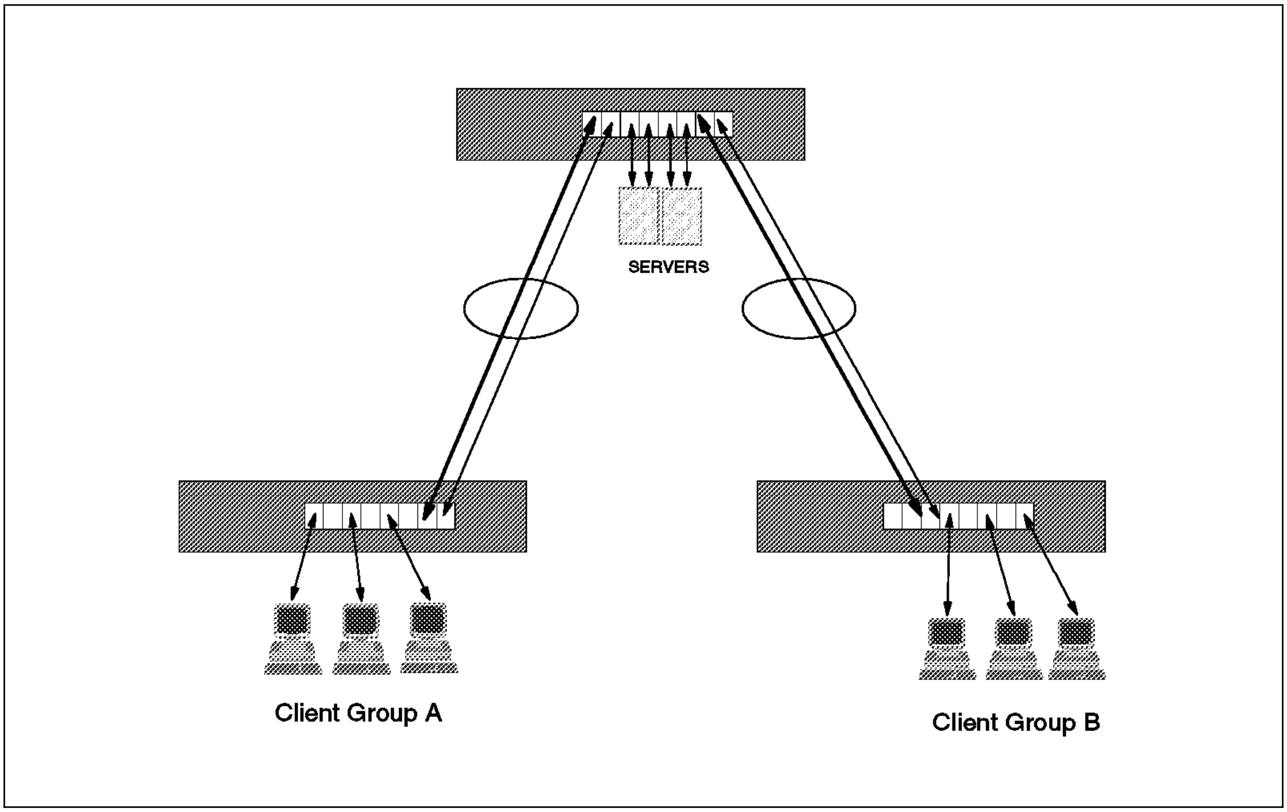


Figure 99. 8271 Connection Using EtherPipe

- **BOOTP/TFTP Support**

  BOOTP/TFTP support enhances customers′ ability to remotely manage their IBM EtherStreamer Switches from a central location. By installing a central BOOTP server, BOOTP-compliant SNMP devices, such as the IBM EtherStreamer Switch, can be downloaded with their IP addresses. This allows IBM EtherStreamer Switches to be more easily installed, eliminating the need to individually configure each IBM EtherStreamer Switch via the console attached to the serial port on the switch. Additionally, BOOTP servers can designate (by IP address) the trivial file transfer protocol (TFTP) server that contains an image of the IBM EtherStreamer Switch microcode. Via either the serial console or via an SNMP management console, users may request a download of the IBM EtherStreamer Switch microcode from this server. This allows new releases (for example, containing service modifications) to be easily distributed to a network of geographically dispersed switches. IBM EtherStreamer Switches with Release 1.0 of the microcode only support microcode download via the serial port.

  You can see in Figure 100 on page 210 how the 8271 establishes communication with the BOOTP server.

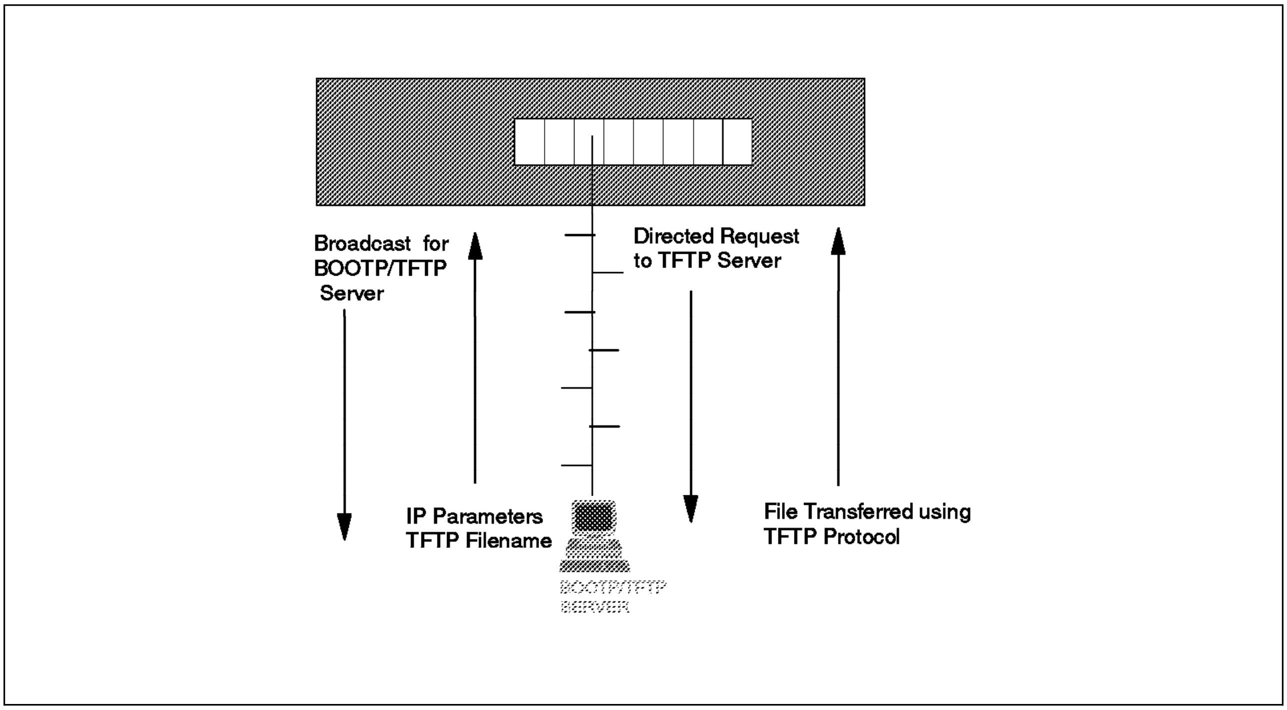


Figure 100. Communication between the BOOTP Server and the 8271

- **Universal Feature Slot**

  The IBM 8271 Model 108′s most significant enhancement over the Model 001 is its universal feature slot. It supports several different optional universal feature cards that provide additional connections to augment the eight 10Base-T Ethernet ports standard in the base product. Some of these universal feature cards are the following:

  – One-Port 155 Mbps ATM

    These optional connections will provide the capability to connect the workgroup LAN switches to an ATM switch, such as an IBM 8260 Multiprotocol Intelligent Switching Hub with its 2-Port ATM Concentrator Module, using a 155 Mbps SONET interface that is fully ATM Forum-compliant. With these optional features, token-ring or Ethernet LAN switches can be connected to an ATM switch using multimode fiber cabling at distances up to two kilometers.

    The ATM uplink supports ATM Forum-compliant LAN emulation.

  – One-port 100Base-T Ethernet

    This feature card provides one 100Base-T Ethernet port for connection to a 100Base-T backbone segment via an external 100Base-T Ethernet repeater/hub or for connection directly to a LAN station equipped with a 100Base-T Ethernet adapter.

  – Multiport 10Base-T Ethernet

    This card is for customers that require more than the eight 10Base-T ports that are available with the base product, but want to use the IBM 8271 EtherStreamer Switch Model 108 in a small to medium size network that does not contain a backbone network.

  – Multiport 10Base-FL Ethernet

This card will provide you multiple 10Base-FL Ethernet ports, with the capability to connect Ethernet segments to the IBM 8271 Model 108 up to two kilometers away. You will be able to interconnect and switch LAN segments that are physically distant from the IBM 8271 Model 108.

– Multiport 100VG Ethernet

  This card will provide multiple 100VG Ethernet ports for connection to 100VG segments or stations.

– 100Base-TX Card

  The 100Base-TX Card provides one 100Base-TX MMIDI-X port with a RJ-45 connector suitable for connection to either a shared 100-Mbps Ethernet segment via a compatible 100-Mbps repeater or a dedicated connection directly to a compatible 100-Mbps Ethernet adapter, such as the IBM 100/10 PCI Ethernet Adapter.

– 4-Port 10Base-T Card

  The 4-Port 10Base-T card provides four 10Base-T MDI-X ports with RJ-45 connectors. It expands the port capacity of the model 108 from 8 to 12. Any of these four ports can be configured similarly to any of the eight fixed 10Base-T ports to provide either shared (half-duplex), 10 Mbps Ethernet connections or dedicated (full-duplex), 20 Mbps connections.

– 3-Port 10Base-FL Card

  The 3-Port 10Base-FL Card provides three 10Base-FL multimode fiber connections via ST connectors. It expands the port capacity of the 8271 from 8 to 11. Any of these three ports can be configured similarly to any of the eight fixed 10Base-T ports to provide either shared (half-duplex), 10 Mbps Ethernet connections or dedicated (full-duplex), 20 Mbps connections at distances up to 2 kilometers.

• **Adaptive Cut-Through**

  In cut-through switching, the switching process begins as soon as the address fields are decoded. This is contrasted with store and forward switching, where the entire packet is received and stored before switching begins.

  8271 cut-through switching has very low latencies (50 milliseconds or less), but can propagate error frames because it starts switching before frame validity is assured. Adaptive-cut-through switching combines cut-through and store-and-forward techniques. The 8271 uses cut-through switching as long as the number of error frames is acceptable, and automatically converts to store-and-forward when error rates are not acceptable.

  The 8271 Model 108 may be configured to operate in either:

  – Cut-through

  – Store-and-forward or

  – Adaptive cut-through mode

• **EtherProbe**

  Another new feature of the IBM 8271 EtherStreamer Switch Model 108 is the EtherProbe network monitoring port that can be used to tune and trouble shoot any of the segments attached to the 8271 Model 108. The EtherProbe port is a separate (additional to the eight used for shared or dedicated Ethernet segments) AUI port on the front of the 8271 Model 108 that can be configured to monitor or "mirror" the activity on any one (at a time) of the eight shared or dedicated segments. This configuration can be changed dynamically via the console or SNMP facilities of the 8271 Model 108. To monitor a full-duplex Ethernet port, the EtherProbe port can be configured to monitor either the transmit or the receive half of the full-duplex Ethernet connection. Using the EtherProbe port, traffic on any of the eight ports on the 8271 Model 108 can be analyzed using a single monitoring device, eliminating the need for an analyzer on every 8271 segment, thereby reducing hardware and overall operating costs. The EtherProbe port on the 8271 Model 108 was designed to be used with a variety of available protocol analyzers such as the IBM DatagLANce Network Analyzer.

The 8271 EtherStreamer Switch Model 108 includes several other enhancements to the IBM 8271 Model 001:

- Significant restructuring of the console interface to improve organization and navigation, as well as to provide additional functions.
- Ability to collect management statistics on a station basis, in addition to the port and switch basis available with the Model 001.
- Ability to specify unique address table aging parameters for each switch port in addition to the global aging parameters used in the Model 001.
- SNMP management of the IBM 8271 Model 108 is supported using IEEE 802.3 frames in addition to Ethernet Version 2 frames (as was required on the Model 001).
- Full-duplex operation can be set remotely (was front panel only).
- The configuration can be made remotely using BOOTP/Telnet.

The 8271 now supports BOOTP/TFTP for remote loading in RFC 951-compliant environments.

3.2 IBM 8272 LANStreamer Switch

The 8272 switch provides the ability to forward token-ring frames among up to eight shared token-ring segments via token-ring twisted pair (UTP/STP) media using RJ-45 connectors. Similar in function to a multiport bridge, the 8272 forwards token-ring frames from one of the eight ports to another and it is able to forward token-ring frames at media speeds. With a highly parallel internal design optimized for performance, the 8272 is able to maintain media speed frame transfer between each of the possible four distinct pairs of ports simultaneously. This feature allows the 8272 to provide an aggregate bandwidth of up to 64 Mbps, switching among eight half-duplex ports. Networks with traffic patterns able to take full advantage of the 8272 could sustain throughput equivalent to four 16 Mbps token-rings. Figure 101 on page 213 shows the IBM 8272 LANStreamer Switch.

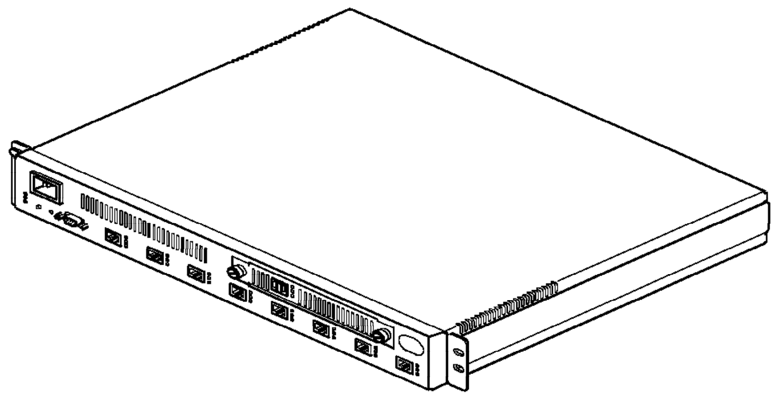


Figure 101. IBM 8272 LANStreamer Switch

The 8272 can be mounted in a standard 19-inch rack or similar surface. The 8272 can also be placed on a flat surface such as a desk or tabletop.

The 8272 provides the following functions:

- **Adaptive Cut-Through**

  The IBM 8272 LANStreamer Switch Model 108 can be configured to operate in cut-through mode that uses a switching technique referred to as "on-the-fly" switching. This provides for extremely low latency or delay as frames traverse the switch. While token-ring networks are generally very reliable, the 8272 may still be used in networks where it may be desirable, at the expense of latency, to operate in what is called "store-and-forward" mode.

  In this mode, by completely checking every frame before forwarding, customers can use the switch to isolate erroneous frames generated on one segment from traversing the switch into another. To address the requirements of these customers, the 8272 may be configured to operate in either cut-through or store and forward modes, or to operate in adaptive cut-through mode where the 8272 will automatically alternate between cut-through and store-forward switching, depending on the user-configurable per port error rate thresholds.

- **TokenPipe**

  Configurations larger than eight token-ring LAN segments can be constructed using the 8272 by connecting 8272 ports together. This capability, called TokenPipe support, allows two IBM 8272s to communicate by connecting together up to four (user-configurable) full-duplex token-ring ports on one 8272 to those on the other.

  Each of these full-duplex token-ring interswitch links provides up to 32 Mbps of bandwidth between the switches, for a maximum of 128 Mbps of bandwidth (using four links) between switches. With multilink TokenPipes, traffic is automatically distributed across the links within a TokenPipe using destination addresses so that traffic load can be more evenly balanced across each of the parallel links between switches. TokenPipe support provides the user with the ability to grow and tune the bandwidth required between 8272s.

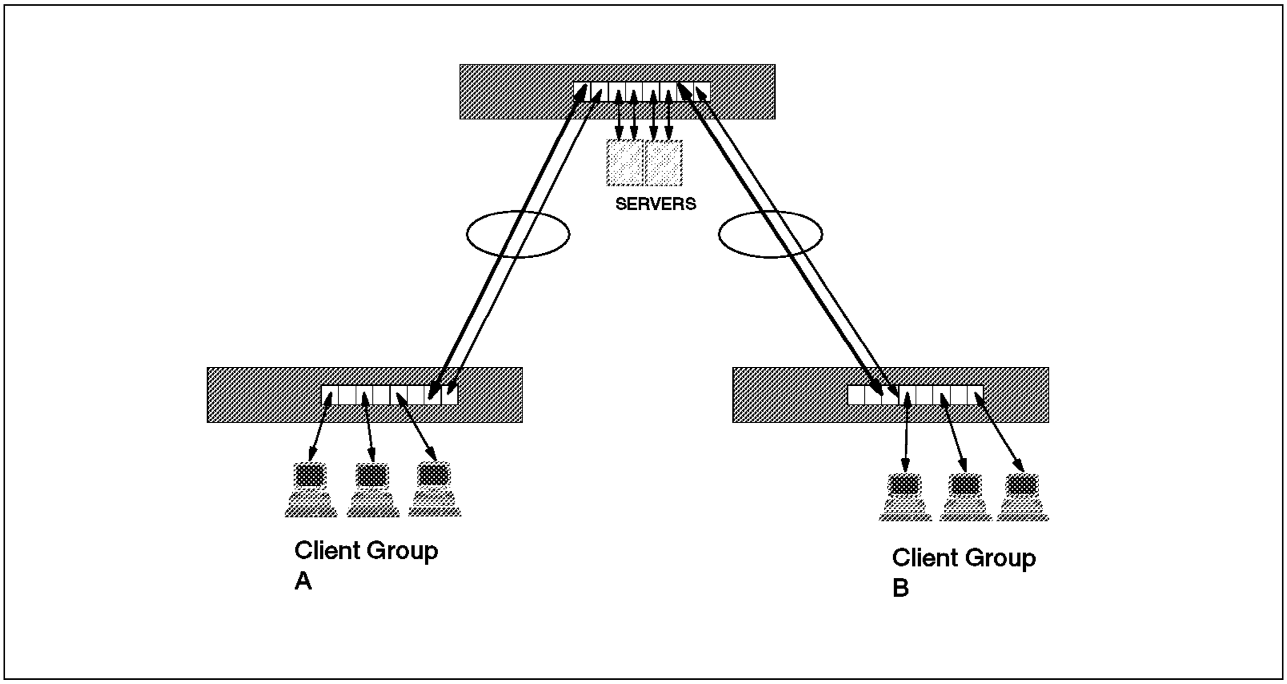


Figure 102. 8272 Example Using TokenPipe

- **Virtual Switch Support**

  It may sometimes be desirable to construct a switch network of less than eight ports. That is, for security or traffic load management reasons, it may be desirable to group ports on a single 8272 so that no traffic (including broadcasts) flows between the ports within one group and any of the switch ports outside the group. This virtual switch capability on the 8272 LANStreamer Switch model 108 allows a single physical 8272 to be divided into two to four virtual switches, each consisting of a nonoverlapping set of two to four switch ports.

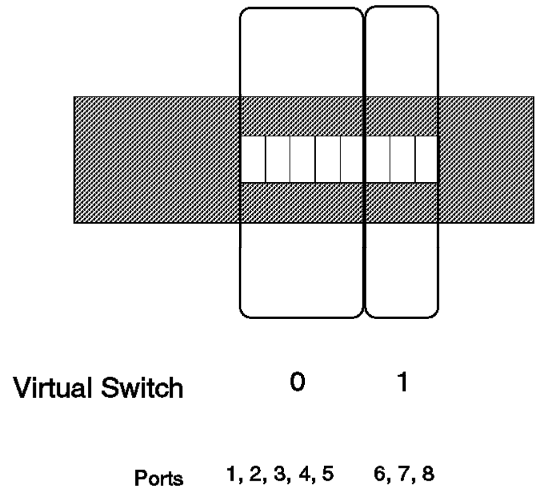


Figure 103. Switch Divided in Two Using TokenPipe

- **Universal Feature Slot**

  The 8272 LANStreamer Switch Model 108 includes one universal feature slot, into which a variety of optional, field-installable, universal feature cards can be inserted to provide additional connections (in addition to the eight token-ring ports standard on the base product).

  Some of the universal feature cards are listed next:

  – One-Port 155 Mbps ATM

    This optional connection provides the capability to connect workgroup LAN switches to an ATM switch, such as an IBM 8260 Multiprotocol Intelligent Switching Hub with its 2-Port ATM Concentrator module, using a 155 Mbps SONET interface that is fully ATM Forum-compliant. With these optional features, token-ring or Ethernet LAN switches can be connected to an ATM switch using multimode fiber cabling at distances up to two kilometers.

    This card fully supports ATM Forum-compliant LAN emulation.

  – Multiport Token-Ring Twisted Pair (UTP/STP)

    For customers that require more than the eight ports that are available with the base 8272 LANStreamer Switch Model 108 product, but want to use the 8272 Model 108 in small or medium size networks that may not have a high-speed backbone, this card for the 8272 will provide multiple additional twisted pair (UTP/STP) ports with RJ-45 connectors.

  – Multiport Token-Ring Fiber

    With this card you can provide multiple connections to an optical fiber ring path. This will allow connections to token-ring segments up to two kilometers away and be able to interconnect and switch LAN segments that are physically distant from the 8272.

  – Multiport 100VG Token-Ring

    This card provides multiple 100VG token-ring ports for connection to 100VG segments or stations.

– 4-Port Token-Ring UTP/STP Card

  The 4-port card provides four token-ring ports that supports token-ring twisted-pair (UTP/STP) media via RJ-45 connectors. It effectively expands the port capacity of the 8272 from 8 to 12. Any of these four ports can be configured similary to any of the eight fixed token-ring ports to provide either shared (half-duplex) 4 or 16 Mbps token-ring connections or dedicated (full-duplex) 32 Mbps connections.

– 2-Port Token-Ring Fiber Card

  The 2-Port Token-Ring Fiber Card provides two token-ring multimode fiber connections via ST connectors. Similar in capability to the 8272′s token-ring UTP/STP ports, each port on this card are switch ports that can each be connected to either a shared token-ring segment via a fiber ring-in (RI) or ring-out (RO) port on a token-ring concentrator or hub that forms the segment, or a token-ring fiber port on another 8272.

- **Source-Route Switching**

  The IBM 8272 LANStreamer Switch Model 108 is a source-routing switch. This technology is optimized to take advantage of the inherent benefits of source routing without forcing the user to manually configure ring and bridge numbers for each and every port on the token-ring switch.

  The 8272 Model 108 functions similar to a multiport bridge, forwarding frames among its eight ports. Like a multiport source-routing bridge, the 8272 can forward frames based on the token-ring routing information field (RIF), thus allowing redundant active paths in the network, as well as duplicate addresses. A key advantage of being a source-routing switch is that all ports appear to be on the same logical ring. The 8272 forwards frames based on destination MAC address, for locally attached stations (those part of token-ring segments directly attached to the 8272), and based on the routing information field within the token-ring frame, for nonlocally attached stations. With all of the ports on the 8272 having the same ring number, duplicate addresses cannot be connected directly to adjacent ports. However, duplicate addresses and redundant paths can easily be supported by use of external source-routing bridges for each redundant path. Since a source-routing switch does not require any ring and bridge numbering, the 8272 substantially reduces the configuration burden on the network administrator, for both initial setup as well as to support ongoing network changes. In fact, the 8272 is ″self configuring″. An additional benefit of the absence of unique bridge and ring numbers, is that the network span of configurations consisting of source-routing switches like the 8272 is not architecturally limited in any way (as is the case with source-routing bridges) to a maximum of seven bridge hops.

  The 8272 LANStreamer Switch Model 108 also supports a transparent spanning tree implementation that is fully compliant with IEEE 802.1d, allowing the 8272 to effectively participate in complex configurations. This provides the capability of having several 8272s interconnected with redundant paths without having to administer source-routing bridge and ring numbers.

- **Auto-Sense/Auto-Configure**

  The 8272 Model 108 also provides several additional usability features that contribute to reducing customers′ costs of installing, operating, and generally owning their switched token-ring networks. With its adaptive cut-through capabilities (described earlier), the 8272 can be self-healing and self-optimizing when media quality problems arise, affecting overall network reliability and performance. Additionally, the 8272 will automatically sense what type of token-ring connection is being employed on each of its ports, whether they be a connection:

- To a shared media segment via a token-ring concentrator
- To a dedicated media segment, directly to a token-ring LAN station
- Operating in half-duplex or full-duplex mode
- Operating at 4 Mbps or at 16 Mbps
- To another IBM 8272

It will automatically configure (requiring no operator action) each port to operate at the highest level of capability possible. No special crossover cables are required for token-ring stations on dedicated media segments or for switch-to-switch connections. These connections can use the same cabling as can be used to connect the IBM 8272 port to shared media segments. This auto-sense/auto-configure capability of the 8272 can be overridden by explicit configuration.

The auto-sense/auto-configure capability minimizes the network administrative burden associated with both initial installation and ongoing network changes and helps assure that customers can easily get optimal use of their network without always having to manage the large number of configuration variables.

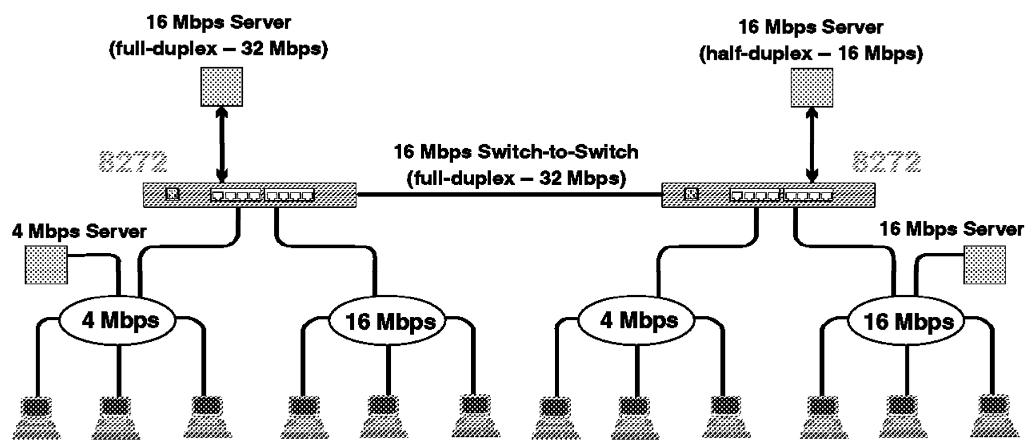


Figure 104. 8272 Auto-Configuration Example

- **Full-Duplex Token-Ring**

  As users segment their LAN populations to relieve network congestion, they often extend this segmentation to a point where they have placed a single station on a dedicated LAN segment, such as a high-traffic file server. This may produce congestion of another sort, congestion at the network access point or adapter within the server. To increase the network bandwidth available to the server, dedicated LAN segments connected to any or all of the IBM 8272′s eight ports can be configured to operate in full-duplex mode. Full-duplex token-ring, an emerging extension to the existing IEEE 802.5 standard, provides for simultaneous, two-way transmission between the IBM 8272 and the server. Full-duplex token-ring provides two independent data paths between the IBM 8272 and the LAN station on the dedicated LAN segment, each with a bandwidth of 16 Mbps, for a total of 32 Mbps per full-duplex token-ring switch port. In fact, these independent, parallel, full-duplex paths are extended throughout the internal design of the IBM 8272 so that each of the two 16 Mbps paths that are part of a full-duplex token-ring connection can be switched to different half-duplex ports on the IBM 8272, or can be switched to half-duplex halves of other full-duplex token-ring connections on the 8272. When all of the ports on the 8272 are configured for full-duplex operation, the 8272 may provide an aggregate bandwidth of up to 128 Mbps, performance not often found in products in this price range. Each port on the 8272 is configured for full-duplex token-ring operation via the console or SNMP management facilities.

Full-duplex token-ring LAN stations are directly connected to the IBM 8272 without the need for an intervening concentrator using a common token-ring cable.

Full-duplex token-ring requires a full-duplex capable token-ring adapter such as the IBM Auto LANStreamer MC 32 Adapter, IBM Dual LANStreamer MC 32 Adapter, or the IBM Auto LANStreamer PCI Adapter. While existing servers may not be currently equipped with adapters capable of full-duplex token-ring, upgrading to adapters capable of full-duplex token-ring may be the most cost-effective way to double network access bandwidth, given server slot constraints and the re-usability of non full-duplex adapters elsewhere in the user′s network.

The IBM LANStreamer Switch:

- Provide a cost-effective alternative for addressing customers′ requirements for interconnecting token-ring LAN segments and for improving the performance of token-ring networks.
- Transport token-ring frames among up to eight token-ring LAN segments, each connected to either a shared or dedicated LAN segment. Bandwidth to the single LAN station on a dedicated LAN segment can be doubled from the usual 16 Mbps to up to 32 Mbps by using the full-duplex capabilities of the IBM LANStreamer Switch and full-duplex token-ring adapters. These includes the IBM Auto LANStreamer MC32 Adapter or the IBM Dual LANStreamer MC32 Adapter.
- Include an SNMP agent that will allow the IBM LANStreamer Switch to be managed from a central SNMP management station. A separate network management application that provides an easy-to-use graphical interface will also be provided for the IBM LANStreamer Switch.

3.2.1 Compatibility

The 8272 LANStreamer Switch is compatible with and can forward frames between existing 4 or 16 Mbps token-ring LAN segments, whether the segments consist of IBM or non-IBM machines, whether the machines contain IBM or non-IBM token-ring adapters, and whether the token-ring LAN segment is formed using IBM or non-IBM concentrators, as long as these network components conform to the specifications listed in the IEEE 802.5 standard. The 8272 is compatible with all current IBM token-ring adapters and concentrators, including:

- IBM LANStreamer MC 16 Adapter
- IBM 16/4 Bus Master EISA Adapter
- IBM Auto 16/4 Token-Ring ISA Adapter
- IBM Auto LANStreamer MC 32 Adapter

- IBM Dual LANStreamer MC 32 Adapter
- IBM Auto LANStreamer PCI Adapter
- IBM 8226 Token-Ring RJ45 Connection Multistation Access Unit
- IBM 8228 Token-Ring Network Multistation Access Unit
- IBM 8230 Token-Ring Network Controlled Access Unit
- IBM 8250 Multiprotocol Intelligent Hub
- IBM 8260 Multiprotocol Intelligent Switching Hub

3.2.2 Full-Duplex Token-Ring Operation

The following section discusses the operation of a full-duplex token-ring.

In September 1993, IBM introduced the concept of dedicated half-duplex and full-duplex token-ring to the IEEE 802.5. More detailed proposals followed in November 1993 and January 1994 meetings. In March 1994 formal standardization work began.

The token-ring MAC protocol is usually executed within a token-ring adapter. When operating in standard token-ring mode, an adapter normally transmits a frame or receives a frame, but not both simultaneously. Figure 105 shows the normal mode of operation of a token-ring adapter. The figure shows the repeat path for all frames, whether received or not, within an adapter. The repeat path is required in half-duplex token-ring operation to allow each transmitted frame to circulate around the entire ring.

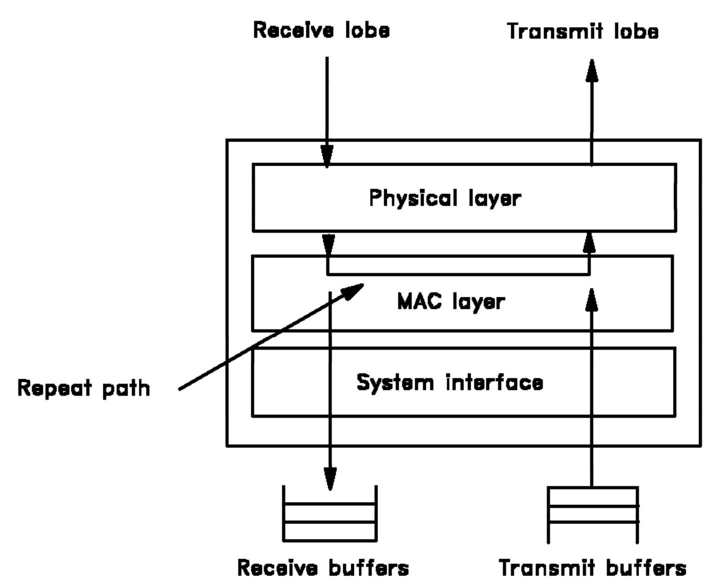


Figure 105. Normal Operation of a Token-Ring Adapter

If the repeat path is removed and other changes made subsequently, a token-ring adapter can transmit a frame on the outgoing link while also receiving a frame on the inbound link; see Figure 106 on page 220. This is full-duplex operation. In this full-duplex mode, frames are transmitted on the outgoing link immediately upon being queued for transmission at the MAC interface.

Depending upon the capabilities of the adapter, its station, and the switch to which it is attached, sustained transmit rates of 16 Mbps are possible.

Even more significantly, the adapter can also simultaneously receive frames at the 16 Mbps rate on the receive link, for an aggregate capacity of 32 Mbps. Typically, LAN applications (for example, client/server) will generate traffic in bursts rather than in continuous streams. Thus, the achievable data rate of an aggregate 32 Mbps will be required in bursts, rather than in a continuous mode of operation.

Note:

In order to run full-duplex token-ring you need to use an adapter that supports full-duplex such as the IBM LANStreamer Adapter family. The PC running full-duplex must be the only device on the segment.

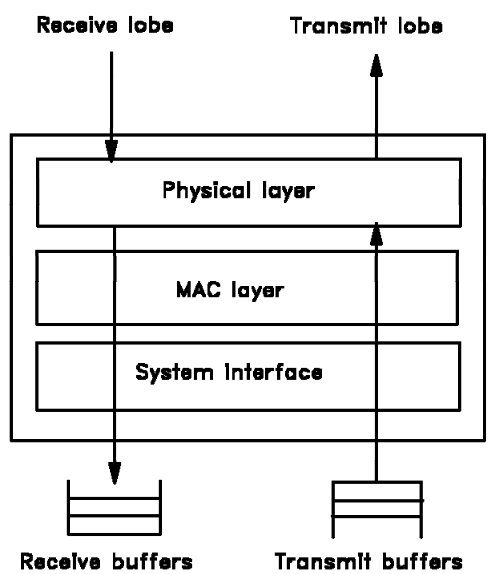


Figure 106. Full-Duplex Operation of a Token-Ring Adapter

In full-duplex mode, a station does not employ token protocols, including:

- Token access and token recovery protocols
- Frame repeating, frame stripping, and end-of-frame status update

A key aspect of full-duplex operation is that the token-ring frame format is preserved without change. The frame control field, priority bits, destination and source address fields, and source routing sub-fields are all maintained. Thus, existing IEEE 802.5 end-user applications, software and network infrastructure (for example, bridges) are preserved making the full-duplex mode of operation transparent to the user.

A single token-ring adapter may support both normal (half-duplex mode), token-ring, and full-duplex operation. There are two logical connectivity options that an adapter should satisfy:

1. Activate in full-duplex mode when attached to a compatible full-duplex switch port.

2. Otherwise, activate in token-ring mode when attached to a standard token-ring access unit or switch port that does not support full-duplex operation.

A station cannot physically determine whether it is attached to a half-duplex token-ring concentrator or to a full-duplex switch. This determination must be accomplished via a logical protocol during the activation procedure. Figure 107 shows one example activation sequence for an adapter to a switch or concentrator port. In state S2 the normal token-ring insertion procedure of internal diagnostics and lobe media test is executed. State S3 advertises (for example, via a MAC frame) the capability of the adapter to operate in full-duplex mode. If the port is capable of full-duplex operation, transition is made to state S6 (full-duplex operation); otherwise transition is made to state S5 (normal token-ring operation).

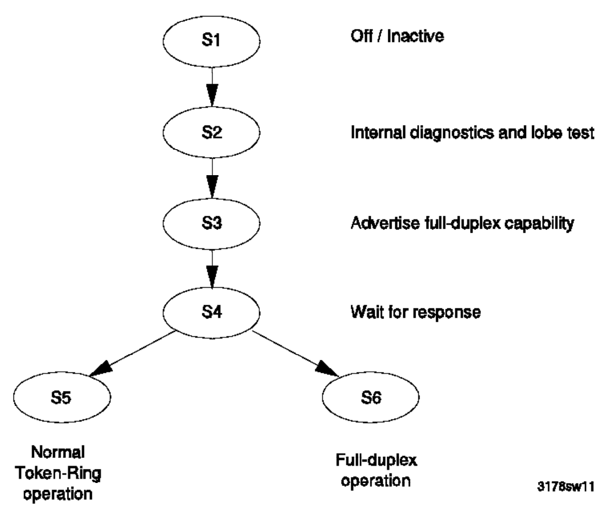


Figure 107. Example Activation Sequence

Following activation for full-duplex mode of operation, the token access protocols can be suspended, while other functions, such as those used to detect and report errors, continue to be active. When in full-duplex mode, each station or switch port must transmit using the local crystal within that station since there is no longer an active monitor providing clocking. The existing differential Manchester encoding scheme is maintained.

Stations will receive incoming signals via the acquired clock of the incoming link. When there are no frames to transmit, a station will transmit (and expect to receive) a continuous idle stream (for example, all zeros). This idle stream provides a continuous signal to the receiving port for clock synchronization and serves as a means of detecting and/or reporting a link failure or disconnection.

All frames can be transmitted immediately upon proper setup to the MAC interface without having to wait for token access. A maximum frame length of 4500 bytes is recommended for full-duplex operation, primarily to both reduce buffer requirements in the LAN switch and end-to-end frame transit delays due to blocking or store-and-forward queueing delays. A station may maintain multiple transmit queues in order to prioritize local access to the full-duplex link. However, first-in first-out frame order within a given priority must be maintained within a station or LAN switch. The low-order three bits of the token-ring frame control field have been designated as the priority bits of a given frame. These bits may be used for priority transmit queueing. A full-duplex station will receive all frames that are properly formatted and contain the appropriate destination address.

When in full-duplex mode, the majority of the normal token-ring MAC level protocols are no longer required and can thus be suspended. Since many of these MAC protocols depend upon specific MAC frames, stations must not transmit these frames, nor should LAN switches forward these frames, when in full-duplex mode. The active monitor and standby monitor present MAC frames could be used to provide a periodic "heartbeat" between a station and a switch port on a full-duplex link to indicate a logical presence to each other. When in full-duplex mode, a switch port can learn the address of its attaching adapter during the activation protocol. This is particularly applicable to mapping a station address to a physical port on an interconnect switch. Beacon MAC frames are still applicable in full-duplex mode to indicate temporary or permanent hard errors. Report soft error MAC frames can also still be used, but some of the error conditions that are reportable in half-duplex token-ring mode do not apply to full-duplex mode.

Full-duplex operation should be less sensitive to many of the disruptions that can occur in normal token-ring operation. For example, errors associated with maintaining token flow are no longer a concern. Also, link errors no longer affect data on the entire ring, but only on an isolated segment. However, there can still be situations where the first indication of a problem is the appearance of soft errors in data frames. Errors in received frames may be indicative of a poor transmission link or of external electromagnetic interference. These errors will normally appear as frame check sequence (FCS) errors. Improperly formatted or incomplete frames must also be handled. A frame that exceeds the maximum allowed frame size for a full-duplex link could be handled as an improperly formatted frame. In general, the receiving station is responsible for detecting frame errors. Frames that exceed the maximum frame length can be detected via the activation of a valid-frame timer (for example, 2.25 milliseconds for a 4500 byte frame limit at 16 Mbps) at the beginning of frame reception. If a valid end delimiter is not detected before the timer expires, the frame reception is terminated. The detection of an abort delimiter during the forwarding of a frame can also immediately terminate frame forwarding.

3.3 IBM Ethernet Quad PeerMaster Server Adapters

IBM Ethernet Quad PeerMaster Server Adapters are available in two versions. The Quad-BT PeerMaster is equipped with four ports with RJ-45 connectors for attaching four independent 10Base-T network segments via unshielded twisted-pair (UTP) cabling of Category 3 or better. The Quad-B2 PeerMaster provides four ports with BNC connectors for attaching four independent 10Base2 network segments through thin coaxial-shielded twisted-pair (STP) media. On both adapters, the LAN segments can support any number of nodes. For maximum flexibility with your existing wiring schemes, you can mix and match any combination of Quad-BT or Quad-B2 adapters, up to the maximum of six per server, and interconnect LANs on both media types through the adapter′s card-to-card switching capabilities.

The adapters have support for the following Networking Operating Systems: IBM OS/2 LAN Server and Novell NetWare.

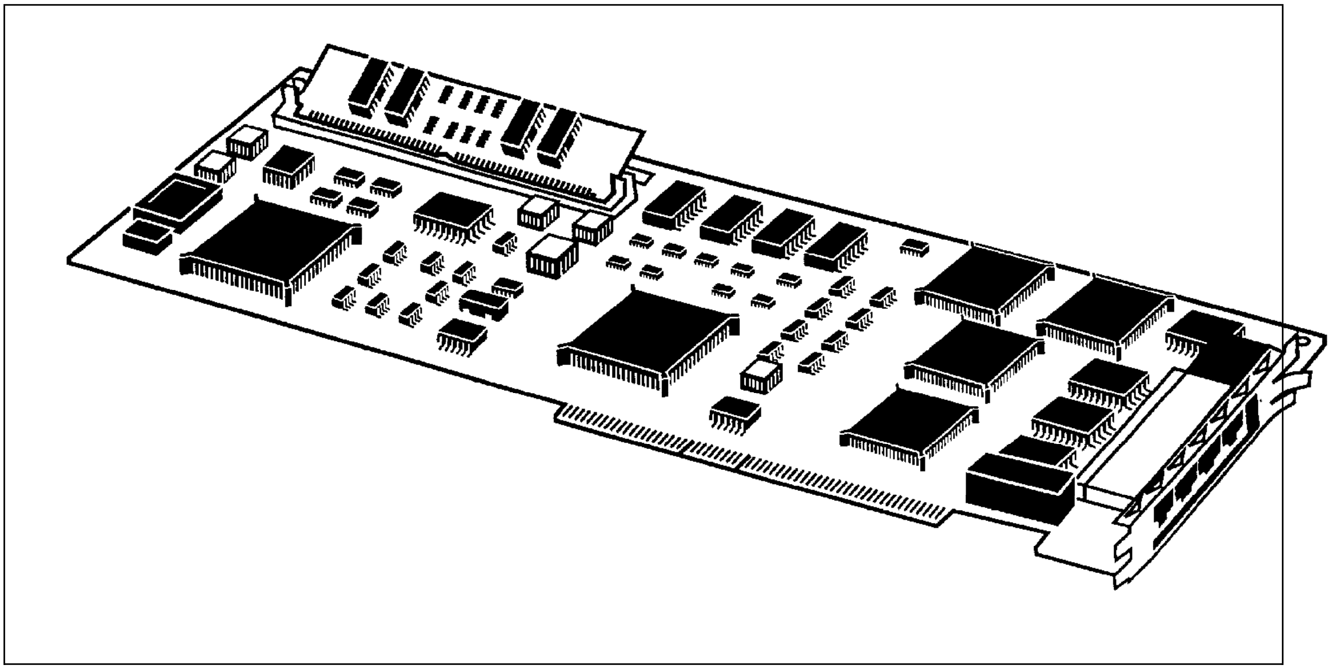


Figure 108. IBM Ethernet Quad-BT PeerMaster Server Adapter

3.4 The IBM 2220 Nways BroadBand Switch

The following section describes an IBM 2220 Nways BroadBand Switch (2220 Nways Switch) and how it implements the BroadBand Networking Services architecture. The 2220 Nways Switch will be presented in the following manner:

- An overview of the physical components of an 2220 Nways Switch and the various models
- A discussion on the 2220 Nways Switch′s architecture
- A high-level view of the cell switch
- Local node management
- Details of the adapters and links supported

Later sections will cover network-wide subjects such as supported user protocols, network management, network clocking and other topics.

3.4.1 General Node Description and Models

The 2220 Nways Switch consists of components that fit into one or two IBM 19-inch racks, depending on the 2220 Nways Switch model. The major sections of a rack and its dimensions are shown in the following figure:

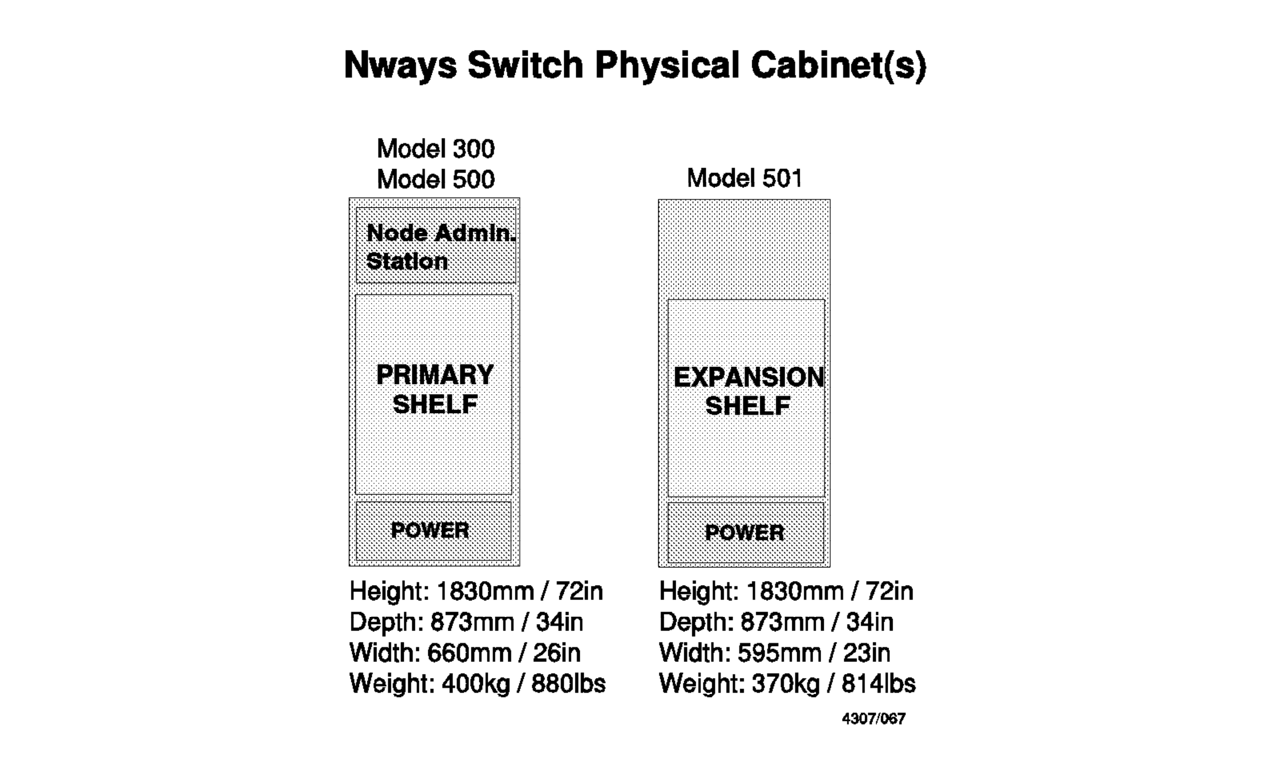


Figure 109. 2220 Nways Switch Rack Configuration

Some of the hardware components are shown in the following figure and briefly described in the text following the figure.

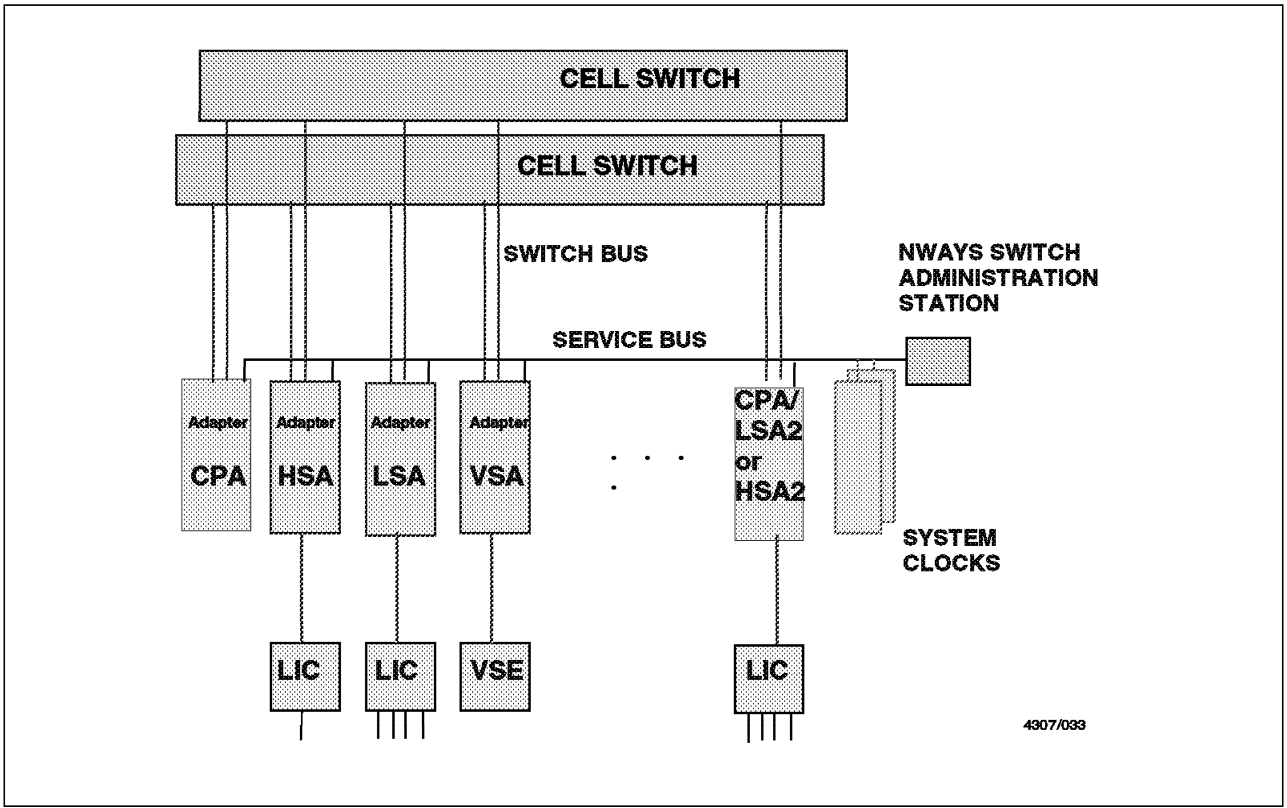


Figure 110. 2220 Nways Switch Hardware Components

Power units, power and alarm control, and fans
Redundant power units, including their own battery backup.

Node Administration Station
Management point for the node. Communicates with remote management station(s), remote console(s), RETAIN Remote Support Facility and the IBM Remote Support Center.

The following components are housed in the primary shelf and (if a model 501) in the expansion shelf. The shelves are divided into front and back sections. Some cards plug into the front section and some the back; for example, adapter cards plug into the front and their associated Line Interface Coupler (LIC)s plug into the back.

Switch
The 2220 Nways Switch switch fabric switches 53-byte cells between all other components.

Adapter cards
These are logic cards containing port, trunk and control point functions; choice of function is determined by software. Trunk and port adapters always have an associated Line Interface Coupler (LIC) on which the physical lines are connected.

Adapters are classified as Low Speed Adapter (LSAs), High Speed Adaper (HSAs), Type-1 or Type-2.

LSA Supports low-speed ports and trunks with speeds up to 2 Mbps per interface.

HSA Supports high-speed ports and trunks with speeds up to 52 Mbps per interface.

Type-1 Supports a certain number of connections, as described in Table 23. Can operate either as a stand-alone control point adapter (not supporting any ports or trunks) *or* as a port or trunk adapter.

Type-2 Supports a certain number of connections (more than Type-1), as be described in Table 23. Can function as a combined trunk *and* control point adapter.

Table 23. Adapter Type Summary

Adapter Type	**LSA Type 1**	**HSA Type 1**	**LSA Type 2**	**HSA Type 2**
Used as Independent Port Adapter	-up to 300 connections per LSA -speed less than 2 Mbps	-up to 300 connections per LSA -speed less than 52 Mbps	-up to 800 connections per LSA -speed less than 2 Mbps	-up to 800 connections per LSA -speed less than 52 Mbps
Used as Independent Trunk Adapter	-up to 900 connections per LSA -speed less than 2 Mbps	-up to 900 connections per HSA -speed less than 52 Mbps	-up to 1000 connections per LSA -speed less than 2 Mbps	-up to 1000 connections per HSA -speed less than 52 Mbps
Used as Independent Control Point Models 300, 500	Network up to -128 nodes -128 trunks	Network up to -128 nodes -128 trunks	Network up to -400 nodes -1750 trunks	Network up to -400 nodes -1750 trunks
Used as Mixed Trunk Adapter and Control Point Models 300, 500	Not Applicable	Not Applicable	Trunk: -1000 connections per LSA -speed less than 2 Mbps Network up to -250 nodes -1000 trunks	Trunk: -1000 connections per HSA -speed less than 52 Mbps Network up to -250 nodes -1000 trunks

Line Interface Coupler (LIC)s
Physical-line cards, connect to external devices, leased lines or carrier services.

Clock Module (optional)
Clock Module to provide synchronization for networks that transport voice or other circuit emulation services.

Voice Server Adapter (VSA) (optional) and Voice Server Extensions (VSE) (optional)
The voice server adapter provides the following functions for 64 Kbps Pulse Code Modulation channels:

- Voice compression
- Silence removal
- A-law/Mu-law conversions
- FAX detection

- Digital echo cancellation

The voice extensions are paired with the voice server and provide support for additional voice circuits.

3.4.1.1 IBM 2220 Nways BroadBand Switch Models

The 2220 Nways Switch is available in the following three models:

2220 Nways Switch Model 300
Contains eight adapter slots.

2220 Nways Switch Model 500
Contains ten adapter slots. It is available separately or as an upgrade from a Model 300.

2220 Nways Switch Model 501
It is an expansion of the Model 500, providing an additional six adapter slots. The Model 500 is a prerequisite which contains the control point switch and other components used by the model 501 expansion unit.

Redundant and Non-Redundant Modes: All of these models can be used in either redundant or non-redundant mode. Redundant mode provides added fault tolerance through the duplication of the following components:

- Control point
- Power unit
- Switch
- Clock Module (if optional clock card is required)

Note: In redundant mode, *all* of these components are duplicated. In non-redundant mode, only the power unit can optionally be duplicated.

3.4.1.2 2220 Nways Switch Model 300

The 2220 Nways Switch Model 300 consists of the following base components:

- Rack with shelf containing eight adapter slots
- Four slots for port or trunk Type-1 or Type-2 adapters or for combined trunk and control point Type-2 adapters, and associated Line Interface Coupler (LIC)s
- Two slots for independent control point Type-1 or Type-2 adapters

  Note: These two slots do not allow for any Line Interface Coupler (LIC)s.

  One of the above six (four plus two) slots must contain either a combined trunk and control point Type-2 or an independent control point Type-1 or Type-2 adapter.
- Two slots for voice server adapters and associated voice server extensions
- AC or DC power input
- One Type-2 adapter

The following required component must be installed on the shelf:

- One combined trunk and control point Type-2 or an independent control point Type-1 or Type-2 adapter, if the Type-2 adapter already included in the base configuration is not used as a combined trunk and control point or an independent control point adapter.

The following optional components can be installed on the shelf:

- Up to three low-speed or high-speed adapters (any type) and associated Line Interface Coupler (LIC)s if the Type-2 adapter already included in the base configuration is used as a combined trunk and control point adapter, *or*
- Up to four low-speed or high-speed adapters (any type) and associated Line Interface Coupler (LIC)s if the Type-2 adapter already included in the base configuration is installed as an independent control point adapter in one of the two slots reserved for them.
- Up to two voice server adapters and optionally two voice server extensions.
- A backup switch.
- A second power supply.
- A second control point.
  (Must be the same adapter type as the primary control point.)
- One or two clock cards.

3.4.1.3 2220 Nways Switch Model 500

The 2220 Nways Switch Model 500 consists of the following base components:

- Rack with shelf containing ten adapter slots
- Eight slots for port or trunk Type-1 or Type-2 adapters, combined trunk and control point Type-2 adapters, and voice server adapters, and associated Line Interface Coupler (LIC)s or voice server extensions
- Two slots for independent control point Type-1 or Type-2 adapters

  Note: These two slots do not allow for any Line Interface Coupler (LIC)s

  One of the above ten (eight plus two) slots must contain either a combined trunk and control point Type-2 or an independent control point Type-1 or Type-2 adapter.
- AC or DC power input

The following required component must be installed on the shelf:

- One combined trunk and control point Type-2 or an independent control point Type-1 or Type-2 adapter

The following optional components can be installed on the shelf:

- Up to seven low-speed or high-speed adapters or voice server adapters if the required control point adapter is a combined trunk and control point adapter, *or*
- Up to eight low-speed or high-speed adapters or voice server adapters if the required control point adapter is installed as an independent control point adapter in one of the two slots reserved for them

  Note: A maximum of four voice server adapters can be installed (in both these cases).
- Up to eight Line Interface Coupler (LIC)s or voice server extensions
- A backup switch
- A second power supply
- A second control point
  (must be the same adapter type as the primary control point)
- One or two clock cards

3.4.1.4 2220 Nways Switch Model 501

The 2220 Nways Switch Model 501 is an expansion unit to the 2220 Nways Switch Model 500. It consists of the following base components:

- A rack with an expansion shelf containing six adapter slots
- Six slots for port or trunk Type-1 or Type-2 adapters or voice-server adapters, and associated Line Interface Coupler (LIC)s or voice server extensions
- AC or DC power input (must be the same as the Model 500 base unit)

The following optional components can be installed on the shelf:

- Up to six low-speed or high-speed adapters or voice server adapters.
- Up to six Line Interface Coupler (LIC)s or voice server extensions.
- A second switch re-drive card
  (Required if the Model 500 base unit has a backup switch)
- One or two clock re-drive cards
  (Must be the same number as the number of clock cards in the Model 500 base unit)
- A second power supply
  (Required if the Model 500 base unit has a second power supply)

3.4.1.5 Software Requirements

In order to operate and manage the 2220 Nways Switch, the following IBM Licensed Program Products are required:

IBM Nways BroadBand Switch Control Program (5622-388)
: Operates the 2220 Nways Switch node, implementing the BroadBand Networking Services architecture. Includes the node configurator program.

IBM Nways BroadBand Switch Manager (5765-320)
: Consists of several applications to manage individual 2220 Nways Switch nodes as well as the overall network. The Nways Switch Manager runs under NetView/6000. *One* per IBM 2220 Nways BroadBand Switch network is required. If several are installed, each of them manages a subset of the network.

AIX SystemView NetView/6000 (5696-362)
: Its latest current release is a prerequisite for Nways Switch Manager.

NetView Distribution Manager/6000 (5765-196)
: Runs the 2220 Nways Switch change control server. *One* per 2220 Nways Switch network is required (Version 1.0).

NetView/6000 and NetViewDM/6000 can run on the same RISC System/6000. If they are running on separate RISC System/6000s, the following program must be installed on the network management station:

NetView Distribution Manager Agent/6000 (NetView Distribution Manager Agent/6000)
: Runs on the network management station and communicates with the 2220 Nways Switch change control server (Version 1.0).

For additional information on the IBM 2220 Nways BroadBand Switch see *IBM 2220 Nways BroadBand Switch: Concepts and Products,* GG24-4307.

Chapter 4. Wireless

This chapter presents an overview of the IBM wireless products in use today which have been developed specifically for or modified to allow communication between mobile or at least portable data handling devices other than radio transceivers. A data handling device could be any size computer, but in the mobile environment it generally refers to a personal computer of the laptop or notebook size.

Another topic is about wireless LAN performance, including subjects about path loss, causes of interferences on propagation, and trouble shooting list.

For greater detail on any of the topics presented here, please refer to *An Introduction to Wireless Technology*, SG24-4465.

4.1 IBM Wireless Products

IBM has developed wireless solutions for a variety of communication environments.[1] IBM Wireless LAN Entry, IBM Wireless LAN and IBM Infrared Wireless LAN, are designed for the local area network environment and support various IBM, OEM and industry standard communication protocols.

Three further products, RadioPAC/400, PagerPAC/400 and ARTour are designed for the wide area network environment. These provide communication between a wireless enabled device and a remote host. They depend upon a third party network provider to supply the wide area networking infrastructure.

Yet another product, AS/400 Wireless LAN, is also designed for the local area network environment and is host-based. IBM products with wireless capability are listed below.

Note: Only the IBM Wireless LAN and IBM Wireless LAN Entry products are dealt with in this document.

4.1.1 IBM Wireless Products

1. The following are local area network products:

   a. IBM Wireless LAN Entry:

      - It supports point-to-point communication between workstations in the same cell.
      - It supports communication with workstations in other cells when the cells are Ethernet LAN connected.
      - It supports seamless roaming between cells which are Ethernet connected.
      - It uses CSMA/CA as a transmission protocol.

        To connect a cell to a LAN, an IBM Wireless LAN Access Point is required. The IBM Wireless LAN Access Point acts as a MAC level bridge between the client devices in the cell and the Ethernet LAN.

[1] Some products mentioned here may not have been announced or homologated in every country.

Note: IBM provides both the software and the wireless LAN adapters.

b. IBM Wireless LAN:

- It supports communication between devices in the same cell via a workstation configured as a base station.
- It supports communication with devices in other cells where the base stations for these cells are connected to the same LAN.
- It uses spread spectrum TDMA as a transmission protocol.

  The base station acts as both a MAC level bridge and a router which allows communication between the client devices and other hosts or workstations on the LAN.

  Note: IBM provides both the software and the wireless LAN adapters.

c. IBM Infrared Wireless LAN:

- It is designed for indoor, short range operation only.
- It uses spread spectrum CSMA/CA as a transmission protocol.
- It supports point-to-point communication between workstations in the same cell.
- It supports roaming between LAN connected cells.
- It supports bridging to token-ring and Ethernet via an Access Point.

  An Access Point is a workstation with both wireless and wired LAN adapters. It is configured as a bridge between the two environments.

  Note: IBM provides both the software and the wireless LAN adapters.

d. AS/400 Wireless LAN:

- It connects PCs and dedicated data collection devices to an AS/400 system.
- It uses spread spectrum direct sequence as a transmission protocol.

  Mobile devices are portable transaction computers (PTCs) that appear to the AS/400 host as 5250 terminals. This allows the PTCs access to applications and functions residing on the AS/400.

  Note: IBM provides both the software and the wireless LAN adapters.

2. The following are wide area network products:

a. RadioPAC/400

- It uses the AS/400 as a communications hub.
- It supports public and private radio frequency data networks.
- It provides two-way wireless communication between radio-enabled devices such as laptop and notebook computers.

b. PagerPAC/400

- It uses the AS/400 as a communications hub.
- It provides a one-way paging function via a public or private paging service.

c. ARTour

- It supports TCP/IP applications over a WAN using a carrier network.
- It supports GSM, RD-LAP (Motorola), Mobitex (Ericsson) and Inmarsat (satellite communication) radio interfaces.

  Note: A 3270/5250 emulation application is available for access to host-based applications.

  Note: IBM provides the software. IBM also provides wireless LAN adapters to support the Mobitex and RD-LAP interfaces.

4.1.2 PC Wireless LAN Product Overview

IBM now supports a number of products that cater to the expanding wireless LAN market. Although some of these products share common functions and features, there are differences in capability which makes each suitable to different areas of deployment.

These wireless LAN products are enabling technologies. Their fundamental purpose is to provide a radio interface and appropriate device drivers to common communication protocols such as TCP/IP, NetBIOS and IPX. The radio component of the LAN is totally transparent to applications using these protocols.

To the end user, an application works exactly the same way as it would on a conventional wired LAN such as Ethernet or token-ring. A brief summary of the host-independent wireless LAN products, IBM Wireless LAN Entry and IBM Wireless LAN is given in the following sections.

4.1.3 IBM Wireless LAN Entry

IBM Wireless LAN Entry is a product which enables workstations to be grouped into logical cells using a radio interface built into a PCMCIA type adapter. These workstations can then communicate with other systems in the following ways:

- To other workstations in the cell on a peer-to-peer basis
- To other workstations in the cell via an IBM Wireless LAN Access Point
- Via an IBM Wireless LAN Access Point to servers or hosts attached to an Ethernet LAN
- To other workstations in other cells via an IBM Wireless LAN Access Point and an Ethernet LAN

IBM Wireless LAN Entry operates in the 2.4 GHz frequency industrial, scientific and medical (ISM) band. Operating in this band requires no license. IBM Wireless LAN Entry employs a technique known as spread spectrum frequency hopping as a means of transmission. CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) is the means by which multiple concurrent transmissions are handled on the same channel. This technique provides reliable security against eavesdropping. It also ensures that there is minimal interference from or to other devices in the vicinity which may be using the same band.

4.1.3.1 The Stand-Alone Cell

To operate in peer-to-peer mode, workstations are configured as part of a stand-alone cell. This configuration can support up to 32 workstations with a maximum distance between them of about 180 meters in an open environment. In a closed or semi-closed environment, the effective distance is reduced by physical factors such as relative positioning of workstations, reflective surfaces and signal absorption by walls and ceilings. In any cell, one workstation is configured as a cell leader whose responsibility it is to dictate what frequency channels are to be used within the cell and in what order. It also provides authentication and authorization functions for the workstations in the cell.

Multiple overlapping cells can exist without generally interfering with each other′s operation, unless the workstation density becomes significantly high. Such overlapping is transparent to individual workstations, as they only communicate with members of their own cell.

4.1.3.2 The Ethernet-Connected Cell

Workstations in a cell communicate with servers, hosts or other devices on an Ethernet LAN by using an IBM Wireless LAN Access Point as a transparent bridge between the radio and LAN interfaces. The cell then becomes known as an Ethernet-connected cell.

In this configuration there is the option of having the workstations continue to communicate directly with each other on a point-to-point basis or indirectly via the IBM Wireless LAN Access Point. Communicating via the IBM Wireless LAN Access Point has the effect of extending the range of communication as the signal is effectively boosted on retransmission. The trade-off is that the performance may be reduced, but overall delivery is more reliable. In an open environment the distance between workstations communicating via the IBM Wireless LAN Access Point can be up to 360 meters.

In an Ethernet-connected cell, the IBM Wireless LAN Access Point performs the tasks of allocating the channel frequencies for the cell and handles the authentication and authorization function. It also manages frame filtering for the workstations in its cell. The maximum number of workstations in an Ethernet-connected cell is 32.

4.1.3.3 The Network of Ethernet-Connected Cells

Workstations can communicate with workstations in other cells providing that all cells are Ethernet-connected to the same LAN. Each cell must be connected to the LAN by its own IBM Wireless LAN Access Point.

Any number of cells can be connected on the LAN or on multiple Ethernet LANs bridged together. Individually, the cells and workstations in them operate in exactly the same manner as in an Ethernet-connected cell.

4.1.3.4 Network Management

The IBM Wireless LAN Access Point can be configured to act as an SNMP agent and has a set of standard MIBs (management information base descriptors) that define generic information about SNMP capable devices on a network. It also has a set of device-specific MIBs which describe the information specific to bridges. Finally, it has an IBM-specific MIB which describes information unique to a wireless bridge device.

As an SNMP agent, the IBM Wireless LAN Access Point can collect and send this information to a management station running NetView for AIX or a similar monitoring application somewhere on the network.

4.1.3.5 Frame Filtering

The IBM Wireless LAN Access Point can also be configured to act as a frame filter. This function can be used to prevent broadcast or multicast frames originating on the Ethernet LAN from reaching the workstations. NetBIOS frames addressed to cell members will be permitted while all others will be rejected.

4.1.4 IBM Wireless LAN

IBM Wireless LAN operates in the 2.4 GHz industrial, scientific and medical (ISM) frequency band. It uses the spread spectrum frequency hopping technique of TDMA (Time Division Multiple Access) as its transmission protocol. TDMA divides the transmission time on a particular channel into a series of time slots. The slots are allocated sequentially to the stations which have data to transmit. The fact that a transmission *hops* from one channel to another provides good security against casual or intentional eavesdropping. (IBM Wireless LAN allows personal systems and workstations to access LANs, such as token-ring, Ethernet or the IBM PC Network, via short range wireless communication.)

An IBM Wireless LAN cell consists of a base station and one or more wireless workstations which are described as follows:

Wireless workstation: This is a workstation on the wireless network.

Base station: This is the focal point of the network providing frame relaying functions between the cell members (wireless workstations). The base station can also be the access point between the wireless workstations and a wired LAN where it can perform IPX/IP routing (Novell Network) and bridging (OS/2 on token-ring) functions between the wired LAN and wireless workstations. IBM Wireless LAN supports both the ODI and NDIS industry standard adapter interfaces.

A base station can coexist with various network operating systems and can support other functions besides bridging and routing. It can, for example, act as an *SNA gateway*.

4.1.4.1 The Stand-Alone Cell

This is the simplest configuration with the base station acting as the relay station for the cell members. A wireless workstation can communicate with the base station as well as with other wireless workstations via the base station. The wireless workstations are used in exactly the same way by the end users as if they were LAN attached. The only hardware requirement is the addition of wireless adapters for the stations. This configuration can support up to 50 wireless workstations but the number of simultaneous users in a cell depends on the volume and type of traffic.

It is possible to install several overlapping cells which do not interfere with each other′s transmissions. However, workstations can only communicate with workstations in their own cell.

Note: There is a physical limit of 12 overlapping cells. However, local (that is country) radio spectrum regulations may specify a maximum of less than this. In Japan, for example, the maximum number of overlapping cells permitted is six.

4.1.4.2 Multiple Wired LAN Cells

A wired LAN cell is a cell connected to a wired LAN backbone. In this configuration, wireless workstations can communicate via the base station with other workstations and servers connected to the wired LAN. If other wireless LAN cells exist on the same wired backbone, the wireless workstations in individual cells can communicate with those in other cells. Acting as a MAC level bridge, IP/IPX router or SNA gateway, the base station forwards frames from the wireless cell to the wired LAN and vice versa. In this configuration, the base station requires both a wireless adapter and an appropriate wired LAN adapter.

4.1.4.3 The Network Administrator Program (NAP)

The NAP is provided as part of the IBM Wireless LAN product. It performs the administration functions for the cell. Such functions include workstation registration, authentication and security control. The NAP cannot be run from a wireless remote station. It can only be installed in a base station or other LAN-attached station designated as a network manager.

Every cell must be managed by a NAP from somewhere. In a stand-alone cell, the base station is that point. In a wired LAN cell the NAP can be run from that cell′s base station or it can be run from the base station of some other cell on the backbone. It may also be run from a dedicated management station somewhere on the backbone and which does not have to be part of any cell itself. In this way, the management of an entire group of up to 60 cells and the workstations in them can be concentrated in one management station.

The base stations communicate with each other and with the NAP station using TCP/IP.

4.1.4.4 Network Management

This is a completely different function to, and independent of, the NAP. The IBM Wireless LAN base station can act as an SNMP agent in much the same way as an IBM Wireless LAN Entry IBM Wireless LAN Access Point. See 4.1.3.4, "Network Management" on page 234.

4.1.5 IBM Wireless LAN Entry and IBM Wireless LAN, Similar but Different

IBM Wireless LAN Entry and IBM Wireless LAN are very similar products in many ways. To the end user, workstations using either product can access a wired LAN and whatever resources the LAN supports. To the network administrator, network designer or systems integrator the radio technology employed in each product is very similar. However, the design concept is somewhat different for each product which gives rise to differences in functionality. Wireless implementers should be aware of these differences when considering a wireless solution. Table 24 gives a comparison of IBM Wireless LAN Entry and IBM Wireless LAN by feature and function.

Table 24 (Page 1 of 2). Comparison of Wireless LAN Products by Feature and Function

Feature/Function	**IBM Wireless LAN Entry**	**IBM Wireless LAN**
Stand-Alone Cell	Yes	Yes
Ethernet-Connected Cell	Yes	Yes
Token-Ring Connected Cell	No	Yes
Operating Frequency	2.4 GHz	2.4 GHz
Spread Spectrum	Yes	Yes

Table 24 (Page 2 of 2). Comparison of Wireless LAN Products by Feature and Function

Feature/Function	**IBM Wireless LAN Entry**	**IBM Wireless LAN**
Frequency Hopping	Yes	Yes
Data Link Layer	CSMA/CA	TDMA/CSMA Hybrid (French Protocol)
Station-to-Station (Peer-to-Peer)	Yes	No
Station-to-Station (Indirect)	Via 8227 Access Point	Via Base Station
Bridge Device	8227 Access Point	Base Station
Bridge Type	Transparent Bridge	Source-Routing Bridge
NetBIOS Filtering (from Wired LAN)	Yes	Yes
Network Routing	Not applicable	Yes (IP and IPX)
Roaming Support	Yes	Yes•
SNMP Agent	Yes	Yes
Throughput	350 Kbps	Up to 1 Mbps
Registration	By 8227 Access Point or Cell Leader	By NAP
Authentication and Authorization	By 8227 Access Point or Cell Leader	By NAP
Data Compression	No	Yes
Data Encryption	No	Yes
Signal Strength Monitor	Yes (Cell Leader Only)	Yes (RSSI)
Remote Program Load	Yes	Yes

Note:

• Within own cell only.

4.1.5.1 Reasons for Selecting IBM Wireless LAN Entry

- Moderate throughput
- Low cost adapters
- Low cost dedicated access point unit
- Built in Ethernet support
- Remote boot (RPL) from server
- Roaming capability
- High mobility
- Directional (8227 only) or omni-directional antenna

4.1.5.2 Reasons for Selecting IBM Wireless LAN

- High throughput
- Support for token-ring, Ethernet
- IP/IPX routing capability
- Centralized multiple cell management
- Non-dedicated base station
- SNA gateway support in base station

4.2 Wireless LAN Performance

For wireless LANs, well defined areas simply do not exist. As radio wave propagation characteristics are dynamic and unpredictable; small changes in position or direction can result in drastic differences in signal strength. In fact propagation patterns will change dynamically as stations, people and objects in the environment move. Generally, we refer to areas of coverage when talking about wireless LANs. However, a more appropriate term would be to use the term volume. For convenience reasons we will use the term *area* as this concept is more familiar and therefore easier to work with.

As in any other analog transmission system, a radio-frequency local area network is impaired by signal attenuation and noise. Unlike its wired counterpart, which may incur a bit error rate (BER) of less than 10^{-12}, a wireless LAN may have a BER that is typically in the range of 10^{-5}. During normal operation special attention should be paid to minimize errors which will reduce overall network throughput.

The challenge for indoor communications, where base and remote stations are either stationary or slowly moving, is to calculate the probability of signal impairment and what are the counter-measures available. Radio channels may suffer from distortion of the transmitted signal due to amplitude attenuation, fading, time delay, phase shifts or some combination of any or all of these.

4.2.1 Path Loss

Path loss is the attenuation of signal strength over distance. When there are no obstacles (as in free space), signal strength decreases as the square of the distance between transmit and receive antenna (inverse square law in free space).

But for indoor transmissions, in a modern partitioned office building for example, signal strength can be reduced up to the fifth power of the distance or greater. In addition to path loss, electromagnetic barriers may exist between a transmit and receive antenna pair, such as:

- Metal surfaces surrounding the antenna
- Reinforced concrete walls, floor, ceiling
- Metallic furniture
- Metallic poles may shadow some area

In addition to the above parameters which are pertinent in any transmission system there are other parameters, such as radio waves which can be reflected, absorbed, or blocked. Therefore radio conditions can vary significantly from site to site and even moment to moment. However, these issues can often be addressed by simply adjusting antenna placement and positioning.

4.2.1.1 Propagation Laws

The well known formula for determining path loss is a R^{-n} law, where R is the distance between transmitter and receiver (you may think of this as the radius of a circle). In free space the path loss exponent is considered to be 2. However, for indoor transmission different values can be used depending on the environment. For example, within building hallways, channel RF energy may experience less loss than free space propagation. But the exponent may increase from 2 to 12 with increasing values of *R*, depending on the obstacles between the transmitter and receiver. In case of obstructed transmissions the following exponent law may be used:

2 for 1 < R < 10m

3 for 10 < R < 20m

6 for 20 < R < 40m

12 for R > 40m

The larger values of *n* are due to the likelihood of an increasing number of signal attenuators (notably walls and partitions) between the transmitter and receiver when *R* increases.

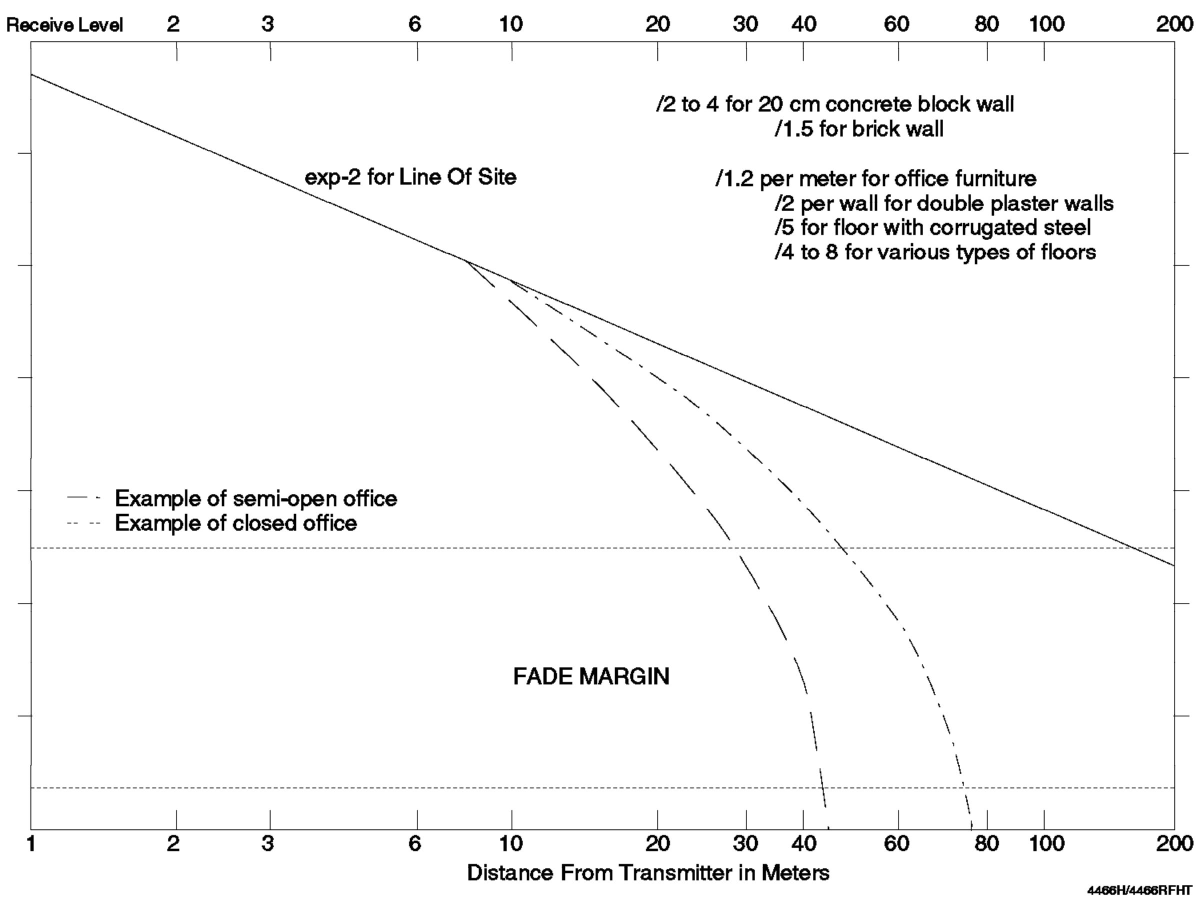


Figure 111. Receive Level versus Distance from Transmitter at 100mW/2.4GHz

Table 25 (Page 1 of 2). Typical Values of Multiplicative Path Loss versus Free Space	
Environment/obstacle description	**Path loss ratio versus free space (exponent 2)**
Office LOS	1
Office OBS	1 to 2
Concrete block wall	3 to 5

Table 25 (Page 2 of 2). Typical Values of Multiplicative Path Loss versus Free Space	
Environment/obstacle description	**Path loss ratio versus free space (exponent 2)**
One floor separation	3 to 4
Storage rack with textile products	1.5 to 3
Storage rack with paper products	1.2 to 2
Storage rack with metal parts	2 to 4
Note: LOS: Line of sight OBS: Obstructed	

4.2.1.2 Propagation through Floors

Although it is possible to propagate through floors under certain conditions, it is not recommended as the path loss will be very high. The path loss is not directly a multiple of the number of floors, as other phenomena will occur, including diffraction or reflection from buildings on the other side of the street for example.

4.2.2 Multipath Fading

Multipath channels cause signals to experience fading due to constructive and destructive interference between replicas of the transmitted signal. Walls, metallized tinted windows, and office cubicles can attenuate signals while inducing multiple reflections that arrive tenths to hundreds of nanoseconds after the first signal component reaches the receiver. Small movements can produce phase shifts in individual multipath components that result in large variations of their coherent sum. Therefore, fading describes small scale variations that occur over short distances (on the order of a meter or less) and small time intervals (on the order of seconds or milliseconds).

4.2.2.1 Flat Fading

Flat fading can occur when the delay spread, which corresponds to the difference in arrival time due to different paths, is significantly less than the bit duration. Here the time dispersion of the channel has a negligible effect on the shape of the transmitted signal, and only the signal gain of the channel varies with time. The amplitude patterns of flat fading signals are often modeled by one or several probability distributions, such as:

Weibull Appropriate for line-of-sight topographies and when there is motion around portable stations.

Nakagami Appropriate when there is motion around bBase stations.

Log-normal Appropriate for shadow fading which corresponds to blockage and attenuation of signal by walls, doors.

Ricean More applicable to obstructed, but still a strong direct path and to cellular.

Rayleigh Direct path is blocked and transmitter and receiver are immersed in highly scattering surroundings.

In office buildings where the environment is divided into separate rooms the fading occurs in bursts lasting tens of seconds with a dynamic range of about 30 dB. For an open space office, fading has been observed to be rather continuous with a dynamic range of 7 to 10 dB.

As the distance between two possible fades is about $\lambda/2$ if a mobile station moves at 3.6 km/h, then the number of possible fades per second will be about: 1/(3/24x2) = 16. Fortunately, fading with significant amplitude does not occur that often. When it does occur it is predicted by statistical distributions which vary with the environment.

4.2.2.2 Frequency Selective Fading

This corresponds to a channel response at time *t* resulting from an impulse applied τ seconds in the past. This can be modeled by the Doppler spread and scattering functions.

- Simple Doppler effect (absence of scatterers)
  - Variation in frequency of the received frequency due to the movement of the mobile relative to the fixed transmitter
  - Random frequency shift modulation
  - Doppler-induced random FM is correlated with vehicle speed $f_d = f_m$ cos, where $f_m = V/\lambda$ is the maximum Doppler frequency (8 Hz at 3.6km/h for 2.4GHz)
  - Affects all multiple modulation paths: some with a positive shift and some with a negative shift, depending upon the arrival angle
- Doppler effect with a single scatterer

  If a signal is reflected by a perfect scatterer the signal received will present nulls proportional to the velocity of the transceiver.
- Doppler effect with multi-scatterers in the vicinity of a mobile station

  In this case the resultant received signal is the sum of all scattered waves from different angles. However, it has been shown that it is the frequency modulation resulting from the highest direct Doppler frequency for a given velocity that is the most probable cause of a Doppler shift in a mobile receiver.

For in-building transmissions there will be a lot of scatterers. Some of them will be highly attenuated due to the beamwidth of the receive antenna. Due to the relatively low velocity of roaming mobile stations the effect of a Doppler shift should not be of concerns at WLAN data rates.

When both transceivers (bBase and mobile) are stationary, motion of people and equipment around the antennae result in multipath disturbances and fading effects.

4.2.3 Interference

Free space used by wireless LANs is sometimes noisy and occupied by various potential and actual sources of interference. Signal interference or radio frequency noise is an environmental signal that is not readily detected and therefore not always considered. Nevertheless if signal interference is present in your environment, then this RF noise will be detected by the receiving antenna of your station. This kind of interference is monitored by the IBM Wireless LAN and is tracked in an event log (IBMWLERL.LOG for Novell). The source of an interfering signal may be:

- Another radio-frequency network from another vendor
- An adjacent IBM Wireless LAN network with a different network ID

- Microwave ovens
- Security systems
- Elevator motors
- Photocopiers
- Known sources of strong electromagnetic disturbance

The effect of these noise sources can be mitigated by proper antenna placement.

4.2.3.1 Colocated Networks

Interference from co-channel and adjacent channel users is a major source of channel impairment in mobile communications and the ratio between the desired signal and the interfering signal might often be in the range of 1000. The presence of people in a room impacts the path loss primarily if the antenna height is low. Placing an antenna in a higher position will usually obtain a gain of 4 to 6 dB in path loss.

Because propagation in buildings is difficult to predict and will vary constantly, interference from other networks/users can be a serious problem. The IBM wireless LAN has a dynamic monitoring capability to detect interference through continuous sampling of the bit error rate per channel. If a particular channel demonstrates consistent and high levels of interference it is dynamically replaced by another one. Thus, with dynamic channel assignment, interference does not affect the reliability of the system as long as there are quiet channels available. Dynamic channel assignment cannot work if there is interference on every channel.

Another technique to reduce interference among users is power control. As discussed above, within a coverage area the signal attenuation between receiver and transmitter can vary widely, by as much as 60 dB or more. If all base stations and remote stations transmitted at the same power level, received and transmitted signals may differ in power, again by as much as 60 dB. This creates an adjacent channel interference problem.

To counteract this problem a remote stations transmit power is adaptively controlled. This should have the effect of minimizing the amount of interference generated within physically proximate networks. Over and above the dynamic capability of the IBM wireless LAN there is a manual facility as well which may be used to reduce the transmit power. This function not only reduces interference between cells/networks but also increases the average number of cells/users per square meter. Still another action is possible for stationary systems which consists of antenna focusing. The transceiver uses a patch antenna. This design offers some directional sensitivity (more gain in one direction). Aiming the antenna towards the transceiver/receiver will minimize the interference while it improves the overall signal quality and strength for both stations.

4.2.3.2 Impulse Noise

In the 2.4 Ghz band a primary source of noise is the microwave oven. The spectrum of noise generated by microwave ovens has a bandwidth greater than 30 MHz. The noise bursts produced by the microwave oven have a duration (16 or 20 ms) that is linked to the power source, 50 Hz or 60 Hz AC with a duty cycle of 50%. Most microwaves operate at a nominal frequency of 2.45 GHz, although this drifts over many tens of MHz in a few seconds.

Other sources of interference include impulse noise produced by copiers, elevator door switches and so forth. Typically, noise peaks are about 2 to 18 dB higher in the 900 MHz band than in the 2.4 GHz band. The occurrence of noise is typically an order of magnitude lower at 2.4 GHz than it is at 900 MHz. Impulse noise generated by a photocopier is significantly higher than that produced by elevator door switches. The average impulse noise duration is less than 200 ns and the average between two pulses is in the range of 1 to 10 ms for the interference sources of particular interest in wireless LAN applications.

4.2.4 Delay Spread

Delay spread is a factor that impacts both reliability and the BER. Delay spread is characterized by channel frequency selective fading. This can occur anywhere but is of primary concern in very large warehouses, atriums, and facilities surrounded by metal walls. As the distance between antennae increases so does the delay spread. If antennae are 5 meters apart then the delay spread is typically 20 ns, while at 30 meters apart it might be 35 ns but values over 100 ns have been reported. The counter-measure for stationary remote stations is selective antenna positioning, which breaks the reflection causing the frequency selective fading.

4.2.5 Cell Arrangement

The placement of the base station is of prime importance when planning the installation of your network. The clearance around the antenna should be sufficient to allow propagation of radio waves in all directions. However, if you want to radiate in a preferred direction you should position the front of the antenna (the side with the IBM logo) in that direction. The highest directional sensitivity is oriented along this plane. To maximize the cell coverage area place the base station antenna as close to the center of your cell as practical. The following radiation pattern is typical for the IBM Wireless LAN antenna design.

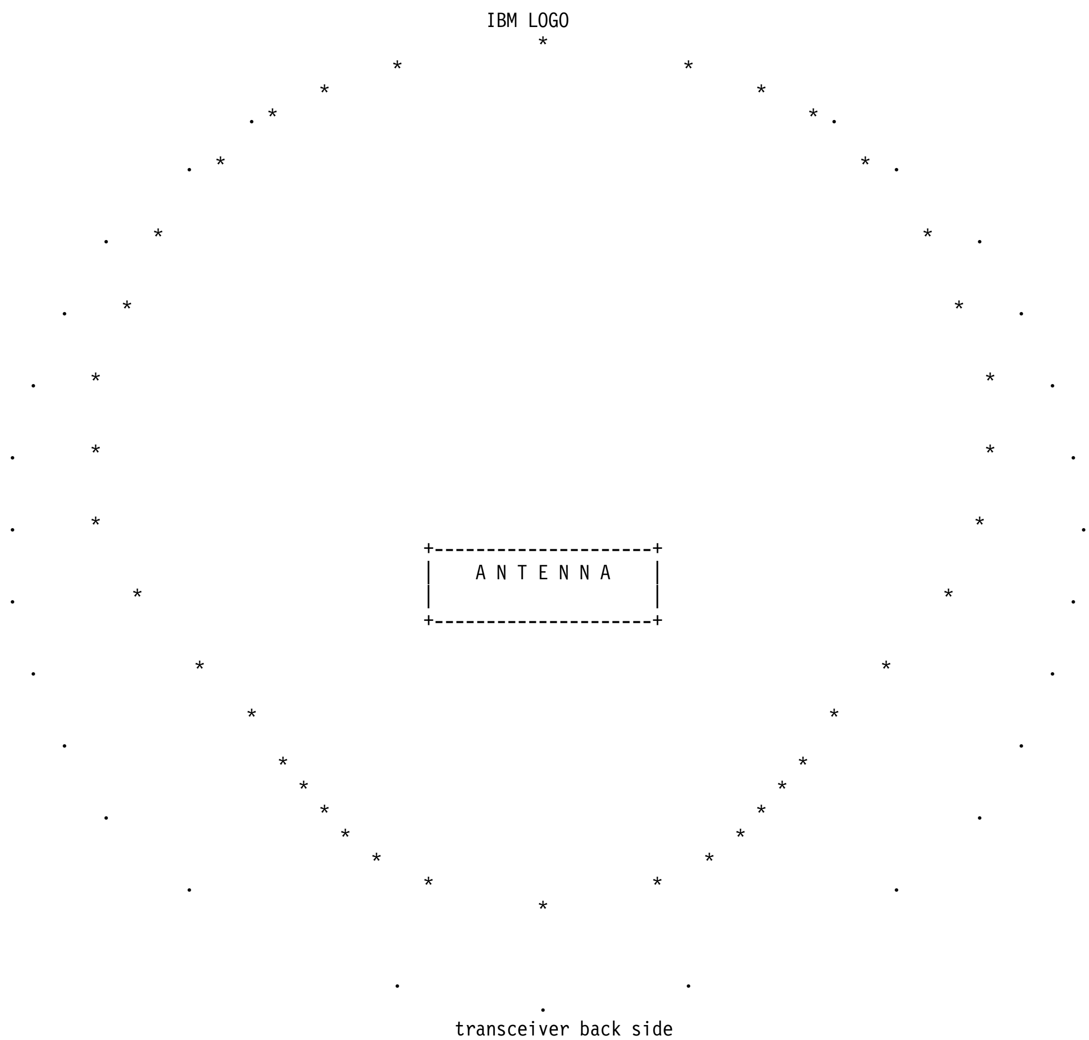


Figure 112. Antenna Directivity in Azimuth and Elevation

The power radiated by the antenna is proportional to its radiation pattern distributed over the *surface* of a large *sphere* with the antenna located at its center.

4.2.6 Trouble Shooting List

The following items are potential sources of signal integrity problems. Review this list when you are experiencing difficulty transceiving or receiving with stations in your wireless LAN.

4.2.6.1 Antenna Positioning

The patch antenna (5 cm by 5 cm) of the transceiver is placed just behind the IBM logo.

- The IBM logo must be visible. If the transceiver is mounted on a desk, do not place the transceiver upside down. Best propagation results are obtained when directing the IBM logo toward the base station. Directing the transceiver in the proper direction may improve the signal strength by a factor of 2 to 3.

- Clear the area (in front of the IBM logo) surrounding the antenna to improve propagation.
- Avoid placing large objects around the transceiver.
- If it is a stationary unit place the transceiver in the highest convenient position. This will reduce signal degradation from furniture and moving people as well as modular partitions if they do not go up to the ceiling. But don′t place it next to the ceiling; maintain at least 30 cm of clearance.
- In case of weak signal strength look for any large metallic items (white board, cabinet, water cooler) in the signal path.
- Do not place the transceiver close to moving objects such as large fans, moving doors, conveyor belts.
- Do not place the transceiver close to any sources of electromagnetic or radio frequency interference such as a microwave oven, radar, or any other wireless system.
- The radio is not waterproof; don′t place it outside a building.
- Do not use metal items to mount the transceiver.
- Do not glue anything on the antenna side (IBM logo) of the radio.
- For the base station use the following additional guidelines:
  - Place the base station transceiver close to the center of your cell. Bear in mind that the propagation path behind the radio is more than twice as short as what it is in front. Use the intersection of corridors to broadcast in all directions of the corridors (corridors guide the waves).
  - Place the radio vertically; if so, do the same thing for the radios of the remote workstations.
  - Orient the transceiver in the direction of the furthest workstation.

The above are suggested remedies that may help you in your environment. The IBM Wireless LAN product has many built-in features to overcome a variety of problems. You can help it do so by keeping these tips in mind when you are installing and/or trouble-shooting your network.

Chapter 5. ATM Products

In 1994 IBM introduced a solution to ATM in the area of adapters, hubs, concentrators, internetworking, and management products, as well as WAN. These products enable you to build and operate your local area networks of any size and mix protocols and interconnect them.

ATM today plays a key role in the desktop-to-world information highway of the future. It works equally well on local and wide area networks, and is used in both private and public networks. ATM is particularly well suited to applications requiring voice, video, and data traffic types. While enabling new applications, ATM extends current application solutions hindered by limited bandwidth.

Since most users will not migrate current LANs to ATM overnight, IBM plans for ATM, as a LAN technology, to coexist for many years with current LANs (token-ring or Ethernet). This is why IBM has implemented ATM in the IBM 8260 Multiprotocol Intelligent Switching Hub. The IBM 8260 already supports connectivity to other LANs (Ethernet, token-ring and FDDI). Changing a workstation connection from current LAN to ATM is similar to changing it from Ethernet to token-ring: a matter of moving a connector in the wiring cabinet from a port on a LAN module to a port on an ATM module.

IBM participates in the ATM Forum and has in a statement declared that all IBM products are to be ATM Forum compliant as the standards are set.

5.1 IBM 8260 ATM Subsystem Mode of Operations

End systems (workstations, bridges, concentrators) connect to the IBM 8260 at 155 Mbps, 100 Mbps and 25 Mbps. End systems can use different modes for ATM operations:

- Classical IP
- LAN Emulation
- Native ATM

5.1.1 Classical IP

In this mode, the IP protocol runs just above the ATM application adaptation layer (AAL). The ATM addresses are used in the same way as the LAN addresses of current LANs (Ethernet or token-ring) were used, namely:

- When connected through PVC, the end systems exchange their IP addresses. This is the InATMARP mechanism, similar to the InARP introduced for IP operation over frame relay.

- When they want to be connected by SVC, the end systems need to perform the following steps:

  1. Set up a PVC or an SVC with an ARP server, which is a particular end system attached to the ATM network, in charge of resolving the IP addresses into ATM addresses.

  2. Register their IP address to the ARP server. This way the server will have the IP address-ATM address mapping of all end systems of the network.

3. When it desires to transmit IP packets to an IP address which is not in its ARP cache, an end system sends an ARP request to the ARP server. The server replies with an ARP reply, including the ATM address of the target end system. The format of the ARP exchanges are very close to the format used on current LANs. The difference is that the physical address is now an ATM address, instead of a MAC address.
4. The requesting end system then sets up an SVC with the target end system, using the UNI signalling.

Both InATMARP and ARP are described in Internet RFC 1577.

End systems using Classical IP can interoperate with end systems attached to current LANs only through an IP router combining the two types of attachment (ATM and current LAN).

5.1.2 LAN Emulation

This mode of operation provides a migration path from current LANs to ATM, with no impact on the upper layer protocol.

The LAN emulation server (LES) implemented in a workstation is in charge of resolving the LAN addresses and performing broadcasts. The LAN emulation client (LEC) (ATM workstations and ATM LAN link), connected to the ATM network, register their LAN address and ATM address to the LES. The LES and the set of registered LECs make up a virtual LAN segment.

A virtual LAN can also be seen as a logical broadcast domain, that is decorellated from physical network structure.

When an LEC wants to send frames to a destination LAN address, it performs the following steps (the example assumes that the LECs have registered to the LES):

1. Transmit the explorer frame to the LES. Note that broadcast frames are always sent to the LES, which performs broadcasting using point-to-multipoint connections.
2. The LES updates the origin LEC with the ATM address of the destination LEC if it can find the destination LAN address in its (LAN address, ATM address) table.
3. The LES forwards the frame to the destination LEC.
4. The origin LEC sets up an SVC to the destination LEC. Subsequent frames will flow on this direct connection between the origin and the destination LEC.

Since the LAN emulation operates at the MAC layer, it is not sensitive to the upper layer protocols. Stations attached to ATM and stations attached to current LANs (Ethernet or token-ring) can interoperate using an ATM LAN link. To the LAN workstations, the ATM network will appear just as an extension of the LAN.

The token-ring LAN emulation server support and the Ethernet LAN emulation server support that are provided for the TURBOWAYS 25, 100 and 155 adapters will comply with the ATM Forum recommendations in early 1996.

The current LES is a software solution on a PS/2 or a PC and capable of supporting 1000 connections. Each ATM-attached station and each bridge count towards this number. But the LAN-attached stations do not count in this calculation. This means that you can have (in theory) 1000 LANs, each with many stations connected to one LES via 1000 bridges.

If you have more than one LES, you have more than one emulated LAN. The only way that the stations attached to two different emulated LANs can communicate with each other is through a bridge (or router). Since we do not currently offer a bridge (router) for this purpose, the only way that you can do it today is to go out of one emulated LAN to a real LAN (through an 8281) and then get to the other LAN (via a LAN bridge or router) and then back into the second emulated LAN via another 8281.

The 8281 can have 512 connections. Each connection to an ATM station or another 8281 counts as one. The connection to the stations behind a bridge (another 8281) does not count.

Note

An IBM 8260 integrated ATM Forum compliant LES will be available in 1996.

5.1.3 Native ATM

Native ATM operates in conformance with ATM UNI 3.0 (ILMI registration, Q93B call setup).

5.2 ATM Subsystem Traffic Management

High-speed ATM networks will support a great diversity of applications with different traffic and quality of service (QOS) requirements. For example, certain applications will require guaranteed levels of delay and throughput (multimedia and time-critical data applications), while others can tolerate variations in delay and throughput (LAN traffic). Such diversity will require different congestion management methods.

The IBM 8260 ATM subsystem supports two types of traffic:

- The ATM reserved bandwidth (RB) service
- The available bit rate (ABR) service (or best effort)

In the ATM reserved bandwidth (RB) service, an application needs to establish a traffic contract with the network before transmitting data. The traffic contract will include specification of a desired QOS class and a set of traffic descriptors. The network, through resource allocation, will provide the desired QOS for the ATM connection or will refuse the call. This method will require the source to be modelled accurately and to be able to describe its traffic pattern precisely. The allocated bandwidth will be usually less than the peak rate in order to benefit from statistical multiplexing gains, which may cause congestion. A source policing scheme will make sure that the source conforms itself to the contract.

An available bit rate (ABR) class of service will be used by the IBM 8260 ATM subsystem to increase link utilization for bursty and unpredictable LAN data traffic.

In this service class, no bandwidth at all will be reserved and the sources can transmit on a best effort basis, grabbing as much bandwidth as they can without affecting the RB traffic. As no bandwidth is allocated, it is impossible to rely on losses inside the network to solve congestion. In fact, every lost cell would trigger the retransmission of a whole frame, which would result in more "offered" traffic and a very poor throughput.

The ABR service intends to implement a congestion control scheme which will not affect the RB traffic and will be fair, treating similar sources in a similar way, independently of their location inside the network. To do that, the IBM 8260 will support the ABR service with a loss-free congestion control scheme relying on network backpressure in which stop/start signals move hop-by-hop from congested areas towards the sources.

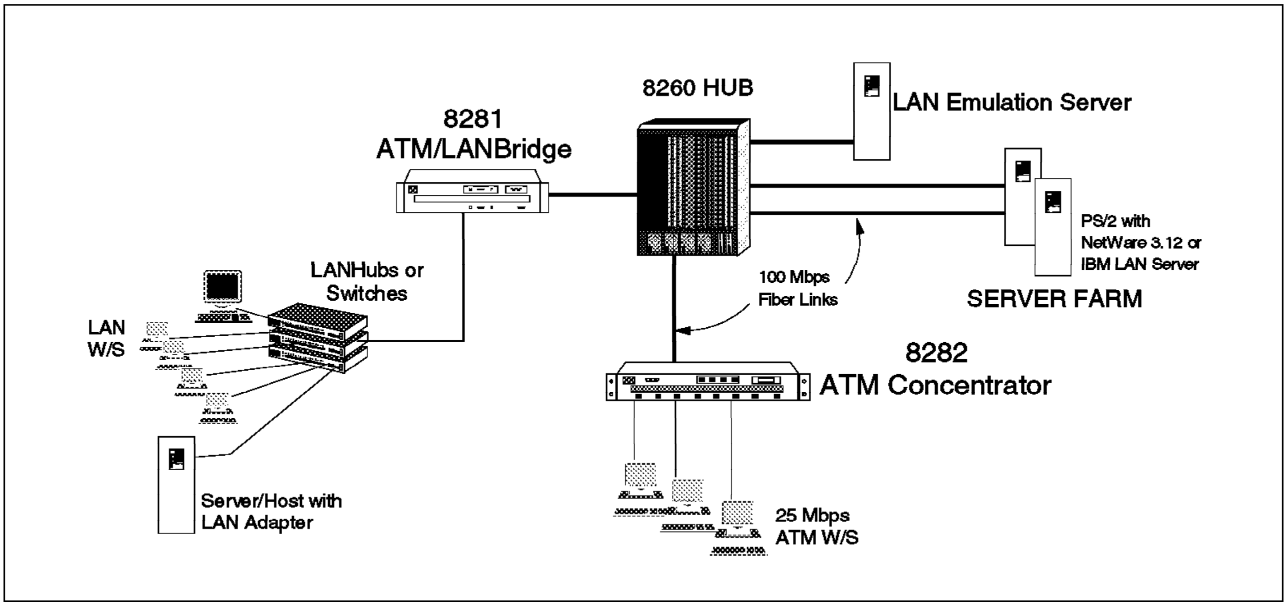


Figure 113. ATM Connectivity

5.3 The IBM 8260 Multiprotocol Intelligent Switching Hub

The IBM 8260 Models A10 and A17 are modular hubs that combine, within the same chassis, the functions of shared media intelligent hub plus those of a modular ATM switch. Models A10/A17 are very similar to Models 010/017 and have 10 slots and 17 slots respectively. The difference is the presence of the ATM backplane.

For general information about the IBM 8260 and the non-ATM functions, see the general IBM 8260 description in this book 2.11, "IBM Nways 8260 Multiprotocol Intelligent Switching Hub" on page 161.

The ATM functions in the IBM 8260, also called the ATM subsystem, are built with the following components:

- An ATM backplane serving the slots of the IBM 8260 for interconnection of the ATM modules.
- A two-slot switch/control point module (S/CPM) that provides stand-alone ATM cell switching functions and network control functions, such as call setup processing, topology discovery and route selection. These network control functions are grouped under the name of control point.

The module also serves as a point of monitoring and control for various ATM modules, through either in-band or out-of-band management.

- ATM concentration modules
  - A 1-slot 4-port ATM concentration module, with FSD (the FDDI MIC) connectors offering 100 Mbps (TAXI) ATM Forum compliant interfaces, over multimode fiber.
  - A 1-slot 4-port ATM concentration module, with SC connectors offering 100 Mbps (TAXI) ATM Forum compliant interfaces, over multimode fiber.
  - A 1-slot 2-port ATM concentration module, with daughter cards offering 155 Mbps (SONET) ATM Forum compliant interfaces, over multimode fiber or single-mode fiber with SC connectors or UTP category 5 or STP wiring with RJ-45 connectors. Any combination of add-on modules is possible.
  - A 1 or 2-slot ATM carrier module for one or two daughter cards with the industry-standard interface UTOPIA 1.

  With both the ATM 155 Mbps and the 100 Mbps ATM concentration modules various speeds are available for you to connect high-speed ATM workstations and bridge/routers or linking ATM switches together.

  Because of its granularity, you can have both ATM speeds installed within a single 8260 hub. Parallel 100 Mbps or 155 Mbps module links can connect 8260s to build backbone links with higher bandwidth. The ATM control point splits the traffic evenly over the parallel links according to the load of each link.

- The Nways 8260 TR/Ethernet ATM LAN Bridge Module

  The ATM bridge gives you a key infrastructure function, that allows you to bridge between token-ring or Ethernet and ATM networks. It is available both as an 8260 module and as a separate unit, the IBM 8281 ATM LAN Bridge.

- The 8260 UTOPIA 1 ATM Carrier Modules A module that gives third party access to IBM's campus technology.

Note

An integrated 25 Mbps ATM workgroup switch will be available in 1996.

5.3.1 The 8260 ATM Backplane

The ATM backplane has a dedicated set of connections between the ATM concentration modules and the switch/control point module. This star architecture gives you much higher bandwidth than traditional bus architecture.

Two separate stars of dedicated connections are available on the ATM backplane in Model A17. This gives you the possibility to install two ATM switch/control point modules. The function of automatic switch-over will be provided later.

This design of the ATM backplane gives you two types of possible configurations in a Model 017:

- Capacity mode:

  One switch/control point module installed in position 9/10. This allows you to have 14 ATM concentration modules installed in slots 1-8 and 12-17.

- Back-up Mode:

  Two switch/control point modules are installed, one serving as a backup:

  – Switch A in position 9/10
  – Switch B in position 11/12

  In slots 1-8 and 13-17 you can install up to 13 ATM concentration modules.

In Model A10 the switch/control point module resides in position 9/10 and allows you to install concentration modules in slots 1-8.

The general architecture of the 8260 LAN backplanes supports hot-plugging and uses passive technology for greater reliability. It uses female connectors to avoid pin bending.

5.3.1.1 The ATM Upgrade MES

If you already have an IBM 8260 Model 010 or Model 017 you can order a model conversion MES. The ATM Upgrade MES consists of installing the ATM backplane in addition to the media backplane (current LANs) which is always present in an IBM 8260 chassis. You install the ATM backplane from the rear, without the need to remove existing modules or cables. This reduces potential errors and the time to perform the upgrade.

The 8260 controller module will automatically sense the presence of the ATM backplane and identify the machine as the right model and pass the information to the network administrator via the distributed management module (DMM).

5.3.2 The ATM Switch/Control Point Module

The switch/control point module (S/CPM) is a double-slot module and contains two full-size cards:

- A base card, with the main function to switch cells from a port on a concentration module to another port on the same or another concentration module. This is done by the switch integrated circuit, also used in the Nways Broadband Switch. This single chip is a non-blocking 16-by-16 times 8-bit parallel switch, with an aggregate throughput that exceeds 8 Gbps.
- A control point card, with a high-speed processor where the control point resides. The card incorporates FLASH memory that contains the code which is loaded into the control point. This allows the code to be updated in the field for future extensions and enhancements.

The 8260 control point gives you a complete set of functions to control your ATM campus network and to interconnect your local ATM networks over ATM wide area networks (WAN).

The ATM network control functions are fully distributed (all nodes participate as peers in the control algorithms) in contrary to a centralized software function that resides on a server. This is key to network availability, scalability, and growth.

The IBM 8260 ATM switch/control point module gives you the following networking functions:

- Switched and permanent virtual circuits (SVC and PVC)
- ATM signalling (SVCs) according to the ATM Forum V3.0 specifications (upgradable to next versions: V3.1, ITU)

- Point-to-point and point-to-multipoint connections for PVC and SVC services
- Topology services and route computation with automatic bypass of failed nodes and links
- Switch-to-switch interface based on an extension of the ATM Forum UNI Version 3.0 as stated in the ATM Forum P-NNI framework
- Interconnection of local ATM networks over an ATM WAN providing permanent virtual path, allowing setup of switched connections between end systems on both sides of the WAN

5.3.3 4-port 100 Mbps ATM Concentration Modules

You can get this one-slot module with four 100 Mbps multimode fiber ports in two versions, with FSD (the FDDI MIC) or SC connectors.

The 100 Mbps ATM Concentration modules can interoperate with each other at the full 2 km distance because both devices have identical electrical and optical characteristics. Both modules follow the specifications given by the ATM UNI FORUM (V3.0) with support of both PVC and SVC modes, and can operate together with any ATM vendor module that follows these specifications.

Maximum distances of fiber links reachable:

- FSD connectors: 3.0 km with 62.5/125 fiber media
- SC connectors: 2.4 km with 62.5/125 fiber media

This ATM-UNI interface complies with the ATM-Forum proposal for physical layer for 100Mbps multimode fiber interface.

- FSD connectors: 2.5 km with 62.5/125 fiber media
- SC connectors: 2.2 km with 62.5/125 fiber media

The modules incorporate the traffic management Application Specific Integrated Circuits (ASICs) and cell buffers that deal with various ATM classes of service, that perform distributed functions such as as cell swapping, rate control and reshaping of the traffic in case of bursty LAN transmissions.

The distributed design ensures that the system performance scales up when the number of modules and ports increases. Each module can support a large number of concurrent virtual circuits. This is important to satisfy your connectivity requirements when you include large servers or high-speed backbone links with a large number of circuits connected.

You can use the ATM concentration module ports for campus backbone communications between different hubs, as parallel links for increased traffic bandwidth, or to attach high capacity servers in native ATM mode. You can also combine these modes of operation.

5.3.3.1 Port Configurations of 100 Mbps Module

All ports of the 100 Mbps concentration module can be configured as UNI (user network interface), NNI (network-to-network connection) or SSI (8260-to-8260 connection).

The following combinations on a given 100 Mbps concentration module are allowed:

- Four ports configured as UNI/NNI interfaces

- Three ports configured as UNI/NNI interfaces, plus one port configure as SSI
- Two ports configured as SSI

5.3.4 Nways 8260 ATM 155 Mbps Concentration Module

This module, called ATMFlex, is a single-slot two-port 155 Mbps concentration module with a modular structure. It is composed of a base card and up to two feature I/O cards.

The ATMFlex module is personalized by you, and you can install the I/O cards yourself.

- One port multidmode fiber I/O card with SC connector
- One port single-mode fiber I/O card with SC connector
- I/O card for UTP5 and STP (planned)

The I/O cards are dynamically sensed and vital product data (VPD) is automatically reported to the management modules.

The module is equipped with the traffic management ASICs and cell buffers that deal with various ATM classes of service, that perform distributed functions such as cell swapping, rate control and reshaping of the traffic in case of bursty LAN transmissions.

The 155 Mbps module supports various cabling types. You can use unshielded twisted pair category 5 or shielded twisted pair mainly for connecting ATM devices at distances of up to 100 meters. To link either workstations, bridge/routers, or switches with distances up to two kilometers, you can use multimode fiber wiring. You may span large geographical areas with distances up to 20 kilometers with single-mode fiber connections, which eliminates the need for external converters.

5.3.4.1 Port Configurations of 155 Mbps Module

All ports of the 155 Mbps concentration module can be configured as UNI (user network interface), NNI (network-to-network connection) or SSI (8260-to-8260 connection).

The following combinations on a given 155 Mbps concentration module are allowed:

- Two ports configured as UNI/NNI interfaces
- One port configured as UNI/NNI interfaces, and one port configured as SSI
- Two ports configured as SSI

5.3.5 The Nways 8260 TR/Ethernet ATM LAN Bridge Module

The ATM bridge allows you to bridge between token-ring or Ethernet and your ATM networks. The function is available both as an 8260 module and as a separate unit, the IBM 8281 ATM LAN Bridge, and offers you the same network functions. For a more detailed description, see 5.6, "IBM 8281 ATM LAN Bridge" on page 260. The main differences are in the area of network management and control.

The value of the LAN bridge resides in its:

- Ability to perform local LAN bridging

- Implementation of LAN emulation, which allows communication between LAN stations and ATM stations, as well as communication between LAN stations throughout the ATM network
- Support of source-routing protocol (SR) for token-ring and transparent bridging for Ethernet

The ATM LAN bridge allows you to consolidate your LAN and ATM networks within the same chassis.

The ATM LAN bridge module characteristics are:

- 2-slot width module
- 4-port RJ-45 or two-port AUI connectors
- Attaches four token-ring or four Ethernet segments
- The ATM port on the ATM backplane
- Supports LAN to LAN over the ATM network
- Supports local bridging between LANs
- Supports bridging LAN to ATM for ATM-attached workstation and servers
- Discovers ATM partners and establishes a connection on an as-needed basis (self learning)
- Provides filtering on token-ring and Ethernet LANs
- Support SNMP network management
- Provides a RS232C front-end port for configuration management

The values of integrated 8281 are:

- You may keep existing hubs for token-ring and Ethernet and just modify your backbone.
- On token ring, both pairs are active, but the ring wraps in case of a link failure.
- In Ethernet, one pair is primary, the other is secondary.
- The integrated 8281 has more bandwidth because of the ATM port on backplane (no sharing with other station, internal ATM backplane speed).
- No need for additional ATM concentration port. This is a true savings when both ports of the 100 Mbps module are used for SSI connections. In this case, the two remaining ports are unavailable for UNI connection.
- Eliminates having to choose between 100 Mbps and 155 Mbps.
- Easy installation and reconfiguration.
- Common management (inventory, power classes).
- Redundant power supplies.

5.3.6 8260 UTOPIA 1 ATM Carrier Modules

The one-slot module and the two-slot module has a generic motherboard which can hold one or two daughter cards respectively.

- It is IBM′s intention to give third parties access to IBM′s ATM campus technology. If you are willing to develop your own ATM applications, you can accomplish this without necessarily investing in an independent or new ATM platform.
- This offers you, as an ATM user, the largest range of applications that make use of ATM transport.
  - It enables you to use new applications, over which new services and opportunities can be developed.
  - It reduces your network cost of ownership through the consolidation of various applications over a single homogeneous ATM infrastructure.

The motherboard accepts a daughterboard that incorporates a specific function or application that will benefit of ATM characteristics. The motherboard offers a simple interface to IBM′s ATM system structure, and provides you with various sets of services that will enable consistency with 8260 system functions and management. The ATM carrier module offers a simple interface based on well-known industry standards (UTOPIA 1).

5.4 Systems Management

:12 refid=8260.systems management Systems management is an important part of the installation, and assists the operators to handle the equipment. The design of the 8260 provides built-in support for this.

5.4.1 Network Reliability

The switched nature of ATM technology requires network control functions to perform all the tasks to select the best route in complex topologies and to manage the connection of ATM circuits. One possible implementation was to put these functions in a specific server connected to the network of switches. However, these functions are very critical for the continuous operations of the ATM networks. IBM has therefore chosen to have them integrated with the 8260 switching element, thus leading to a distribution of the control system in every switching node. The consequences are:

- An added availability for two main reasons:
  - Physically, every module in the IBM 8260 benefits from the fault-tolerant design of the IBM 8260 chassis.
  - Logically, the ATM network benefits from distributed control that eliminates single point of failure.
- An improved network performance because of distribution of network control load. This gives you a faster network startup and connection setup, and avoids network bottlenecks.

5.4.2 ATM Power with LAN Simplicity

The rich set of functions of the 8260 ATM subsystem are designed to make your installation and exploitation of ATM networks very simple.

Installation of an 8260 ATM network is nearly as easy as installing a shared media LAN, because of two things:

- The control point is integrated in the hub, so there is no need to set up a separate server for connection management or configuration. You do not need to have a given server operational.
- You only need to set a few network parameters. The control point learns dynamically the machine resources, port speeds, and network topology.

This makes it easier for you to install and operate the ATM network, and fewer resources are needed to manage it.

5.4.3 Multinetworking with ATM

The control point architecture of the 8260 ATM switch/control point incorporates all the functions you need to handle small to large scale networks. This includes the interconnection of ATM campus networks over ATM wide area networks (WAN).

Networks of 8260s can be grouped into multiple subnetworks, where the topology of each subnetwork is hidden from other subnetworks. This subnetworking is essential where you have multiple ATM LANs interconnected through an ATM WAN, because subnetworks on each side of the WAN do not need to exchange topology information. This reduces the overhead of control traffic over WAN links.

Also, when you connect the 8260 to a WAN ATM, the total amount of bandwidth to be carried over this connection can be restricted, so you do not overflow the WAN links with campus traffic or you do not exceed the contracted bandwidth with the WAN service bearer. This function is essential to limit the traffic that needs to cross the WAN, which usually has much lower bandwidth than the campus LAN. It also avoids cell loss due to a mismatch of bandwidth.

The 8260 allows you to define multiple networks, with different ATM network addresses. This is important when you interconnect ATM networks with different addressing structures or authorities. A typical application is when you merge sites. You link their networks without the need to redefine their ATM addresses.

5.4.4 Module Management

The 8260 switch/control point module has a local console RS-232 port for out-of-band management from a local or remote (via a modem) terminal. Easy-to-use but powerful line-edit commands are available for management operations. Access to this interface is also possible in-band through an TCP/IP Telnet session.

The switch/control point module supports program updates either from the local port or in-band using TFTP protocols.

The module is provided with a set of tools for troubleshooting. It is able to trigger traces on selected functions or to save dumps. The saved files can be sent via the network for analysis.

In line with the general architecture of the 8260, the ATM modules have light emitting diodes (LED) for visual troubleshooting and they fully participate in the intelligent power and inventory management of the 8260. The modules are full floating (with the exception of the switch/control point module) and hot-pluggable.

5.4.4.1 Security

The ATM switch/control point module has these security features:

- Access to the module commands is protected by two levels of passwords (user and administrator).
- An ″inactivity″ timer that terminates a session with the module when the inactivity time expires.

5.4.5 ATM Network Management

The 8260 switch/control point module implements an SNMP ATM agent, that includes objects defined by the standard bodies, as well as IBM-specific extensions. This gives you superior manageability of your ATM networks from the network management station.

This SNMP agent features the following functions:

- Full SNMP support (get, get next, set and traps) allowing complete control and monitoring through SNMP commands.
- Support of IP over ATM (RFC 1577) for node management and service.

  Network management stations can therefore contact the switch/control point module agent either through direct connection to the ATM network using IP over ATM, or connected to a traditional LAN that is routed to the ATM subnetwork.
- MIB 2 support.
- Full ILMI (ATM Forum V3.0) support (at UNI and from network management station).

  This allows the network administrator to get the information that was registered by the end systems.
- IETF AToMIB, allowing the network administrator to display the status and configuration of 8260 ATM interfaces, including active VPCs and VCCs. Statistics on ATM interfaces are also collected via this MIB.
- MIB support for topology and route computation management, allowing the display from the central management station of the topology of the 8260 network and the set of attached ATM stations.
- IBM-specific extensions:
  - Box specific (switch, modules and ports) for greater manageability of system resources
  - Enhanced PVC management (automatic route computation and recovery)
  - Signalling (Q.2931 and SAAL) configurations and statistics
  - ATM statistics, to monitor activity on the network (number of cells, errors, policy violations, etc.)
  - Services for local and remote administration

When you use it in combination with the IBM ATM Campus Manager for AIX, the management of ATM networks is greatly simplified through a graphical application.

5.5 Requirements

To get an ATM system running, certain hardware and software functions must be available.

5.5.1 Hardware Requirements

The minimum system you need for running ATM operations consists of an IBM 8260 Model A17 or A10, an ATM switch/control point module and an ATM concentration module to connect workstations or other switches.

You need an ASCII-type terminal for initial configuration of the ATM subsystem. This terminal is not needed subsequently.

To monitor the power supplies and temperature, you need to have at least one power supply installed and powered up.

A management module is not mandatory to operate the machine, but you ought to have at least one module installed.

If you have an 8260 with only ATM functions (ATM switch/control point module and ATM concentration modules), you do not need to have a DMM because all the ATM configuration and management is done through the ATM switch/control point module. However, installing a DMM is desirable when you need to monitor chassis components, such as power supplies or temperature. Also, a DMM is required if you want to run the Hub Manager Program for AIX V2, and display the hub view with module face-plates.

If you want to manage the 8260 ATM modules and the ATM network from NetView for AIX, you need the IBM ATM Campus Manager for AIX. This program provides you with topology display, resources configuration, statistics display and other value-add functions for management of ATM networks.

The Hub Manager Program for AIX is not required for that purpose.

5.5.1.1 Out-of-Band Download

In case of code update of the ATM switch/control point module through the local console port (out-of-band download), the 8260 Universal Code Download kit should be ordered. This kit is not needed when performing in-band file transfer.

5.5.2 Electronic Customer Support

IBM offers you the capability for remote service support. You need to provide a communication line and an AT COMMAND (V32) compatible modem, such as the IBM 7855 or equivalent, to allow remote maintenance and service. This will provide you with an enhanced service level and increased system availability.

As an alternative, you may provide IBM service personnel with either an ASCII terminal or a PC/PS with VT100 emulation. In normal operation mode, the IBM 8260 does not need the ASCII terminal. If you have a TCP/IP terminal available in the LAN, this can handle the function.

Instead of the above remote access to the 8260, remote access to a RISC System/6000 in the network, with the programs described in 5.5.3, "Software Requirements" on page 260, provides the enhanced serviceability to the IBM 8260 Hub.

5.5.3 Software Requirements

You do not need any mandatory software to operate the 8260 hub. However, we recommend that you install the last versions for the distributed management module (DMM) and for the ATM switch/control point module to have all the latest 8260 products announced recognized by the code. With the 8260 Automatic Update Service (AUS), the updates are automatically sent to you.

The configurators for the Nways 8281 TR/Ethernet ATM LAN Bridge Module and the Nways 8282 ATM Concentrator Module are both designed to run under IBM DOS 5.0, or later, and with IBM TCP/IP for DOS 2.1, or later, or equivalent. The configurators are shipped with the modules.

5.5.4 8260 MIB Installation

To manage your 8260 from an SNMP management station, you have to install the 8260 MIB. It gives you the full benefit from the 8260 SNMP-compliant management information base (MIB) extensions for ATM operations. You may obtain the latest version of the 8260 MIB from a public Internet library. Do as follows:

1. FTP to `venera.isi.edu` or `128.9.0.32`.
2. Enter the login name `anonymous` and the password `guest`.
3. Change to the MIB directory using the `cd /mib` command.
4. List the contents of the directory using the `ls -l` command and use CTRL-S to pause the display to view the available IBM entries.
5. Copy the MIB file to your current directory with the command `get ibm-hub-mib.txt`.
6. Exit FTP with the `quit` command.

If you do not have access to the Internet, contact IBM for assistance.

5.6 IBM 8281 ATM LAN Bridge

The following figure shows the front panel of the 8281 ATM LAN Bridge.

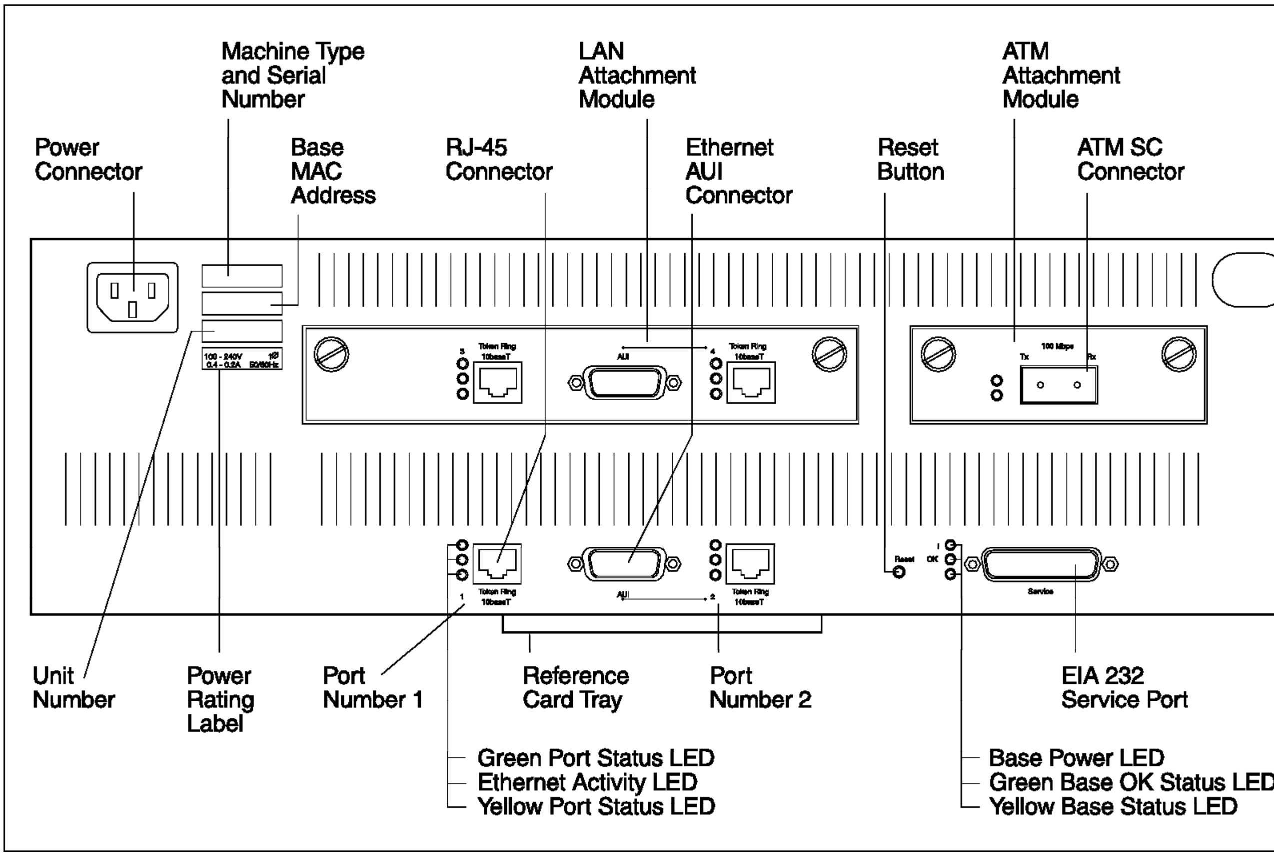


Figure 114. The 8281 Front Panel. The attachment modules are optional.

The ATM bridge provides a transition between traditional LANs, token-ring or Ethernet, and an ATM network. Many networks are close to the limit of current technology. More and more users are attached to local area networks, and network servers are growing in speed and capacity. Use of client/server applications is climbing and delay-sensitive applications such as voice and video put new requirements on your network. Communication expands from a local group to a global interconnection.

The ATM bridge gives you the ability, to phase ATM into your networks in an orderly fashion. Today′s LANs can be interconnected through a high-capacity ATM network. Network servers connects directly to the ATM network. This frees them from the constrains of traditional LAN attachment. Users who need more power are connected with 25 Mbps ATM. Users on traditional LANs gain some of the ATM benefits without disruption by using ATM as a backbone.

Your current applications operate unaltered, and your current LAN infrastructure of workstation adapters, LAN wiring, and LAN concentrators and hubs continue to function without modifications. This gives you the ability to roll out ATM today without installing an interim solution such as FDDI or fast Ethernet.

The ATM bridge is ideal for connecting current LANs with ATM networks. It is designed for very high-traffic applications. Extensive filtering is provided to block unnecessary traffic coming from the attached LANs.

The ATM bridge fully participates in source routing. This allows it to be used in complex token-ring networks, which include source-route bridges and parallel bridges.

The ATM bridge will filter in the token-ring world based on hop-count, MAC address, ring number, source SAP, and SNAP header. For Ethernet, it filters based on MAC address, Source SAP, and Ethertype. This gives the ATM bridge an advantage when compared to simple LAN switches which do not support filtering.

ATM is optional. The ATM bridge is ideal for applications where you need a multiport bridge today and ATM in the future.

Open Enterprise: ATM UNI Specification V3.0 RFC 1213 - MIB II

Because of the difference in frame format, all ATM bridges that share a LAN emulation server have to be configured as the same LAN type (token-ring or Ethernet).

Highlights of the ATM bridge include the following:

- Attaches two or four token-ring or Ethernet LAN segments
- Attaches to an ATM switch at 100 Mbps full-duplex using SC connector and multimode fiber (optional), which allows the bridge to be at a distance of two kilometers
- Supports LAN to LAN over the ATM network
- Supports local bridging between LANs
- Supports bridging LAN to ATM for ATM-attached workstations and servers
- Discovers ATM partners and establishes a connection on an as needed basis (self learning)
- Provides filtering on token-ring and Ethernet LANs
- Supports SNMP network management
- Provides a PC-based configuration tool for configuration management
- Provides front connection with RJ-45 and SC connectors

5.6.1 Hardware Requirements

The ATM bridge requires the LAN emulation server that is shipped with the TURBOWAYS 100 ATM Adapter. The LAN emulation server allows current LAN applications transparent access to an ATM network. These servers provide the MAC-to-ATM address resolution and broadcast capabilities to emulated LANs on the ATM networks. The driver for the LAN emulation server supports either token-ring or Ethernet and is selectively loaded into the LAN emulation server.

5.6.2 Software Requirements

The ATM bridge configurator is designed to run under IBM DOS 5.0 or later and with IBM TCP/IP for DOS 2.1 or later, or equivalent. The configurator is shipped with the ATM bridge.

The ATM bridge supports a maximum of 256 VCs.

See also 5.3.5, “The Nways 8260 TR/Ethernet ATM LAN Bridge Module” on page 254.

5.7 IBM TURBOWAYS 8282 ATM Workgroup Concentrator

The following figure shows the front panel of the 8282 ATM Workgroup Concentrator:

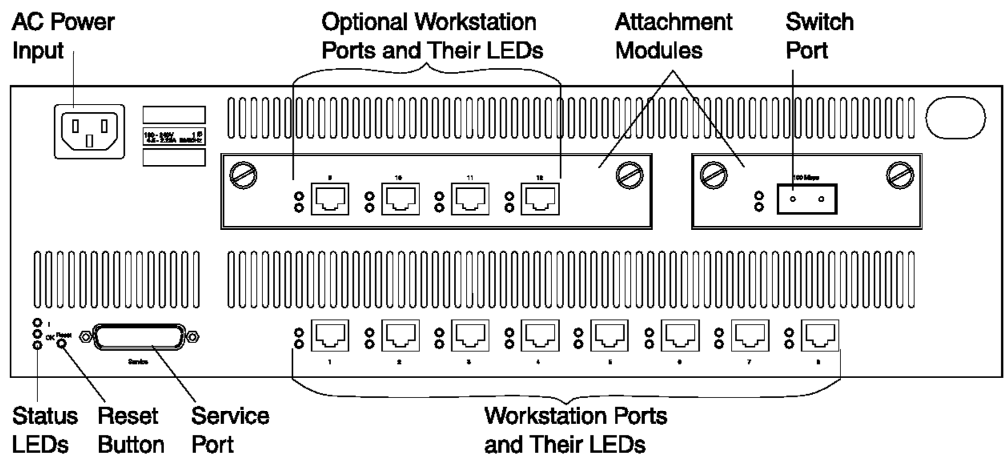


Figure 115. The 8282 Front Panel. This 8282 has the optional 4-port module installed.

The IBM TURBOWAYS 8282 ATM Workgroup Concentrator allows you to connect twelve 25 Mbps ATM devices to 100 Mbps ATM switches. This gives you affordable ATM access to the desktop. When you need higher bandwidth or quick response time, you can easily migrate from your current shared LAN environment to a dedicated ATM environment. You do not need to replace your wiring to the office or change the applications on your workstation. Full-duplex 25 Mbps ATM links provide you with the extra capacity you need.

ATM concentrator highlights include the following:

- Attachment of eight or twelve 25 Mbps full-duplex ATM workstations using existing UTP or STP cables
- Attachment to an ATM Switch at 100 Mbps full duplex using multimode fiber and SC connectors allows the concentrator to be at a distance of two kilometers
- Support of SVC and PVC ATM networks
- Support of SNMP (over IP) and ILMI (SNMP over AAL) network management
- PC-based configuration tool for configuration management
- Rack mounted or free standing unit with front side connectors

The ATM Workgroup Concentrator gives you the link between your workstation ATM requirements and your high-speed ATM network. When you increase your use of client/server applications, you will require improved response time from your LAN network. The 25 Mbps ATM provides the solution for even the most demanding of your users. Your normal end users require high bandwidth for short periods, so you do not need to install a high-speed ATM adapter and dedicate a high-speed ATM switch port for each end user. The ATM workgroup concentrator helps you to optimize your solution by allowing you to install cost-effective full-duplex 25 Mbps ATM adapters in end-user workstations and share a full-duplex 100 Mbps port on the ATM switch.

Open Enterprise: ATM UNI Specification V3.0 RFC 1213 - MIB II RFC 1577 - For SNMP Support

LAN Emulation Only

Workstations using the IBM TURBOWAYS 25 adapters, with its supplied device drivers, can only communicate over ATM with other devices that also participate in LAN emulation. Participation in the emulated LAN can be by an ATM adapter itself or via an 8281 ATM LAN Bridge.

5.8 ATM Adapters

IBM supplies ATM adapters for various products and interfaces. IBM has also expressed the intention to support implementation of ATM on new products. For products not yet available, this information represents IBM′s current intent, and can be subject to change or withdrawal, and represents only goals and objectives.

5.8.1 Workstations and Tabletop

The following adapters are available:

- ATM 155 Mbps for PS/2, RS/6000 and Sun
- ATM 100 Mbps for PS/2 and RS/6000
- ATM 25 Mbps for PS/2, PC/ISA and Sun

5.8.2 3172-003 ATM Adapter

The IBM 3172 Interconnect Controller offers you a cost effective ATM solution for LAN and channel connectivity.

IBM provides the 3172 with an ATM gateway to S/3X0 Host via ESCON or parallel channels. The LAN emulation, which gives your applications transparent access to an ATM network, is handled by the TURBOWAYS 100 Adapter for 3172-003. and its supporting LAN emulation software at 100 Mbps.

This TURBOWAYS 155 Adapter is announced to be available in 1996.

5.8.3 IBM 8271 and IBM 8272 155 Mbps ATM Up-links

The IBM 8271 EtherStreamer Switch Model 108 and the IBM 8272 LANStreamer Switch Model 108 are stand-alone LAN switches which provide a high-performance method for interconnecting LAN segments. LAN switches are becoming important components of networks because they offer you a way to address performance concerns.

IBM will make field-installable 155 Mbps ATM up-links for these streamer switches available.

They will connect your token-ring or Ethernet LAN switches to an 155 Mbps ATM concentration module using multimode fiber cabling and SC connectors at distances up to two kilometers. The 155 Mbps SONET interface is fully ATM Forum compliant.

For both the Ethernet and token-ring switches, IBM will support ATM Forum-compliant LAN emulation. The shipment of these ATM up-links to early support customers is planned for mid 1996.

5.8.4 S/390 OSA

IBM intends to enhance the network connectivity capabilities of the S/390 Open Systems Adapter 2 by providing support for ATM. IBM intends to comply with ATM Forum (UNI) Specification Version 3.1.

IBM intends to provide support for ATM Forum-compliant LAN emulation as well as native ATM support. It is expected that this support will be provided at data rates up to 155 Mbps.

5.8.5 3746

IBM intends to enhance the IBM 3746 Nways Multinetwork Controller (Model 950) and the IBM 3746 Model 900 Network Node to offer solutions responding to the emergence of ATM.

The IBM 3746 Model 950 and Model 900 will provide an ATM interface supporting the frame relay emulation for connection to the Nways switch family and to standard ATM networks.

Appendix A. Adapter Tables

Table 26 on page 270 is an easy-to-use fact sheet providing answers to most of the commonly asked questions concerning shared RAM style IBM token-ring adapters. It should also be useful as an aid in identifying already installed adapters. Most of the information found in this table can be referenced in the individual adapter announcements and *LAN Technical Reference IEEE 802.2 an NetBIOS APIs,* SC30-3587 or *LAN Technical Reference Adapter Interfaces,* SBOF-6221. The following items describe the headings in Table 26 on page 270.

A.1.1 Adapter Name

In most cases, the adapter names used in Table 26 on page 270 and Table 27 on page 272 should be prefixed with the phrase ″IBM Token-Ring Network″. We could not find original boxes for the older adapters and did not have access to boxes for some of the newest adapters which means the names used may be slightly incorrect in certain cases.

A.1.2 Feature Code

IBM Marketing forces use the feature code to identify adapters they wish to order for customers. The feature code must always be accompanied by a machine type or ordering vehicle, which is needed to identify what class of machines the individual feature code will function with. In the case of token-ring adapters, there are three relevant ordering vehicles. One is 8530-ZZZ which is used to order adapters which are used in PC bus or AT/ISA bus PCs and PS/2s. A second is 8550-ZZZ which is used to order adapters used in Micro Channel PS/2s and to order the PCMCIA Credit Card Adapter. A third ordering vehicle is 7551-ZZZ which is used to order the EISA adapter and the 16/4 ISA-16 Adapter.

A.1.3 Part Number

A part number serves the same purpose as the machine type/feature code but tends to be used by IBM dealers as opposed to the direct sales force.

A.1.4 Field Replaceable Unit Number

FRU numbers are used by IBM customer engineers to order replacement adapters for those units which fail. In most cases, the FRU number is a different number than the Part Number. The reason for this is that a Part Number will include an adapter, a set of installation instructions, a diagnostic diskette, and a ″pretty box″. A FRU number will only include an adapter and a ″plain brown wrapper″.

A.1.5 Adapter Speed

This simply identifies the adapter as being either a 4 Mbps adapter or an adapter capable of running at 4 or 16 Mbps (16/4).

A.1.6 Shared ROM Size

At this point in time, all shared RAM adapters produced by IBM use 8 KB for shared ROM. This 8 KB space is divided into two areas called the BIOS area and the MMIO area. The BIOS area is 7.5 KB in size and the MMIO area is .5 KB in size. The BIOS area contains remote IPL initialization code which is executed at power-on if RIPL capability is present on the card and if IPL-able disks are not present in the PC or PS/2. A shared RAM adapter will use the entire 8 K shared ROM area even if RIPL is not used. The MMIO area is a collection of registers which contain information about the adapter such as the interrupt level that the adapter is using and the location of the shared RAM segment.

A.1.7 Shared RAM Size

This field details the amount of available RAM on the card.

A.1.8 RIPL - Remote Initial Program Load

The older token-ring cards required that the customer buy a RIPL PROM to physically add to the card to enable RIPL. The RIPL field gives the feature code of the RIPL PROM for the specific adapter. The newer cards have RIPL built in which negates the need to buy an additional feature.

A.1.9 Bus Type

IBM manufactures adapters for five bus types and/or form factors as of the date of this writing. The following are the supported bus types/form factors:

- PC Bus 8 bit
- AT/ISA Bus 16 bit
- Micro Channel 16 and 32 bit
- PCMCIA Version 2
- EISA 32 bit

A.1.10 Data/Address Lines

This field gives the number of data and address lines present on the card.

A.1.11 Announcement Number

This is simply the number of the original IBM document announcing the adapter. The announcements are an excellent source of reference material for the individual adapters they represent. Items such as supported machine types and supported software can be found in these documents.

A.1.12 Card Length

The primary reason for the card length field is to help customers identify which adapter they are using. Most adapters do not carry distinguishing part numbers. Being able to identify the adapter is sometimes critical when trying to troubleshoot problems concerning IBM token-ring adapters.

A.1.13 RJ-45

This field indicates the presence of an RJ-45 connector on the card in addition to the standard female D-shell, 9-pin connector. Cards equipped with RJ-45 connectors also have built-in media filters suitable for use on 4 Mbps or 16 Mbps LANs.

Table 26. Token-Ring Adapter Summary - Shared RAM Adapters

ADAPTER NAME	F.C.	PART #	FRU #	SPEED (Mbps)	ROM SIZE	RAM SIZE	RIPL F.C.	BUS TYPE	DATA/ ADDR LINES	ANN. #	CARD LENGTH	RJ-45
ADAPTER	3391	6339100	Same as PN	4	8 KB	8 KB	7839	PC	8/20	185-123	13 1/4″	NO
ADAPTER II	5063	67X0438	Same as PN	4	8KB	16KB	7839	PC	8/20	186-066	13 1/4″	NO
	9858 *	25F9858	16F0463				7839			188-204	5 3/8″	
ADAPTER/A	4790 *	69X8138	69X8138	4	8KB	16KB	8881	mC	16/24	187-076	12 1/4″	NO
			39F6479 25F7540								6 1/4″	
16/4 /A	1133	16F1133	16F1144 53F7748 93F0331	16/4	8 KB	64 KB	8881	mC	16/24	188-202	12 1/4″	NO
16/4 /A ″Shorty″	0149 *	74F9410	74F9415	16/4	8 KB	64 KB	ON BOARD	mC	16/24	191-216	6 1/4″	NO
P70	1598	39F9598	39F6479 25F7540	4	8 KB	16 KB	8881	mC	16/24	190-004	6 1/4″	NO
16/4	7367 *	25F7367	25F8884	16/4	8 KB	64 KB	8881	PC	8/20	188-203	7 3/4″	NO
			25F9492 93F0334								5 5/8″	
TAP	5773	96X5773	Same as PN	4	8 KB	16 KB	no support	PC	8/20	187-180	13 1/4″	NO
TAP/A	5774	96X5774	Same as PN	4	8 KB	16 KB	no support	mC	16/24	187-180	12 1/4″	NO
16/4 TAP	5121 *	74F5121	74F5129	16/4	8 KB	64 KB	no support	PC	8/20	190-090	5 5/8″	NO
16/4 TAP/A	5130 *	74F5130	74F5138	16/4	8 KB	64 KB	no support	mC	16/24	190-090	12 1/4″	NO
CREDIT CARD	8072 *	0933462	Same as PN	16/4	8 KB	64 KB	no support	PCMCIA	16/26	192-213	3.4″	NO
16/4 ISA-16	7462 *	73G2032	73G2048	16/4	8 KB	64 KB	ON BOARD	ISA	16/20	193-233	6.8″	YES

Note: * indicates the adapters which are currently available from IBM as of 8/03/93.

A.2 Field Descriptions for Bus Master/DMA Adapters

The field descriptions for the bus master/DMA adapters are the same as the fields for the shared RAM adapters EXCEPT for two fields. The ROM Size and RAM Size fields are replaced by the mCODE and the XMIT/RCV BUFFER RAM fields.

A.2.1 Microcode Level (mCODE)

This field describes the size and nature of the adapter′s microcode. The bus master/A adapter used microcode which came on diskette with the adapter and had to be loaded into a RAM area on the adapter from the PS/2 at IPL time. The newer bus master adapters include the microcode in on board ROM.

A.2.2 Transmit/Receive (xmit/rcv) BUFFER RAM

The Buffer RAM field indicates the amount of RAM on the adapter which is used for transmit and receive buffers.

Table 27. Token-Ring Adapter Summary - Bus Master/DMA Adapters

ADAPTER NAME	F.C.	PART #	FRU #	SPEED (Mbps)	mCODE	xmit/rcv BUFFER RAM	RIPL F.C.	BUS TYPE	DATA/ ADDR LINES	ANN. #	CARD LENGTH	RJ-45
BUSMTR/A	4041	74F4140	74F4149	16/4	loadable 64KB in RAM	64 KB	not supported	mC	16/24	190-208	12 1/4″	NO
16/4 ADAPTER II	5120 *	03F0215	03F0212	16/4	64 KB in ROM	64 KB	ON BOARD	AT/ISA	16/24	192-208	10 3/8″	YES
16/4 ADAPTER II (US GOVT.)	0255 *	03F0255	03F0256	16/4	64 KB in ROM	64 KB	ON BOARD	AT/ISA	16/24	192-208	10 3/8″	YES
LANStreamer MC 32	8942 *	92F8942	92F8941	16/4	64KB in ROM	In PC memory	ON BOARD	mC	32/32	193-056	12 1/4″	YES
LANStreamer MC 16	8998 *	59G8998	59G9965	16/4	64 KB in ROM	In PC memory	ON BOARD	mC	16/24	193-177	8″	YES
EISA	0412 *	63F0412	63F0417	16/4	64 KB in ROM	64 KB	not supported	EISA	32/32	193-178	10.93″	YES

Note: * indicates the adapters which are currently available from IBM as of 8/03/93.

Appendix B. Microcode Level Tables

Table 28 on page 274 and Table 29 on page 275 are lists of known microcode levels for 4 Mbps only and 16/4 adapters respectively. These tables may be useful when trying to identify the ring speed capability of an adapter by querying an adapter from LAN Network Manager and looking at the microcode level. This is useful for customers who are running a 4 Mbps ring and want to upgrade to 16 Mbps but do not know how many adapters are 4 Mbps only and how many are 16/4s. Having that knowledge would let the customer know how many additional 16/4 cards he would need to buy. Be *cautious* because the microcode level will not always tell you whether the card is an AT bus card or a Micro Channel card since both types of cards sometimes use the very same microcode levels. The moral here is to use this table as a rough guide for your card-purchasing estimates. The following are the field descriptions for each table.

B.1.1 Adapter Name

Same as adapter name in Appendix A, "Adapter Tables" on page 267.

B.1.2 Field Replaceable Unit Number

Same as field replaceable unit number in Appendix A, "Adapter Tables" on page 267.

B.1.3 EPROM Part Numbers

In general, the microcode for the adapters is located on a set of two removable EPROMS. Newer adapters use only one EPROM. These EPROMS are marked with part numbers which coincide with a particular level of microcode.

B.1.4 Microcode Level

This is the level of the adapter′s microcode which can be displayed by querying the adapter from LAN Network Manager or by running adapter diagnostics.

Table 28. Token-Ring Adapter Microcode Levels for 4 Mbps Adapters

ADAPTER NAME	FRU #	EPROM P.N.		MICROCODE LEVEL
		EVEN	ODD	
ADAPTER	6339100	6339746	6339747	A33802
		6466910	6466911	A33802B
		61X3822	61X3821	A33802E
		61X3808	61X3809	A33831
		69X7746	69X7745	A33831A
		69X7766	69X7767	A33831B
		69X7770	69X7769	A33831C
		6466674	6466675	A33831D
ADAPTER II	67X0438	67X0390	67X0389	A33842
		6466676	6466677	A33842B
				00 0000 A33842C
	16F0463	96X5736	96X5735	A77525
		16F0542	16F0541	A77525B
		25F8882	25F8883	A77525C
		25F8306	25F8305	00 0000 A78081
		39F7448	39F7447	
		92F5920	92F5921	00 0000 C25179
ADAPTER/A and P70	69X8138	83X7458	83X7457	A58769
		83X7486	83X7485	A58769B
	39F6479			
	25F7540	93F0196	93F0197	00 0001 C25210
		25F9158	25F9157	00 0002 342278A
TAP	96X5773	96X6368	96X6369	A77533
TAP/A	96X5774	96X6372	96X6371	A77534A

Table 29. Token-Ring Adapter Microcode Levels for 16/4 Mbps Adapters

ADAPTER NAME	FRU #	EPROM P.N.		MICROCODE LEVEL
		EVEN	ODD	
16/4 /A	16F1144	25F9532	25F9531	00 0002 342279A
	53F7748	25F9524	25F9523	00 0008 A78064
	53F7748	74F9326	74F9325	00 0000 C24550
	93F0331	92F4538	92F4539	00 0002 C24944
16/4 /A "SHORTY"	74F9415	74F9686	74F9687	00 0010 A79073
	74F9415	60G2484	60G2483	000300 FP1CA3
16/4	25F8884	25F9444	25F9443	00 0002 A77567B
	25F9492	25F9524	25F9523	00 0008 A78064
	25F9492	74F9326	74F9325	00 0000 C24550
	93F0334	92F4538	92F4539	00 0002 C24944
BUS MASTER/A	74F4149	none	none	A78083
16/4 TAP	74F5129	74F3354	74F3353	00 0008 A78064
16/4 TAP/A	74F5138	74F3354	74F3353	00 0008 A78064
16/4 ADAPTER II	03F0212	NONE	U6 03F0297	000C97096C
16/4 ADAPTER II (US GOVT.)	03F0256	none	U6 03F0297	000C97096C
CREDIT CARD	0933462	none	none	000010 A79073
	0933462	none	none	000300 FP1CA3
LANStreamer MC 32	92F8941	none	60G0661	0006 00DB12EH
	92F8941	73G1514	none	0007 00DB13EJ
	92F8941	none	73G5805	0008 00DB14EM
LANStreamer MC 16	59G9965	73G1514	none	0007 00DB13EJ
	59G9965	none	73G5805	0008 00DB14EM
EISA	63F0417			0000 05FM1DA5
16/4 ISA-16	73G2048	73G2042	none	000600 FP1DA2

Appendix C. ISA Adapter Switch Settings

This appendix shows the various switch settings for several token-ring adapters.

C.1 Original Adapter and Adapter II (Feature Codes 3391 and 5063)

Switch settings for the original and Adapter II token-ring cards.

C.1.1 Switch Block Number One

Table 30. Switch Block 1 - ROM Addresses - Switches 1-6

ROM Address	Switch #					
	1	2	3	4	5	6
CC000	off	on	on	off	off	on
DC000	off	on	off	off	off	on

Table 31. Switch Block 1 - Interrupt Levels - Switches 7-8

Interrupt Level	Switch #	
	7	8
2	on	on
3	on	off
6	off	on
7	off	off

C.1.2 Switch Block Number Two

Table 32. Switch Block 2 - Primary or Alternate - Switch 2

Primary or Alternate	Switch #
	2
Primary	off
Alternate	on

Table 33. Switch Block 2 - Factory Settings - Switches 1, 3-8

Factory Settings	Switch #						
	1	3	4	5	6	7	8
Adapter	off	on	off	on	on	on	on
Adapter II	on	on	off	on	on	on	on

C.2 Adapter II (Feature Code 9858)

Table 34. ROM Addresses - Switches 1-6

ROM Address	Switch #					
	1	2	3	4	5	6
C0000	off	on	on	on	on	on
C2000	off	on	on	on	on	off
C4000	off	on	on	on	off	on
C6000	off	on	on	on	off	off
C8000	off	on	on	off	on	on
CA000	off	on	on	off	on	off
CC000	off	on	on	off	off	on
CE000	off	on	on	off	off	off
D0000	off	on	off	on	on	on
D2000	off	on	off	on	on	off
D4000	off	on	off	on	off	on
D6000	off	on	off	on	off	off
D8000	off	on	off	off	on	on
DA000	off	on	off	off	on	off
DC000	off	on	off	off	off	on
DE000	off	on	off	off	off	off

Table 35. Interrupt Levels - Switches 7-8

Interrupt Level	Switch #	
	7	8
2	on	on
3	on	off
6	off	on
7	off	off

Table 36. Primary or Alternate - Switch 9

Primary or Alternate	Switch #
	9
Primary	off
Alternate	on

Table 37 (Page 1 of 2). Shared RAM Size - Switch 10

Shared RAM Size	Switch #
	10
8 KB	on

Table 37 (Page 2 of 2). Shared RAM Size - Switch 10	
Shared RAM Size	**Switch #**
	10
16 KB	off

Table 38. Factory Settings - Switches 11-12		
Factory Settings	**Switch #**	
	11	**12**
Setting (don't change!)	on	on

C.3 16/4 Adapter (Feature Code 7367)

Table 39. ROM Addresses - Switches 1-6

ROM Address	Switch #					
	1	2	3	4	5	6
C0000	off	on	on	on	on	on
C2000	off	on	on	on	on	off
C4000	off	on	on	on	off	on
C6000	off	on	on	on	off	off
C8000	off	on	on	off	on	on
CA000	off	on	on	off	on	off
CC000	off	on	on	off	off	on
CE000	off	on	on	off	off	off
D0000	off	on	off	on	on	on
D2000	off	on	off	on	on	off
D4000	off	on	off	on	off	on
D6000	off	on	off	on	off	off
D8000	off	on	off	off	on	on
DA000	off	on	off	off	on	off
DC000	off	on	off	off	off	on
DE000	off	on	off	off	off	off

Table 40. Interrupt Levels - Switches 7-8

Interrupt Level	Switch #	
	7	8
2	on	on
3	on	off
6	off	on
7	off	off

Table 41. Primary or Alternate - Switch 9

Primary or Alternate	Switch #
	9
Primary	off
Alternate	on

Table 42 (Page 1 of 2). Shared RAM Size - Switches 10-11

Shared RAM Size	Switch #	
	10	11
8 KB	on	on

Table 42 (Page 2 of 2). Shared RAM Size - Switches 10-11		
Shared RAM Size	**Switch #**	
	10	**11**
16 KB	off	on
32 KB	on	off
64 KB	off	off

Table 43. Adapter Data Rate - Switch 12	
16 Mbps or 4 Mbps	**Switch #**
	12
16 Mbps	off
4 Mbps	on

C.4 16/4 Adapter II (Feature Codes 5120 and 0255)

Table 44. I/O Base or RPL ROM Address - Switches 1-3

I/O Base Address	Switch #			RPL ROM Address
	1	2	3	
86A0	on	on	on	C0000
96A0	off	on	on	C4000
A6A0	on	off	on	C8000
B6A0	off	off	on	CC000
C6A0	on	on	off	D0000
D6A0	off	on	off	D4000
E6A0	on	off	off	D8000
F6A0	off	off	off	DC000

Table 45. Interrupt Levels - Switches 4-5

Interrupt Level	Switch #	
	4	5
9	on	on
10	off	on
11	on	off
15	off	off

Table 46. Wait State - Switch 6

Normal or Fast Machine	Switch #
	6
Normal	on
Fast	off

Table 47. Adapter Mode - Switch 7

Normal or Reserved Operation	Switch #
	7
Normal	on
Reserved (don't use this setting!)	off

Table 48. Remote Program Load - Switch 8

RPL - Enable or Disable	Switch #
	8
Enable	off
Disable	on

Table 49. DMA Channel - Switches 9-10		
DMA Channel	**Switch #**	
	9	**10**
5	on	on
6	off	on
7	on	off
not used	off	off

Table 50. Ring Speed - Switch 11	
4 Mbps or 16 Mbps	**Switch #**
	11
4 Mbps	on
16 Mbps	off

Table 51. Cable Type - Switch 12	
STP or UTP	**Switch #**
	12
STP (D-shell, 9-pin connector)	on
UTP (RJ-45 connector)	off

C.5 16/4 ISA-16 Adapter (Feature Code 7462)

Switch settings for the 16/4 ISA-16 Adapter.

C.5.1 Switch Block Number One

Table 52. Switch Block 1 - Cable Type - Switch 1

STP or UTP	**Switch #**
	1
STP (D-shell, 9-pin connector)	on
UTP (RJ-45 connector)	off

Table 53. Switch Block 1 - Remote Program Load - Switch 2

RPL - Enable or Disable	**Switch #**
	2
Enable	on
Disable	off

C.5.2 Switch Block Number Two

Table 54. Switch Block 2 - ROM Addresses - Switches 1-6

ROM Address	**Switch #**					
	1	**2**	**3**	**4**	**5**	**6**
C0000	off	on	on	on	on	on
C2000	off	on	on	on	on	off
C4000	off	on	on	on	off	on
C6000	off	on	on	on	off	off
C8000	off	on	on	off	on	on
CA000	off	on	on	off	on	off
CC000	off	on	on	off	off	on
CE000	off	on	on	off	off	off
D0000	off	on	off	on	on	on
D2000	off	on	off	on	on	off
D4000	off	on	off	on	off	on
D6000	off	on	off	on	off	off
D8000	off	on	off	off	on	on
DA000	off	on	off	off	on	off
DC000	off	on	off	off	off	on
DE000	off	on	off	off	off	off

Table 55. Switch Block 2 - Interrupt Levels - Switches 7-8		
Interrupt Level	**Switch #**	
	7	**8**
2	on	on
3	on	off
6	off	on
7	off	off

Table 56. Switch Block 2 - Primary or Alternate - Switch 9	
Primary or Alternate	**Switch #**
	9
Primary	off
Alternate	on

Table 57. Switch Block 2 - Shared RAM Size - Switches 10-11		
Shared RAM Size	**Switch #**	
	10	**11**
8 KB	on	on
16 KB	off	on
32 KB	on	off
64 KB	off	off

Table 58. Switch Block 2 - Adapter Data Rate - Switch 12	
16 Mbps or 4 Mbps	**Switch #**
	12
16 Mbps	off
4 Mbps	on

C.5.3 Jumper Setting

Table 59. Jumper Setting for 8 or 8/16 Mode	
Jumper Position	**Mode Setting**
1-2	8-bit
2-3	8/16 bit

Appendix D. LAN Adapter Selection Summary

This appendix summarizes the different IBM PC adapters and their uses.

IBM* 16/4 TOKEN-RING ADAPTER HIGHLIGHTS

ADAPTER NAME Part # Single/Multi	BUS TYPE	DATA/ADD. WIDTH	RPL	UTP STD	PRIMARY USE
16/4 ISA-16 Adapter (73G2032/73G2079)	ISA	16/NA	Std	Y	o DOS clients (particularly 802.2 apps[1]), OR o PCs with >16M memory, OR o IBM T-R Bridge Program support
16/4 Adapter II (03F0215/60G0989)	ISA	16/24	Std	Y	o OS/2 clients, servers, and gateways, OR o NetWare** servers
16/4 Adapter/A (74F9410/60G0985)	MC	16/NA	Std	Opt	o DOS clients (particularly 802.2 apps[1]), OR o PCs with >16M memory, OR o IBM T-R Bridge Program support
LANStreamer* MC 16 (59G8998/73G1515)	MC	16/24	Std	Y	o OS/2 clients, low-end servers, and gateways, OR o Low-end NetWare servers o LANStreamer T-R Bridge
LANStreamer MC 32 (92F8942/60G1100)	MC	32/32	Std	Y	o High performance servers, gateways, and clients, OR o PCs with > 16M memory, OR o LANStreamer T-R Bridge
16/4 Busmaster EISA (63F0412/54G2327)	EISA	32/32	N	Y	o High performance servers, gateways, and clients, OR o PCs with >16M memory
Token-Ring Credit Card Adapter (0933462/ N/A)	PCM-CIA	16/NA	N	Opt	o Notebook computers and workstations with PCMCIA Type II slots with Card and Socket Services Release 2

Opt = Optional feature
Std = Standard-no extra cost

UTP STD = UTP shielding included
no external filters needed

(1) 3270 emulation and AS/400 PC Support are examples of 802.2 applications

* Trademark or registered trademark of International Business Machines Corp.
** Registered trademark of the Novell, Inc.

Figure 116. Token-Ring Adapter Summary

IBM* 16/4 TOKEN-RING ADAPTER RECOMMENDED SOLUTIONS

	ISA	MC	EISA	PCMCIA
DOS or Windows** 3.X Clients (1)	16/4 ISA-16 Adapter 73G2032/73G2079	16/4 Adapter/A 74F9410/60G0985	16/4 ISA-16 Adapter 73G2032/73G2079	16/4 Credit Card Adapter 0933462
OS/2* Clients	16/4 Adapter II (2) 03F0215/60G0989	PERF LANStreamer* 32 (> 16MB Memory) 92F8942/60G1100 LANStreamer 16 59G8998/73G1515	16/4 EISA Busmaster 63F0412/54G2327	16/4 Credit Card Adapter 0933462
Servers and Gateways	16/4 Adapter II (2) 03F0215/60G0989	PERF LANStreamer 32 (> 16MB Memory) 92F8942/60G1100 LANStreamer 16 59G8998/73G1515	16/4 EISA Busmaster 63F0412/54G2327	16/4 Credit Card Adapter 0933462
Bridges	16/4 ISA-16 Adapter 73G2032/73G2079	PERF LANStreamer 32 92F8942/60G1100 LANStreamer 16 59G8998/73G1515	16/4 ISA-16 Adapter 73G2032/73G2079	

(1) For applications using NDIS/ODI device drivers, the adapters recommendedfor OS/2 clients will provide improved performance
(2) Supports 16MB memory or less
NOTE: When 2 part numbers are given, first is single-pack, second multi-pack

Figure 117. Token-Ring Adapter Selection

IBM ETHERNET ADAPTER HIGHLIGHTS

ADAPTER NAME (Part# Single/Multi)	BUS	DATA/ADD WIDTH	RPL	MEDIA	PRIMARY USE
LAN Adapter for Ethernet TP (60G0605/60G1576)	ISA	8 or 16/ NA	Y	10BaseT	o Lowest cost solution for customers with 10Base-T Ethernet networks.
LAN Adapter for Ethernet CX (60G0615/60G1579)	ISA	8 or 16/ NA	Y	10Base2	o Lowest cost solution for customers with 10Base-2 Ethernet networks.
LAN Adapter for Ethernet (48G7169/60G0740)	ISA	8 or 16/ NA	Y	10BaseT 10Base2 AUI	o For customers that desire the flexibility of having support for all Ethernet media types.
LAN Adapter/A for Ethernet (48G7171/60G0745)	MC	16 or 32/ NA	Y	10BaseT 10Base2 AUI	o Workstation adapter for customers with MicroChannel machines.
EtherStreamer* MC Adapter (59G9066/60G3310)	32 MC	32/32	N	10BaseT 10Base2 AUI	o High-performance adapter for servers and workstations running high I/O applications.
Ethernet Credit Card Adapter (0933290/ N/A) (0933280/ N/A)	PCMCIA	16/NA	N	10BaseT 10Base2	o Notebook computers and workstations with PCMCIA Type II slots with Card and Socket Services Release 2

Figure 118. Ethernet Adapter Comparison

Appendix E. Special Notices

This publication is intended to help customers, systems engineers, services specialists, and marketing specialists understand LANs and IBM LAN solutions and architectures for planning and support purposes. The information in this publication is not intended as the specification of any programming interfaces that are provided by the products mentioned in this book. See the PUBLICATIONS section of the IBM Programming Announcement for IBM LAN products for more information about what publications are considered to be product documentation.

References in this publication to IBM products, programs or services do not imply that IBM intends to make these available in all countries in which IBM operates. Any reference to an IBM product, program, or service is not intended to state or imply that only IBM′s product, program, or service may be used. Any functionally equivalent program that does not infringe any of IBM′s intellectual property rights may be used instead of the IBM product, program or service.

Information in this book was developed in conjunction with use of the equipment specified, and is limited in application to those specific hardware and software products and levels.

IBM may have patents or pending patent applications covering subject matter in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to the IBM Director of Licensing, IBM Corporation, 500 Columbus Avenue, Thornwood, NY 10594 USA.

The information contained in this document has not been submitted to any formal IBM test and is distributed AS IS. The information about non-IBM (″vendor″) products in this manual has been supplied by the vendor and IBM assumes no responsibility for its accuracy or completeness. The use of this information or the implementation of any of these techniques is a customer responsibility and depends on the customer′s ability to evaluate and integrate them into the customer′s operational environment. While each item may have been reviewed by IBM for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. Customers attempting to adapt these techniques to their own environments do so at their own risk.

The following terms are trademarks of the International Business Machines Corporation in the United States and/or other countries:

AIX	AnyNet
APPN	ARTour
AS/400	AT
DatagLANce	ESCON
EtherStreamer	Extended Services
Extended Services for OS/2	HelpCenter
IBM	LAN Distance
LANStreamer	NetFinity
NetView	Nways
Operating System/2	OS/2
OS/400	Personal Computer AT
Personal System/2	PowerPC
Presentation Manager	PS/ValuePoint
PS/2	RISC System/6000

RS/6000	S/390
Streamer	SystemView
System/36	Trouble Ticket
TURBOWAYS	Ultimedia
ValuePoint	VM/ESA
400	

The following terms are trademarks of other companies:

C-bus is a trademark of Corollary, Inc.

PC Direct is a trademark of Ziff Communications Company and is used by IBM Corporation under license.

UNIX is a registered trademark in the United States and other countries licensed exclusively through X/Open Company Limited.

Microsoft, Windows, and the Windows 95 logo are trademarks or registered trademarks of Microsoft Corporation.

Advantis	Advantis
Apple, AppleTalk, EtherTalk, LocalTalk, Macintosh, TokenTalk	Apple Computer, Incorporated
ARCnet	Datapoint Corporation
AT&T	American Telephone and Telegraph Company
Attachmate	Attachmate Corporation
Banyan	Banyan Systems, Incorporated
Cisco	Cisco Systems, Incorporated
Compaq	Compaq Computer Corporation
DCE	The Open Software Foundation
DEC, DECnet, Digital, VT100	Digital Equipment Corporation
EtherLink, NDIS, 3Com	3Com Corporation
Hewlett-Packard	Hewlett-Packard Company
HP	Hewlett-Packard Company
HYPERchannel	Network Systems Corporation
IDNX	Network Equipment Technologies, Incorporated
Intel, i960, Pentium, 386, 486, 80386	Intel Corporation
IPX, LANalyzer, NetWare, NetWire, NE2000, Novell, SFT	Novell, Incorporated
LANtastic	Artisoft, Incorporated
Lotus, Lotus Notes	Lotus Development Corporation
Mobitex	Televerket
MS, MS-DOS	Microsoft Corporation
Network File System, NFS, Solaris, Sun, SunOS	Sun Microsystems Incorporated
NT	Northern Telecom Limited or Microsoft Corporation
OpenView	Hewlett-Packard Company
Prodigy	Prodigy Services Company
Proteon	Proteon, Incorporated
QEMM	Quarterdeck Office Systems
Qualitas	Qualitas
Quarterdeck	Quarterdeck Corporation
SCO	The Santa Cruz Operation, Incorporated
Sniffer Network Analyzer	Network General Corporation
SPARCstation	SPARC International, Incorporated
SynOptics	SynOptics Communication Incorporated
Toshiba	Toshiba Corporation
VESA	Video Electronics Standards Association

Wellfleet	Wellfleet Communications, Incorporated
X/Open	X/Open Company Limited
Xerox	Xerox Corporation
386MAX	Qualitas, Incorporated

Other trademarks are trademarks of their respective companies.

Appendix F. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

F.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see “How To Get ITSO Redbooks” on page 297.

- *Installation Guidelines for the IBM Token-Ring Network Products*, GG24-3291-02 (available on CD-ROM, SK2T-6022)
- *IBM 8250 Intelligent Hub and IBM Hub Management Program/6000*, GG24-4033-00
- *FDDI Concepts and Products*, GG24-3865-00
- *High-Speed Networking Technology: An Introductory Survey*, GG24-3816-01 (available on CD-ROM, SK2T-6022)
- *IBM Workgroup Hubs and Switches*, GG24-2528-00
- *8260 Multiprotocol Intelligent Switching Hub*, GG24-4370-0
- *IBM 2220 Nways BroadBand Switch: Concepts and Products*, GG24-4307-00
- *Asynchronous Transfer Mode (ATM) Technical Overview*, SG24-4625-00

A complete list of International Technical Support Organization publications, known as redbooks, with a brief description of each, may be found in:

International Technical Support Organization Bibliography of Redbooks, GG24-3070.

F.2 Other Publications

This publication is also relevant as a further information source:

- *Internetworking with TCP/IP Volume I: Principles, Protocols, and Architecture*, SC31-6144

How To Get ITSO Redbooks

This section explains how both customers and IBM employees can find out about ITSO redbooks, CD-ROMs, workshops, and residencies. A form for ordering books and CD-ROMs is also provided.

This information was current at the time of publication, but is continually subject to change. The latest information may be found at URL `http://www.redbooks.ibm.com/redbooks`.

How IBM Employees Can Get ITSO Redbooks

Employees may request ITSO deliverables (redbooks, BookManager BOOKs, and CD-ROMs) and information about redbooks, workshops, and residencies in the following ways:

- **PUBORDER** — to order hardcopies in United States
- **GOPHER link to the Internet**

  Type `GOPHER.WTSCPOK.ITSO.IBM.COM`
- **Tools disks**

  To get LIST3820s of redbooks, type one of the following commands:

  ```
  TOOLS SENDTO EHONE4 TOOLS2 REDPRINT GET SG24xxxx PACKAGE
  TOOLS SENDTO CANVM2 TOOLS REDPRINT GET SG24xxxx PACKAGE (Canadian users only)
  ```

  To get lists of redbooks:

  ```
  TOOLS SENDTO WTSCPOK TOOLS REDBOOKS GET REDBOOKS CATALOG
  TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET ITSOCAT TXT
  TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET LISTSERV PACKAGE
  ```

  To register for information on workshops, residencies, and redbooks:

  ```
  TOOLS SENDTO WTSCPOK TOOLS ZDISK GET ITSOREGI 1996
  ```

  For a list of product area specialists in the ITSO:

  ```
  TOOLS SENDTO WTSCPOK TOOLS ZDISK GET ORGCARD PACKAGE
  ```
- **Redbooks Home Page on the World Wide Web**

  `http://w3.itso.ibm.com/redbooks/redbooks.html`
- **IBM Direct Publications Catalog on the World Wide Web**

  `http://www.elink.ibmlink.ibm.com/pbl/pbl`

  IBM employees may obtain LIST3820s of redbooks from this page.
- **ITSO4USA category on INEWS**
- **IBM Bookshop** — send orders to:

  USIB6FPL at IBMMAIL or DKIBMBSH at IBMMAIL
- **Internet Listserver**

  With an Internet E-mail address, anyone can subscribe to an IBM Announcement Listserver. To initiate the service, send an E-mail note to `announce@webster.ibmlink.ibm.com` with the keyword `subscribe` in the body of the note (leave the subject line blank). A category form and detailed instructions will be sent to you.

How Customers Can Get ITSO Redbooks

Customers may request ITSO deliverables (redbooks, BookManager BOOKs, and CD-ROMs) and information about redbooks, workshops, and residencies in the following ways:

- **IBMLINK**

  Registered customers have access to PUBORDER to order hardcopy, to REDPRINT to obtain BookManager BOOKs

- **IBM Bookshop** — send orders to:

  usib6fpl@ibmmail.com (United States)
  bookshop@dk.ibm.com (Outside United States)

- **Telephone orders**

1-800-879-2755	Toll free, United States only
(45) 4810-1500	Long-distance charge to Denmark, answered in English
(45) 4810-1200	Long-distance charge to Denmark, answered in French
(45) 4810-1000	Long-distance charge to Denmark, answered in German
(45) 4810-1600	Long-distance charge to Denmark, answered in Italian
(45) 4810-1100	Long-distance charge to Denmark, answered in Spanish

- **Mail Orders** — send orders to:

IBM Publications	IBM Direct Services
P.O. Box 9046	Sortemosevej 21
Boulder, CO 80301-9191	DK-3450 Allerød
USA	Denmark

- **Fax** — send orders to:

1-800-445-9269	Toll-free, United States only
45-4814-2207	Long distance to Denmark

- **1-800-IBM-4FAX (United States only)** — ask for:

  Index # 4421 Abstracts of new redbooks
  Index # 4422 IBM redbooks
  Index # 4420 Redbooks for last six months

- **Direct Services**

  Send note to `softwareshop@vnet.ibm.com`

- **Redbooks Home Page on the World Wide Web**

  `http://www.redbooks.ibm.com/redbooks`

- **IBM Direct Publications Catalog on the World Wide Web**

  `http://www.elink.ibmlink.ibm.com/pbl/pbl`

- **Internet Listserver**

  With an Internet E-mail address, anyone can subscribe to an IBM Announcement Listserver. To initiate the service, send an E-mail note to `announce@webster.ibmlink.ibm.com` with the keyword `subscribe` in the body of the note (leave the subject line blank). A category form and detailed instructions will be sent to you.

IBM Redbook Order Form

Please send me the following:

Title	Order Number	Quantity

- **Please put me on the mailing list for updated versions of the IBM Redbook Catalog.**

First name Last name

Company

Address

City Postal code Country

Telephone number Telefax number VAT number

- Invoice to customer number
- Credit card number

Credit card expiration date Card issued to Signature

We accept American Express, Diners, Eurocard, Master Card, and Visa. Payment by credit card not available in all countries. Signature mandatory for credit card payment.

DO NOT SEND CREDIT CARD NUMBERS OVER THE INTERNET.

Index

Special Characters

Numerics

A

B

C

F

G

H

I

J

L

M

N

O

P

Q

R

S

W

X

Printed in U.S.A.

SG24-4754-00