IBM

Token-Ring Network

**Telephone Twisted-Pair
Media Guide**

GA27-3714-4

IBM

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Telephone Twisted-Pair Media Guide

Federal Communications Commission (FCC) Statement

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Instructions to User: If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the computer with respect to the receiver.
- Move the computer away from the receiver.
- Plug the computer into a different outlet so that computer and receiver are on different branch circuits.

Properly shielded and grounded cables and connectors must be used for connection to peripherals in order to meet FCC emission limits. Proper cables are available from IBM authorized dealers. IBM is not responsible for any radio or television interference caused by using other than recommended cables or by unauthorized modifications to this equipment. It is the responsibility of the user to correct such interference.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

How to Identify and Resolve Radio-TV Interference Problems

This booklet is available from the following:

Consumer Assistance and   FOB Public Contact Branch
Small Business Division   Room 725
Room 254   1919 M St. NW
1919 M St. NW   Washington, DC 20554
Washington, DC 20554   Tele (202) 634-1940
Tele (202) 632-7000

Note: This product is intended for use within a single establishment and within a single, homogeneous user population. For sensitive applications requiring isolation from each other, management may wish to provide isolated cabling or to encrypt the sensitive data before putting it on the network.

Fifth Edition (December 1987)

This major revision obsoletes GA27-3714-3. Changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

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Preface

This manual describes how to plan and install an IBM Token-Ring Network that uses telephone twisted-pair media to connect attaching devices to the network.

By reading this manual, the user will learn:

- How to plan and implement a single-ring network using telephone twisted-pair media

- The functions of the special components needed for IBM Token-Ring Networks using telephone twisted-pair media

- How to use IBM 8218 Copper Repeaters and IBM 8219 Optical Fiber Repeaters in rings with telephone wire lobes

- How to connect rings together using bridges to form multiple-ring networks

- How to connect IBM 3720 and 3725 Communication Controllers and 3174 Subsystem Control Units to telephone twisted-pair-based rings

- The guidelines for new and existing installations of telephone twisted-pair media intended for use with network components

- IBM Cabling System Type 3 Media Specifications

- Recommended physical layouts for networks using telephone twisted-pair media

- How to find and correct media problems in lobes using telephone wire.

By following these planning and installation procedures, the user's network will be completely documented for both installation and subsequent changes and maintenance functions.

Audience

The audience is executive management, network project planners, consultants, and designer/installers.

The manual's user does not need any data processing or network operations knowledge other than an understanding of the information contained in the *IBM Cabling System Planning and Installation Guide*, GA27-3361. However, the assistance of a designer/installer familiar with telephony installations may be required to help qualify existing wiring for use with the IBM Token-Ring Network, to plan a new installation of telephone twisted-pair media for use with the network, or to perform problem determination.

Related Publications

IBM publications that may be useful in planning an IBM Token-Ring Network are:

* *IBM Token-Ring Network Introduction and Planning Guide*, GA27-3677

  This manual provides additional information about the network and a section on reconfiguring a network.

* *IBM Cabling System Planning and Installation Guide*, GA27-3361

  This manual provides detailed instruction for planning and installing IBM Cabling System cabling and associated racks, faceplates, and patch cables.

* *IBM Token-Ring Network Optical Fiber Cable Options*, GA27-3747

  This manual describes how to qualify other types of optical fiber cable other than IBM Cabling System type 5 cable for use with the IBM Token-Ring Network.

* *A Building Planning Guide for Communication Wiring*, G320-8059.

  This manual helps you plan for new installations of building cabling and wiring closet areas.

Summary of Changes

An assembly procedure for the type B data connector has been added to the "Grounding a Network Not Using Equipment Racks" section in Chapter 4.

The performance information has been removed, and various other technical changes have been made throughout the manual as indicated by a vertical bar to the left of the change.

Contents

Figures

Chapter 1. Understanding the IBM Token-Ring Network

IBM Token-Ring Network Operation

ring. A network configuration where a series of devices are connected by unidirectional transmission links to form a closed path.

attaching device. Any device equipped with an adapter that is physically attached to the ring.

adapter. The circuit card within an attaching device (along with its associated software) that enables the device to be attached to a network.

token. A unique bit sequence that is passed along a network from one adapter to another.

frame. The unit of transmission in the IBM Token-Ring Network. A frame is created when a token has data appended to it by an adapter.

baseband system. A data transmission system in which information is encoded, multiplexed, and transmitted without modulation of a carrier.

The IBM Token-Ring Network is a star-wired *ring* that when used with IBM Cabling System Type 3 Specified Media,[1] allows you to connect up to 72 *attaching devices* (printers, processors, controllers) per ring through specially designed *adapters* installed in the attaching devices. The attaching device interfaces with the adapter to use the ring for sending and receiving data. The attaching device tells the adapter that it wants to send a message to another attaching device. The adapter places the message, the sender's address, and the recipient's address on a *token* circulating around the ring. The token then becomes a *frame.*

The recipient's address on the frame tells each adapter on the ring whether or not the message contained on the frame is intended for it. If it is, the adapter passes the information on the frame to its attaching device and indicates on the frame that the message has been received. Then the frame continues around the ring until it returns to the adapter that put the information on it. After that adapter checks the information on the frame to assure that it has not been corrupted, it releases a new token on the ring.

The IBM Token-Ring Network is a *baseband system* that permits only one token or frame on the ring at a time. Messages are transmitted and received at a rate of 4 megabits per second. All normal network operations are performed without user intervention once the message has been directed to the adapter. The operator of the attaching device does not have to be aware of routing and protocol procedures.

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[1] This is IBM's term for the version of telephone twisted-pair media recommended for use with the IBM Token-Ring Network. See page 1-18 or Appendix A for the media specifications.

The Serially Wired Ring

work area. An area in which attaching devices are located.

A network that has been wired like the serially wired ring shown in the following figure presents problems in expansion, reconfiguration, and reliability. Because all *work areas* are wired into the ring path, installing a new workstation requires new cabling. Removing workstations due to changing needs or operational problems is equally complex. Any disabling error in the operation of the network affects all users and cannot be easily bypassed while the problem is being repaired. Since there is no central point where all the wiring meets, problems are distributed evenly around the ring. Repair personnel are forced to walk around the ring to find them.
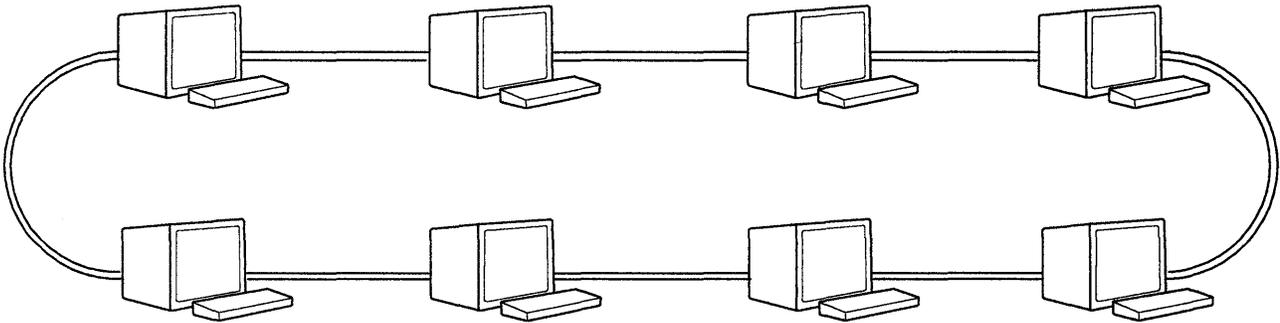
The Star-Wired Ring

wiring concentrator. A lobe concentrator that allows a number of attaching devices access to the ring at a central point such as a wiring closet or in an open work area. IBM Token-Ring Network wiring concentrators are called *access units.*

lobe. The section of cabling between an attaching device and a wiring concentrator (access unit).

A star-wired ring retains the logical flow of data of a serially wired ring while avoiding some of the serially wired ring's limitations. A star-wired ring places a *wiring concentrator* (called an access unit) on the ring to provide access to the network for a number of attaching devices at a single point even though the devices may be scattered about the establishment.

The star-wired arrangement minimizes the distance around the network when only a few attaching devices are using it by bypassing offline devices and their *lobes*. Furthermore, since the lobes all go to access units in central locations, adding new attaching devices, moving existing ones to new locations, or bypassing segments that need repair do not affect the operation of the rest of the network.

When the attaching device wants to gain access to the ring to send or receive messages, the adapter tells the access unit that it wants access to the ring. The access unit then makes the lobe part of the network. The following figure illustrates the change in the wiring path that occurs when an attaching device becomes part of the network.
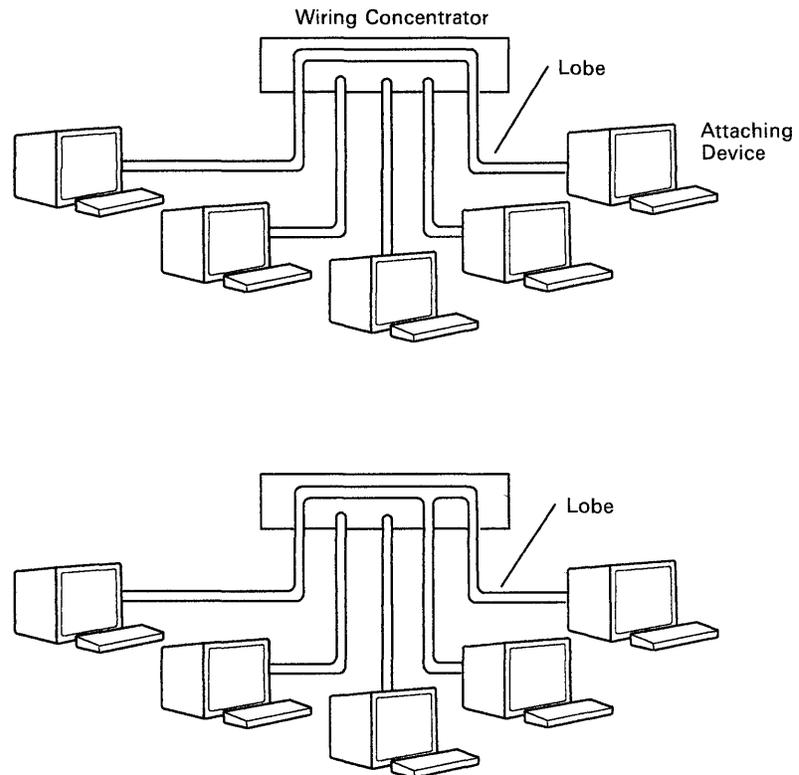
IBM Token-Ring Networks using telephone twisted-pair media for lobe wiring are extremely flexible. All work areas in the building can have IBM Cabling System Type 3 Specified Media installed from work areas to *wiring closets.* IBM Cabling System type 1 cables, which are required between wiring closets spanned by a single ring, can be put into place. As your establishment's needs change, modifying your network to meet the new needs is simple.

In some situations, such as in areas of high electromagnetic interference or for longer lobe lengths, it may be desirable to use IBM Cabling System data grade media wiring for a few of the lobes on a telephone twisted-pair ring. Specific restrictions for doing this are described in Chapter 2, including the requirement that each of the data grade media lobes use the Data Grade Media-to-Type 3 Filter described later in this chapter.

Since the data connectors used with IBM copper cables in the main ring path are self-shorting, disconnecting any data connector in the system causes the signal to "wrap around" and travel on the backup path provided in all IBM Cabling System copper cables.

IBM Token-Ring Network Components

The following components are currently available for use with your IBM Token-Ring Network.

IBM Token-Ring Network Adapters

IBM Token-Ring Network Adapters are required for attaching devices to a ring. Since a broad range of IBM products are supported for use in the Token-Ring Network, you should consult the attaching device's documentation for adapter requirements. Your IBM representative can also assist you in selecting adapters suited to your needs.

IBM Token-Ring Network 8228 Multistation Access Unit

The IBM 8228 Multistation Access Unit is an eight-lobe wiring concentrator that can be installed in a rack in a wiring closet or in a component housing that has been wall-mounted or placed on a shelf or table. Each IBM 8228 allows up to eight attaching devices to have access to a ring. The IBM 8228 does not require an external power source for its operation.

IBM 8228s can be operated in an environment with a temperature range of 10 to 40.6°C (50 to 105°F) with relative humidity ranging from 8 to 80%. The wet bulb temperature should not exceed 26.7 °C (80°F). A single IBM 8228 forms a star-wired network as shown below.
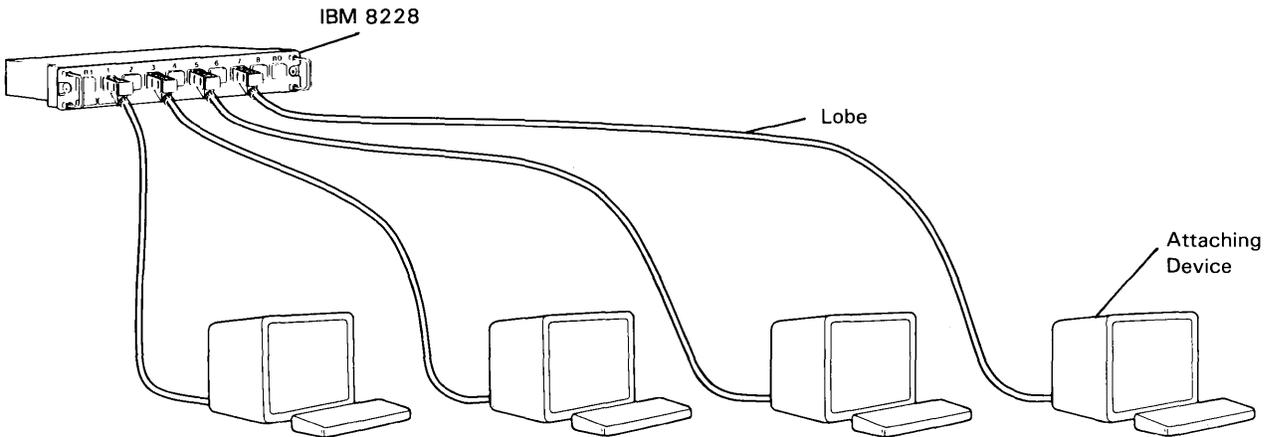
IBM 8228s can be linked together to form rings that are larger than eight lobes by attaching the Ring Out (RO) receptacle of one 8228 to the Ring In (RI) receptacle of another 8228, as shown below.
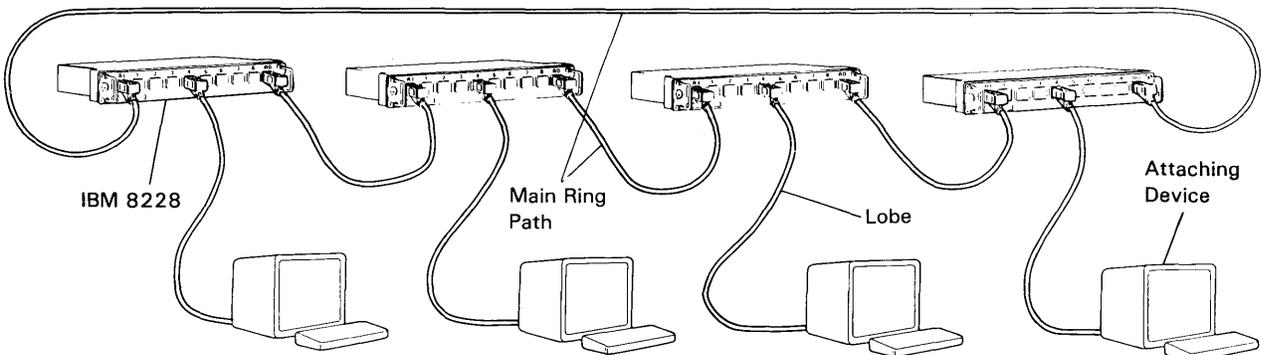
Component Housing

The component housing is used to protect the 8228 when it is installed in a work area or permanently mounted on a shelf or table. The housing also provides cable management brackets and an area for labeling connections.

IBM 8228

254 mm
(10 in.)

305-1067 mm
(12-42 in.)
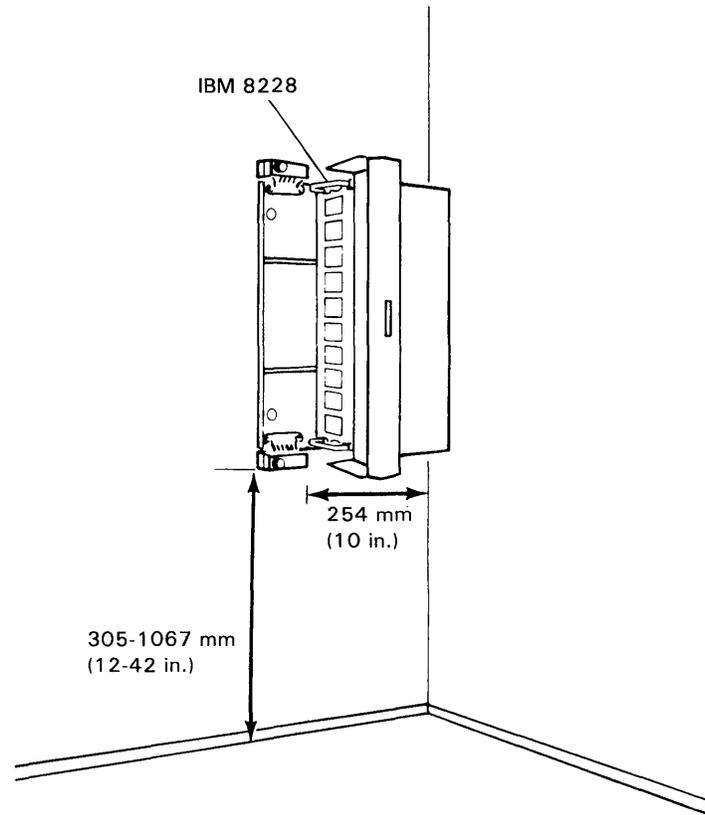
IBM Token-Ring Network 8218 Copper Repeater

The IBM 8218 Copper Repeater is a copper wire-to-copper wire repeater that allows an IBM Token-Ring Network to cover a larger geographic area than a similar network without repeaters. The 8218 is installed in pairs on the cables between wiring closets to compensate for signal loss caused by the cables and Multistation Access Units in the signal path. IBM 8218s can be installed in an equipment rack using an optional rack mounting assembly or on a flat surface using an optional surface mounting bracket.
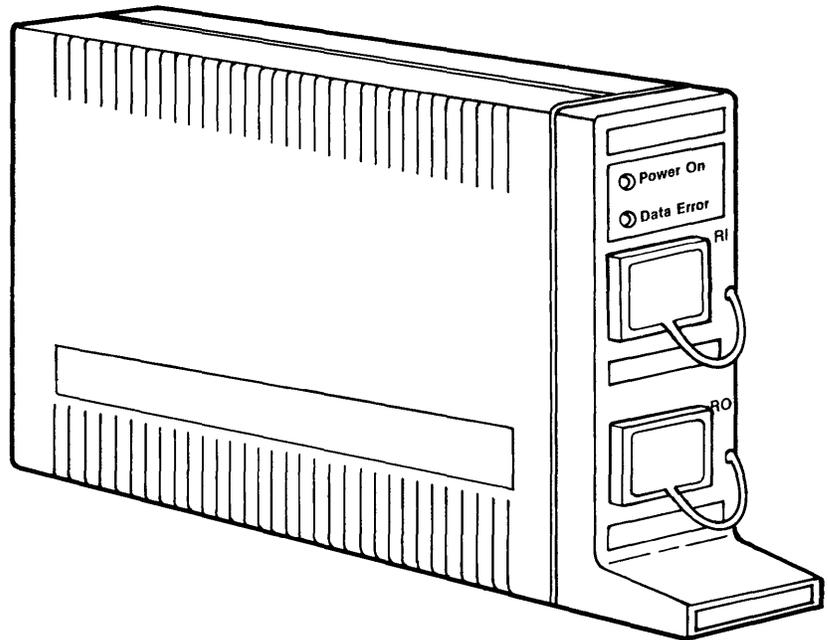
IBM Token-Ring Network 8219 Optical Fiber Repeater

The IBM 8219 Optical Fiber Repeater allows the IBM Token-Ring Network to use optical fiber cables between wiring closets as a means of increasing the geographical coverage of the network. The IBM 8219 converts the network signal from an electrical pulse on copper wire to an optical signal on optical fiber cable. It also converts the optical signal back to an electrical pulse when the transmission medium changes from optical fiber cable to copper wire. IBM 8219s can be installed in an equipment rack using an optional rack mounting assembly or on a flat surface using an optional surface mounting bracket.

The 8219 can be used with IBM Cabling System type 5, type 5 Japanese (J), type 5 riser (R), and type 5 outdoor (OD) optical fiber cables. For information about using the 8219 with cables other than IBM Cabling System type 5, type 5 J, type 5 R, and type 5 OD optical fiber cables, see *IBM Token-Ring Network Optical Fiber Cable Options*.
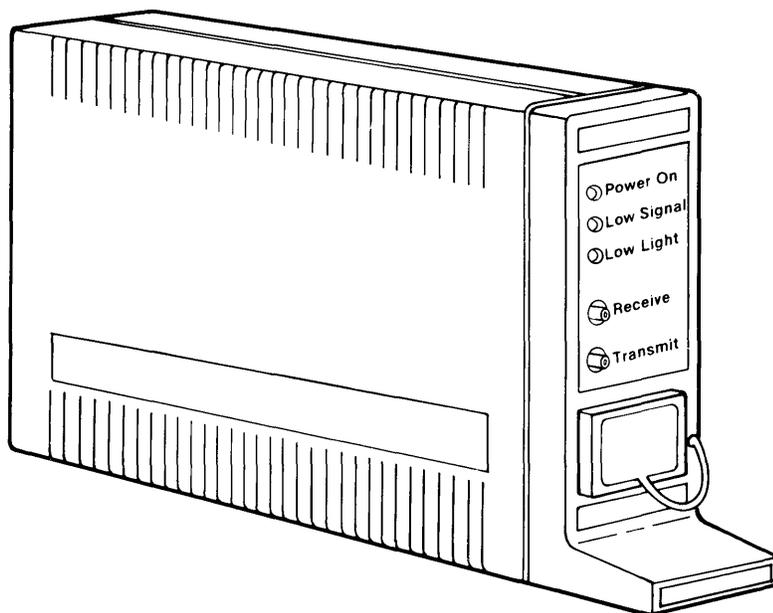
Surface Mounting Bracket
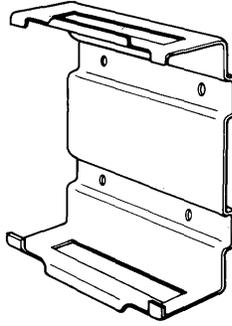
This bracket is used to install IBM 8218s or 8219s on a wall in cases where the seven-slot rack mounting assembly is not needed. The bracket comes with a separate optical fiber mounting bracket for use with optical fiber cables when installing an IBM 8219.

Rack Mounting Assembly
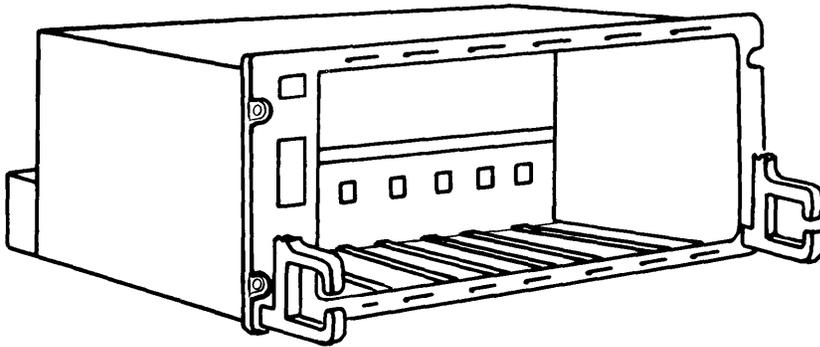
This assembly is used to install up to seven IBM 8218s or 8219s in any combination in a standard 483-millimeter (19-inch) equipment rack. The assembly provides electrical power to all of the 8218s or 8219s that are installed in it.

Note: The rack mounting assembly should be installed at the bottom of the rack. No other powered device should occupy the same rack. If you require two rack mounting assemblies in the same rack, you should leave an unobstructed space of 152 millimeters (6 inches) between the two rack mounting assemblies.

Crossover Patch Cable
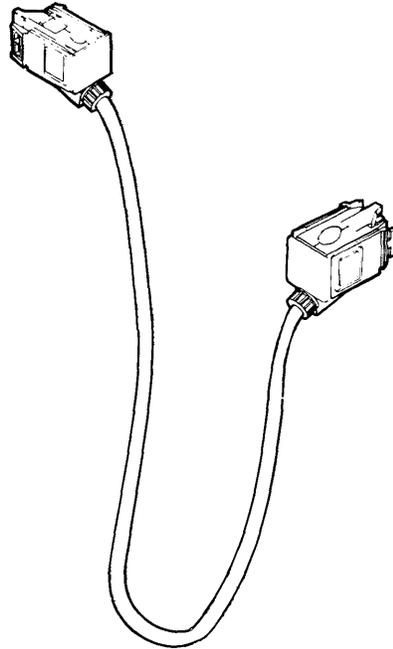
The crossover patch cable is a specially designed cable used with two IBM 8218s or IBM 8219s to provide repeating capability for the backup path. The crossover patch cable is 2.4 meters (8 feet) long. The cables are yellow to distinguish them from ordinary (black) patch cables. The crossover patch cable cannot be repaired in the field. Use of crossover patch cables with IBM 8218 Copper Repeaters and IBM 8219 Optical Fiber Repeaters is described in Chapter 5 of this manual.

Crossover patch cables (IBM Specification 6339137) are not available from IBM. Contact your IBM representative or local branch office for a list of suppliers of this part.

Optical Fiber BNC-to-Biconic Patch Cables
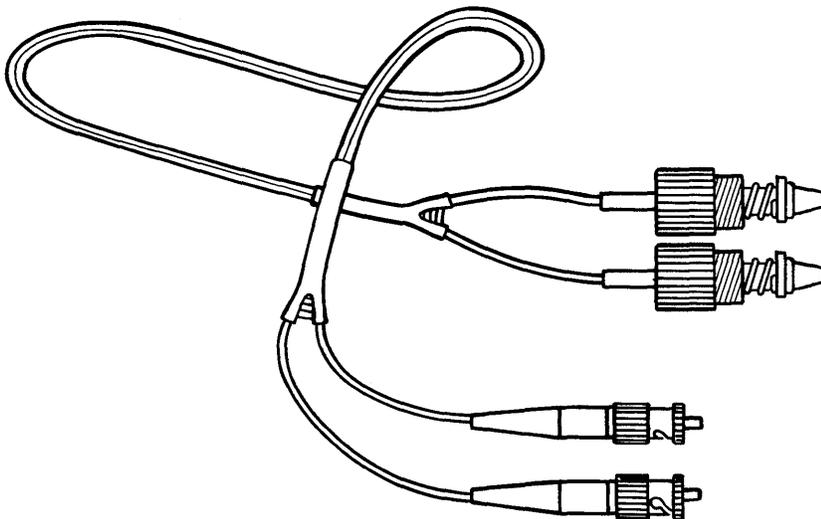
These specially designed patch cables are used to connect the IBM 8219 to IBM Cabling System type 5 optical fiber cable at a distribution panel or to a strain relief mounting bracket. The cable is 2.4 meters (8 feet) long. The ends of the cables that attach to the 8219 are color-coded with black and orange heat shrink tubing to distinguish the two optical fibers in the cable.

Optical fiber BNC-to-biconic patch cables (IBM Specification 6165811) are not available from IBM. Contact your IBM representative or local branch office for a list of suppliers of this part.

Optical Fiber Biconic-to-Biconic Patch Cables
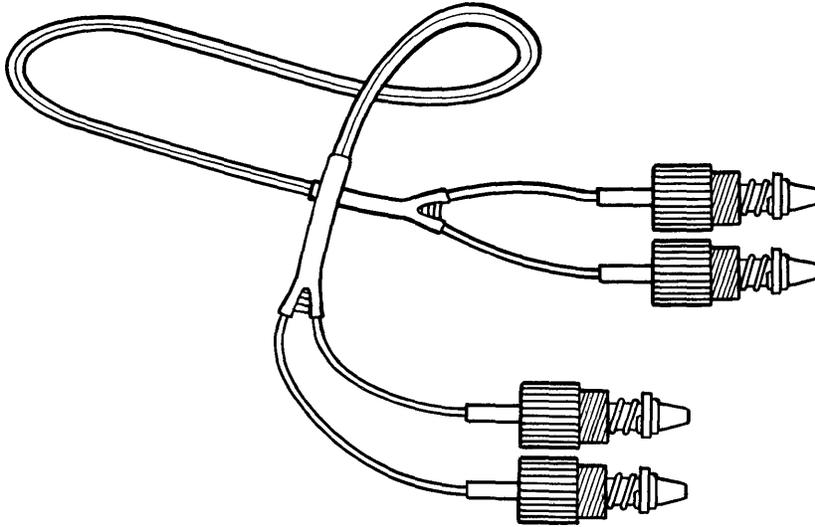
These patch cables are used to connect any two pieces of IBM Cabling System type 5 optical fiber cables at a distribution panel. These cables are available in two lengths: 2.4 meters (8 feet) and 14 meters (45 feet). The connectors are color-coded orange and black to distinguish between the two optical fibers in the cable.

Optical fiber biconic-to-biconic patch cables (IBM Specification 6165812 and 6165813) are not available from IBM. Contact your IBM representative or local branch office for a list of suppliers of this part.

Optical Fiber Dual Socket Clip
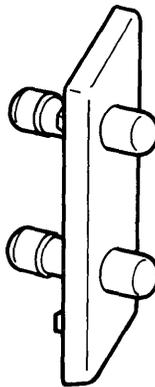
This device is used to adapt the distribution panel connector slots for use with optical fiber cable biconic connectors rather than the standard IBM Cabling System data connector. It is also used with the strain relief mounting bracket supplied with the surface mounting assembly.

The optical fiber dual socket mounting clip (IBM Specification 6165847) is not available from IBM. Contact your IBM representative or local branch office for a list of suppliers of this part.

Type 3 Media Filter

This component consists of a filter housed in a 9-pin D-connector, 2.4 meters (8 feet) of two-twisted-pair telephone wire and a 6-pin modular plug. It is used to connect an IBM Personal Computer, or equivalent, or an IBM 3174 Model 3R, 53R, or 1L with the 3270 Gateway feature to a 6- or 8-pin modular jack. The low-pass filter in the D-connector limits the amount of radiated electrical energy to meet FCC regulations. The Type 3 Media Filter (IBM Specification 6466941) is not available from IBM. Consult your IBM representative or local branch office for a list of suppliers of this part.

Data Label
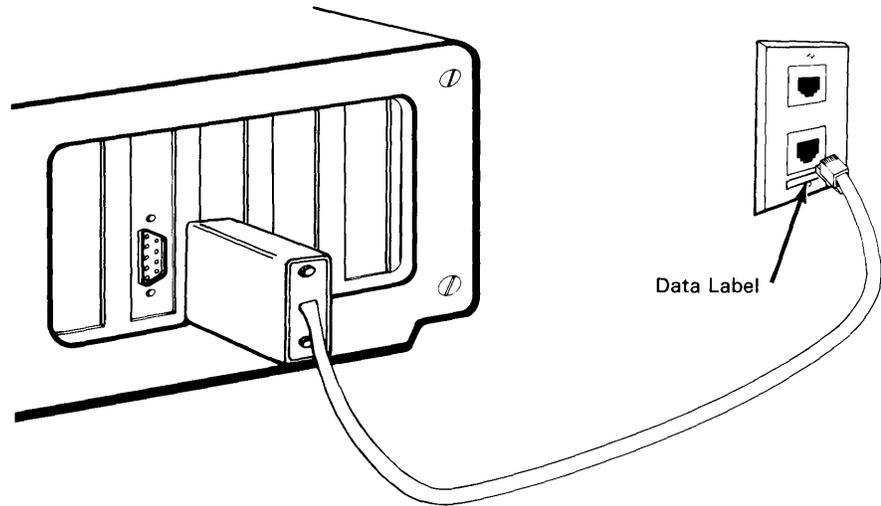
Data Grade
Media-to-Type 3 Filter

This component consists of a cable terminated on each end by IBM Cabling System data connectors that contain filtering components. It is used to connect devices when both data grade media and type 3 specified media are used as lobe wiring on a single ring. The Data Grade Media-to-Type 3 Filter must be used to connect those devices that use data grade media as their lobe wiring. The IBM 3725 and 3720 Communication Controllers are always connected to a Token-Ring Network using data grade media, and therefore must always use this filter when connected to a ring that uses type 3 specified media on other lobes. The Data Grade Media-to-Type 3 Filter (IBM Specification 6466943) is not available from IBM. Consult your IBM representative or local branch office for a list of suppliers of this part.

Type 3 Media Jumper Cable

This jumper cable carries the signal from a type 66 connecting block (a termination fixture for telephone twisted-pair media, see Figure 3-1 on page 3-4) to a receptacle on an IBM 8228 or to a distribution panel. The cable is 4 meters (13 feet) long and has an IBM Cabling System data connector on one end. On the other end are four individual, color-coded wires that can be inserted into a type 66 connecting block. The Type 3 Media Jumper Cable (IBM Specification 6466944) is not available from IBM. Consult your IBM representative or local branch office for a list of suppliers of this part. The figure illustrates the use of this cable and a type 66 connecting block.
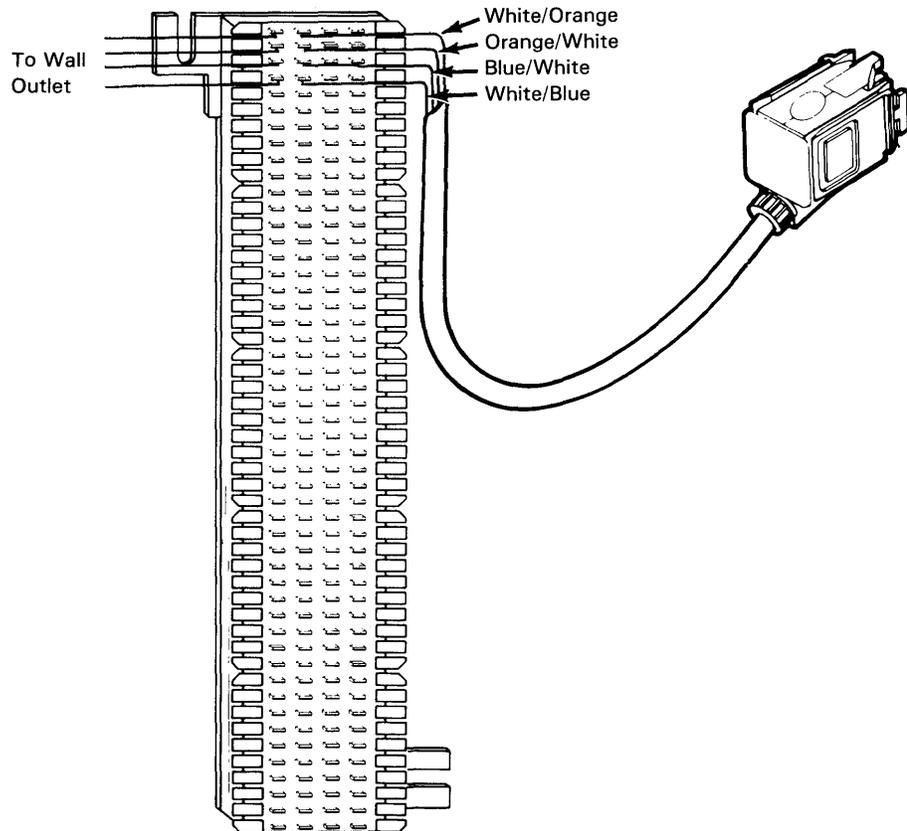
IBM Cabling System
Patch Cables
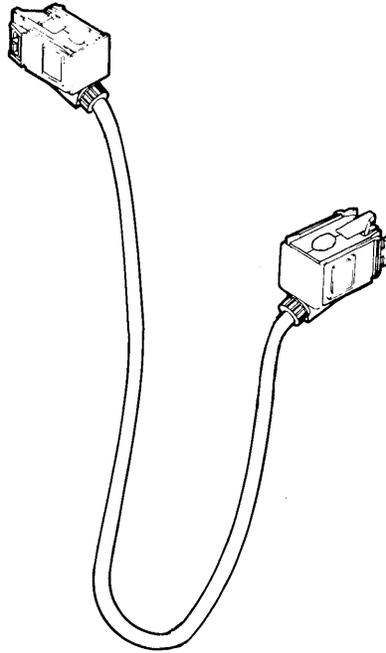
Patch cables connect network products together and to IBM Cabling System components and accessories. Patch cables are used in your network:

- Between distribution panel connectors and IBM 8228 receptacles
- Between IBM 8228s in the same network in a wiring closet
- Between attaching devices and faceplates (optional)
- Between attaching devices and IBM 8228s in component housings (optional)
- Between IBM 8228s and IBM 8218 Copper Repeaters
- Between IBM 8228s and IBM 8219 Optical Fiber Repeaters.

Patch cables are available in lengths of 2.4, 9.1, 22.9, and 45.7 meters (8, 30, 75, and 150 feet).

IBM Cabling System Type 3 Media Specification

For IBM Token-Ring Networks operating on telephone twisted pairs, IBM recommends using telephone cable that meets the IBM Cabling System Type 3 Media Specification. A designer/installer can help you determine if your present cabling meets these specifications.

- #22 or #24 AWG (American Wire Gauge)

- Solid copper twisted pairs

  - A minimum of two twists per foot

- A maximum of 28.6 ohms DC resistance per 305 meters (1000 feet)

- Characteristic impedance

  - 90 to 120 ohms at 256 kHz
  - 87 to 117.5 ohms at 512 kHz
  - 85 to 114 ohms at 772 kHz
  - 84 to 113 ohms at 1000 kHz

- Maximum attenuation per 305 meters (1000 feet)

  - 4.00 dB at 256 kHz
  - 5.66 dB at 512 kHz
  - 6.73 dB at 772 kHz
  - 8.00 dB at 1000 kHz

- In addition, all type 3 specified media must meet at least one of the following industry specifications:

  - ANSI/ICEA S-80-576-1983
  - REA PE-71
  - Bell Systems 48007.

Your IBM representative can supply you with the names of suppliers whose cable meets the IBM Cabling System Type 3 Media Specification.

Network Management and Diagnostic Tools

In addition to the user diagnostics included with an IBM Token-Ring Network PC Adapter, software tools are available to help you diagnose troubles on your network. See your IBM representative for information about the diagnostic tools available for your use.

Network Software Capabilities

Attaching PC devices and Personal System/2s that are part of a network can use any software developed to run under Version 3.2 or higher of the IBM PC Disk Operating System (DOS). Network operation will not interfere with the normal operation of other software running on attaching devices.

Many programs written for the IBM PC Network and using the NETBIOS interface will operate on the Token-Ring Network.

Any software product that meets the requirements contained in the *IBM Token-Ring Network PC Adapter Technical Reference* should operate on the IBM Token-Ring Network. See your IBM representative for information about the software products available.

Chapter 2. Planning Considerations

The IBM Token-Ring Network was designed for use with twisted-pair media. Although the data grade media of the IBM Cabling System offers a greater range of environments and distances, telephone media permits satisfactory operation under most circumstances. Because telephone twisted-pair media characteristics differ from those of the IBM Cabling System data grade media, customers considering using telephone media as part of their network should analyze their environment to ensure satisfactory operation.

Most of the telephone wiring installed to date throughout the world has been designed for voice band (0.3 kHz - 4 kHz), analog phone applications. It was not designed for high-speed data (> 1 Mb/s) and is not functionally specified (that is, guaranteed) for such operation.[1] For example, such critical characteristics as characteristic impedance, attenuation, and pair-to-pair crosstalk are not quantified in the frequency range of interest for use in data transmission. Manufacturers of high-speed communication products must specify these characteristics to ensure successful operation of their products on telephone wiring.

However, token-ring transmission at 4 megabits per second is possible in most cases on telephone wire. With careful planning, IBM Token-Ring Network products can be operated successfully on a wide variety of telephone twisted-pair media in many general office environments at an extremely low cost per attaching device.

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[1] *Bell System Technical Reference* 48007 and ANSI/ICEA S-80-576-1983.

Unlike IBM Cabling System data grade media, telephone twisted-pairs are unshielded and generally not well balanced at high frequencies. They are, therefore, more subject to crosstalk and electrical interference from:

- Intercoms
- Fluorescent lighting
- Power cables
- Arc welding equipment
- HVAC (heating, ventilation, and air conditioning) equipment
- Radio frequency transmissions from commercial broadcasters and base-station operations
- Radar installations
- Electric motors
- Other sources of electronic interference.

Consequently, environmental considerations for networks using telephone media are more stringent than for systems using IBM Cabling System data grade media.

The electrical characteristics of telephone media limit the number of devices available on a single network, the maximum distance allowed between the work area and wiring closet, the distance between wiring closets, and the number of wiring closets in the network. The network configurations described in this document have been tested and shown to be operational in typical office environments. These configurations will operate satisfactorily in most situations. However, they may not operate satisfactorily in some areas subject to electrical interference. The customer must take into account those environments that may be exposed to interference when planning his primary and alternative network configurations. Network operation with non-specified media, jacks, plugs, connecting blocks, or drive distances may not be adequate and is not recommended. IBM cannot offer solutions for network problems attributable to telephone wiring systems or electronic interference.

The planning considerations described in this manual apply only to using IBM Token-Ring Network components operating at 4 Mbps. Always consult the appropriate IBM product documentation to determine unique planning considerations for specific products.

For IBM Token-Ring Networks operating on telephone twisted pairs IBM recommends using telephone cable that meets the IBM Cabling System Type 3 Media Specification in Chapter 1. A designer/installer can help you determine if your present cabling meets these specifications. Chapter 3 provides instructions for a walk-through site inspection that you can perform with the assistance of a designer/installer to determine if your establishment is suitable for installing an IBM Token-Ring Network using type 3 specified media.

Recommended Planning Guidelines

Before you begin determining your establishment's needs, you should be aware of the basic parameters for token-ring operation on telephone twisted-pair media. A single ring can serve up to 72 attaching devices using up to nine IBM 8228 Multistation Access Units.

For small rings whose members are all in close geographic proximity, you can plan rings that do not use 8218 Copper Repeaters or 8219 Optical Fiber Repeaters using the following guidelines:

- Lobes of type 3 specified media should not exceed 45 meters (150 feet), including the connection from the telephone connecting blocks to the data connecting blocks. (See Figure 2-5 on page 2-12 for an illustration of a typical installation.)

- If your network lobes all terminate in a single wiring closet and you do not intend to expand your network to two wiring closets, lobes may be up to 100 meters (330 feet) of type 3 specified media.

- For configurations using two wiring closets, the length of each cable between the wiring closets must not be more than 120 meters (390 feet) of IBM Cabling System type 1 cable. Two cables are required to complete the main ring path in a two-wiring-closet network. *Telephone twisted-pair media cannot be used in the main ring path.*

If your ring must cover a larger geographic area than described above, you can use IBM 8218 Copper Repeaters or IBM 8219 Optical Fiber Repeaters to increase the geographical coverage of your ring. However, for each 8218 Copper Repeater or 8219 Optical Fiber Repeater used, you must reduce by one the total device capacity of the ring.

IBM 8218 Copper Repeaters are used with IBM Cabling System type 1 cable in the main ring path. IBM 8219 Optical Fiber Repeaters can be used with IBM Cabling System type 5 optical fiber cable between wiring closets to extend the geographical coverage of your network. IBM 8219 Optical Fiber Repeaters may also be used with other types of optical fiber cable. The procedures for qualifying optical fiber cable for use with the network are contained in *IBM Token-Ring Network Optical Fiber Cable Options.*

Rings that use type 1 outdoor cable between buildings must have surge suppressors installed at the entrance to each building. The planning considerations for surge suppressors are described in this manual. A description of surge suppressors and installation procedures can be found in the *IBM Cabling System Planning and Installation Guide.*

Another way of joining rings together, particularly when communication among more than 72 attaching devices is required, is to use bridges. Using bridges to join rings together is described in Chapter 6.

Rings Covering Large Areas

You will need IBM 8218 Copper Repeaters or IBM 8219 Optical Fiber Repeaters to compensate for the signal loss on the network wiring, if your ring will:

- Pass through more than two wiring closets

- Have lobes longer than 45 meters (150 feet) but not exceeding 100 meters (330 feet) and more than one wiring closet

- Have two wiring closets that are farther than 120 meters (390 feet) apart.

Using IBM 8218 Copper Repeaters

IBM 8218 Copper Repeaters are always placed on the main ring path in pairs to provide a reliable backup path for the network. Using 8218 Copper Repeaters in pairs increases the availability of the network. To determine where to place 8218 Copper Repeaters in your main ring path, you should make a sketch of your ring showing the number of 8228 Multistation Access Units in each wiring closet, the location of each wiring closet, and the length of each cable between wiring closets. A typical sketch might look like the one in Figure 2-1.
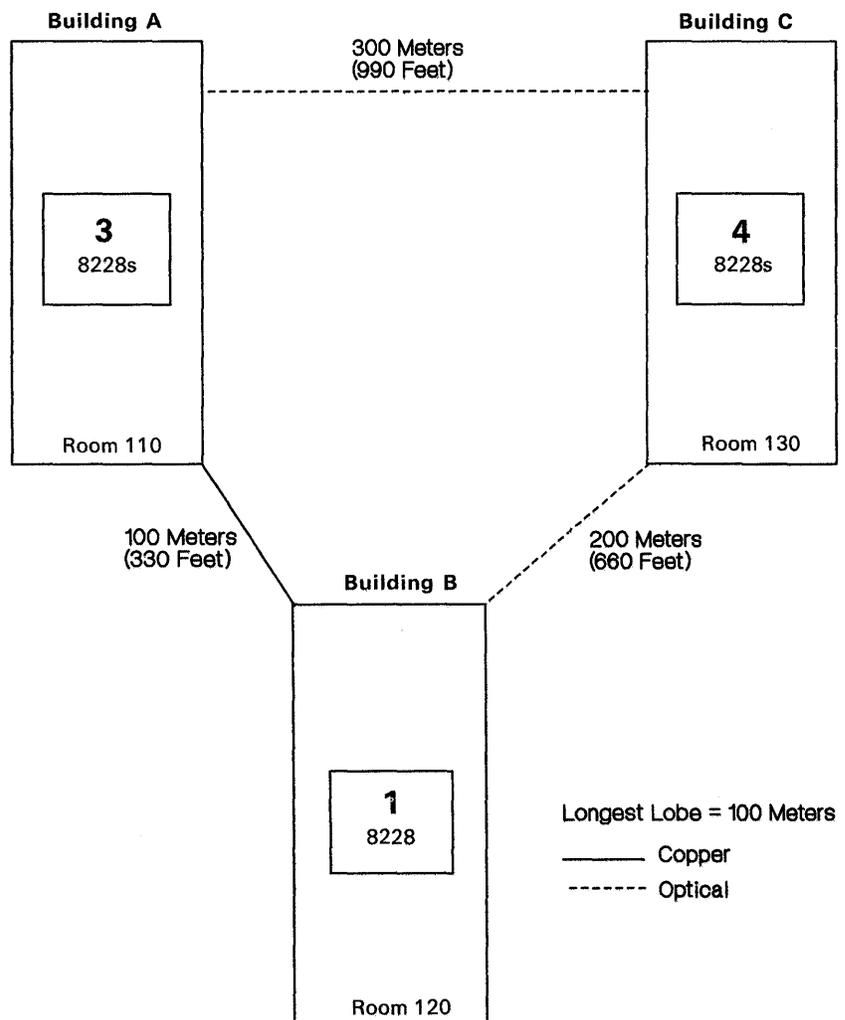
Figure 2-1. A Sketch of a Ring Used to Determine Placement of Repeaters

To determine where you should place repeaters, you should look at your rough sketch to see which of the following three cases fits your configuration best.

- If your longest lobe is more than 45 meters (150 feet) but does not exceed 100 meters (330 feet), you may have one wiring closet between pairs of 8218 Copper Repeaters. Each pair of 8218s may be up to 200 meters (660 feet) from the wiring closet. The following figure illustrates this configuration.

| 8218 | 8218 | 200 Meters Max. (660 Feet) | Wiring Closet | 200 Meters Max. (660 Feet) | 8218 | 8218 |
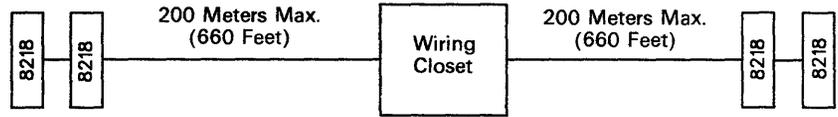
Longest Lobe = 100 Meters
(330 Feet)

- If your longest lobe does not exceed 45 meters (150 feet), you may have two wiring closets between pairs of 8218 Repeaters. The wiring closets may be up to 120 meters (400 feet) apart, and the pairs of 8218s may be up to 90 meters (300 feet) from each of the wiring closets. The following figure illustrates this configuration.

| 8218 | 8218 | 90 M (300 Ft) Max. | Wiring Closet | 120 M (400 Ft) Max. | Wiring Closet | 90 M (300 Ft) Max. | 8218 | 8218 |
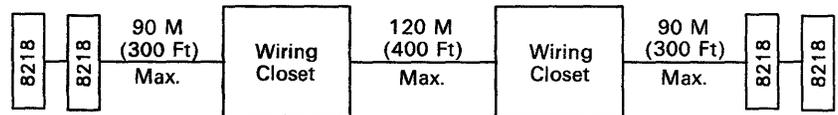
Longest Lobe - 45 M
(150 Ft)

• If there are no wiring closets between 8218s, you may have up to 600 meters (1968 feet) of type 1 cable between wiring closets. Reduce this distance by 30 meters (100 feet) for each surge suppressor between the pairs of 8218s or between a pair of 8218s and an 8228. One pair of surge suppressors may be in a main ring path segment between 8228s, between 8218s, or between an 8228 and an 8218. The following figure illustrates this configuration.
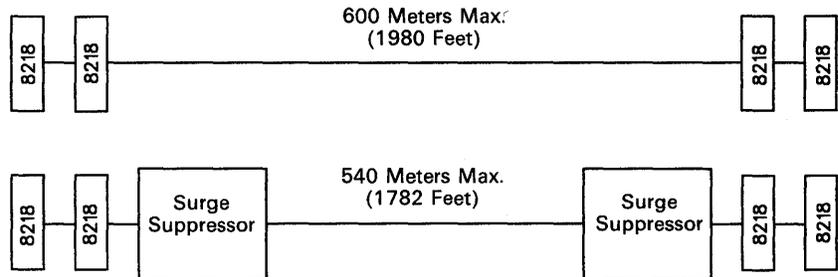
All of these configurations assume that you are using IBM Cabling System type 1 cabling between wiring closets.

If you are using type 6 cable between wiring closets, multiply the length of type 6 cable by 4/3 to calculate the apparent drive distance of the cable. If you are using type 9 cable between wiring closets, multiply the length of type 9 cable by 3/2 to calculate the apparent drive distance of the cable. You may ignore the length of single 8-foot patch cables used between components in the ring. Any additional patch cables must be included in the length calculation. Patch cables are made up of IBM Cabling System type 6 cable.

Using IBM 8219 Optical Fiber Repeaters

If you are using optical fiber cabling between wiring closets, you will need to use IBM 8219 Optical Fiber Repeaters in the main ring path. An 8219 Optical Fiber Repeater is capable of converting a signal from an electrical impulse to a light signal and transmitting it over 2 kilometers (6560 feet) of IBM Cabling System type 5 optical fiber cable with a maximum of two pairs of connectors between the transmitting 8219 and the receiving one. For each additional pair of connectors in the circuit, you should reduce the drive distance by 500 meters (1640 feet).

The ring design on the copper wire side of the 8219 Repeaters must follow the same rules as a ring using 8218 Repeaters, with each 8219 being treated like a pair of 8218s.

If the optical fiber cable you are planning to use is not IBM type 5 cable, you should consult the *IBM Token-Ring Network Optical Fiber Cable Options*, for procedures to qualify other optical fiber cabling for use in IBM Token-Ring Networks.

Figure 2-2 on page 2-8 shows the main ring path of a ring using optical fiber cabling between all wiring closets.
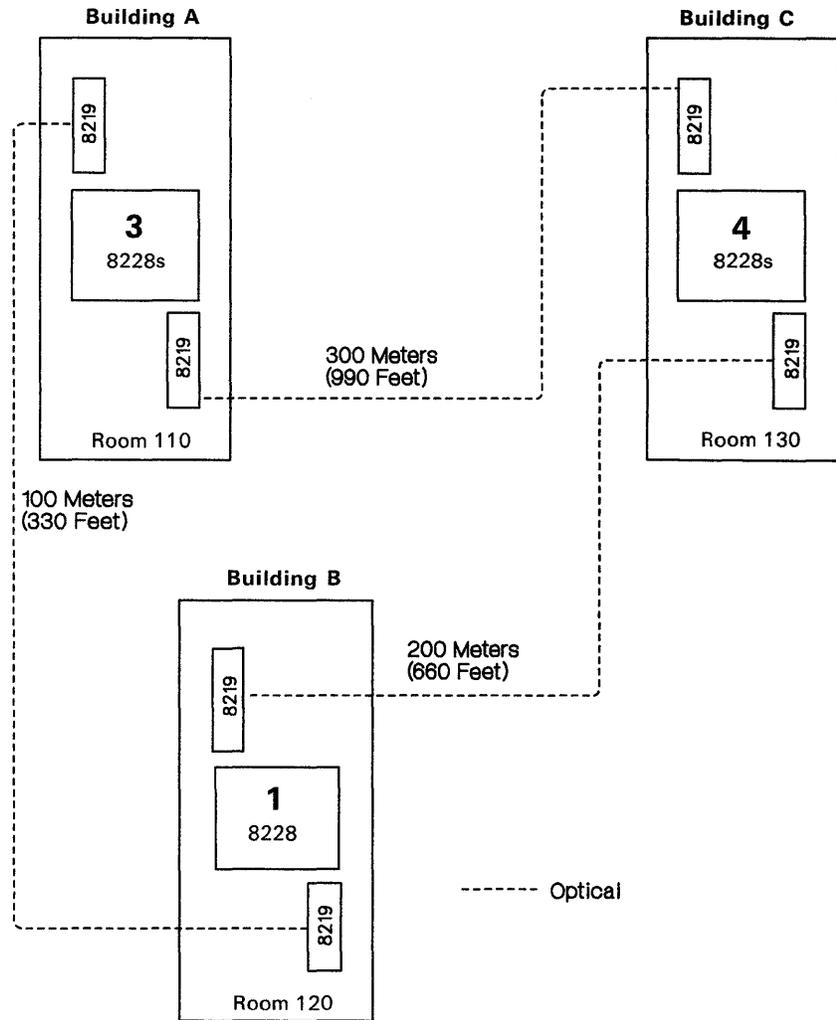
Figure 2-2. Using Optical Fiber Cabling between Wiring Closets.

If your ring also has type 1 cabling between some wiring closets (see Figure 2-3), that ring segment must follow the drive distance rules explained previously in this chapter for rings using copper repeaters. Figure 2-2 and Figure 2-3 illustrate two ways of designing a ring for the establishment illustrated in Figure 2-1 on page 2-4.

Building A

Building B

```
SS

        3
      8228s

        8219        300 Meters
                    (990 Feet)

    Room 110
```

```
        8219

          4
        8228s

                        8219

      Room 120
```

100 Meters
(330 Feet)

Building C

```
  8219

    1
  8228

            200 Meters
            (660 Feet)

SS   8218 8218

    Room 130
```

——— Copper
- - - - - Optical
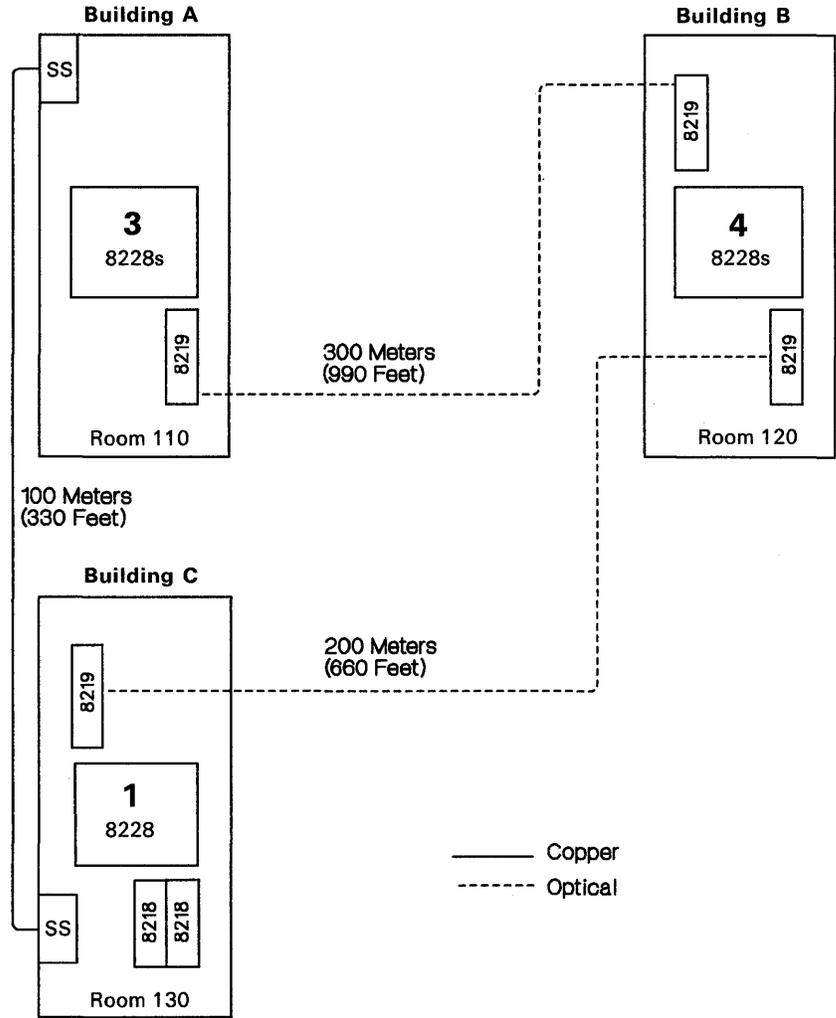
Figure 2-3. A Ring Using Optical Fiber and Type 1 Cables

Using Data Grade Media-to-Type 3 Filters on Token-Ring Lobes

Data grade media lobes may be used in Token-Rings whose predominant lobe wiring is telephone twisted-pair media. In such cases, Data Grade Media-to-Type 3 Filters must be used on those lobes that use data grade media. Data grade media might, for example, be used in certain lobes to alleviate electrical noise interference problems or to achieve additional lobe drive capability beyond the distances allowed using telephone twisted-pair wiring. Data grade media lobes are in all cases required to connect 3720 and 3725 Communication Controllers to a Token-Ring Network. If any lobe on a single ring uses telephone twisted-pair media, the entire ring is subject to the wiring rules stated in this manual.

IBM products such as the IBM 3720 and 3725 Controllers that have a data connector as the Token-Ring Network attachment port are normally connected to the network using data grade media. These devices are connected to a Token-Ring Network using data grade wires even when the ring uses telephone twisted-pair lobes. For these configurations, you must place a Data Grade Media-to-Type 3 Media Filter on the lobe between the device and the IBM 8228 Multistation Access Unit lobe receptacle to which it is attached, as shown below. The length of such lobe connections should not exceed the equivalent length of type 3 specified media allowed, depending upon your configuration. If your configuration allows up to 100 meters (330 feet) of type 3 media, you should not exceed 200 meters (660 feet) of type 1 cable, 150 meters (492 feet) of type 6 cable, or 133 meters (437 feet) of type 9 cable.

If your configuration allows up to 45 meters (150 feet) of type 3 media, you should not exceed 90 meters (300 feet) of type 1 cable, 67.5 meters (223 feet) of type 6 cable, or 60 meters (200 feet) of type 9 cable.

While the DGM-to-Type 3 Filter permits the attachment of 3720 and 3725 Controllers and other devices attached using data-grade media, it does not increase the number of attaching devices permitted on a network. For rings that use telephone twisted-pair media, the total number of Type 3 Media Filters and DGM-to-Type 3 Filters on the lobes and in the main ring path cannot exceed 72.
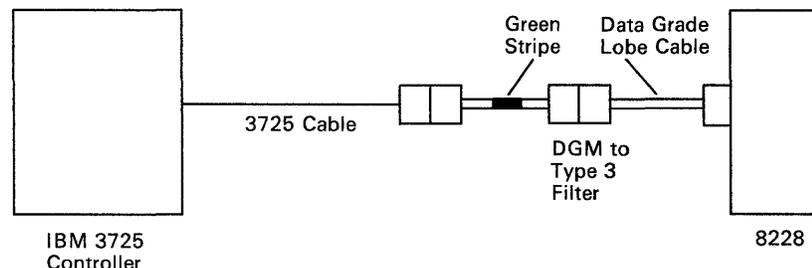
Figure 2-4. Using the DGM to Type 3 Media Filter with the IBM 3725 Controller

Determining Your Needs

Before doing the walk-through site inspection to qualify your existing twisted-pair media for use in a Token-Ring Network, you should determine:

- Where attaching devices for your network will be located
- Which telephone wiring closets are the terminating points for the lines that will serve the attaching devices
- Where to place IBM 8228s
- Where to place IBM 8218s and IBM 8219s
- How many separate rings you will need to serve your users
- Which rings should be joined by bridges.

Copies of your building's floor plans will help you determine the layout of the existing wiring. As you are identifying your users, remember to take into consideration the number of devices supported and the distance restrictions listed previously.

If the basic requirements cannot be met, the IBM Token-Ring Network may not operate properly. You may wish to consider installing additional type 3 specified media and additional telephone wiring closets or installing IBM Cabling System type 1 cable and creating new wiring closets. You should consult the *IBM Cabling System Planning and Installation Guide* and the *IBM Building Planning Guide for Communication Wiring* and seek the advice of a designer/installer.

Physical Planning Considerations

Each IBM 8228 must be placed either in a 483-millimeter (19-inch) equipment rack, as described in the *IBM Cabling System Planning and Installation Guide*, or in a component housing permanently mounted on a wall or placed on a shelf. Figure 2-5 on page 2-12 illustrates an installation of IBM 8228s in both racks and component housings as well as cabling to and from telephone media.

Each IBM 8218 or 8219 must be placed either in a rack mounting assembly installed in a 483-millimeter (19-inch) equipment rack, as described in the *IBM Cabling System Planning and Installation Guide*, or in a surface mounting bracket permanently mounted on a wall. Figure 2-5 on page 2-12 illustrates an installation of IBM 8219s in both racks and component housings as well as cabling to and from telephone media.

Note: In West Germany and Austria, IBM 8218 Copper Repeaters and IBM 8219 Optical Fiber Repeaters used in rings whose lobe wiring is telephone twisted-pair media *cannot* be installed in rack mounting assemblies. In those countries, IBM 8218s and 8219s must be installed using the surface mounting bracket.

For additional information about planning for installation of equipment racks and IBM Cabling System type 1 and type 5 cable, see the *IBM Cabling System Planning and Installation Guide*.

Optical Fiber Cable
to Building B

Building A

3002 —

Type 3 Media
Jumper Cable

Voice Pairs

Telephone
Jumper Wire

Type 3
Specified Media

Dual
Modular Jack
Faceplates

Type 3
Media Filter

PC10

Type 66
Connecting Block
for Data

Type 66
Connecting Block
for Data and
Voice

100
106-12-B6   Room 100

1006
1007
1008

119B
106-12-C6   Room 119B

PC22

100
106-12-B6

DGM-to-Type 3
Filter

119C
106-12-G6   Room 119C

PC23

BNC to Biconic
Patch Cable

PC14

— 4001   2003

104
106-12-H6   Room 104

Room 106

Surge
Suppressor

All unlabeled cables are
IBM Cabling System
8-foot patch cables.

This figure shows only
how the cables are
connected, not how
they should be routed.

Building C

— 4001

Yellow
Crossover
Patch Cable

DGM-to-Type 3
Filter

Yellow
Crossover
Patch Cable

Optical Fiber
Patch Cable

Optical Fiber Cable
from Building B

—3001

3002

1005   2002

Surge
Suppressor

3001

DGM-to-Type 3
Filter

Yellow
Crossover
Patch Cable

DGM-to-Type 3
Filter

DGM-to-Type 3
Filter

Yellow
Crossover
Patch Cable

Optical Fiber
Mounting Bracket

Room 130

See Figure 5-5 for this network's Ring Sequence Chart

Figure   2-5.   A Network Installation Using Telephone Cable

Figure 2-6 illustrates how to plan a ring for a typical building layout.
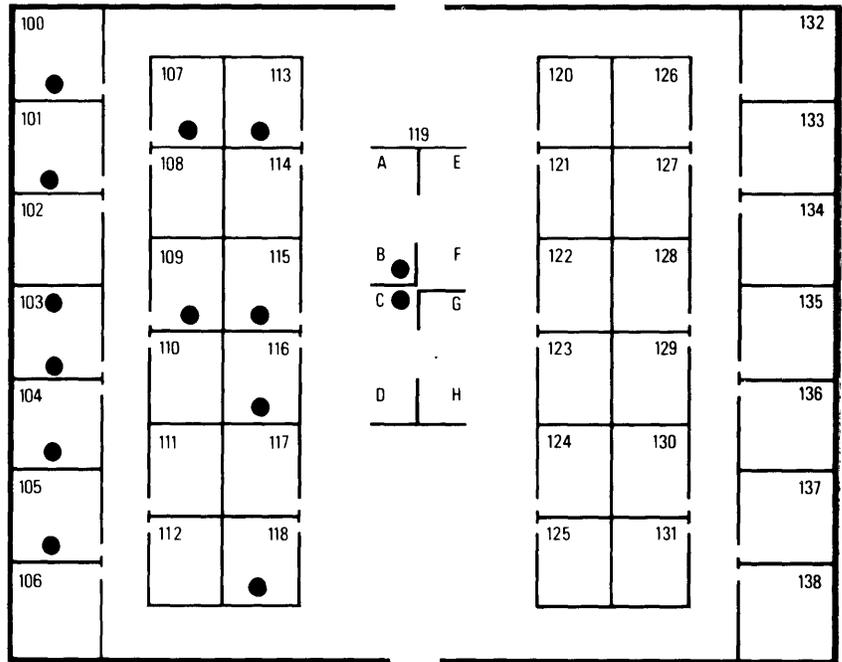
Scale: 1 inch = 20 feet.   Room 106 is a wiring closet.   ● = Attaching Device

Figure 2-6. Planning a Ring Layout

Each IBM 8228 can serve up to eight attaching devices. If you want to leave room on your ring so that you can add attaching devices without adding 8228s, you may assign fewer attaching devices to each 8228. The IBM 8228s in a wiring closet are connected to each other using IBM Cabling System 8-foot patch cables. If the 8228s are to be rack-mounted, place the racks close enough to the data connecting blocks so that the Type 3 Media Jumper Cables, which are 4 meters (13 feet) long, can be inserted into the back of the rack's distribution panels without placing a strain on the jumper cables. If the 8228s are to be wall-mounted, they must be located close enough to the data connecting block so that the Type 3 Media Jumper Cables can reach the 8228's lobe connectors without straining the cables.

Mark the locations of the attaching devices you will need for your ring on the floor plan. Measure the distances between the 8228s and the attaching devices they serve, remembering to allow for the actual routing distance that the media must cover from the work area to the data connecting block, not merely the straight-line distance between the points.

If the 8228s for a ring are not all in the same wiring closet, measure the distance between each wiring closet in the main ring path. Use the guidelines established previously in this chapter in the section called "Rings Covering Large Areas" to determine whether you should use IBM Cabling System type 1 cable and 8218 Repeaters or optical fiber cable and 8219 Optical Fiber Repeaters.

Figure 2-7 shows a building floor plan with actual cable routing for both lobes and the main ring path marked.
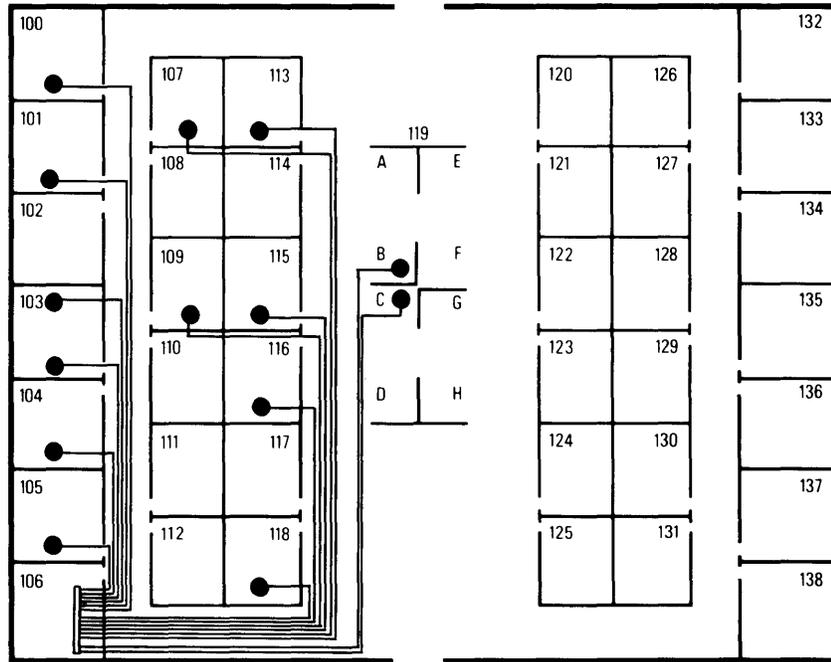
Scale: 1 inch = 20 feet.   Cable lengths are to scale.
Room 106 is a wiring closet.   Add 20 feet to each drop to
● = Ring Member   allow for floor to ceiling distance.

Figure 2-7. A Typical Floor Plan Showing Cable Lengths

Now that you have determined the locations of attaching devices, the number of devices per ring, the locations of IBM 8228s, 8218s, 8219s, and the number of rings you will need, you should, with the help of a designer/installer, conduct the walk-through inspection described in Chapter 3.

Chapter 3. Guidelines for Site Qualification

As you plan your installation of the IBM Token-Ring Network, one of the first decisions you may have to make is whether your site is appropriate for a network using existing telephone wiring, or whether you should plan to install new wiring. Appendix A contains a Walk-Through Site Inspection Checklist that will help you make this determination. The checklist can also be used as a specification for installing new IBM Cabling System type 3 specified media for a network.

Because of the technical nature of some of the inspection points, a designer/installer or a qualified telephony consultant should assist in performing your site evaluation.

You should complete the Walk-Through Site Inspection before requesting measurement and testing of your wiring, as described in Appendix B, should you elect to have IBM do these measurements and tests.

Using the Checklist

The Walk-Through Site Inspection Checklist consists of a series of questions about your building. These questions have been divided into three sections:

- Inspecting the wiring closet
- Inspecting the work areas
- Checking the telephone lines.

Each question calls for either a "yes" or "no" response. If your inspection results in "yes" responses for all questions, then your site should qualify for installation of an IBM Token-Ring Network. IBM recommends that all items receiving "no" responses should be addressed before installing a network.

Many items on the checklist can be performed easily by persons with a knowledge of the establishment's needs but without special training either in networks or in telephony. However, determining the suitability of existing wiring, planning the installation of new wiring if needed, and determining the physical locations of IBM Token-Ring Network components in wiring closets are all best performed by designer/installers or qualified telephony consultants.

Section 1: Inspecting the Wiring Closet

This section will help you decide if the telephone wiring closets are suitable for installation of IBM Token-Ring Network components.

1-1. Do you have, or can you obtain, entry rights to the wiring closet?

If you do not have free entry to the wiring closet or control over what may be installed in it, you should not plan to install your IBM Token-Ring Network components in it. Chapter 4 suggests a physical layout that allows you to place the components in an area adjacent to the wiring closet so that they are available for reconfiguring the network and performing problem determination. Figure 4-2 on page 4-4 shows an installation that uses an area adjacent to the telephone wiring closet for installing network products. The length of type 3 specified media from the telephone connecting blocks to the data connecting blocks must be added to the length of type 3 specified media from the work area to the telephone connecting block to determine the lobe length. Consequently, you should always try to minimize the distance between the telephone wiring closet and the network wiring closet.

Telephone wiring closets selected for use in the network should always be intermediate distributing frames (IDFs) rather than your building's MDF (main distributing frame), where interference from some types of telephone key equipment may cause interference with data transmission. Twisted pairs used for data should pass through no more than one IDF or satellite closet before being terminated at the data connecting block.

1-2. Is there adequate space available for additional type 66 connecting blocks for use in isolating data pairs from voice pairs?

A designer/installer should determine if the existing telephone wiring closet has space for additional type 66 connecting blocks so that you can separate voice pairs from those carrying data. Figure 4-1 on page 4-3 illustrates physical layouts for this separation. If there is insufficient room for additional type 66 connecting blocks in the wiring closet, see Figure 4-2 on page 4-4 for a physical layout that uses an adjacent area for installing the data connecting blocks and network components.

1-3. Is there adequate space for installing a 483-millimeter (19-inch) equipment rack?

1-3a. If not, is there adequate space for wall-mounting all the IBM 8228s you will need in each wiring closet?

The *IBM Cabling System Planning and Installation Guide* lists minimum clearances for installing equipment racks suitable for network components. If a wiring closet has more than two IBM 8228s assigned to it, rack-mounting is strongly recommended over wall-mounting for ease of installation and cable management. No more than 12 IBM 8228s should be installed in an equipment rack.

The figure on page 1-8 shows the clearances necessary for installing a component housing for an IBM 8228. Figure 4-3 on page 4-5 shows a typical installation of network components without using equipment racks.

1-4. In the area where the IBM 8228s will be installed, is the room temperature continuously within the range of 10 to 40.6°C (50 to 105°F)?

Is the relative humidity range continuously between 8 and 80%?

Is the wet bulb temperature always 26.7°C (80°F) non-condensing or less?

IBM Token-Ring Network components will not operate reliably in areas that do not meet these temperature and humidity requirements.

1-5. Is the wiring free from stubs and bridge taps?

Stubs and bridge taps are sections of telephone wire that are connected to the wires carrying data signals, but are not in the primary data path. They sometimes result from wires being added to the telephone connecting block to allow multiple telephone connections on single lines. They can also result from splices at the station end for the same purpose. Stubs and bridge taps can interfere with data transmission and should be removed from the media you plan to use for the network.

1-6. Are the connecting blocks type 66?

Figure 3-1 illustrates a type 66 connecting block suitable for use with IBM Token-Ring Network components. Token-ring transmission has been successfully tested on type 66 connecting blocks, and the type 66 connecting block is the recommended terminal block for attaching telephone wire to the ring. Other terminal blocks, especially insulation-displacement-type terminal equipment, may be acceptable substitutes. IBM makes no statement about the suitability of these alternate attachment components, except to state that if telephone lobes using these components prove acceptable in a functional test of the wiring, then they should be acceptable for token-ring transmission.
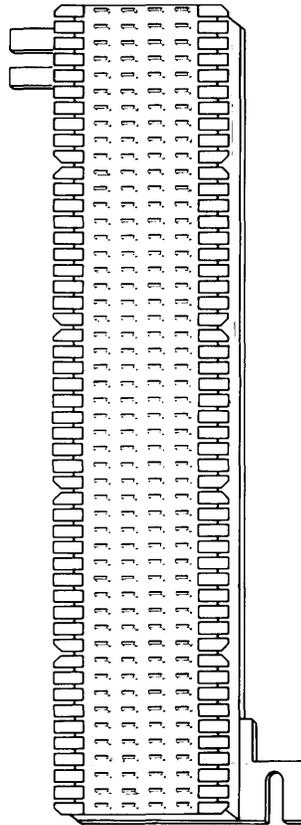
Figure   3-1. A Type 66 Connecting Block

1-7. Is there at least one duplex electrical wall outlet in each wiring closet?

A source of electrical power may be useful for test equipment or for devices to be installed in the wiring closet. If you will be installing equipment racks in the wiring closet, the *IBM Cabling System Planning and Installation Guide* recommends that you install at least one duplex wall outlet per rack.

Section 2: Inspecting the Work Areas

This section helps you determine if the work areas where attaching devices will be located are ready for installation.

2-1. Do all work areas have two spare telephone twisted pairs available?

Each attaching device on a network requires a cable with two twisted pairs for data. In each cable used for data, there should be no more than one analog or digital phone connection and one additional data connection that share that cable with the attaching device. Any additional transmission in the same cable is not recommended unless the documentation for the devices requiring that transmission specifically supports it.

2-2. Are all cables that will be used for data free of stubs and bridge taps?

As described above in question 1-5, stubs and bridge taps can interfere with data transmission. In work areas, Amphenol bridging adapters are frequently used to allow several telephones to share a line. All stubs and bridge taps must be removed from any pairs that will be used for data transmission.

2-3. Are all work areas equipped with 6- or 8-pin modular jacks, preferably duplex?

2-3a. If so, are the modular jacks that are designated for data wired according to the specifications in Chapter 4?

2-3b. If no modular jacks are available, are there 50-pin Amphenol-type connectors so that modular jacks may be installed for data transmission?

Modular jacks are mandatory for use with the Type 3 Media Filter. Duplex outlets are preferable so that the work area may have access to both telephone and data services from the same cable. Chapter 4 describes the correct wiring of the 6-pin and 8-pin modular jacks for data transmission.

Section 3: Checking the Telephone Lines

This section helps you determine if your current telephone lines are suitable for data transmission using an IBM Token-Ring Network.

3-1. Do you own the telephone twisted-pair media in your establishment?

If not, can you get the permission of the owner to use the spare pairs in the cables for the network?

If you do not own the telephone lines, you will have to secure the permission of the owner to use the spare pairs for your network. If such permission cannot be secured, you must install new media.

Accurate cable schedules are necessary for planning your network. If you do not own the telephone lines, you should ask the owner for the records as well as permission to use the spare pairs.

3-2. Is the wire #22 or #24 AWG (American Wire Gauge)?

3-3. Are there at least two pairs in each cable available for data? (For new installations we recommend cables with four twisted pairs.)

3-4. Is the wire solid copper with a minimum of two twists per foot?

3-5. Is the DC resistance no more than 28.6 ohms per 305 meters (1000 feet)?

3-6. Does the cable have the following characteristic impedances?

- **90 to 120 ohms at 256 kHz**
- **87 to 117.5 ohms at 512 kHz**
- **85 to 114 ohms at 772 kHz**
- **84 to 113 ohms at 1000 kHz**

3-7. Is the attenuation per 305 meters (1000 feet) no greater than the following?

- **4.00 dB at 256 kHz**
- **5.66 dB at 512 kHz**
- **6.73 dB at 772 kHz**
- **8.00 dB at 1000 kHz**

Questions 3-2 through 3-7 outline the IBM Cabling System Type 3 Specification. If your telephone lines do not meet these specifications, IBM recommends that you install new telephone lines that meet the IBM Cabling System Type 3 Media Specification.

Provided that your existing telephone lines meet all the other criteria listed on the checklist, cables with up to 25 twisted pairs per cable sheath may be used with IBM Token-Ring Network components.

3-8. Are the telephone lines in good physical condition?

- Is the insulation in good condition?
- Are the lines free of splices from the office to the wiring closet connecting block?
- Is there no other evidence of physical deterioration?

Your designer/installer should make an assessment of the general physical condition of the lines. Any lines showing deterioration should be replaced to ensure safety as well as data and voice transmission integrity and reliability.

3-9. In each cable to be used for data, is there no more than one analog or digital phone connection, one additional data connection, and one token-ring connection?

Any additional transmission in the same cable is not recommended unless the documentation for the devices requiring that transmission specifically supports it.

3-10. Are all data cables:

- At least 127 millimeters (5 inches) from power lines carrying 2KVA or less?
- At least 305 millimeters (12 inches) from power lines carrying from 2 to 5KVA?
- At least 915 millimeters (36 inches) from power lines carrying more than 5KVA?
- At least 127 millimeters (5 inches) from all fluorescent lights?

Is the area free of other possible sources of interference found in some environments such as:

- Sources of radio interference within or near the facility?
- Sources of electrical interference from electric motors, HVAC equipment, arc welders, or intercoms?
- Radar installations in the immediate area?

Telephone twisted-pair media used with the IBM Token-Ring Network should not be exposed to electrically noisy environments because of potential interference with the network signal.

If you suspect that any of the cables you want to use for data transmission is exposed to an excessively noisy environment, contact your IBM representative or nearest branch office to arrange for a functional test to help you determine the extent of your noise problems.

Chapter 4. The Physical Layout

The most appropriate physical layout of your network installation will depend upon such factors as access to telephone wiring closets, the physical dimensions of wiring closets, security considerations, and the number of IBM 8228s, 8218s, and 8219s in each wiring closet. Refer to the *IBM Building Planning Guide for Communication Wiring* and consult a designer/installer for advice about planning wiring closets in new installations.

The Recommended Physical Layout

For installations that have more than one IBM 8228 in a wiring closet, we recommend a physical layout that uses a type 66 connecting block to isolate voice and data lines and an equipment rack with distribution panels for installation of 8228s and cable management. Standard telephone #22 or 24 AWG jumper wire is used to connect the telephone connecting block and the data connecting block. The length of the jumper wire must be included when determining the lobe length. Jumper wires should not be run in the same D-rings as telephone lines because of crosstalk caused by ringing voltages.

For installations using two wiring closets, two IBM Cabling System type 1 cables or two optical fiber cables should be installed between the wiring closets as recommended in the *IBM Cabling System Planning and Installation Guide*. If type 1 cable is used, both ends of each cable should terminate at grounded equipment racks. If this is not possible see "Grounding a Network Not Using Equipment Racks." Rings that pass through more than two wiring closets must use data grade media or optical fiber cable to complete the ring connection from the first wiring closet to the last, and back to the first one. A typical installation is illustrated in Figure 4-1 on page 4-3.

All work areas must have at least one 6- or 8-pin modular jack for data use.

Building A

Optical Fiber Cable to Building B

3002 —

Type 3 Media Jumper Cable

Voice Pairs

Dual Modular Jack Faceplates

Type 3 Media Filter

PC10

Telephone Jumper Wire

Type 3 Specified Media

100
106-12-B6   Room 100

Type 66 Connecting Block for Data

Type 66 Connecting Block for Data and Voice

PC22

119B
106-12-C6   Room 119B

1006
1007
1008

PC23

100
106-12-B6

119C
106-12-G6   Room 119C

DGM-to-Type 3 Filter

PC14

BNC to Biconic Patch Cable

104
106-12-H6   Room 104

4001   2003

Room 106

All unlabeled cables are IBM Cabling System 8-foot patch cables.

This figure shows only how the cables are connected, not how they should be routed.

Surge Suppressor

Building C

Yellow Crossover Patch Cable

Yellow Crossover Patch Cable

Optical Fiber Cable from Building B

4001

DGM-to-Type 3 Filter

Optical Fiber Patch Cable

3001

3002

1005   2002

DGM-to-Type 3 Filter

Optical Fiber Mounting Bracket

Surge Suppressor

3001

DGM-to-Type 3 Filter

Yellow Crossover Patch Cable

Room 130

See Figure 5-5 for this network's Ring Sequence Chart

Figure   4-1. Physical Layout of a Typical Network Installation

Alternative Physical Layouts

If access to the telephone wiring closet is not readily available, or if there is insufficient space in the wiring closet for an equipment rack and a data connecting block, this equipment may be installed in an area adjacent to the telephone closet as shown in Figure 4-2. The telephone connecting block and the data connecting block are wired together using type 3 specified media.
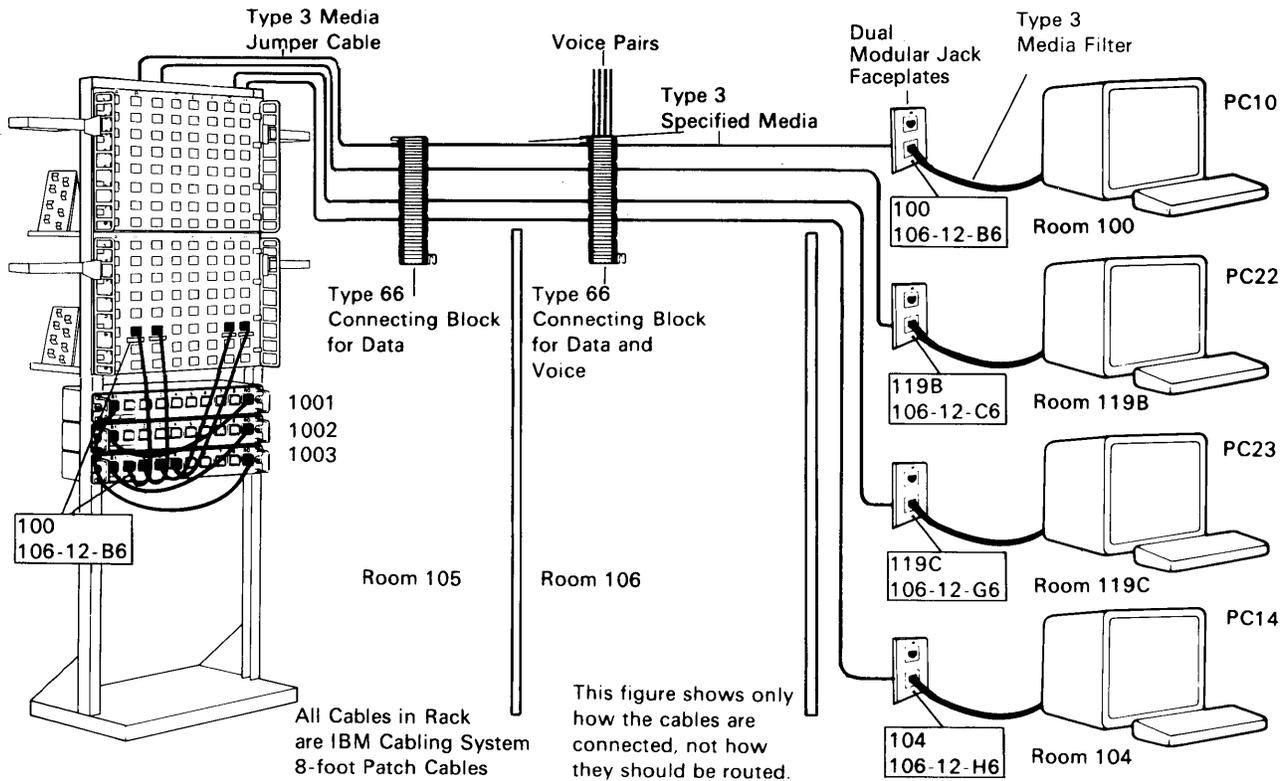
Figure 4-2. A Physical Layout Using an Adjacent Area for Network Equipment

When such a layout is used, you must include the length of type 3 specified media between the two connecting blocks when calculating the lengths of the lobes.

For networks that have a very limited number of IBM 8228s in a wiring closet and no space for equipment racks, the 8228s can be installed in component housings. These must be placed so that the 4-meter (13-foot) Type 3 Media Jumper Cables can reach from the data connecting block to the 8228 without strain. Figure 4-3 on page 4-5 shows an appropriate placement of a component housing in a wiring closet.
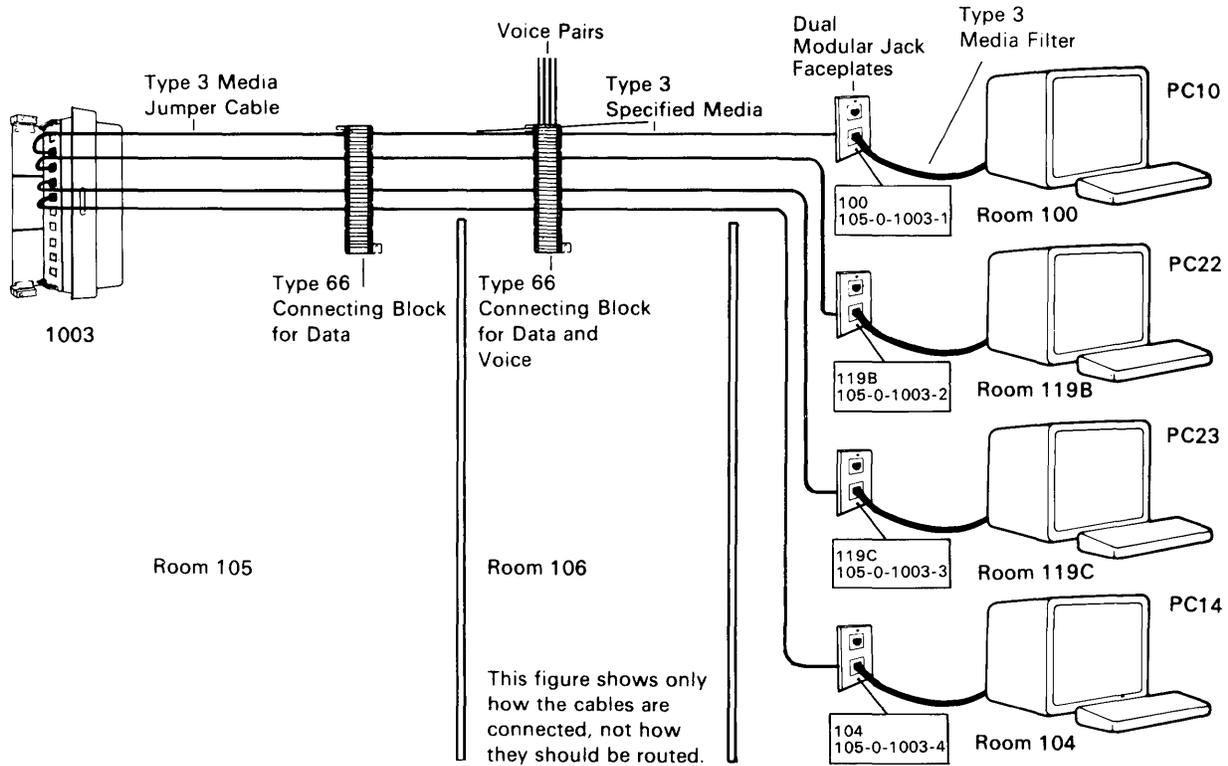
Figure 4-3. Physical Layout of a Network without Equipment Racks

The labels visible in the figure:

Voice Pairs

Type 3 Media Jumper Cable

Type 3 Specified Media

Dual Modular Jack Faceplates

Type 3 Media Filter

PC10

Type 66 Connecting Block for Data

Type 66 Connecting Block for Data and Voice

1003

100
105-0-1003-1   Room 100

119B
105-0-1003-2   Room 119B

PC22

PC23

119C
105-0-1003-3   Room 119C

Room 105

Room 106

This figure shows only how the cables are connected, not how they should be routed.

104
105-0-1003-4   Room 104

PC14

Grounding a Network Not Using Equipment Racks

If your network has components in two wiring closets, the IBM Cabling System type 1 cable connecting the 8228s in the two wiring closets must be grounded. This is done most conveniently by grounding the equipment racks at which the cables terminate according to the instructions in the *IBM Cabling System Planning and Installation Guide*.

Note: Buildings supplied by more than one electrical main must have equipotential bonding throughout. Contact your building electrical engineer to verify that equipotential bonding requirements have been met. Devices connected to the network must be connected to a properly wired and grounded power outlet.

If you are not using equipment racks, you must terminate each end of the type 1 cable at an IBM Cabling System faceplate and ground each end of the cable shield. To do this:

- Use the appropriate faceplate installation procedure in the *IBM Cabling System Planning and Installation Guide* (Surface Mount Box Installation or European Faceplate Installation) to install the box and insert the cable through it.

- Choose the appropriate data connector assembly procedure (*type A* or *type B*) in this chapter.

  Type A and *type B* data connectors are equal in function and mating and are shown below.

- Modify the installation procedure as shown here. That is, leave about 255 millimeters (10 inches) of cable protruding from the box so that you can prepare the cable shield for grounding and attach the *type A* or *type B* data connector as shown on the following pages.

- Return to the faceplate installation procedure in the *IBM Cabling System Planning and Installation Guide* to install the faceplate.
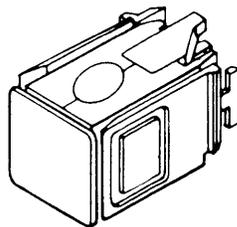
Type A Data Connector (P/N 8310574)
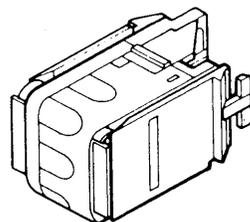
Type B Data Connector (P/N 6091000)

Type A Data Connector Assembly
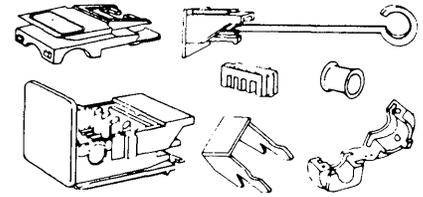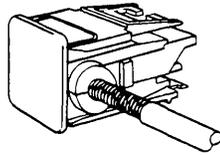
Parts Needed

Warning: Do not use wire strippers on the jacket; use the ripcord under the jacket.
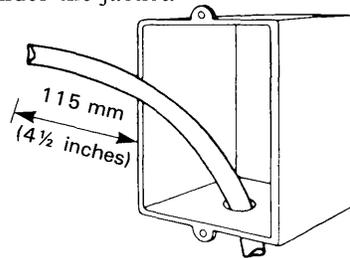
1. Cut off excess cable. Leave 115 mm (4-1/2 in.) of cable (measured from the wall) protruding from the box.

   Note: Leave any remaining slack inside the wall.
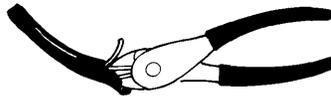
2. After installing the cable into the outlet box, strip the cable jacket back 210 mm (8-1/4 in.) from the end of the cable.

   Cut the jacket back a little way to expose the ripcord.
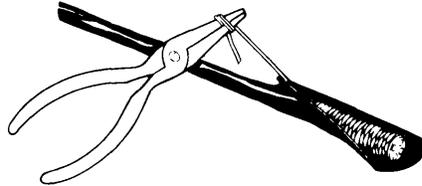
   Grasp the ripcord with needlenose pliers, wrapping it around the end of the pliers as shown.
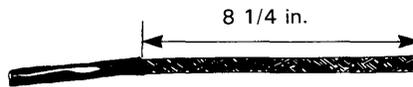
   Gently pull back on the ripcord, stripping back 210 mm (8 1/4 in.) of the jacket.

3. Cut off the excess jacket, ripcord, and plastic wrap (if present) covering the braided shield.

1 in.
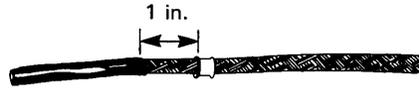
4. Install a ferrule over the braided shield 25 mm (1 in.) from the end of the cable jacket.
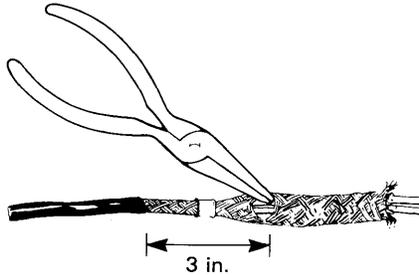
3 in.

5. Using a pair of needlenose pliers, tease a circular opening 13 mm (1/2 in.) in diameter whose center is 76 mm (3 in.) from the end of the cable jacket. Be sure not to cut the strands of the cable shield braid.
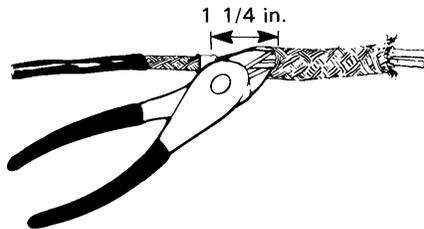
1 1/4 in.

6. Using a pair of wire cutters inserted through the opening, cut the wires at least 32 mm (1-1/4 in.) from the nearest edge of the ferrule.
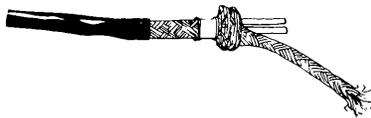
7. Carefully guide the end of the wires through the opening in the braided shield.
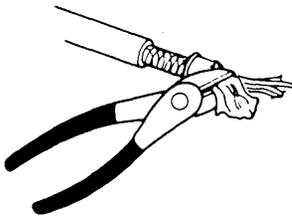
8. Peel back and cut off the foil covering the data wires.
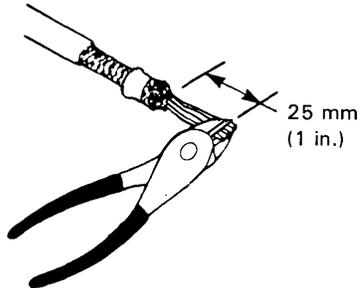
9. Trim the data wires evenly as shown.

25 mm
(1 in.)
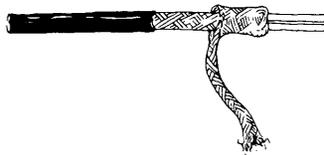
10. Slip the braided shield over the ferrule and flatten out the 122-mm (5-in.) shield with your fingers. Remove the metallic paper from around the wires in the cable.
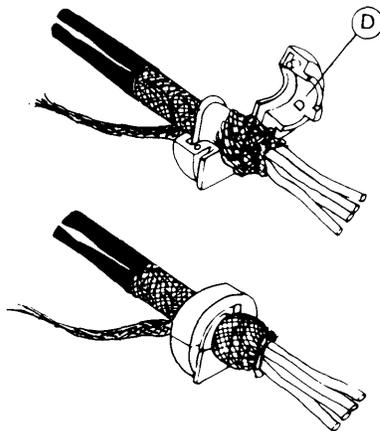
11. Fasten the strain relief bushing marked "D" of the *type A* data connector over the edge of the ferrule closest to the cable jacket.
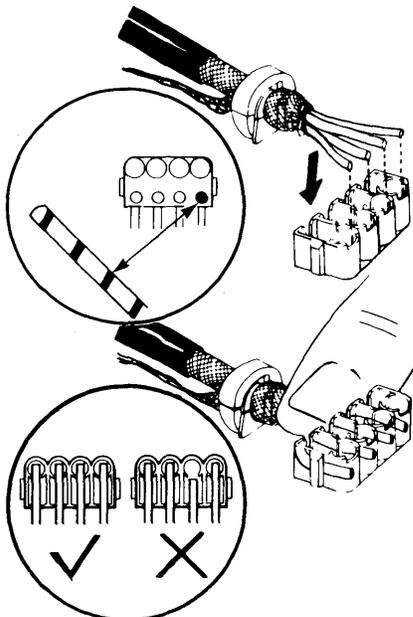
12. Do not strip the insulation from the wires.

Insert the wires into the matching color-coded slots of the stuffer cap, as shown.

Make sure that the tips of the wires are flush with the rear of the holes in the stuffer cap, and press the wires down into the cap.
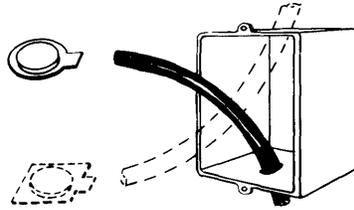
13. Note whether the cable enters the box from the top or bottom.

    If the cable enters the box from the top, pull the square tab out of the side of the connector housing.

    If the cable enters from the bottom, pull the round tab out of the side of the connector housing.

    Note: Do not twist the tab from side to side. Instead, pull it straight out with an arcing motion upward.
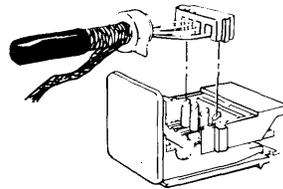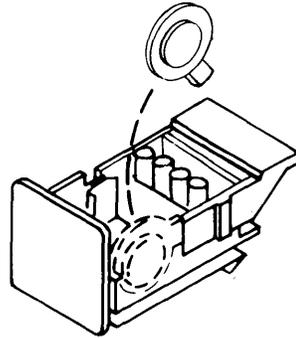
14. Align the stuffer cap with the contact assembly in the connector housing, and press the cap onto the contacts.
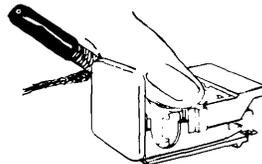
15. With your thumbs, gently seat the stuffer cap into the connector housing. If necessary, use slip joint pliers to seat the stuffer cap.

    Note: Inspect the assembly at this point to make sure that the tips of the wires are flush with the rear of the contact barrels. If not, cut off the cable end and restart this procedure.
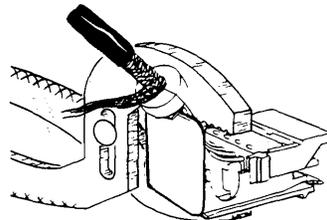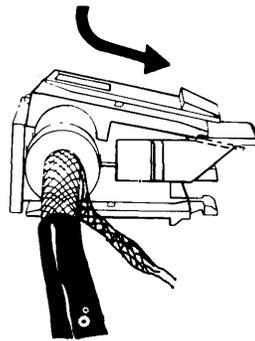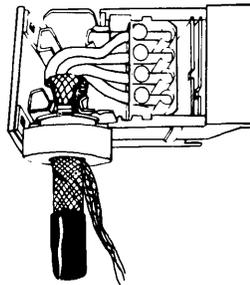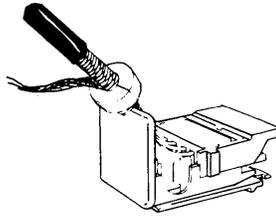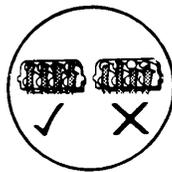
16. Position the flat edge of the D bushing into the slot in the bottom of the connector housing.

   Make sure that the ferrule is positioned with its longest sides top to bottom and with the braided portion of the ferrule extending between the metal ground posts as shown.

   Then, slide the bushing to the bottom of the slot. Make sure the wires are inside the ground posts.

17. Install the top cover by tilting it and inserting the two plastic front tabs under the opening above the contact assembly.

   Align the rear pins inside the top cover with the tops of the ground posts inside the connector housing, and press the cover down.

   Note: Proper alignment of the rear pins with the ground posts is necessary for correct closure
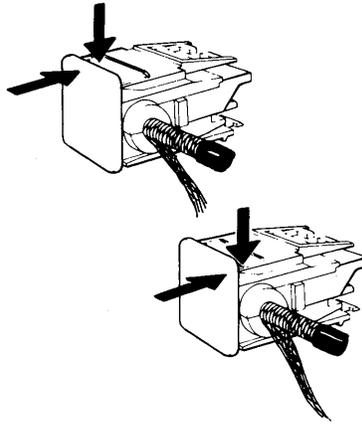
18. To snap the cover in place, first engage the locking tab on the side opposite the cable exit, then engage the tab on the other side (it is easier to engage each tab separately than to attempt both at once).

Ensure that both locking tabs are engaged.

| Note: A dust cover is included in each bag of connector parts for protecting the unmated data connector contacts from dust, dirt, and other particles, particularly during building construction. The dust cover should remain in place when the connector is not mated to another connector. The dust cover strap retains the dust cover when the connector is mated.
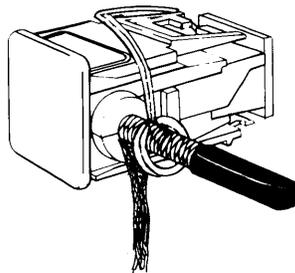
19. Attach the dust cover strap to the cable behind the connector as shown. Route the dust cover strap under the connector and install the dust cover onto the front of the data connector.

20. Save the locking clip supplied with the connector to attach the connector to a faceplate.
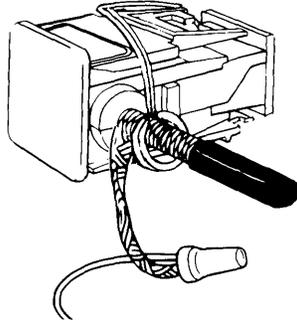
21. With a wire nut, connect the braided shield to a 2-mm diameter (AWG#12) grounding wire. Connect the other end of the grounding wire to a suitable ground as shown in Figure 4-4.
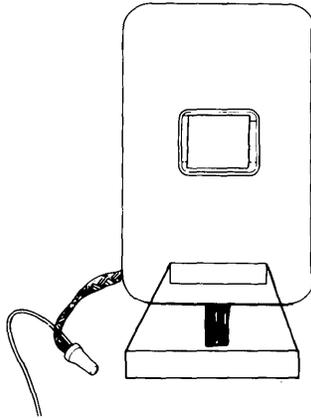
22. Return to the faceplate installation procedure in the *IBM Cabling System Planning and Installation Guide*. Assemble the data connector to the faceplate, and install the faceplate in the outlet box.

Type B Data Connector Assembly
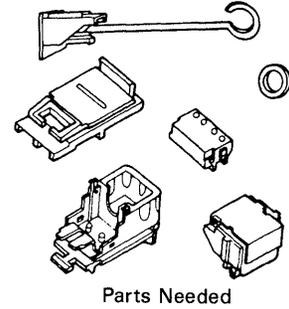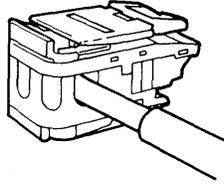
Parts Needed

Warning: Do not use wire strippers on the jacket; use the ripcord under the jacket.
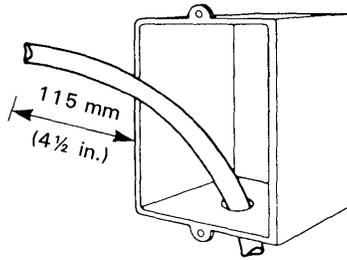
1. Cut off excess cable. Leave 155 mm (4-1/2 in.) of cable (measured from the wall) protruding from the box.

   Note: Leave any remaining slack inside the wall.

2. After installing the cable into the outlet box, strip the cable jacket back 210 mm (8-1/4 in.) from the end of the cable.

   Cut the jacket back a little way to expose the ripcord.

   Grasp the ripcord with needlenose pliers, wrapping it around the end of the pliers as shown.

   Gently pull back on the ripcord, stripping back 210 mm (8 1/4 in.) of the jacket.

115 mm
(4½ in.)
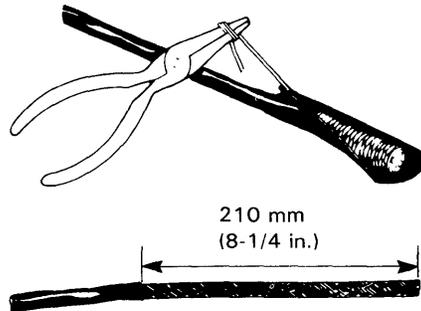
210 mm
(8-1/4 in.)

3. Cut off the excess jacket, ripcord, and plastic wrap (if present) covering the braided shield.
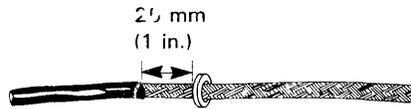
25 mm
(1 in.)

4. Install the strain relief washer over the braided shield 25 mm (1 in.) from the end of the cable jacket.
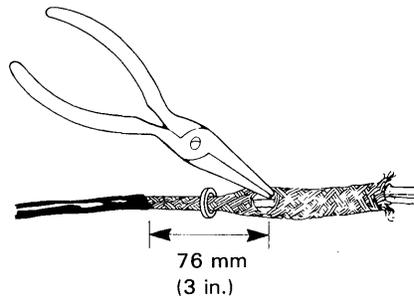
76 mm
(3 in.)

5. Using a pair of needlenose pliers, tease a circular opening 13 mm (1/2 in.) in diameter whose center is 76 mm (3 in.) from the end of the cable jacket. Be sure not to cut the strands of the cable shield braid.
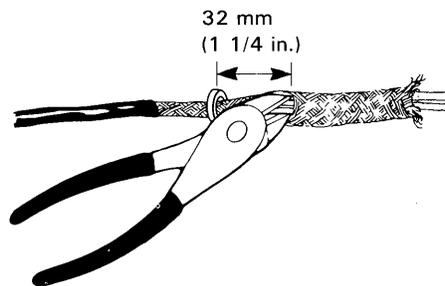
32 mm
(1 1/4 in.)

6. Using a pair of wire cutters inserted through the opening, cut the wires at least 32 mm (1-1/4 in.) from the nearest edge of the strain relief washer.
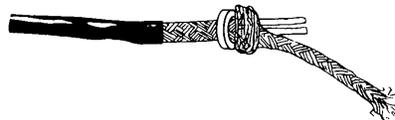
7. Carefully guide the end of the wires through the opening in the braided shield.
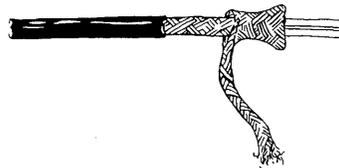
8. Slip the braided shield over the washer and flatten out the 122-mm (5-in.) shield with your fingers. Be sure to move as much of the folded braid over the washer as possible. Remove the metallic paper from around the wires in the cable.

Note: Ensure that there are no stray strands of the braid. (See warning note on next page.)
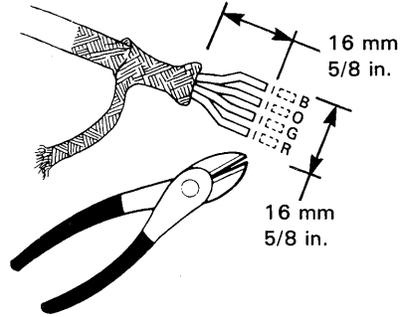
16 mm
5/8 in.

16 mm
5/8 in.

9. Spread the data wires evenly
   and in the order as shown.

   Trim the data wires to the
   16 mm (5/8 in.) dimension.

Warning: Ensure that there are
no stray strands of the braid. A
stray strand of the braid
touching the dressing block
contacts will cause an electrical
short and the connector will not
function properly.
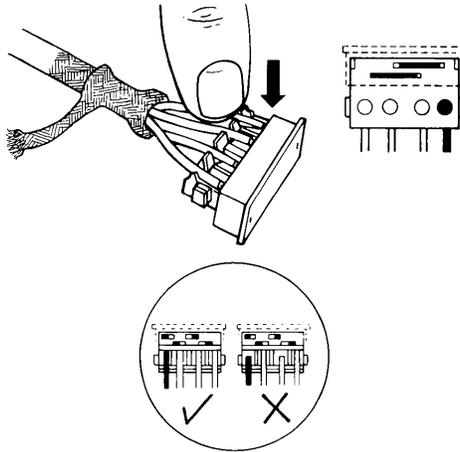
10. Do not strip the insulation
    from the wires.

    Insert the data wires into the
    matching color-coded slots
    of the dressing block, as
    shown.

    Make sure that the tips of
    the wires are flush with the
    rear of the wire channels in
    the dressing block, and press
    the wires down into the
    grooves.
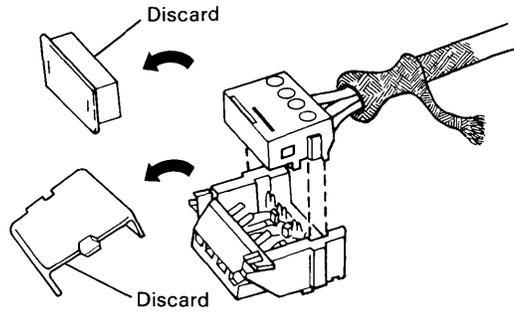
11. Remove the temporary protective covers from the dressing block and the contact housing.

Align the dressing block with the contact housing, and press the dressing block onto the contacts. If necessary, use slip joint pliers to seat the dressing block.
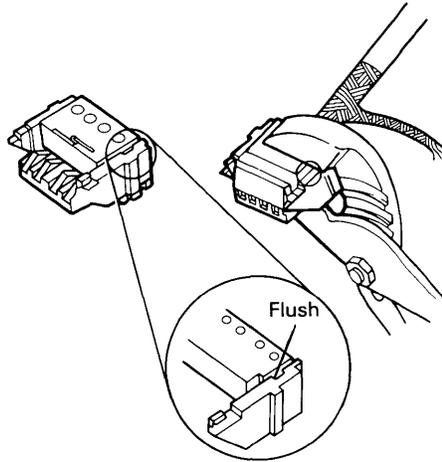
Ensure that the top of the plastic guide on the dressing block is flush with the top of the groove on the contact assembly housing.

Note: Inspect the assembly at this point to make sure that the tips of the wires are flush with the rear of the wire channels. If not, cut off the cable end and restart this procedure.
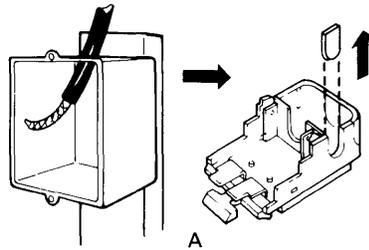
12. Note whether the cable enters the box from the top or the bottom.

If the cable enters the outlet box from the *top*, remove the exit cover from the appropriate side of the bottom cover as shown in illustration *A* at left.
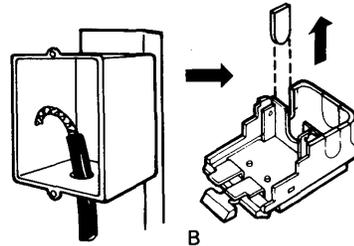
If the cable enters from the *bottom* of the outlet box, remove the exit cover tab from the appropriate side of the bottom cover as shown in illustration *B* at left.
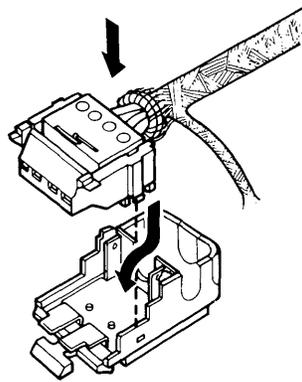
13. Insert and fully seat the contact assembly into the bottom cover.
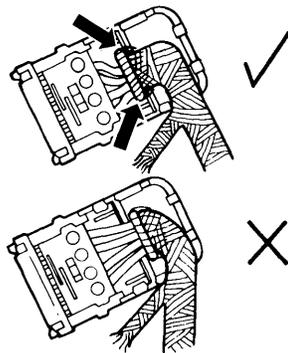
Note: Position the strain relief washer on the *contact side* of the internal bulkhead as shown.
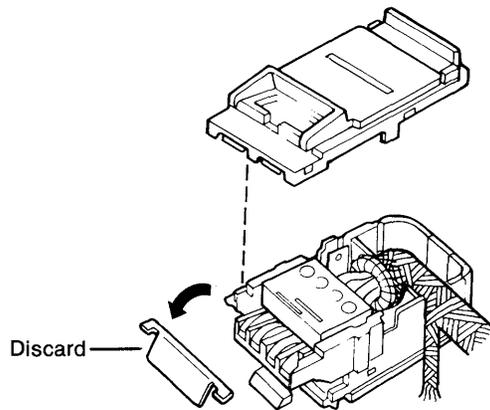
14. Remove the temporary protective cover from the contacts on the contact housing and align the top cover with the bottom cover.

Discard ——
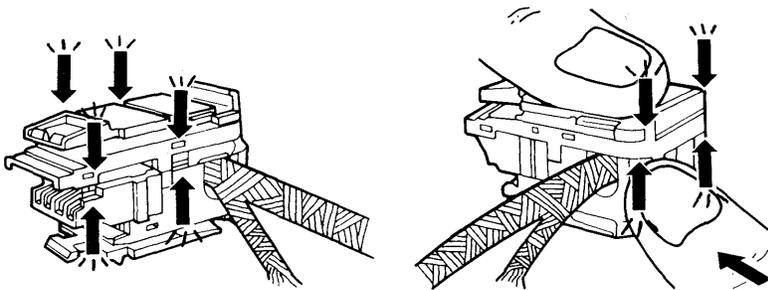
15. To snap the cover in place, first engage the locking tabs on both sides of the connector.

Ensure that the locking tabs on both sides are engaged, then press firmly in on the rear of the connector and down on the cover to engage both of the rear locking tabs.

Note: A dust cover is included
in each bag of connector parts
for protecting the unmated data
connector contacts from dust,
dirt, and other particles,
particularly during building
construction. The dust cover
should remain in place when the
connector is not mated to
another connector. The dust
cover strap retains the dust
cover when the connector is
mated.
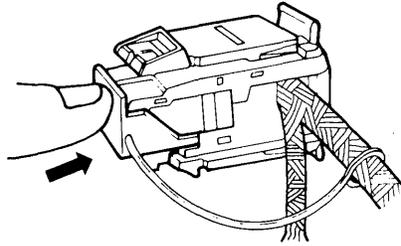
16. Attach the dust cover strap
to the cable behind the data
connector as shown. Route
the dust cover strap under
the connector and install the
dust cover onto the front of
the data connector.
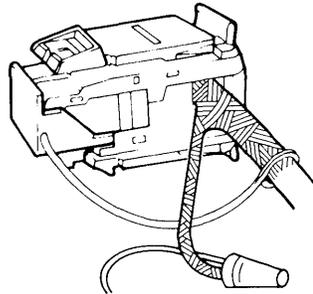
17. With a wire nut, connect the
braided shield to a 2 mm
diameter (AWG#12)
grounding wire. Connect
the other end of the
grounding wire to a suitable
ground as shown in Figure
4-4.
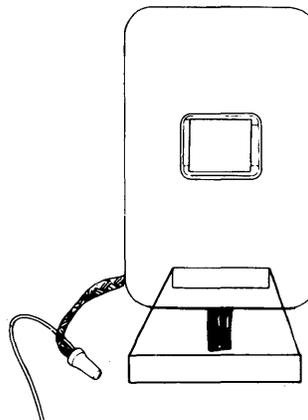
18. Return to the faceplate
installation procedure in the
*IBM Cabling System
Planning and Installation
Guide.* Assemble the data
connector to the faceplate,
and install the faceplate in
the outlet box.

This figure shows only how
the cables are connected
not how they should be routed.

Type 3
Specified Media

Type 3
Media Filter

Patch—
Cable

Wiring Closet   Work Area

Transformer Grounding
Electrode Conductor

Transformer

Floor XX

Type 1 Faceplate

Braid to
Grounding Conductor

Grounding Conductor

Type 1 cable connecting
the 8228s in the two
wiring closets must be
grounded.

Transformer Grounding
Electrode Conductor

Transformer

Floor 1

Type 1 Faceplate

Braid to
Grounding Conductor

Grounding Conductor

Transformer Grounding Electrode
(Equipment Grounding Conductor,
Building Steel, Waterpipe, etc.)

Type 3
Specified Media

Type 3
Media Filter

Patch—
Cable

—Grounding Riser
(4mm [#6 AWG] or larger)

Building
Grounding Electrode

Wiring Closet   Work Area

Figure 4-4. Grounding a Network without Equipment Racks

Wire Continuity from Type 3 Media Filter to Type 3 Jumper Cable

The IBM Token-Ring Network uses two twisted pairs to transmit and receive data. Both of these pairs must retain their polarity from the attaching device to the IBM 8228. Figure 4-5 illustrates all of the connections from the work area to the Type 3 Media Jumper Cable. See Appendix C, PD Techniques for lobe wiring.

Setup Problems:

It is essential for the lobe wiring connections to match those shown in figure 4-5. Specifically, the first data twisted pair must be connected to the tip and ring of the data jack (pins 3 and 4 for a 6-pin modular jack), and a second data twisted pair must be connected to tip-2 and ring-2 of that data jack (pins 2 and 5 for a 6-pin modular jack). The first pair must be electrically connected to the white/orange-orange/white wires of the type 3 media jumper cable, while the second pair must be connected to the blue/white-white/blue pair of the media jumper cable. If the pairs are split, that is one twisted pair connected to pins 2 and 3, the other connected to pins 4 and 5, high error rates, or no valid transmission may occur.

If the pairs are reversed, that is pins 3 and 4 are connected to the blue/white-white/blue pair, the lobe checkout tests will work, but insertion into the ring will fail and will bring down the ring in the process.

Because correct hookup is essential for proper operation, these procedures should be performed by someone familiar both with telephony practices and with the requirements set forth in this guide.

Flat telephone wire extension cables should also be avoided. These cables often have a high crosstalk noise associated with them and are inappropriate for token-ring use.

If proper installation has been verified, and the lobe insertion tests will not run successfully, then that lobe may be unsuitable for token-ring use.

Note: This wiring scheme does *not* conform to the color coding in usual telephony practice. If the wires are not installed as shown in the following figure, the lobe will not function. Further, if the pairs are reversed, the Adapter Diagnostics supplied with the Adapter and the Adapter II, which were designed to check out an adapter or wire fault assuming correct wiring, will not detect an error, but the lobe will not operate.

6-Pin Modular Jack (Voice)

Voice Pairs

From 6-Pin Modular Data Jack Pin Numbers

3
4
2
5

Type 3 Specified Media

2
3
4
5

6-Pin Modular Jack (Data)

White/Orange
Orange/White
Blue/White
White/Blue

Data Connector

Type 66 Connecting Block for Data and Voice

Type 66 Connecting Block for Data
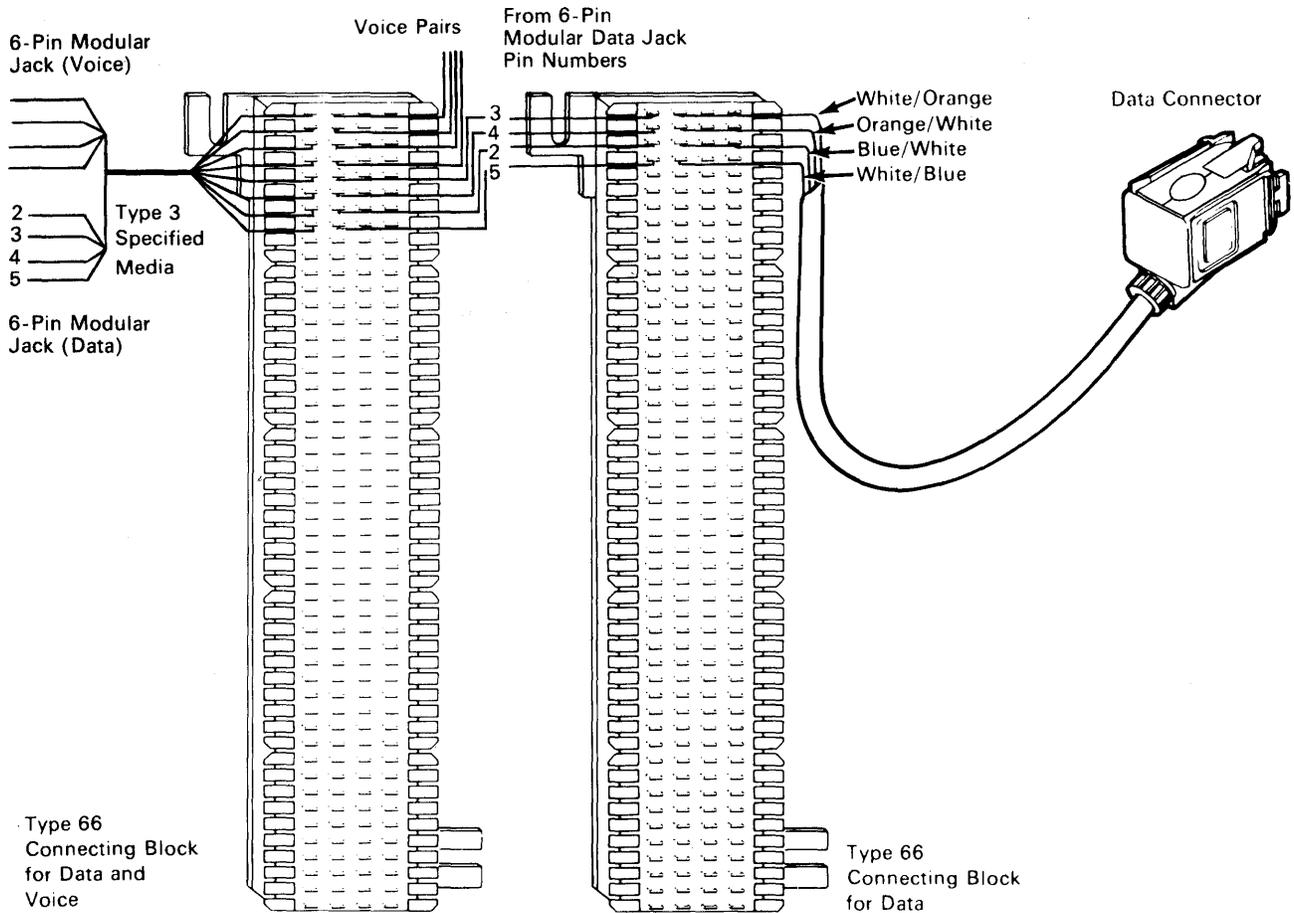
Figure 4-5. Wire Continuity from Type 3 Media Filter to Type 3 Jumper Cable

9-Pin D Shell Connector Pin Number	6-Pin Modular Jack Pin Number	8-Pin Modular Jack Pin Number	Telephone Wire Connection	Line Name	Type 3 Jumper Cable Color Code	Data Connector Color Code
5	2	3	Pair 2 - Tip	T−	Blue/White	Black
1	3	4	Pair 1 - Ring	R+	White/Orange	Red
6	4	5	Pair 1 - Tip	R−	Orange/White	Green
9	5	6	Pair 2 - Ring	T+	White/Blue	Orange
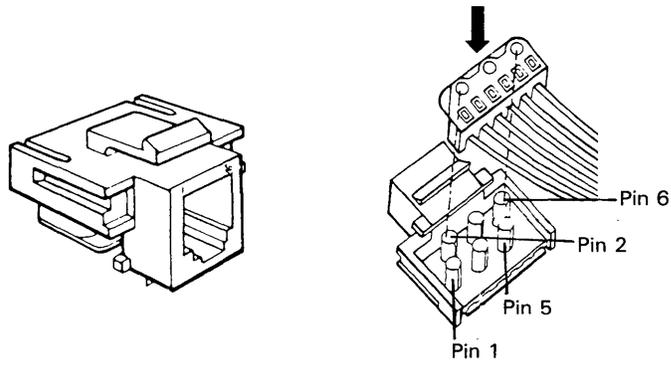
Figure   4-6. Three-Pair Telephone Jack Connector

Alternate
Design A

Alternate
Design B
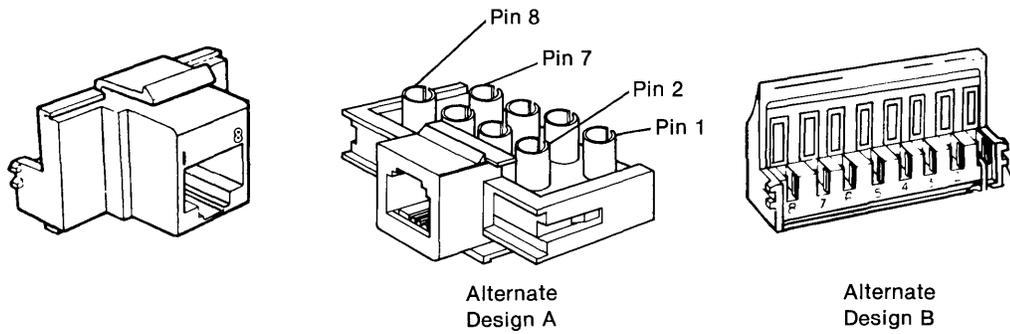
Figure   4-7. Four-Pair Telephone Jack Connector
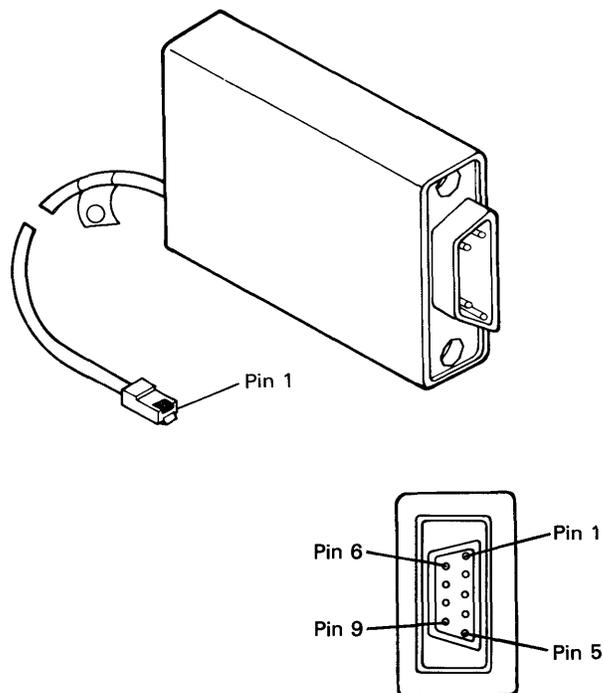
Figure   4-8. Nine-Pin D Shell Connector

Terminating Wires at Type 66 Connecting Blocks

You may wish to protect the connections on your type 66 connecting blocks with terminal clips, installed as shown in Figure 4-9 or with dust covers for the connecting blocks.

Terminal Clips
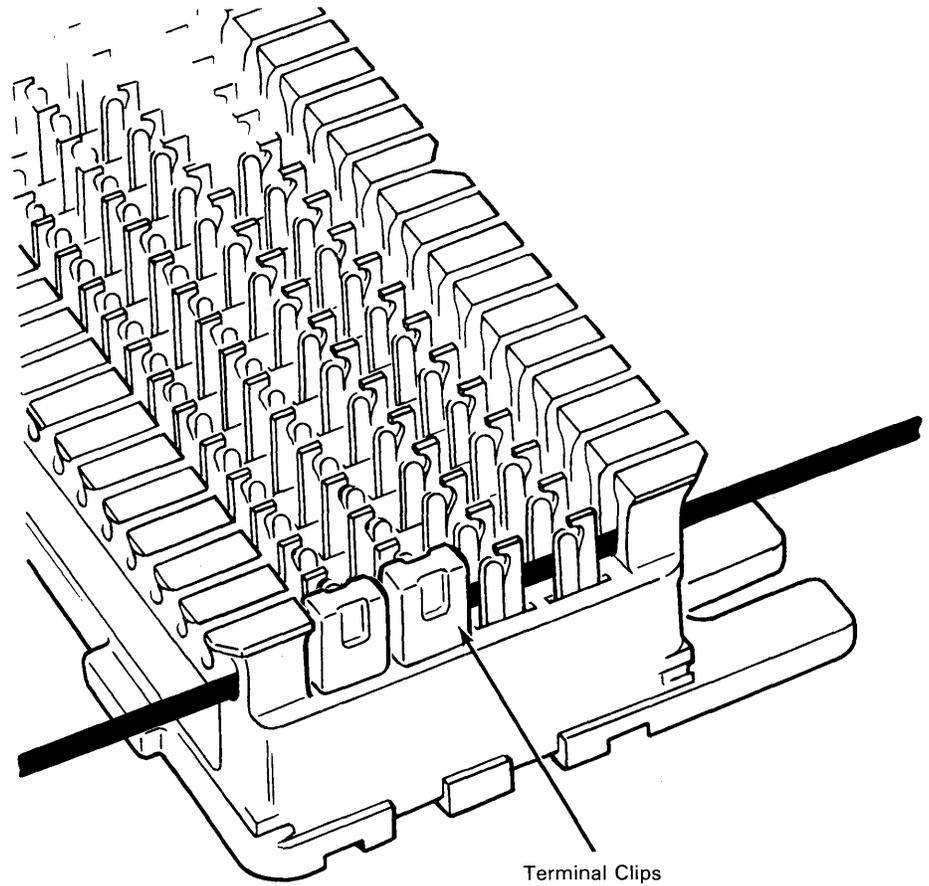
Figure 4-9. Proper Terminations at Type 66 Connecting Blocks

Chapter 5. Planning the Network

This chapter describes how to fill out the IBM Token-Ring Network planning forms in Appendix E to assure that your network can be installed properly and that adequate records are available for problem determination and reconfiguration to meet changing needs.

If your establishment has a number of rings or a single, large ring whose configuration is subject to frequent change, you may want to use the program listing available in the *IBM Token-Ring Network Introduction and Planning Guide* to help you automate your network record-keeping.

Establishing a Numbering and Labeling System

You should establish a numbering system for your installation of the IBM Token-Ring Network so that you will be able to make changes to the network and perform problem determination procedures that depend upon accurate records about the network. If you are planning more than one ring for your establishment, each ring should be planned separately, but the numbering system should be consistent from ring to ring. The numbering system you use should provide a number or identifier, unique within your establishment, for each:

- Ring
- Attaching device
- Work area
- IBM 8228 Multistation Access Unit
- IBM 8218 Copper Repeater
- IBM 8219 Optical Fiber Repeater.

Figure 5-1 on page 5-3 illustrates an appropriate numbering scheme and the placement of labels for a network.

In addition, you should ensure that your telephone wiring is adequately labeled so that each pair's termination point is identifiable from the telephone wiring closet.
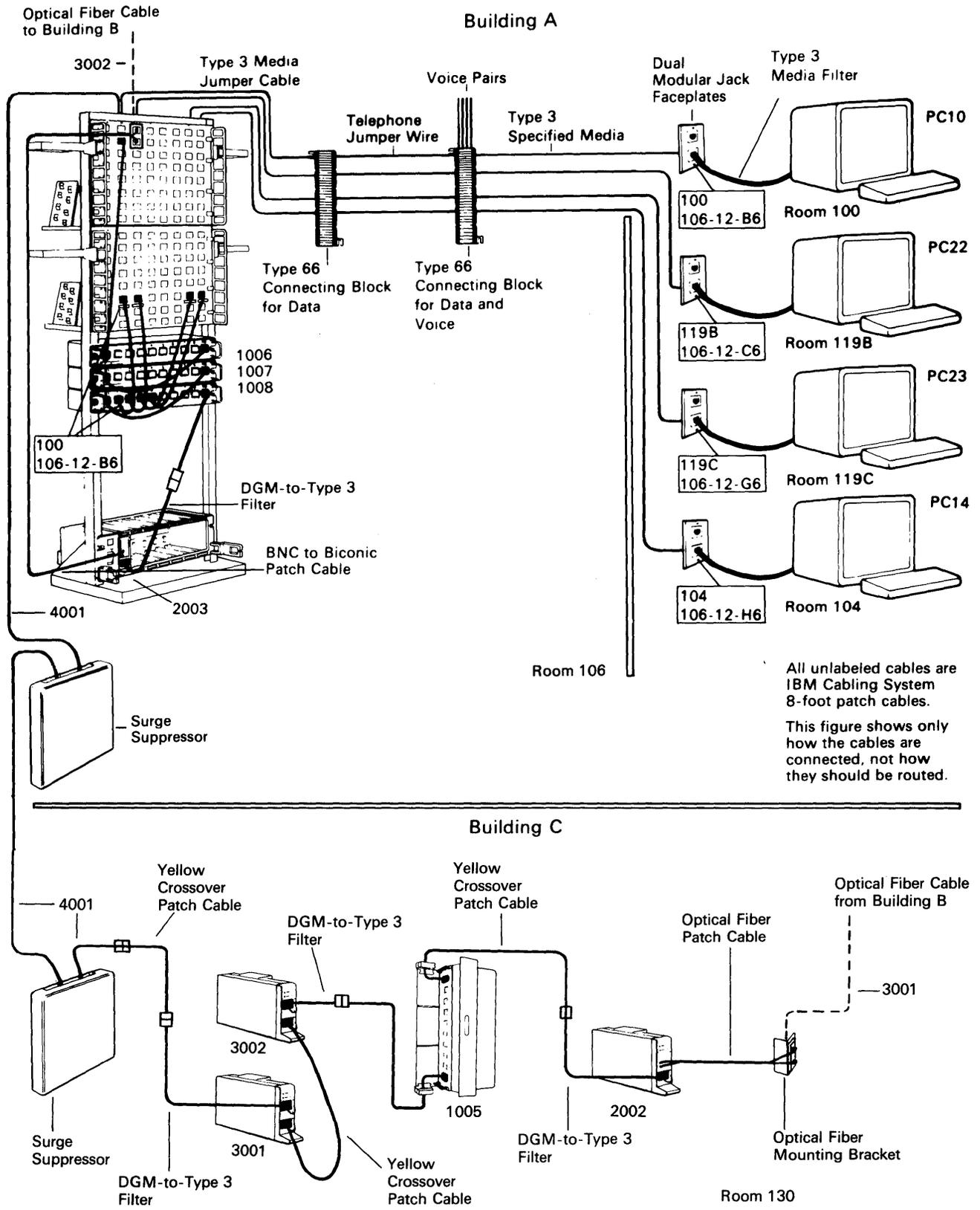
Figure 5-1. Numbering and Labeling a Network Using Telephone Cabling

See Figure 5-5 for this network's Ring Sequence Chart

Filling Out the Planning Forms

You should fill out these forms to aid in installing or modifying your ring, performing problem determination procedures, or integrating your ring with a subsequent installation of the IBM Cabling System:

- IBM 8228 Cabling Charts
- IBM 8218 Cabling Charts for Telephone Twisted-Pair-Based Rings
- IBM 8219 Cabling Charts for Telephone Twisted-Pair-Based Rings
- Ring Sequence Charts
- Locator Charts
- Network Ordering Worksheet.

These forms are included in Appendix E. You may make photocopies of them for use in planning your network.

The IBM 8228 Cabling Chart

The IBM 8228 Cabling Chart records information used for installation and problem determination for your ring. It forms part of your permanent records for your network. You should fill out an IBM 8228 Cabling Chart for each 8228 in your network.

In Section 1 of each chart, indicate:

1. The date the chart is filled out

2. The unique unit number assigned to the 8228

3. The location of the 8228

4. Whether the 8228 is rack-mounted or wall-mounted

5. The ring number.

In section 2 of the 8228 Cabling Chart, indicate:

6. In the "Connect to" row, the location of each attaching device connected to the 8228

7. In the "Device" row, write the number that you have assigned to each attaching device. If an attaching device is used as a file server, print server, bridge, or network manager, you should indicate it in this space.

Section 3 of the IBM 8228 Cabling Chart should be filled out as you are filling out the Ring Sequence Chart.

IBM 8228 Cabling Chart

Date __4/2/86__

Section 1 Identification

| Unit Number __1001__ | Building __B__ Location __120-1__ | Rack-mounted ☑ Wall-mounted ☐ | Ring __1__ |

Section 2 Receptacle Connections

Receptacle	1	2	3	4	5	6	7	8
Connect to:	120-12-A1	120-12-B1	120-12-C1	120-12-D1				

| Device | PC110 | PC115 | PC163 | PC194 Bridge | | | | |

Section 3 Ring Connections

A. Connect RI of this 8228 to: _____

B. Connect RO of this 8228 to: _____

Figure 5-2. Filling Out the IBM 8228 Cabling Chart

The IBM 8218 Cabling Chart

Each IBM 8218 Cabling Chart records the location of a pair of 8218 Copper Repeaters and the number of the ring they belong to. This cabling chart is used during installation and cabling of the 8218s and while performing problem determination procedures.

Note: You must use the IBM 8218 Cabling Chart for Telephone-Twisted-Pair-Based Rings in Appendix E of this manual.

IBM 8218s can be placed in racks in wiring closets or in surface mounting brackets in work areas. When 8218s are placed in work areas, there must be two type 1 or type 2 cables leading to the work area so that the Ring In (RI) and Ring Out (RO) receptacles on the 8218 may be connected to the rest of the ring.

For each 8218 in the ring, first check the Rack Inventory Chart to see if there is enough space in the rack to install the 8218 in its rack mounting assembly at the bottom of the equipment rack. Since 8218s are always installed in pairs, you should be sure that two adjacent slots in the rack mounting assembly are available for installing a pair of 8218s to facilitate installation and problem determination.

If the 8218 is installed in a surface mounting bracket, it should be close to the 8228s, if any, and to a properly grounded electrical outlet.

The 8218 Cabling Chart shows a pair of 8218s and the correct cables leading to them. Record the following information on the IBM 8218 Cabling Chart:

1. The date the chart is filled out.

2. The 8218 unit number (assign a four-digit number, unique within your establishment).

3. The building in which the 8218s are to be installed.

4. The wiring closet number or work area where the 8218s are to be placed.

5. Whether the 8218s are rack-mounted or wall-mounted.

6. The ring number (assign a unique number).

The Ring Connections information in Section 2 of the IBM 8218 Cabling Chart is filled out later after the Ring Sequence Chart has been prepared.

Prepare an 8218 unit number label with the four-digit number you have assigned for each of the 8218s.

IBM 8218 Cabling Chart
for Telephone Twisted-Pair-Based Rings

Section 1   Date _____ 4/2/86 _____

Ring _____ 1 _____

_3001_   Unit Number   _3001_

Building _____ C _____

Location _____ 130 _____

Rack-Mounted ☐

Wall-Mounted ☑

Section 2

Connect to   RI   RI   Connect to

Green   Green

White DGM to   RO   RO   White DGM to   Yellow
Type 3 Filter   Type 3 Filter   Crossover
                                                                       Cable

Yellow
Crossover
Cable
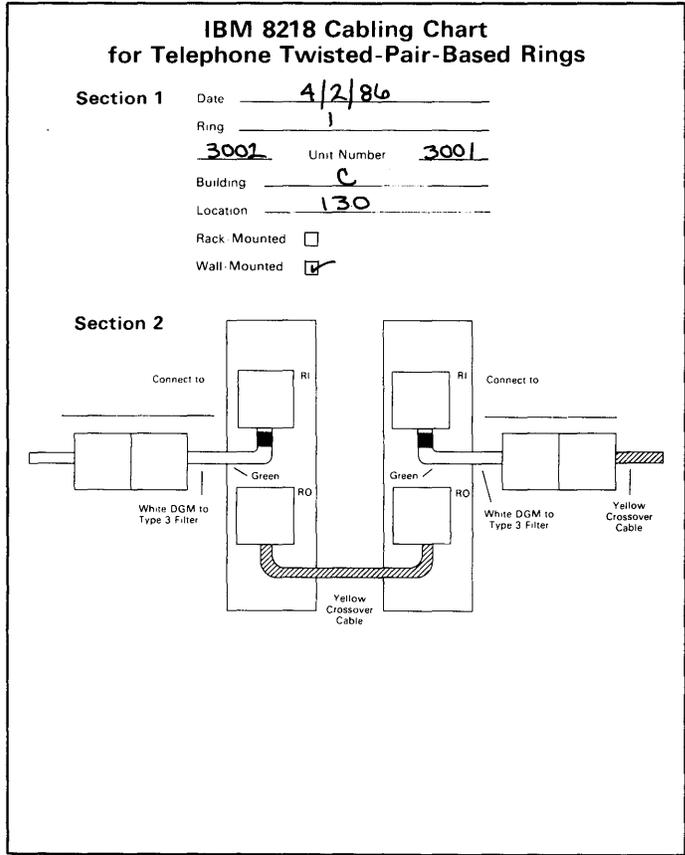
Figure   5-3. Filling Out the IBM 8218 Cabling Chart

The IBM 8219 Cabling Chart

Each IBM 8219 Cabling Chart records the locations of a pair of 8219 Optical Fiber Repeaters and the number of the ring they belong to. This cabling chart is used during installation and cabling of the 8219s and while performing problem determination procedures.

Note: You must use the IBM 8219 Cabling Chart for Telephone-Twisted-Pair-Based Rings in Appendix E of this manual.

IBM 8219s can be placed in racks in wiring closets or in surface mounting brackets in work areas.

For each 8219 in the ring, first check the Rack Inventory Chart to see if there is enough space in the rack to install the 8219 in its rack mounting assembly at the bottom of the equipment rack.

In a wiring closet, each 8219 should be located in the same rack as the distribution panel where its cables terminate. This will allow the optical fiber patch cables to reach between the 8219 Transmit and Receive receptacles and the distribution panel. If the 8219 is installed in a surface mounting bracket, it should be close to a properly grounded electrical outlet.

Record the following information about each of the two 8219s on the IBM 8219 Cabling Chart:

1. The date the chart is filled out.

2. The 8219 unit number (assign a four-digit number, unique within your establishment).

3. The building in which the 8219 is to be installed.

4. The wiring closet number or work area where the 8219 is to be placed.

5. Whether the 8219 is rack-mounted or wall-mounted.

6. The ring number (assign a unique number).

The Ring Connections information in Section 2 of the IBM 8219 Cabling Chart is filled out later as the Ring Sequence Chart is being prepared.

Prepare 8219 unit number labels with the four-digit number you have assigned to the 8219s.

**IBM 8219 Cabling Chart
for Telephone Twisted-Pair-Based Rings**

Figure   5-4. Filling Out the IBM 8219 Cabling Chart

The Ring Sequence Chart

The Ring Sequence Chart is used as a worksheet for cabling together the IBM 8228s, 8218s, and 8219s that form the main ring path. This chart serves as an ongoing record of your ring's physical structure so that you have a basis for changing the network and a guide for use while performing problem determination procedures.

The Ring Sequence Chart has been designed so that you can identify all components and cables in the main ring path. Each of the rectangles on the chart can be used to identify an IBM 8228, 8218, 8219, a distribution panel coordinate, a faceplate, or a surge suppressor. The signal flow through the network is from the top of the form to the bottom. The lines between the rectangles represent patch cables of various types and wiring closet-to-wiring closet cables.

Although this example shows a network that has its components in racks, the Ring Sequence Chart can also be used for systems that use wall-mounted components.

The rough sketch of the ring that you used to help determine the allowable drive distance and the placement of repeaters in the main ring path will help you fill out the Ring Sequence Chart. Sort the 8228, 8218, and 8219 Cabling Charts by wiring closet or work area location. Using the rough sketch, arrange the 8228, 8218, and 8219 Cabling Charts in the order in which the devices will be installed in the main ring path. Now you are ready to begin filling out the Ring Sequence Chart.

The sample Ring Sequence Chart in Figure 5-5 on page 5-15 is based upon the sketch shown below.
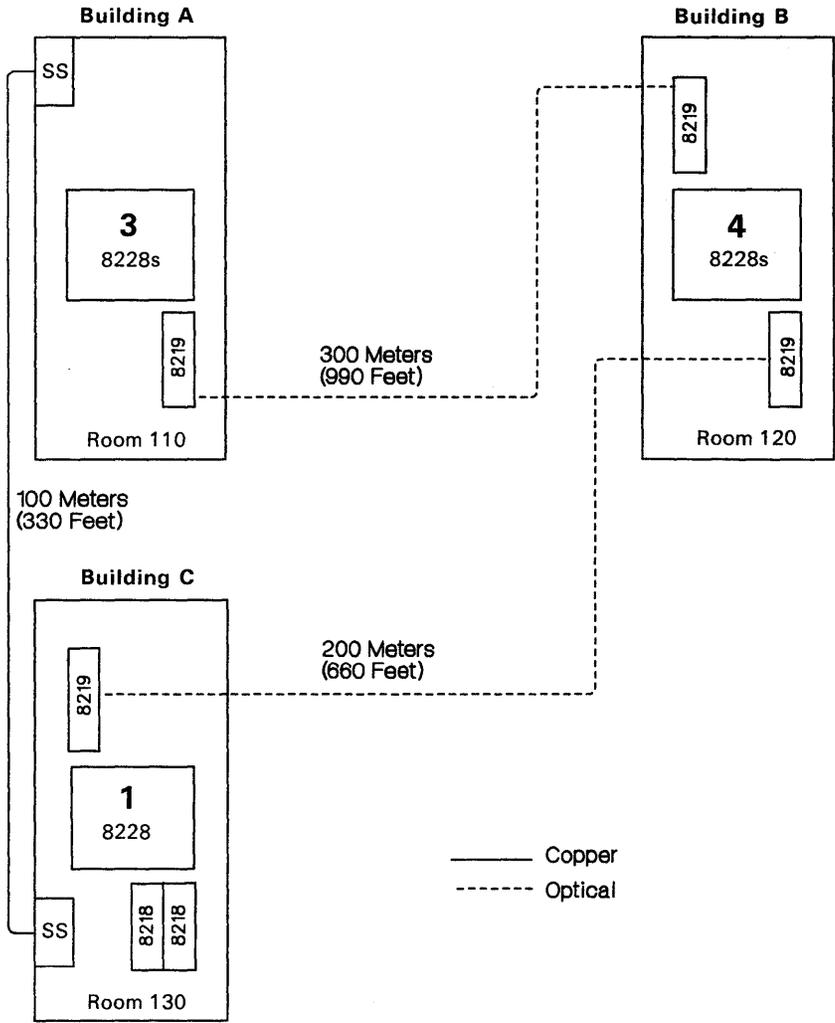
To fill out the Ring Sequence Chart:

1. Write the ring number, the date, and the page number at the top of the chart.

2. Choose a starting point for the ring. For a ring that is contained in a single rack, start with the topmost 8228 in the rack. For a ring that passes through several racks, pick the first 8228 (the one closest to the top of the rack) in the first rack (according to the IBM Cabling System labeling conventions) in any of the wiring closets.

3. In the first rectangle on the form, write the component type ("MSAU" for IBM 8228) and unit number of the 8228 you have just identified. Write its location (wiring closet and rack number) below the line.

4. If the next component is an 8228 connected to the first by a patch cable, write "P" in the blank space in the middle of the line connecting the two rectangles. Also record the length of the patch cable in the same place. Standard patch cable lengths are 8, 30, 75, and 150 feet. For each subsequent 8228 that is in the same rack as the first two, repeat this step until all the 8228s in the rack have been recorded on the Ring Sequence Chart.

   - If the next components in the main ring path are a pair of IBM 8218 Copper Repeaters, go to step 5.

   - If the next component in the main ring path is a surge suppressor, go to step 6.

   - If the next component in the main ring path is an IBM 8219 Optical Fiber Repeater, go to step 7.

   - If the next component is in another rack, go to step 8.

   - If you have reached the bottom of the chart, go to step 9.

   - If you have recorded all of the 8228s in the network, go to the last step in this procedure (step 10).

     Return to this step after going to all other steps except step 10.

5. If the next components in your main ring path are a pair of 8218 Copper Repeaters:

   a. Enter "DGM/P" in the blank space following the last filled-in rectangle to indicate that an assembly of a DGM-to-type 3 filter and a patch cable connects the last component to the 8218.

b. In the rectangle, enter "RPTR" and the unit number of the first of the pair of repeaters. Enter its location under the line.

c. Enter "YCP" in the blank space following the last filled-in rectangle to indicate that a yellow crossover cable connects the *Ring Out* connector of the first repeater to the *Ring Out* of the second in the pair.

d. In the next blank rectangle, enter "RPTR," the unit number, and location of the second of the pair of 8218s.

e. In the blank space following the filled-in rectangle, enter "DGM/YCP" for the DGM-to-type 3 filter and yellow crossover patch cable assembly that leads to the next component.

f. See "Section 2 of the IBM 8218 Cabling Chart" later in this chapter, and complete Section 2 of the chart for this pair of repeaters.

g. Go back to step 4.

6. If the next component in the main ring path is a surge suppressor:

a. Enter "SS" above the line in the next rectangle on the form.

b. Assign a unit number to the surge suppressor and write it next to "SS" in the rectangle.

c. Write the location below the line in the rectangle.

d. In the blank below the rectangle, record the number of the cable leaving the surge suppressor.

e. Go back to step 4.

7. If the next component in your main ring path is an IBM 8219 Optical Fiber Repeater:

a. Enter "DGM/P" to indicate an assembly of a DGM-to-type 3 filter and a patch cable in the blank space following the last filled-in rectangle if the component in that rectangle is not an 8219. If it is, enter "DGM/YCP" to indicate an assembly made up of a DGM-to-type 3 filter and a yellow crossover patch cable.

b. In the next rectangle, enter "OFRPTR" for optical fiber repeater, and its unit number above the line. Enter its location below the line.

c. Enter "OFP" in the blank space following the filled-in rectangle to indicate the use of an optical fiber BNC-to-biconic patch cable.

d. In the next rectangle, enter "DP" and the distribution panel coordinates for the optical fiber cable that leads to the next wiring closet.

e. In the blank following the filled-in rectangle, enter the number of the optical fiber cable that leads to the next component in the main ring path.

f. In the next rectangle, enter "DP" and the distribution panel coordinates where the optical fiber cable terminates.

g. In the blank following the rectangle, enter "OFP".

h. In the next rectangle, enter "OFRPTR" for optical fiber repeater, and its unit number above the line. Enter its location below the line.

i. Enter "DGM/YCP" in the blank space after the rectangle.

j. See the section in this chapter called "Section 2 of the IBM 8219 Cabling Chart" for instructions on completing the information on that chart.

k. Go back to step 4.

8. Record all of the cables and components in the ring as you trace your system from rack to rack. Use "DP" to abbreviate distribution panel, "MB" for mounting bracket, and "FP" for faceplate. Be sure to record the correct cable number and termination point for each of the wiring closet-to-wiring closet cables. If your ring connections go from wiring closet to wiring closet, the entries on the Ring Sequence Chart will be similar to those shown in Figure 5-5 on page 5-15. Go back to step 4.

9. When you change pages on the Ring Sequence Chart, indicate the cable at the bottom of the completed form and at the top of the form you are starting, as shown in Figure 5-5 on page 5-15. Go back to step 4.

10. Remember that the last component in the sequence and the Ring In of the first 8228 shown on your form must be connected.

   a. If the last and first components are in the same wiring closet, connect them with a patch cable and show the connection on the Ring Sequence Chart.

   b. If the last and first components are not in the same wiring closet, the entries on your Ring Sequence Chart will be similar to the ones in Figure 5-5.

Ring Sequence Chart

Ring Number ___1___   Date 4/2/86   Page 1 of 3

cable from DGM YCP

on page 3

(component) MSAU 1001
(location) B120-1

P8

(component) MSAU 1002
(location) B120-1

P8

(component) MSAU 1003
(location) B120-1

P8

(component) MSAU 1004
(location) B120-1

DGM P8

(component) OFRPTR 2001
(location) B120-1

OFP

(component) DP
(location) B120-11-A1 + A2

3001

(component) MB
(location) C130-0-0+B

cable to OFP
on page 2

Suggested Abbreviations:

DP - Distribution Panel
P - Patch Cable
YCP - (Yellow) Crossover Patch Cable
OFP - Optical Fiber Patch Cable

FP - Faceplate
MB - Optical Fiber
     Mounting Bracket
SS - Surge Suppressor

MSAU - IBM 8228 Multistation Access Unit
RPTR - IBM 8218 Copper Repeater
OFRPTR - IBM 8219 Optical Fiber Repeater

Figure 5-5 (Part 1 of 2). Filling Out the Ring Sequence Chart

Ring Sequence Chart

Ring Number _____1_____   Date 4/2/86   Page 2 of 3

cable from OFP
on page 1

(component)	OFRPTR 2002
(location)	C130-0

DGM
YCP

(component)	MSAU 1005
(location)	C130-0

DGM
P8

(component)	RPTR 3002
(location)	C130-0

YCP

(component)	RPTR 3001
(location)	C130-0

DGM
YCP

(component)	SS
(location)	C130-0

4001

(component)	SS
(location)	A110-1

4001

(component)	DP
(location)	A110-11-B1

cable to P8
on page 3

Suggested Abbreviations:

DP - Distribution Panel   FP - Faceplate
P - Patch Cable   MB - Optical Fiber   MSAU - IBM 8228 Multistation Access Unit
YCP - (Yellow) Crossover Patch Cable   Mounting Bracket   RPTR- IBM 8218 Copper Repeater
OFP - Optical Fiber Patch Cable   SS - Surge Suppressor   OFRPTR - IBM 8219 Optical Fiber Repeater

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Ring Sequence Chart

Ring Number _____1_____   Date 4/2/86   Page 3 of 3

cable from P8
on page 2

(component)	MSAU 1006
(location)	A110-1

P8

(component)	MSAU 1007
(location)	A110-1

P8

(component)	MSAU 1008
(location)	A110-1

DGM
P8

(component)	OFRPTR 2003
(location)	A110-1

OFP

(component)	DP
(location)	A110-11-C1+C2

3002

(component)	DP
(location)	B120-11-C1+C2

OFP

(component)	OFRPTR 2009
(location)	B120-1

cable to DGM/YCP
on page 1

Suggested Abbreviations:

DP - Distribution Panel   FP - Faceplate
P - Patch Cable   MB - Optical Fiber   MSAU - IBM 8228 Multistation Access Unit
YCP - (Yellow) Crossover Patch Cable   Mounting Bracket   RPTR- IBM 8218 Copper Repeater
OFP - Optical Fiber Patch Cable   SS - Surge Suppressor   OFRPTR - IBM 8219 Optical Fiber Repeater

Figure 5-5 (Part 2 of 2). Filling Out the Ring Sequence Chart

Section 3 of the IBM 8228 Cabling Chart

As you are filling out the Ring Sequence Chart, arrange the IBM 8228 Cabling Charts in the same order as the 8228s appear on the Ring Sequence Chart. In Section 3 of each IBM 8228 Cabling Chart, indicate the component connected to the RI receptacle of that unit and the component connected to the RO receptacle. If the RI or RO of an 8228 is connected to a distribution panel, indicate the connector location and the rack and panel number. Figure 5-6 illustrates the correct way to fill out section 3 of the IBM 8228 Cabling Chart.

IBM 8228 Cabling Chart

Date __4/2/86__

Section 1 Identification

| Unit Number __1001__ | Building __B__ Location __120-1__ | Rack-mounted ☑ Wall-mounted ☐ Ring __1__ |

Section 2 Receptacle Connections

Receptacle	1	2	3	4	5	6	7	8
Connect to:	120-12-A1	120-12-B1	120-12-C1	120-12-D1				
Device	PC110	PC115	PC113	PC194 Bridge				

Section 3 Ring Connections

| A. Connect RI of this 8228 to: __B120-1-2004__ |
| B. Connect RO of this 8228 to: __B120-1-1002-R1__ |

Figure 5-6. Filling Out Section 3 of the IBM 8228 Cabling Chart

Section 2 of the IBM 8218 Cabling Chart

Section 2 of the 8218 Cabling Chart shows a pair of repeaters with the necessary patch cable and crossover cable connections illustrated.

On the "Connect to" line to the left of the first 8218, enter the location, component number and receptacle of the component immediately upstream of the 8218.

In the "Connect to" line to the right of the second 8218, enter the location, component number, and receptacle of the component downstream from the second 8218 shown on the chart.

Figure 5-7 shows how Section 2 of the 8218 Cabling chart might be filled out.

**IBM 8218 Cabling Chart
for Telephone Twisted-Pair-Based Rings**

Section 1   Date ____4/2/86____

Ring ____1____

____3002____   Unit Number ____3001____

Building ____C____

Location ____130____

Rack-Mounted ☐

Wall-Mounted ☑

Section 2

Connect to   C130-0-100S-RO

White DGM to Type 3 Filter   Green   RI   RO

Green   RI   RO   Connect to   C130-0-SS

White DGM to Type 3 Filter   Yellow Crossover Cable

Yellow Crossover Cable
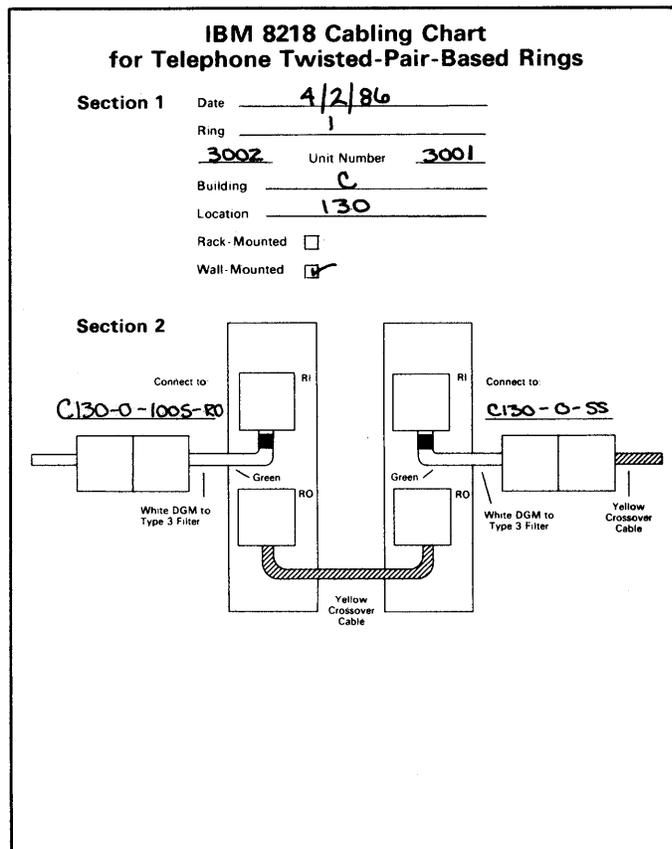
Figure 5-7. Filling Out Section 2 of the IBM 8218 Cabling Chart

Section 2 of the IBM 8219 Cabling Chart

Section 2 of the IBM 8219 Cabling Chart shows a pair of IBM 8219 Optical Fiber Repeaters with the appropriate cables attached. For the Optical Fiber Repeater on the left side of the page, on the " Connect To:" line to the left of the square connector, enter the location, component number and receptacle of the device immediately upstream of that 8219. If the upstream component is another 8219, check the "Yellow Crossover Cable" box beneath the cable; otherwise, check the box for black "Patch Cable".

Fill in the two "DP or MB Connections" lines above the first 8219 with the distribution panel coordinates for that 8219's connection to the optical fiber cable between wiring closets.

Fill in the pair of "DP or MB Connections" lines above the second 8219 with the distribution panel coordinates where the optical fiber cable terminates in the next wiring closet.

Fill in the "Connect to" line to the right of the second 8219 with the location, component number, and receptacle of the device immediately downstream of the second 8219. Figure 5-8 illustrates filling out section 2 of the 8219 Cabling Chart.
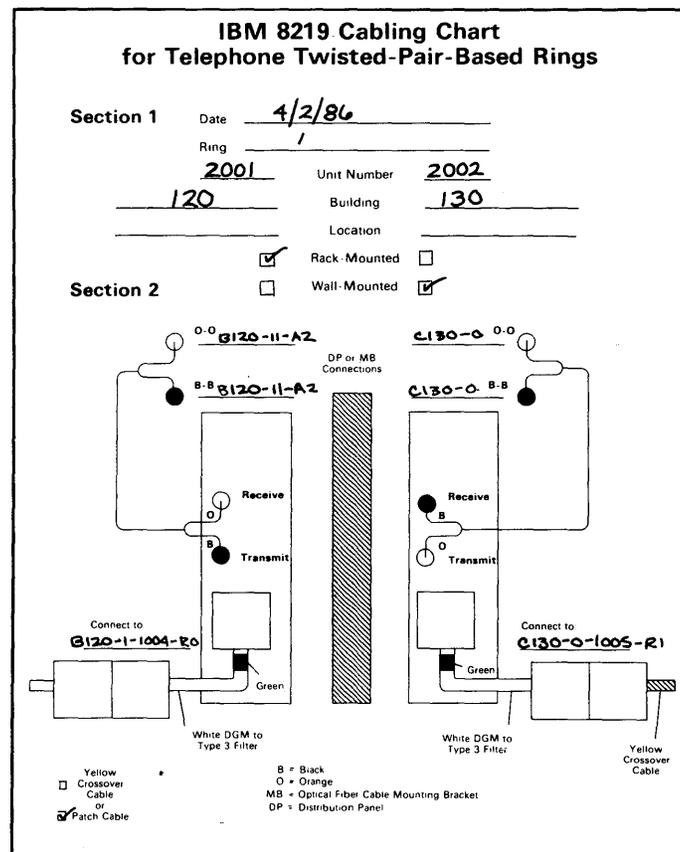
Figure   5-8. Filling Out Section 2 of the IBM 8219 Cabling Chart

The Locator Charts

Each of the attaching devices in your establishment is assigned to a specific physical location. Also, each attaching device has its own unique identification number. You have used these identifiers to indicate specific attaching devices on your planning documents.

On the network, however, an attaching device is known not by its location or assigned identification number, but by its adapter address. This address may be one of two types: universally administered or locally administered. Find out the adapter's address after installing the adapter in each device (see the adapter documentation).

Adapter Address to Physical Location
Locator Chart

Adapter Address	Physical Location	Device Identification	Ring Number	IBM 8228 Unit Number
10005A000000	100	PC 10	1	1003
10005A000001	101	PC 11	1	1001
10005A000002	103	PC 12	1	1001
10005A000003	103	PC 13	1	1001
10005A000004	104	PC 14	1	1003
10005A000005	105	PC 15	1	1001
10005A000006	107	PC 16	1	1001
10005A000007	109	PC 18	1	1002
10005A000008	113	PC 17	1	1002
10005A000009	115	PC 19	1	1002
10005A00000A	116	PC 20	1	1002
10005A00000B	118	PC 21	1	1002
10005A00000C	119 B	PC 22	1	1003
10005A00000D	119 C	PC 23	1	1003

Figure   5-9. Adapter Address to Physical Location Locator Chart

The locator charts relate the adapter address to the physical location and device identification numbers. These charts are vital for problem determination and must be kept current. On the Adapter Address to Physical Location Locator Chart, record the adapter addresses of all devices in the network in numerical order. On the Physical Location to Adapter Address Locator Chart, record the physical locations of all devices arranged by building and room number.

In the "Device Identification" column on both charts, in addition to entering the device identification, you should also indicate such functions as print servers, file servers, gateways, and bridges

Physical Location to Adapter Address
Locator Chart

Physical Location	Adapter Address	Device Identification	Ring Number	IBM 8228 Unit Number
100	1000 5A000000	PC 10	1	1003
101	1000 5A000001	PC 11	1	1001
103	1000 5A000002	PC 12	1	1001
103	1000 5A000003	PC 13	1	1001
104	1000 5A000004	PC 14	1	1003
105	1000 5A000005	PC 15	1	1001
107	1000 5A000006	PC 16	1	1001
109	1000 5A000007	PC 18	1	1002
113	1000 5A000008	PC 17	1	1002
115	1000 5A000009	PC 19	1	1002
116	1000 5A00000A	PC 20	1	1002
118	1000 5A00000B	PC 21	1	1002
119 B	1000 5A00000C	PC 22	1	1003
119 C	1000 5A00000D	PC 23	1	1003

Figure 5-10. Physical Location to Adapter Address Locator Chart

Filling Out the Network Ordering Worksheet

The information needed to fill out the Network Ordering Worksheet can be derived from your completed Ring·Sequence Charts and IBM 8228, 8218, and 8219 Cabling Charts. You will need to know the following:

1. The number of rack-mounted IBM 8228s (from the IBM 8228 Cabling Charts)

2. The number of wall-mounted IBM 8228s (from the IBM 8228 Cabling Charts)

3. The number of rack-mounted IBM 8218s (from the IBM 8218 Cabling Charts)

4. The number of wall-mounted IBM 8218s (from the IBM 8218 Cabling Charts)

5. The number of rack-mounted IBM 8219s (from the IBM 8219 Cabling Charts)

6. The number of wall-mounted IBM 8219s (from the IBM 8219 Cabling Charts)

7. The number of 8-, 30-, 75-, and 150-foot patch cables in the main ring path (from the Ring Sequence Charts)

8. The number of patch cables of each length used on all the lobes in the ring (count the number of active lobes recorded on the IBM 8228 Cabling Charts)

9. The number of yellow crossover patch cables (from the 8218 and 8219 Cabling Charts)

10. The number of optical fiber BNC-to-biconic patch cables (from the 8219 Cabling Charts)

11. The number of optical fiber biconic-to-biconic patch cables (from the Ring Sequence Charts)

12. The number of type 3 media filters (one for each lobe that uses twisted-pair wire)

13. The number of type 3 media jumper cables (one for each lobe that uses twisted-pair wire)

14. The number of data grade media-to-type 3 filters (one for each lobe that uses data grade media plus one for each 8218 Copper Repeater and each 8219 Optical Fiber Repeater)

Remember to order a component housing for each IBM 8228 that will not be mounted in a rack and a surface mounting bracket for each 8218 or 8219 not installed in a rack.

Spare Network Components

All installations must have at least one spare crossover patch cable, optical fiber BNC-to-Biconic patch cable, optical fiber biconic-to-biconic patch cable, and copper wire patch cable of each length and type used in the network. You must also have a spare type 3 media filter, type 3 media jumper cable, and data grade media-to-type 3 filter. These spares may be used for problem determination, to replace defective cables, or to expand the network quickly.

Network Ordering Worksheet

1. Rack-mounted IBM 8228 Multistation Access Units	7
2. Wall-mounted IBM 8228 Multistation Access Units	1
Total Number of IBM 8228 Multistation Access Units (P/N 6091014)	8
3. Rack-mounted IBM 8218 Copper Repeaters	0
4. Wall-mounted IBM 8218 Copper Repeaters	2
Total Number of IBM 8218 Copper Repeaters (P/N 6339532)	2
5. Rack-mounted IBM 8219 Optical Fiber Repeaters	3
.6. Wall-mounted IBM 8219 Optical Fiber Repeaters	1
Total Number of IBM 8219 Optical Fiber Repeaters (P/N 6339535)	4
7. 8-foot Patch Cables (for lobes)	60
8. 8-foot Patch Cables (for main ring path)	9
9. Spare 8-foot Patch Cables	3
Total Number of 8-foot Patch Cables (P/N 8642551)	72
10. 30-foot Patch Cables (for lobes)	0
11. 30-foot Patch Cables (for main ring path)	0
12. Spare 30-foot Patch Cables	0
Total Number of 30-foot Patch Cables (P/N 8642552)	0
13. 75-foot Patch Cables (for lobes)	0
14. 75-foot Patch Cables (for main ring path)	0
15. Spare 75-foot Patch Cables	0
Total Number of 75-foot Patch Cables (P/N 6339134)	0
16. 150-foot Patch Cables (for lobes)	0
17. 150-foot Patch Cables (for main ring path)	0
18. Spare 150-foot Patch Cables	0
Total Number of 150-foot Patch Cables (P/N 6339135)	0

Figure 5-11 (Part 1 of 2). A Filled-Out Network Ordering Worksheet

19. Crossover Patch Cables	6
20. Spare Crossover Patch Cables	1
Total Number of Crossover Patch Cables **(IBM Specification 6339137)**	7
21. Optical Fiber BNC-to-Biconic Patch Cables	4
22. Spare Optical Fiber BNC-to-Biconic Patch Cables	1
Total Number of Optical Fiber BNC-to-Biconic Patch Cables **(IBM Specification 6165811)**	5
23. 8-foot Optical Fiber Biconic-to-Biconic Patch Cables	0
24. Spare 8-foot Optical Fiber Biconic-to-Biconic Patch Cables	0
Total Number of 8-foot Optical Fiber Biconic-to-Biconic **Patch Cables (IBM Specification 6165812)**	0
25. 45-foot Optical Fiber Biconic-to-Biconic Patch Cables	0
26. Spare 45-foot Optical Fiber Biconic-to-Biconic Patch Cables	0
Total Number of 45-foot Optical Fiber Biconic-to-Biconic **Patch Cables (IBM Specification 6825813)**	0
27. Type 3 Media Jumper Cables	60
28. Spare Type 3 Media Jumper Cables	1
Total Number of Type 3 Media Jumper Cables **(IBM Specification 6466944)**	61
29. Data Grade Media-to-Type 3 Filters	5
30. Spare Data Grade Media-to-Type 3 Filters	1
Total Number of Data Grade Media-to-Type 3 Filters **(IBM Specification 342234)**	6
31. Type 3 Media Filters	60
32. Spare Type 3 Media Filters	1
Total Number of Type 3 Media Filters **(IBM Specification 6466941)**	61
33. Optical Fiber Dual Socket Mounting Clips (IBM Specification 6165847)	4

34. Component Housings (one for each wall-mounted IBM 8228) (P/N 6091078)	1
35. Surface Mounting Brackets (one for each wall-mounted IBM 8218 or 8219) (P/N 6339140)	3
36. Rack Mounting Assembly (one for each seven rack-mounted IBM 8218 or 8219) (P/N 9339139)	2

Figure   5-11 (Part 2 of 2). A Filled-Out Network Ordering Worksheet

Label Preparation

Accurate labeling is a vital part of record-keeping for the network and is necessary for performing problem determination procedures.

Sheets of labels for use with your network may be ordered through the *IBM Cabling System Catalog*, G570-2040. If your network components are installed in a rack with a distribution panel, you will need to prepare *three* identical labels for each lobe. If your network components are not rack-mounted, you will need *two* labels for each lobe. Be sure to indicate on the labels the room number where the lobe terminates. Placement of these labels is illustrated in Figure 5-12 on page 5-26.

In addition to the lobe labels, each IBM 8228 should have a label indicating its unit number. See Figure 5-12 on page 5-26.

Optical Fiber Cable to Building B

3002

Type 3 Media Jumper Cable

Building A

Voice Pairs

Dual Modular Jack Faceplates

Type 3 Media Filter

PC10

Telephone Jumper Wire

Type 3 Specified Media

Type 66 Connecting Block for Data

Type 66 Connecting Block for Data and Voice

100
106-12-B6   Room 100

1006
1007
1008

PC22

119B
106-12-C6   Room 119B

100
106-12-B6

PC23

DGM-to-Type 3 Filter

119C
106-12-G6   Room 119C

PC14

BNC to Biconic Patch Cable

4001   2003

104
106-12-H6   Room 104

Room 106

All unlabeled cables are IBM Cabling System 8-foot patch cables.

This figure shows only how the cables are connected, not how they should be routed.

Surge Suppressor

Building C

4001

Yellow Crossover Patch Cable

DGM-to-Type 3 Filter

Yellow Crossover Patch Cable

Optical Fiber Patch Cable

Optical Fiber Cable from Building B

3001

3002

1005   2002

Surge Suppressor

3001

DGM-to-Type 3 Filter

Yellow Crossover Patch Cable

DGM-to-Type 3 Filter

Optical Fiber Mounting Bracket

Room 130

See Figure 5-5 for this network's Ring Sequence Chart

Figure   5-12. Labeling the Network

Chapter 6. Joining Rings with Bridges

Bridges between rings offer a number of planning alternatives not available in single-ring-network configurations. Using bridges, you can join rings together into networks that can serve more than the 72 attaching devices that the single ring is limited to. With careful planning, bridges can increase the availability and serviceability of your network.

Network Topologies Using Bridges

As shown in the figure below, the computer serving as the bridge is an attaching device on a lobe of each ring. The bridge software resident in the computer handles the transfer of frames from one ring to the other.
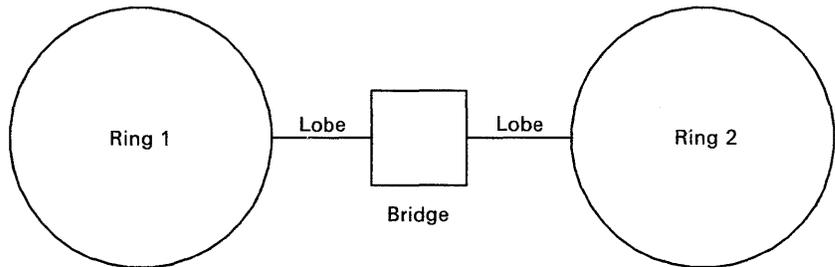
Several topologies are available when using bridges. The topology, or combination of topologies, you select will depend upon the traffic flow in your particular network and the physical layout of the rings you wish to join together. Bridges will allow you to form networks with more than the 72 attaching devices allowed on a single ring. Print servers and file servers can be placed on rings with their most frequent users, yet can still be available to users attached to other rings on the network. Multiple-ring networks can be configured to share the resources of host systems efficiently.

To install a bridge between two rings, you must make sure that a lobe from one of the rings terminates in the same location as a lobe from the other ring.

Hierarchical and Mesh Networks

All multiple-ring networks whose rings are connected by bridges are either *hierarchical* or *mesh* networks. The hierarchical network provides only one path through intermediate rings between a source ring and a destination ring. For example, in the figure illustrating a hierarchical network below, a frame whose source is on ring 3 *must* pass through bridge C, ring 1, and either bridge A or B to reach its destination on ring 2. No other path is possible. For this routing, ring 1 will always be the only possible intermediate ring.

Ring 1

Bridge A

Bridge B

Ring 2

Bridge C

Bridge D

Ring 3

Ring 4

Hierarchical Network
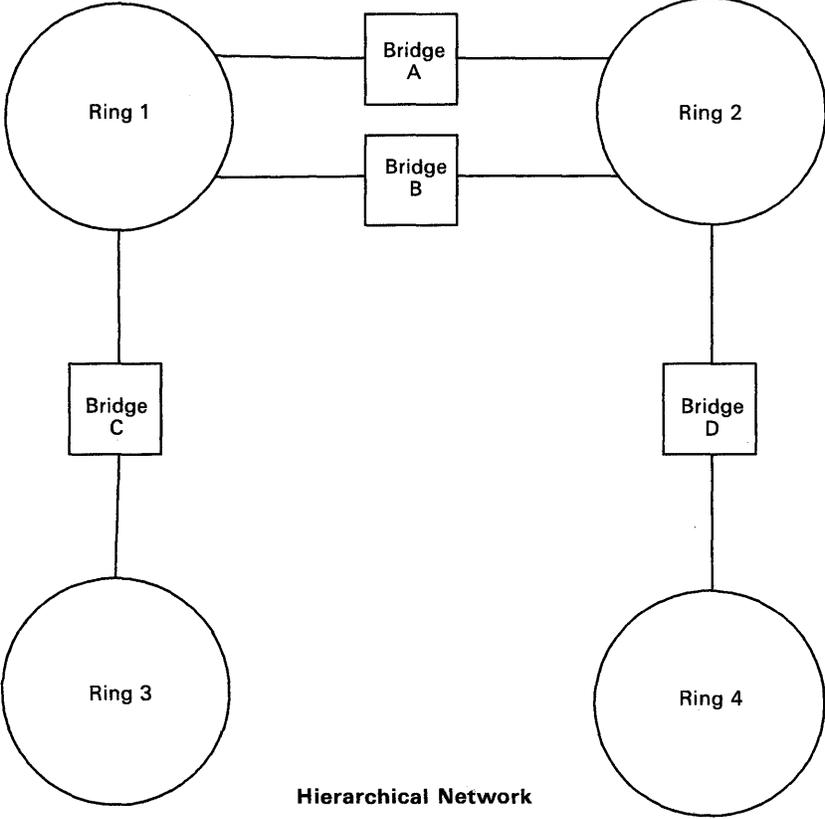
Mesh networks, on the other hand, provide multiple paths through intermediate rings between source rings and destination rings. In the following figure, which illustrates a mesh network, a frame whose source is on ring 3 and whose destination is on ring 2 has two possible paths. The frame can pass from ring 3, through bridge C, ring 1, and either bridge A or B to ring 2. Unlike the hierarchical example, however, the frame can also pass from ring 3 through bridge E, ring 4, and bridge D to its destination on ring 2. In this case, both ring 1 and ring 4 are possible intermediate rings.

Mesh Network
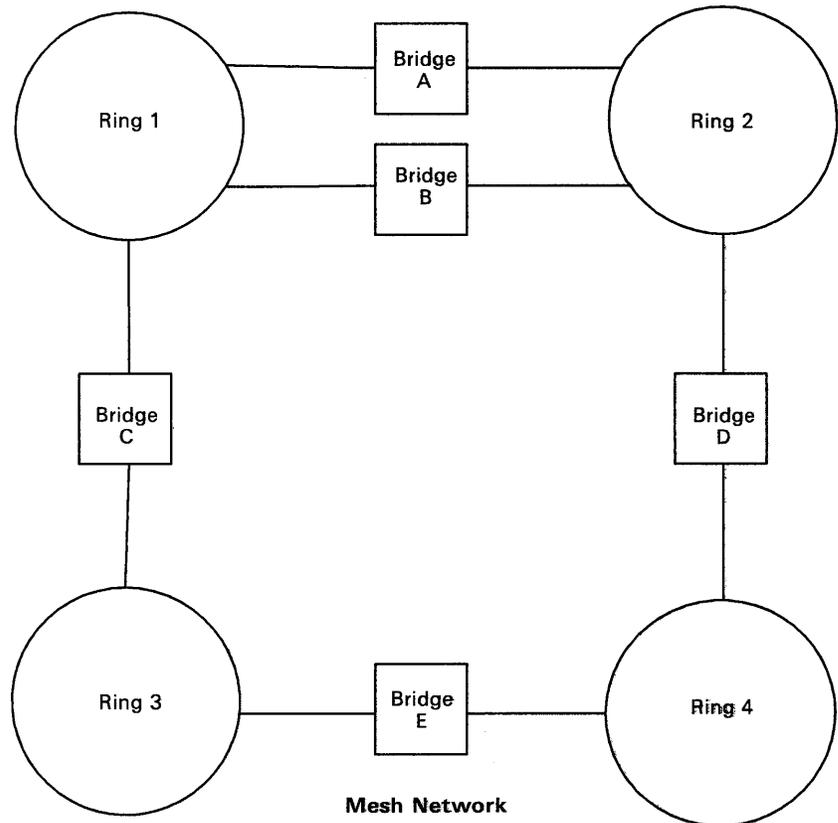
The Simple Connection

The following figure shows two rings joined by a single bridge. This topology is effective if you are joining rings that serve two departments that exchange information. The rings should be arranged so that most of the traffic in the network stays on its own ring rather than crossing the bridge.

```
  ( Ring 1 )──────[ Bridge ]──────( Ring 2 )
```
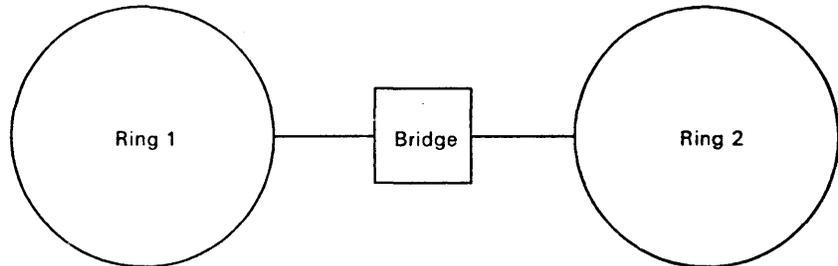
The Parallel Connection

The parallel connection shown below could be used to provide for redundancy in networks requiring high levels of availability. A maximum of 16 parallel bridges is allowed between any two rings.

```
             ┌─[ Bridge 1 ]─┐
  ( Ring 1 )─┤              ├─( Ring 2 )
             └─[ Bridge 2 ]─┘
```
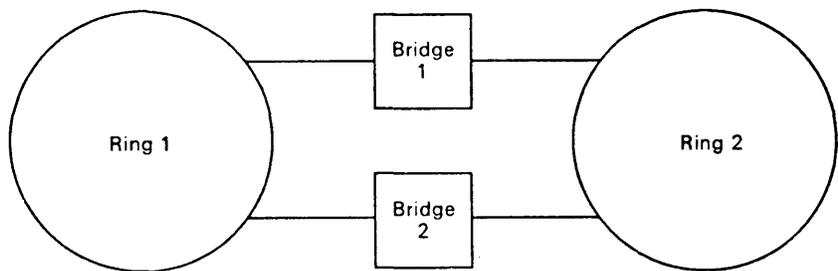
The Backbone Connection

A backbone ring connects other rings together with bridges to form a hierarchical network providing any-to-any communication across several rings. The backbone ring in the following figure is ring A. For multiple-ring networks where any-to-any communication is needed, the hierarchical backbone ring can provide the shortest average path between any two attaching devices on the network. Additionally, by placing shared devices such as print servers, file servers, and host computers on the backbone ring, the most direct access to those devices is provided for all members of the network.

One typical use for a backbone ring is in a multistory building where there is a ring on each floor that is connected by a backbone ring that spans all the floors. If your establishment consists of several buildings with one or more separate rings in each building, a backbone ring can serve to connect all your establishment's rings into a multiple-ring network. To eliminate concerns over differing ground potential between buildings and environmental hazards, you may want to use optical fiber cable in the main ring path of such a backbone ring.

Remember that backbone rings are subject to the same planning considerations as any other single ring. You should plan your backbone rings according to the recommendations in Chapter 2 of this manual.

Backbone Connection
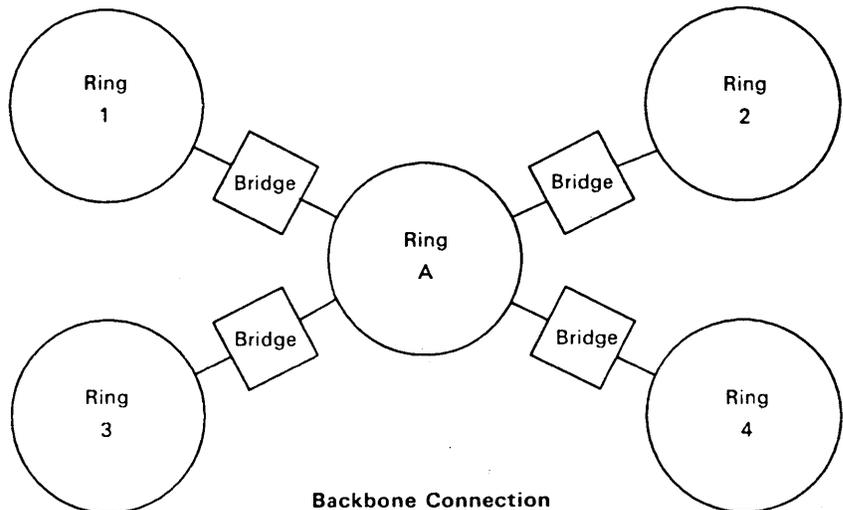
A variation of the backbone ring is shown in the following figure. It depicts a large accounting department that has been divided into rings by function. Each of the functions — Payroll, Accounts Payable, Accounts Receivable, Inventory, and General Ledger — has a separate ring because most of the users communicate most frequently with members of their own function. However, the ring belonging to the General Ledger function is also a backbone, since all of the other functions provide input to the General Ledger. The accounting department's host computer should be located on the General Ledger or backbone ring.
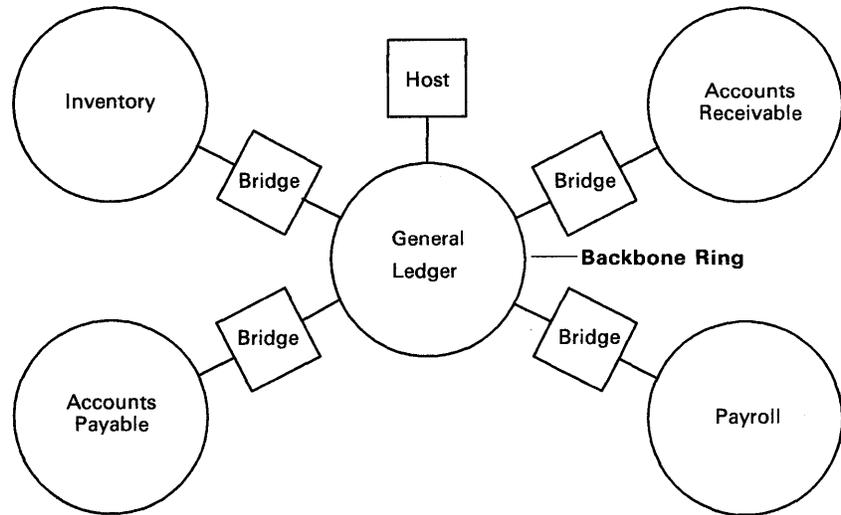
In large establishments, where users may require interactive access to many hosts, placing the host systems on a backbone ring allows the network administrator the freedom to place new applications on whichever host is most appropriate, unless otherwise constrained. In the following figure, the departmental host system attached to the Inventory ring interacts almost exclusively with other attaching devices on the Inventory ring. However, the host systems attached to the General Ledger ring are used by attaching devices on all the rings. Since the network provides connectivity between all devices, placing the multiuser access hosts on the backbone ring provides the shortest average path length between the host systems and other attaching devices.
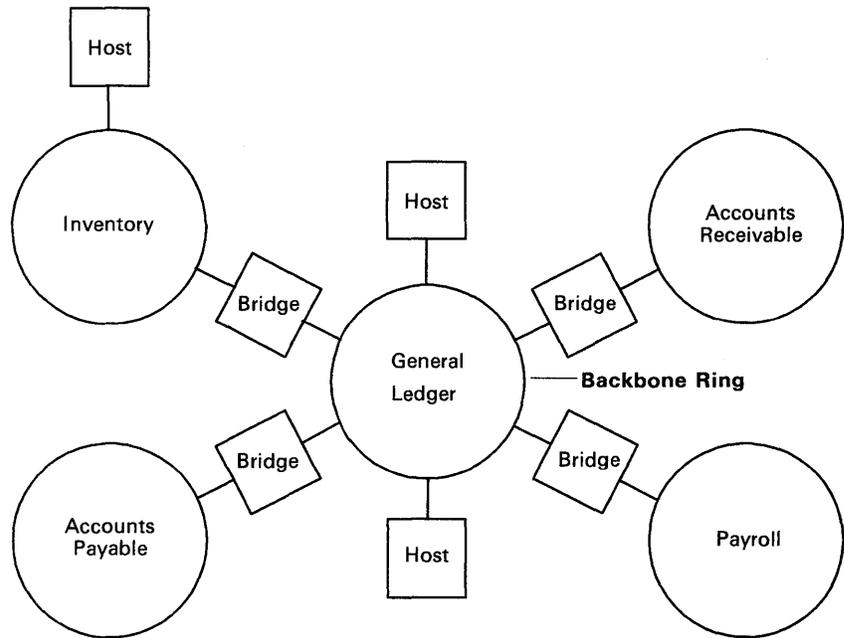
Physical Planning Considerations

We recommend that you prepare a topological sketch of your entire local area network like the one shown below. It should indicate the physical location of all bridges as well as the unit number and location of all IBM 8228 Multistation Access Units where bridges are attached.
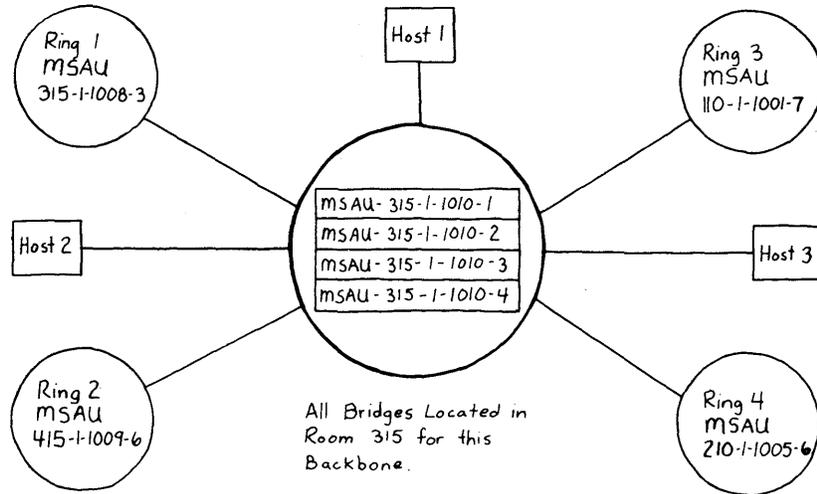
Additional Information about Planning Bridges

You may need the assistance of your network administrator or other person knowledgeable about how users of the network will interact with each other to select the appropriate parameters for configuring bridges. Additional information is provided in the *IBM Token-Ring Network Administrator's Guide*.

Appendix A. Walk-Through Site Inspection Checklist

Section 1: Inspecting the Wiring Closet

		YES	NO
1-1.	Do you have, or can you obtain, entry rights to the wiring closet?	___	___
1-2.	Is there adequate space available for additional type 66 connecting blocks for use in isolating data pairs from voice pairs?	___	___
1-3.	Is there adequate space for installing a 483-millimeter (19-inch) equipment rack?	___	___
1-3a.	If not, is there adequate space for wall-mounting all of the IBM 8228s you will need in each wiring closet?	___	___
1-4.	In the area where the IBM 8228s will be installed, is the room temperature continuously within the range of 10 to 40.6°C (50 to 105°F)?	___	___
	Is the relative humidity range continuously between 8 and 80%?	___	___
	Is the wet bulb temperature always 26.7°C (80°F) non-condensing or less?	___	___
1-5.	Is the wiring free from stubs and bridge taps?	___	___
1-6.	Are the connecting blocks type 66?	___	___
1-7.	Is there at least one duplex electrical wall outlet in each wiring closet?	___	___

Section 2: Inspecting the Work Areas

		YES	NO

2-1. Do all work areas have two spare
telephone twisted pairs available?   ____   ____

2-2. Are all cables that will be used for data free
of stubs and bridge taps?   ____   ____

2-3. Are all work areas equipped with 6- or 8-pin
modular jacks, preferably duplex?   ____   ____

2-3a. If so, are the modular jacks that are
designated for data wired according
to the specifications in Chapter 4?   ____   ____

2-3b. If no modular jacks are available, are
there 50-pin Amphenol-type connectors
so that modular jacks
may be installed for data transmission?   ____   ____

Section 3: Checking the Telephone Lines

	YES	NO

3-1. Do you own the telephone twisted-pair media
       in your establishment?

       If not, can you get the permission of the
       owner to use the spare pairs in the
       cables for the network?   ____   ____

3-2. Is the wire #22 or #24 AWG (American Wire Gauge)?   ____   ____

3-3. Are there at least two pairs in each cable?
       (For new installations, we recommend cables with
       four twisted pairs.)   ____   ____

3-4. Is the wire solid copper with a minimum
       of two twists per foot?   ____   ____

3-5. Is the DC resistance no more than 28.6 ohms
       per 305 meters (1000 feet?)   ____   ____

3-6. Does the cable have the following
       impedance characteristics?

       • 90 to 120 ohms at 256 kHz   ____   ____
       • 87 to 117.5 ohms at 512 kHz   ____   ____
       • 85 to 114 ohms at 772 kHz   ____   ____
       • 84 to 113 ohms at 1000 kHz   ____   ____

3-7. Is the attenuation per 305 meters (1000 feet)
       no greater than the following?

       • 4.00 dB at 256 kHz   ____   ____
       • 5.66 dB at 512 kHz   ____   ____
       • 6.73 dB at 772 kHz   ____   ____
       • 8.00 dB at 1000 kHz   ____   ____

3-8. Are the telephone lines in good physical condition?

       • Is the insulation in good condition?   ____   ____
       • Are the lines free of splices from the
         office to the wiring closet connecting
         block?   ____   ____
       • Is there no other evidence of physical
         deterioration?   ____   ____

3-9. In each cable to be used for data, is there
       no more than one analog or digital
       phone connection, one additional data
       connection, and one token-ring connection?   ____   ____

3-10. Environmental considerations

    Are all data cables:
- At least 127 millimeters
  (5 inches) from power lines
  carrying 2KVA or less?   ____ ____
- At least 305 millimeters
  (12 inches) from power lines
  carrying from 2 to 5 KVA?   ____ ____
- At least 915 millimeters
  (36 inches) from power lines
  carrying more than 5KVA?   ____ ____
- At least 127 millimeters (5 inches)
  from all fluorescent lights?   ____ ____

Is the area free of other possible sources of
interference found in some environments such as:

- Sources of radio interference
  within or near the facility?   ____ ____
- Sources of electrical
  interference from electric motors,
  HVAC, arc welders, or intercoms?   ____ ____
- Radar installations
  in the immediate area?   ____ ____

IBM Cabling System Type 3 Media Specification

For IBM Token-Ring Networks operating on telephone twisted pairs, IBM recommends using telephone cable that meets the IBM Cabling System Type 3 Media Specification.

- #22 or 24 AWG (American Wire Gauge)

- Solid copper twisted pairs

  - A minimum of two twists per foot

- A maximum of 28.6 ohms DC resistance per 305 meters (1000 feet)

- Characteristic impedances

  - 90 to 120 ohms at 256 kHz
  - 87 to 117.5 ohms at 512 kHz
  - 85 to 114 ohms at 772 kHz
  - 84 to 113 ohms at 1000 kHz

- Maximum attenuation per 305 meters (1000 feet)

  - 4.00 dB at 256 kHz
  - 5.66 dB at 512 kHz
  - 6.73 dB at 772 kHz
  - 8.00 dB at 1000 kHz

- In addition, all type 3 specified media must meet at least one of the following industry specifications:

  - ANSI/ICEA S-80-576-1983
  - REA PE-71
  - Bell Systems 48007.

Appendix B. Telephone Twisted-Pair Media Testing

The IBM National Service Division will perform measurements and tests of existing telephone twisted-pair media lines that you designate. The tests are designed to determine certain key characteristics of the installed media under the conditions that exist at the time of the tests. There may be other factors, not detected by the tests, that will not permit the installed media to be used satisfactorily. The results of the measurements and tests are intended to assist you in selecting the appropriate media for the IBM Token-Ring Network or for the attachment of the IBM 3270 family of products using the 3270 Coax-to-Twisted-Pair Adapter. This service is offered on an IBM Hourly Service basis. It is suggested that you complete the Walk-Through Site Inspection before requesting this service.

In most cases, the existing telephone twisted-pair media has been designed for voice and low-speed data transmissions and not necessarily for high-speed (4 megabit/second) data transmissions.

Telephone twisted-pair testing is not intended to be an evaluation of the quality of workmanship of the telephone twisted-pair media designer/planner, installer or servicer, nor is it intended to be used for problem determination or problem isolation for telephone twisted-pair media problems.

After the testing activity has been completed, you will be given copies of the Telephone Twisted-Pair Media Test Summary Form for each specific telephone twisted-pair media line tested. The decision to use or not to use the existing media for the IBM Token-Ring Network or for the attachment of IBM 3270 products is your responsibility.

Tests Performed

The following tests will be performed:

1. Power line tests

   - Test the AC power receptacle for proper wiring
   - Measure the AC voltage
   - Measure the AC power ground resistance

2. Telephone wire safety, ground, and resistance tests

   - Test each wire for the presence of AC and DC voltages with respect to power ground
   - Test each wire for faults to power ground
   - Measure the DC resistance of each wire loop

3. Telephone wire characteristics

   - Impedance discontinuities
   - Characteristic impedance
   - Length of wire to the wiring closet
   - Total length of the wire loop
   - Near-end crosstalk

4. Functional testing with Token-Ring Network

   - This test involves running the IBM Token-Ring Network PC Adapter Advanced Diagnostics on an IBM PC with a Token-Ring Adapter installed and connected to the wire loop.

5. Error rate tests:

   - If the Advanced Diagnostics program runs successfully, a data error rate monitor test is performed.

Site Inspection and Preparation

You should perform the Walk-Through Site Inspection of the building telephone cable installation. After completing the Walk-Through Site Inspection Checklist, contact IBM to arrange for the tests and measurements to be performed.

Before testing can begin, you must:

- Prepare the drops to be tested

- Provide IBM personnel with cable identification and location charts

- Provide access to the office locations and wiring closets where testing will be done.

You must designate someone to guide the IBM test personnel through your establishment to identify the location of offices and wiring closets where testing will be done. Also, someone must be available to make any necessary changes or corrections to the test setup wiring.

Selecting and Preparing Cables for Testing

You must select and prepare each line to be tested. Normally, testing is done on a sampling of lines of your choosing. The criteria for choosing the lines should be the length of cable, exposure to electromagnetic interference, and the presence of other conditions that might cause transmission problems. From the building wiring charts, select the longest lines and those that you expect will be exposed to the highest levels of electromagnetic interference. Note, however, that cables tested should be no longer than 100 meters (330 feet); cables longer than this will not be tested.

After you have selected the cables to be tested, prepare each pair of twisted-pair wires (four wires) for testing, as described under Preparation Instructions.

Preparation Instructions

Before your telephone wiring can be tested, you must complete the following procedures:

1. Ensure that two telephone twisted pairs (four wires) are available for use in each cable to be tested. The cable must run from the office workstation location to a telephone-type connecting block.

2. At the office workstation location, terminate the two twisted pairs at a 6- or 8-pin modular jack mounted in a faceplate. Figure B-1 on page B-5 shows how the wires must be connected.

3. Install Type 3 Media Jumper Cables on the telephone connecting block in the wiring closet for each line to be tested. Use the impact insertion tool to connect the jumper cable to the type 66 connecting block. Figure B-1 on page B-5 shows how the wires must be connected.

   Lines to be tested must be disconnected from all telephone and other signaling circuits. The use of type 66 connecting blocks to isolate data pairs from voice pairs, as described in Chapter 4, is recommended.

   Each Type 3 Media Jumper Cable is used as a "wrap-back" connection. The shorting bars in the data connector wrap the transmit pair of wires back to the receive pair. This forms a twisted-pair loop circuit that begins at the office modular jack, wraps back through the Type 3 Media Jumper Cable, and ends back at the office modular jack.

4. Identify and label each modular jack and each Type 3 Media Jumper Cable with the appropriate cable number, office location number, and wiring closet number.

5. Ensure that all wires to be tested are free of splices, stubs, bridge taps, loading coils, capacitors, or other circuits or devices that may cause loading or reflections.

Parts and Tools Needed for Test Preparation

The following parts and tools are required to prepare the lines for measurement and testing.

1. One Type 3 Media Jumper Cable (specification number 6466944) is required for each line to be tested. This part is not available from IBM. Contact the IBM marketing or service representative or local branch office for a list of suppliers.

2. One impact tool for inserting the Type 3 Media Jumper Cable into the Type 66 connecting block is required.

3. A single or dual faceplate for six- or eight-position modular jacks is required at each workstation location.

4. Connecting blocks (type 66 are recommended) for use in isolating data pairs from voice pairs should be installed in the wiring closet(s).
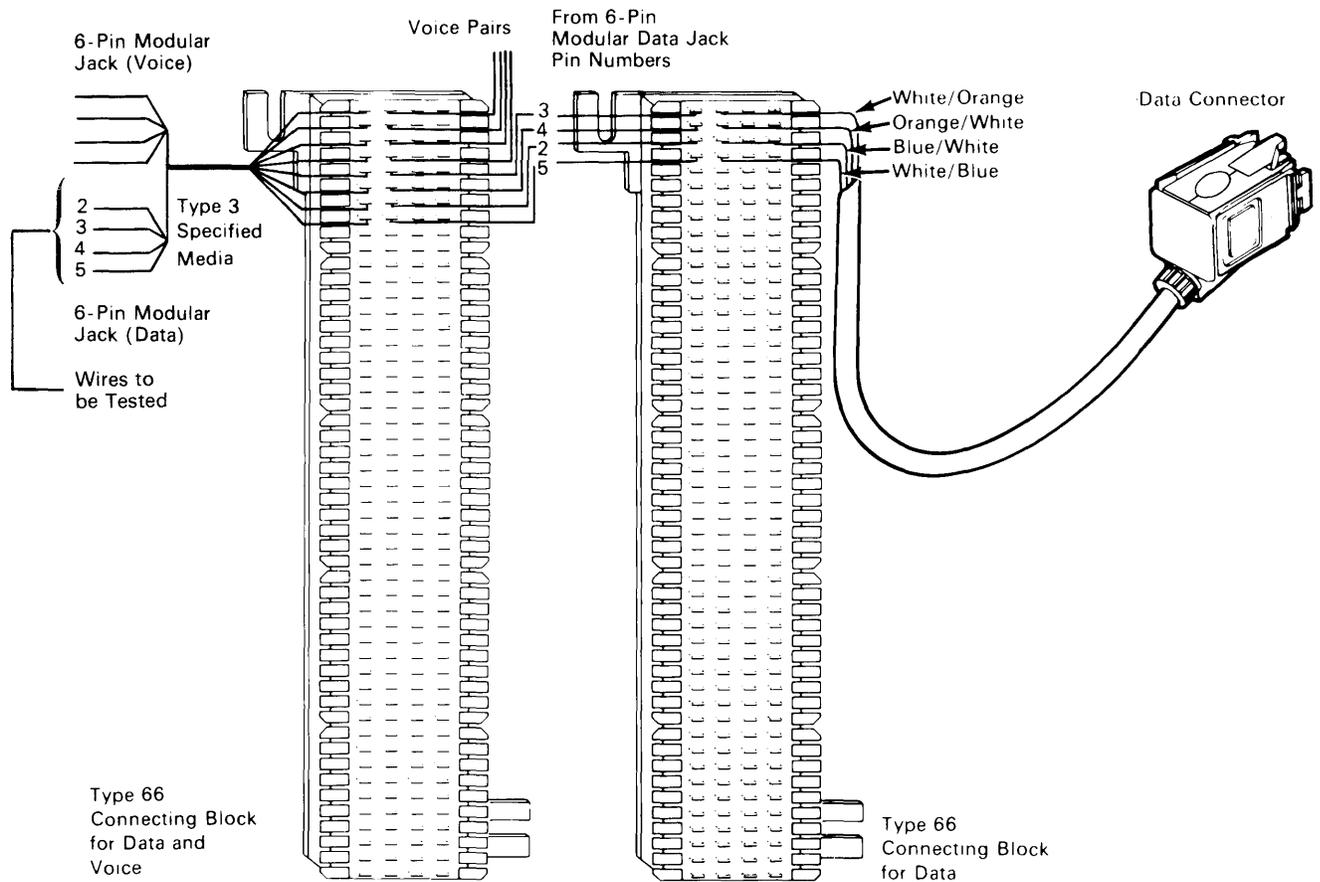
6-Pin Modular Jack Pin Number	8-Pin Modular Jack Pin Number	Telephone Wire Connection	Line Name	Type 3 Jumper Cable Color Code	Data Connector Color Code
2	3	Pair 2 - Tip	T−	Blue/White	Black
3	4	Pair 1 - Ring	R+	White/Orange	Red
4	5	Pair 1 - Tip	R−	Orange/White	Green
5	6	Pair 2 - Ring	T+	White/Blue	Orange

Note: Internal shorting bars in the data connector wrap the transmit pair to the receive pair.

Figure   B-1. Wiring Diagram of Wires to be Tested

Potential Problem Areas

When you are provided the results of the test, you should consider each of the items that do not meet requirements, and either take steps to correct them or not use the lines with the Token-Ring Network. Some of the possible problem areas are:

- Power and grounding
- Wire resistance and attenuation
- Extraneous voltage on the twisted-pair wires
- Wire characteristic impedance and impedance discontinuities
- Crosstalk
- Shorts, opens, and other wire faults
- Stubs, bridge taps, and extensions
- Electromagnetic interference.

Note: The items listed above and discussed here are not all-inclusive of possible problem causes and consequences. The following paragraphs elaborate on the potential problem areas to assist you in interpreting the test results.

Power Receptacle

Improperly wired or grounded power receptacles can be a safety hazard, and can contribute unacceptable levels of noise onto the network. In some cases, errors may be highly intermittent. If the AC voltage is not within acceptable limits, the attached device may introduce errors onto the network or may not work at all.

AC or DC Voltage on Twisted-Pair Wires

AC voltage may be induced into the twisted-pair wires from nearby power or signal cables. AC or DC voltage may be caused by shorts or unintentional connection to other circuits. Such voltages (depending on the magnitude) can be a safety hazard, introduce errors into the network, or cause the network to be inoperative.

Wire Resistance

Wire resistance measurements indicate the presence of opens, shorts, faults, high-resistance connections, or improper wire size. Opens, shorts, or faults usually will result in an inoperative network. High-resistance connections or improper wire size may result in high error rates or an inoperative network or attached device. Small wire size may limit the drive capability below the allowable distance specified.

Measured Wire Resistance Length versus Electrical Length

Comparing the wire length determined by a resistance measurement to the length measured by a time domain reflectometer may indicate that wire of different sizes exists in the loop. This indicates that the wiring in the building is not uniform. Such wire loops should not be used for token-ring transmission.

Wire length exceeding specified limits can cause excessive errors, intermittent errors, or result in an inoperative network or attached device.

Characteristic Impedance

Wire whose characteristic impedance exceeds the specified limits may not be suitable for high-speed data transmission. Increased error rates can result from use of such wire.

Impedance Discontinuities

Impedance discontinuities may be caused by opens, shorts, loose connections, wiring stubs, bridge taps, loading circuits, telephone jacks, connector blocks, and so forth, that exist along the wire path. Excessive impedance discontinuities cause reflections that can increase the error rate, cause erratic performance, or in extreme cases result in an inoperative network or attached device.

Attenuation

Excessive attenuation (signal loss) may be caused by the cable's attenuation characteristics, wire that is too small, or impedance discontinuities. Excessive attenuation will limit the drive capability below the specified allowable distances.

Crosstalk

Excessive near-end crosstalk is a function of the design and manufacture of the cable. Excessive crosstalk may cause high error rates or an inoperative network or attached device. In some cases it can cause diagnostic procedures to produce false readings.

Functional Test Results

Failure of the functional test to run successfully indicates that the wire is unsuitable for use with the Token-Ring. Failure of the test may be caused by one or more of the preceding items not within specifications, or from excessive electromagnetic interference.

Excessive Token-Ring Error Rate

An excessive error rate indicated by the Advanced Diagnostics program can also be caused by one or more of the preceding items not within specifications, or from excessive electromagnetic interference.

Appendix C. Problem Determination Techniques for Lobe Wiring

The procedures in this appendix will help you find a problem in the wiring between the office wall and an IBM 8228 Multistation Access Unit.

These procedures are intended to be used only for lobes that were operational but are now inoperative. They are not intended to be used to locate problems at initial setup of a ring. You should use them only after you have performed the problem determination procedure for telephone twisted-pair media in the *IBM Token-Ring Network Problem Determination Guide*. The first procedure describes how to check continuity. The second procedure suggests methods for finding environmental problems that may affect the integrity of the signals on the wire. You should perform the continuity checks before checking for environmental problems.

Setup Problems:

It is essential for the lobe wiring connections to match those shown in Figure C-1. Specifically, the first data twisted pair must be connected to the tip and ring of the data jack (pins 3 and 4 for a 6-pin modular jack), and a second data twisted pair must be connected to tip-2 and ring-2 of that data jack (pins 2 and 5 for a 6-pin modular jack). The first pair must be electrically connected to the white/orange-orange/white wires of the type 3 media jumper cable, while the second pair must be connected to the blue/white-white/blue pair of the media jumper cable. If the pairs are split, that is one twisted pair connected to pins 2 and 3, the other connected to pins 4 and 5, high error rates, or no valid transmission may occur.

If the pairs are reversed, that is pins 3 and 4 are connected to the blue/white-white/blue pair, the lobe checkout tests will work, but insertion into the ring will fail and will bring down the ring in the process.

Because correct hookup is essential for proper operation, these procedures should be performed by someone familiar both with telephony practices and with the requirements set forth in this guide.

Flat telephone wire extension cables should also be avoided. These cables often have a high crosstalk noise associated with them and are inappropriate for token-ring use.

If proper installation has been verified, and the lobe insertion tests will not run successfully, then that lobe may be unsuitable for token-ring use.

Checking Lobe Continuity

The procedure in the *IBM Token-Ring Network Problem Determination Guide* has proven that the lobe problem is somewhere between the modular telephone jack and the Type 3 Media Jumper Cable. The following procedures will help you isolate problems caused by discontinuity or short circuits in the lobe wiring. Before performing these procedures, you should verify that the lobe has been wired correctly (no tip-ring reversals). Figure C-1 on page C-2 shows a typical wiring scheme for a Token-Ring Network lobe using telephone wire.
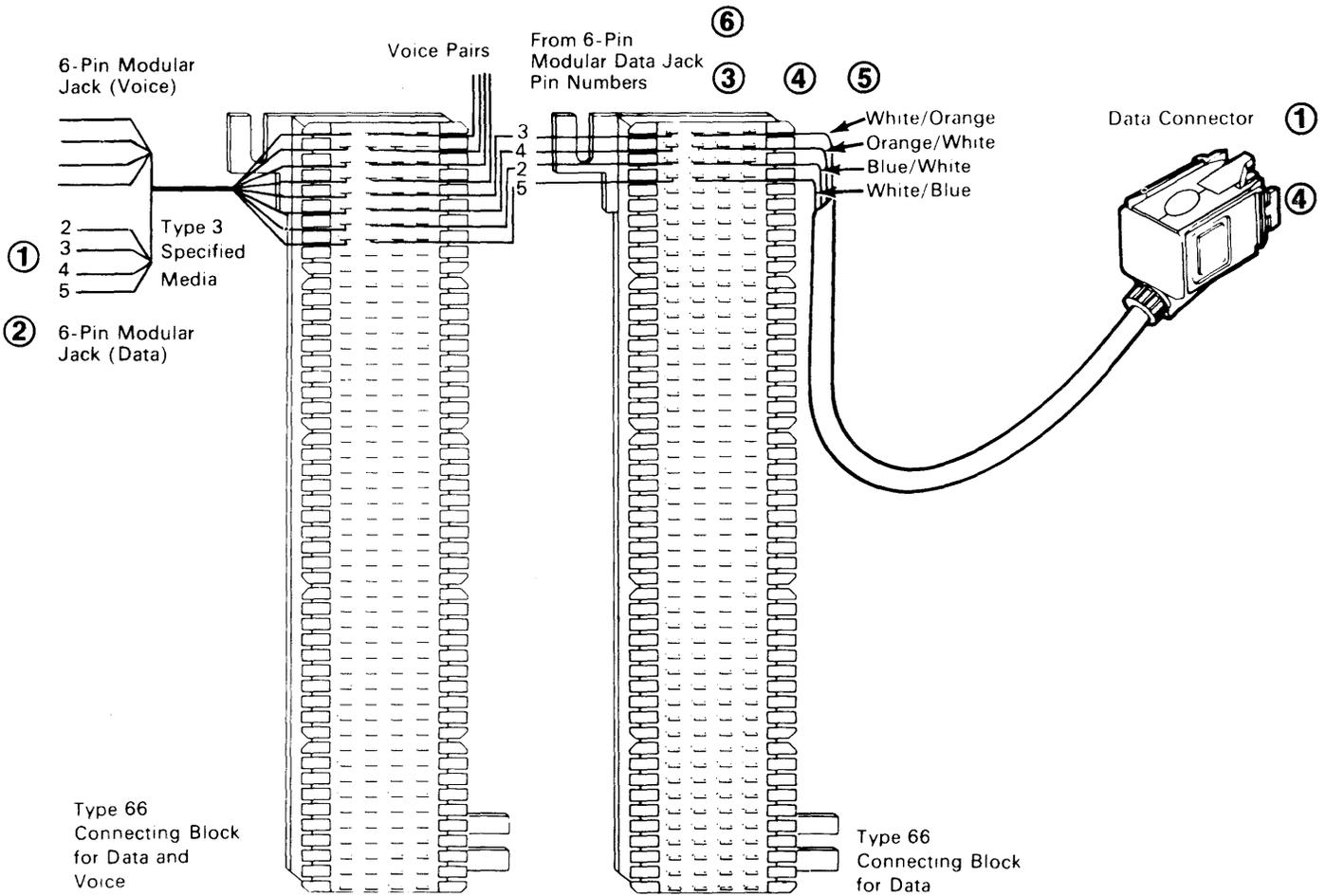

Figure C-1. A Typical Lobe Wiring Scheme

The following equipment is needed to check for lobe continuity:

- An ohmmeter
- An unwired IBM Cabling System data connector
- A 6-pin modular telephone plug with four bare wires from pins 2, 3, 4, and 5 (can be used to test an 8-pin jack in which pins 3, 4, 5, and 6 have been wired).

The circled numbers on the figure indicate the locations and order of the checks. The steps following provide detailed instructions for each of the locations and checks.

1. Before beginning these checks, make sure that the lobe wiring is disconnected at the data connector end of the Type 3 Media Jumper Cable and that the Type 3 Media Filter has been disconnected from the modular telephone jack. The data connector at the end of the Type 3 Media Jumper Cable is self-shorting when disconnected. All other connections should be in their normal state as you begin these checks.

2. At the modular jack used for data, insert the modular plug with four bare wires to perform the checks for opens and lobe resistance shown in the following table.

Pin Numbers	150-Foot Lobes	330-Foot Lobes
2 to 4	15 ohms or less	30 ohms or less
3 to 5	15 ohms or less	30 ohms or less

- If the resistance is greater than the indicated limits but not an open, the total length of wire in the lobe may be too long.

- If an open is indicated, go to step 3.

- If the resistance is within the limits indicated, go to step 4.

3. In the wiring closet, perform the following continuity checks at the type 66 connecting block used for data:

Pin Numbers	Correct Readings
2 to 4	0 ohms
3 to 5	0 ohms

- If you get the expected resistance in each case, the open is in the wiring between the type 66 connecting block and the modular telephone jack. Use normal telephony procedures to correct the problem.

- If you do not get the expected resistance, install a new Type 3 Media Jumper Cable. Have the network administrator reconnect it to the IBM 8228, connect the attaching device to the modular telephone jack, and check the operation of the lobe.

4. In the wiring closet, connect an unwired IBM Cabling System data connector to the Type 3 Media Jumper Cable to open the self-shorting bars in the connector. Then check for shorts from the modular jack as shown in the following table.

Pin Numbers	Correct Reading
2 to 3	open
2 to 4	open
2 to 5	open
3 to 4	open
3 to 5	open
4 to 5	open

- If you get the expected resistance in each case, the lobe wiring is good. Have the network administrator reconnect the attaching device to the lobe and check the operation of the lobe. If the problem persists, go to "Finding Environmental Problems" in this appendix.

- If you do not get the expected resistance, go to step 5.

5. In the wiring closet, remove the Type 3 Media Jumper Cable from the type 66 connecting block, and connect the unwired data connector to the connector on the Type 3 Media Jumper Cable. Perform the following continuity checks:

Wire Color Codes	Correct Reading
B/W to O/W	open
B/W to W/B	open
W/O to O/W	open
W/O to W/B	open
O/W to W/B	open
B/W to W/O	open

- If you get the expected resistance in each case, go to step 6.

- If you do not get the expected resistance, install a new Type 3 Media Jumper Cable. Have the network administrator reconnect the Jumper Cable to the IBM 8228, reconnect the attaching device to the modular telephone jack, and check the operation of the lobe.

6. The Type 3 Media Jumper Cable appears to be good, so the short must be in the wiring between the type 66 connecting block and the modular telephone jack. At the type 66 connecting block, perform the following checks:

Pin Numbers	Correct Reading
2 to 3	open
2 to 4	open
2 to 5	open
3 to 4	open
3 to 5	open
4 to 5	open

- If you get the expected resistance in each case, the problem has disappeared. Have the network administrator reconnect the attaching device to the modular telephone jack and the Type 3 Media Jumper Cable to the IBM 8228, and check the operation of the lobe. If the problem persists, go to "Finding Environmental Problems" in this appendix.

- If you do not get the expected resistance, there is a problem in the telephone wiring between the modular jack and the type 66 connecting block for data. Use normal telephony procedures to isolate and correct the problem. Then reinstall the Type 3 Media Jumper Cable. Have the network administrator connect it to the IBM 8228, reconnect the attaching device to the modular telephone jack, and check the operation of the lobe.

Finding Environmental Problems

Use these procedures only when all other procedures have failed to isolate the problem.

1. Verify that the system configuration matches the paper records for your network and building wiring.

2. Verify that the maximum allowable lobe length has not been violated.

    *   The resistance measured across the modular telephone jack pins 2 to 4 and 3 to 5 should not exceed 30 ohms for lobes connected to single-wiring-closet networks or 15 ohms for lobes connected to multiple-wiring-closet networks.

3. Verify that the cables are separated from sources of electromagnetic and radio frequency interference. See Appendix A and Chapter 3 for further information.

4. Verify the integrity of the AC power grounding system for the building. Have a qualified person do the following:

    a. Verify the proper grounding of the power distribution transformer (the connection of the secondary neutral to power and building ground).

    b. Verify the correct wiring and grounding of the office AC power receptacles serving the attaching devices of the system.

5. For each segment of the data path, perform the "Ground Potential Difference and Ground Path Resistance Measurement" procedure in the *IBM Cabling System Planning and Installation Guide*. If the readings exceed the specified values, contact the responsible party to make the necessary corrections. Retest to verify that the ground potential difference is within the specified limits.

6. If any change was made to the cabling or grounding as a result of measurements in step 5, determine if the problem has been resolved before proceeding.

7. If the problem persists, perform the "Measuring Ground Potential Difference" described in the *IBM Cabling System Planning and Installation Guide*.

    The operational ground potential difference measurement is a closed-loop measurement that measures the amount of potential seen at the input of the attaching device. This could be different from that measured open-circuit, as in step 5.

    The operational ground potential differences reading at any device must not exceed 1.0 volt AC.

Appendix D. Planning Forms

- IBM 8228 Cabling Chart

- IBM 8218 Cabling Chart for Telephone-Twisted-Pair-Based Rings

- IBM 8219 Cabling Chart for Telephone-Twisted-Pair-Based Rings

- Ring Sequence Chart

- Physical Location to Adapter Address Locator Chart

- Adapter Address to Physical Location Locator Chart

- Network Ordering Worksheet.

Make as many copies of the forms as you need to plan your network. Save the blank originals for later copies.

You are hereby authorized to copy pages E-2 through E-11 only.

IBM 8228 Cabling Chart

Date _____

Section 1 Identification

| Unit
Number _____ | Building _____
Location _____ | Rack-mounted ☐
Wall-mounted ☐ | Ring _____ |

Section 2 Receptacle Connections

Receptacle	1	2	3	4	5	6	7	8
Connect to:								

Device								

Section 3 Ring Connections

A. Connect RI of this 8228 to: _____

B. Connect RO of this 8228 to: _____

IBM 8218 Cabling Chart
for Telephone Twisted-Pair-Based Rings

Section 1

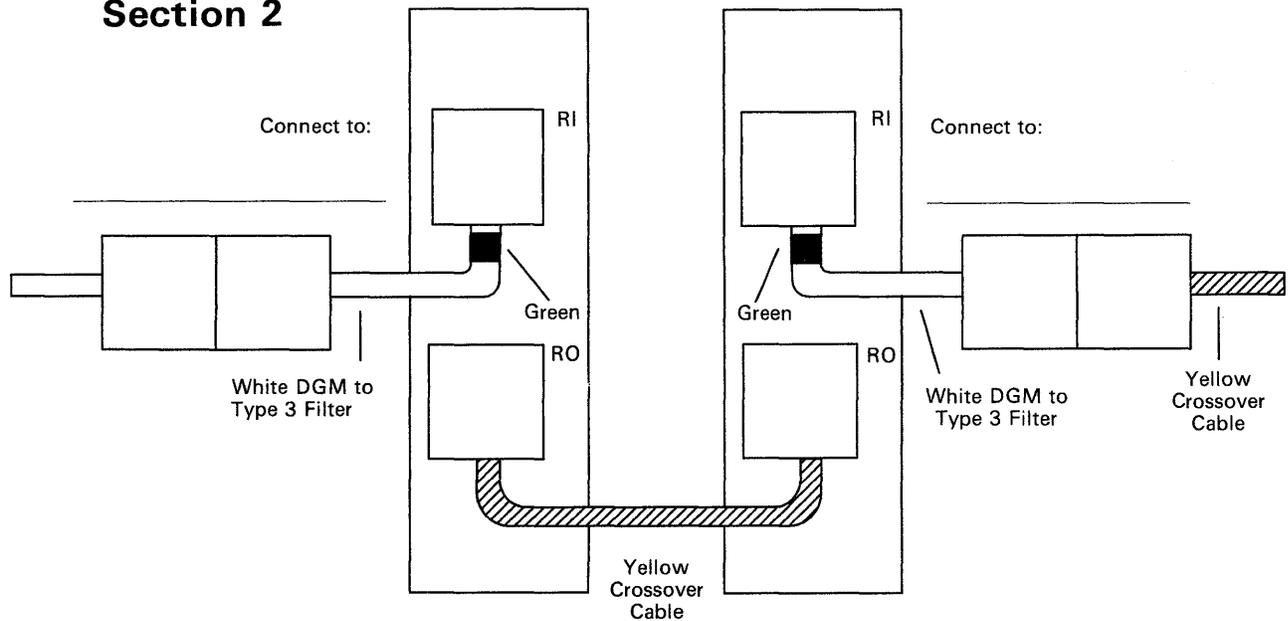Date _____

Ring _____

_____ Unit Numbers _____

Building _____

Location _____

Rack-Mounted ☐

Wall-Mounted ☐

Section 2

Connect to: _____

RI

Green

RO

White DGM to
Type 3 Filter

RI

Green

RO

Connect to: _____

White DGM to
Type 3 Filter

Yellow
Crossover
Cable

Yellow
Crossover
Cable

IBM 8219 Cabling Chart
for Telephone Twisted-Pair-Based Rings

Section 1

Date _____

Ring _____

_____ Unit Numbers _____

_____ Building _____

_____ Location _____

☐ Rack-Mounted ☐

Section 2 ☐ Wall-Mounted ☐

O-O   DP or MB   O-O
             Connections

B-B   ●   ●   B-B

●   Receive   ● Receive
O   B

B   ●   O
●   Transmit   Transmit

Connect to: Connect to:

_____   _____

Green   Green

White DGM to   White DGM to   Yellow
Type 3 Filter   Type 3 Filter   Crossover
                                              Cable

Yellow   B = Black
☐ Crossover   O = Orange
   Cable   MB = Optical Fiber Cable Mounting Bracket
   or   DP = Distribution Panel
☐ Patch Cable
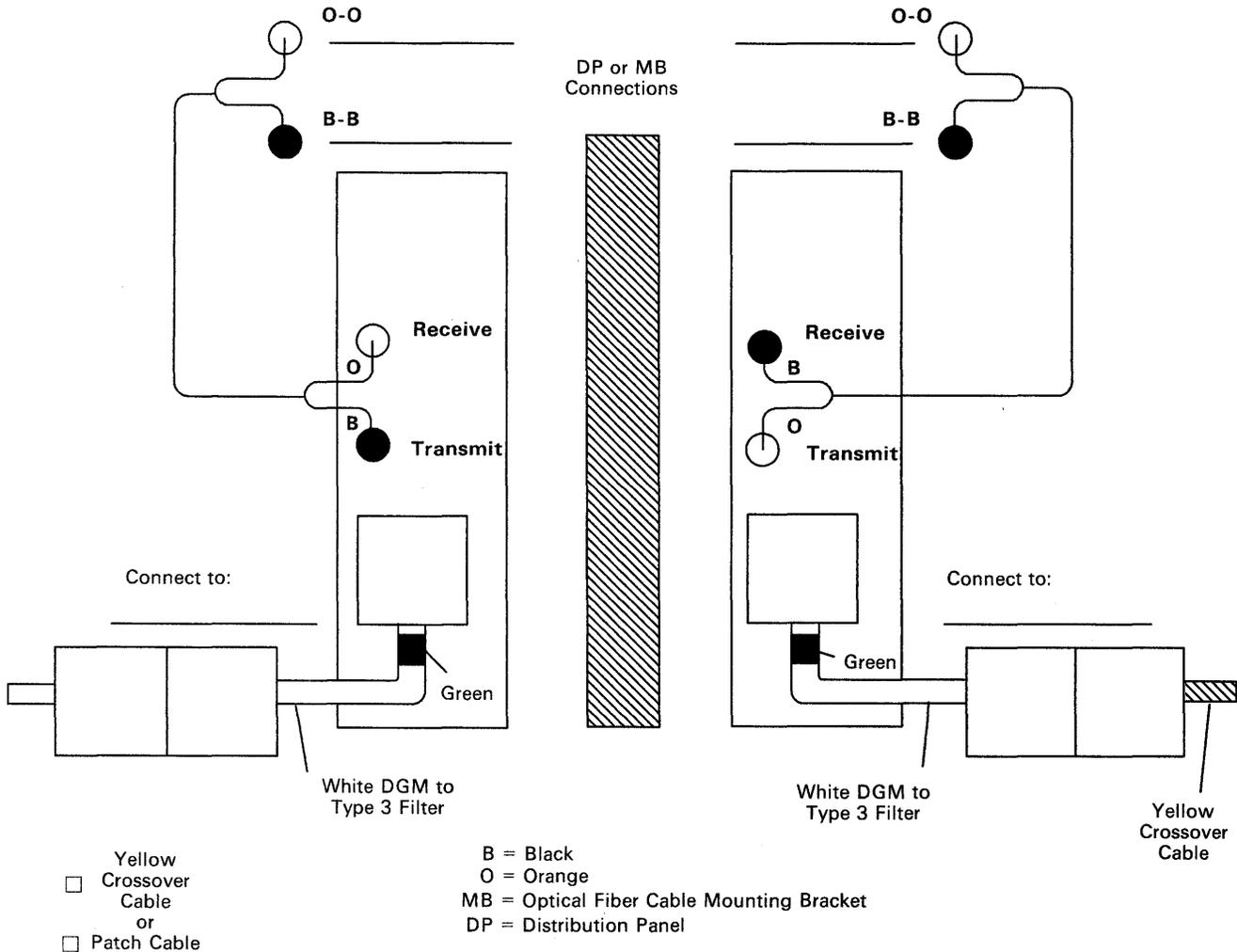
Ring Sequence Chart

Ring Number _____   Date _____   Page ____ of ____

cable from _____ _____

on page _____

(component)
(location)

(component)
(location)

(component)
(location)

(component)
(location)

(component)
(location)

(component)
(location)

(component)
(location)

cable to _____

on page _____

Suggested Abbreviations:

DP - Distribution Panel	FP - Faceplate	MSAU - IBM 8228 Multistation Access Unit
P - Patch Cable	MB - Optical Fiber	RPTR- IBM 8218 Copper Repeater
YCP - (Yellow) Crossover Patch Cable	Mounting Bracket	OFRPTR - IBM 8219 Optical Fiber Repeater
OFP - Optical Fiber Patch Cable	SS - Surge Suppressor	

Physical Location to Adapter Address Locator Chart

Physical Location	Adapter Address	Device Identification	Ring Number	IBM 8228 Unit No.

Adapter Address to Physical Location Locator Chart

Adapter Address	Physical Location	Device Identification	Ring Number	IBM 8228 Unit No.

Network Ordering Worksheet

1. Rack-mounted IBM 8228 Multistation Access Units	
2. Wall-mounted IBM 8228 Multistation Access Units	
Total Number of IBM 8228 Multistation Access Units (P/N 6091014)	
3. Rack-mounted IBM 8218 Copper Repeaters	
4. Wall-mounted IBM 8218 Copper Repeaters	
Total Number of IBM 8218 Copper Repeaters (P/N 6339532)	
5. Rack-mounted IBM 8219 Optical Fiber Repeaters	
6. Wall-mounted IBM 8219 Optical Fiber Repeaters	
Total Number of IBM 8219 Optical Fiber Repeaters (P/N 6339535)	
7. 8-foot Patch Cables (for lobes)	
8. 8-foot Patch Cables (for main ring path)	
9. Spare 8-foot Patch Cables	
Total Number of 8-foot Patch Cables (P/N 8642551)	
10. 30-foot Patch Cables (for lobes)	
11. 30-foot Patch Cables (for main ring path)	
12. Spare 30-foot Patch Cables	
Total Number of 30-foot Patch Cables (P/N 8642552)	
13. 75-foot Patch Cables (for lobes)	
14. 75-foot Patch Cables (for main ring path)	
15. Spare 75-foot Patch Cables	
Total Number of 75-foot Patch Cables (P/N 6339134)	
16. 150-foot Patch Cables (for lobes)	
17. 150-foot Patch Cables (for main ring path)	
18. Spare 150-foot Patch Cables	
Total Number of 150-foot Patch Cables (P/N 6339135)	

19. Crossover Patch Cables	
20. Spare Crossover Patch Cables	
Total Number of Crossover Patch Cables (IBM Specification 6339137)	
21. Optical Fiber BNC-to-Biconic Patch Cables	
22. Spare Optical Fiber BNC-to-Biconic Patch Cables	
Total Number of Optical Fiber BNC-to-Biconic Patch Cables (IBM Specification 6165811)	
23. 8-foot Optical Fiber Biconic-to-Biconic Patch Cables	
24. Spare 8-foot Optical Fiber Biconic-to-Biconic Patch Cables	
Total Number of 8-foot Optical Fiber Biconic-to-Biconic Patch Cables (IBM Specification 6165812)	
25. 45-foot Optical Fiber Biconic-to-Biconic Patch Cables	
26. Spare 45-foot Optical Fiber Biconic-to-Biconic Patch Cables	
Total Number of 45-foot Optical Fiber Biconic-to-Biconic Patch Cables (IBM Specification 6825813)	
27. Type 3 Media Jumper Cables	
28. Spare Type 3 Media Jumper Cables	
Total Number of Type 3 Media Jumper Cables (IBM Specification 6466944)	
29. Data Grade Media-to-Type 3 Filters	
30. Spare Data Grade Media-to-Type 3 Filters	
Total Number of Data Grade Media-to-Type 3 Filters (IBM Specification 6466943)	
31. Type 3 Media Filters	
32. Spare Type 3 Media Filters	
Total Number of Type 3 Media Filters (IBM Specification 6466941)	
33. Optical Fiber Dual Socket Mounting Clips (IBM Specification 6165847)	

34. Component Housings (one for each wall-mounted IBM 8228) (P/N 6091078)	
35. Surface Mounting Brackets (one for each wall-mounted IBM 8218 or 8219) (P/N 6339140)	
36. Rack Mounting Assembly (one for each seven rack-mounted IBM 8218 or 8219) (P/N 9339139)	

Abbreviations

ANSI	American National Standards Institute		**MB**	optical fiber mounting bracket
ARL	adjusted ring length		**MDF**	main distributing frame
ASCII	American National Standard Code for Information Interchange		**mm**	millimeter (or millimeters)
			MSAU	Multistation Access Unit
DGM	data grade media		**NEC**	National Electrical Code
DOS	Disk Operating System		**NEMA**	National Electrical Manufacturers Association
DP	distribution panel			
FP	faceplate		**OFP**	Optical fiber patch cable
ft	foot (or feet)		**OFRPTR**	IBM 8219 Optical Fiber Repeater
ICEA	Insulated Cable Engineers Association		**P**	patch cable
IDF	intermediate distributing frame		**PC**	Personal Computer
IEC	International Electrotechnical Commission		**REA**	Rural Electrification Administration
IEEE	Institute of Electrical and Electronic Engineers		**RI**	Ring In
			RO	Ring Out
in.	inch (or inches)		**RPTR**	IBM 8218 Copper Repeater
Kb	Kilobyte		**SELV**	safety extra low voltage
kHz	kilohertz		**TTP**	telephone twisted-pair
LL	longest lobe		**YCP**	(yellow) crossover patch cable
m	meter (or meters)			

Glossary

A

adapter. The circuit card within a communicating device, and its associated software, that enable the device to communicate over a local area network.

attaching device. Any device that is physically connected to a network and can communicate over the network.

B

backup path. An alternative path for signal flow through access units and their main ring path cabling. The backup path allows recovery of the operable portion of the network while problem determination procedures are being performed.

baseband local area network. A local area network in which information is encoded, multiplexed, and transmitted without modulation of a carrier.

bridge. An attaching device connected to two rings simultaneously to allow the transfer of information from one ring to the other. Rings joined together by bridges form multiple ring networks.

C

component. Any part of a network other than an attaching device, such as a multistation access unit.

connecting blocks. Fixtures used to terminate telephone wires in a wiring closet.

D

distribution panel. A wiring board that provides a patch panel function and mounts in a rack.

E

equipotential bonding. A means of limiting ground potential differences within a building.

F

frame. The unit of transmission in some local area networks, including the IBM Token-Ring Network. It includes delimiters, control characters, information, and checking characters. A frame is created from a token when the token has data appended to it.

L

lobe. In the IBM Token-Ring Network, the section of cable (which may consist of several segments) that connects an attaching device to an access unit.

lobe receptacle. An outlet on a multistation access unit for connecting a lobe.

local area network. A network in which communications are limited to a moderate-sized geographic area such as a single office building, warehouse, or campus and which do not generally extend across public rights-of-way.

M

multistation access unit. In the IBM Token-Ring Network, a wiring concentrator that can connect up to eight lobes to the network.

P

patch cable. In the IBM Cabling System, a length of type 6 cable with data connectors on both ends.

R

ring (network). A network configuration where a series of attaching devices are connected by unidirectional transmission links to form a closed path.

ring in (RI). On an access unit, the receive or input receptacle.

ring out (RO). On an access unit, the transmit or output receptacle.

ring sequence. The order in which devices are attached on a ring network.

S

star. A wiring arrangement in which an individual cable runs from each work area to a concentration point.

T

token. A sequence of bits passed from one device to another along the network. When the token has data appended to it, the token becomes a *frame*.

token ring. A network with a ring topology that passes tokens from adapter to adapter.

transmission medium. A physical carrier of electrical energy or electromagnetic radiation.

W

wiring closet. A room that contains one or more distribution panels and racks with drops from work areas and/or inter-wiring closet cables. Sometimes called a *network wiring closet* to distinguish it from a telephone wiring closet.

wiring concentrator. A lobe concentrator that allows multiple attaching devices access to the ring at a central point such as a wiring closet or in an open work area.

work area. An area in which terminal devices (such as displays, keyboards, and printers) are located. Access units may also be located in work areas.

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IBM Token-Ring Network
Telephone Twisted-Pair Media Guide

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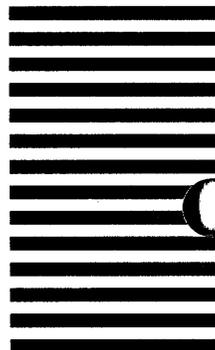**Reader's Comment Form**

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