Document 402-0127-01
Revision B-2

Multistation Access Unit
User's Guide

Plus Series Models:
MAU 8216 Plus
MAU 8228 Plus
MAU 8224 Plus
MAU 8228-DC Plus
MAU 8224-DC Plus

E Series Models:
MAU 8228 E
MAU 8228-DC E

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The United States Government Federal Communications Commission has specified that the following notice be brought to the attention of users of this product:

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 with 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.

NOTE:

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set forth in the radio interference regulations of the Canadian Department of Communications.

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CHAPTER ONE Introduction

This user's guide covers the following models of Andrew MAUs:

Model	***Description***
Plus Series	
MAU 8224 *Plus*	4 ports, RJ45 connectors
MAU 8228 *Plus*	8 ports, RJ45 connectors
MAU 8216 *Plus*	16 ports, RJ45 connectors
MAU 8224-DC *Plus*	4 ports, data connectors
MAU 8228-DC *Plus*	8 ports, data connectors
E Series	
MAU 8228 *E*	8 ports, RJ45 connectors
MAU 8228-DC *E*	8 ports, data connectors

1.1 Token Ring Background

Computer users have become less and less dependent on large centralized computing systems because of continuing increases in the processing power of microcomputers and minicomputers. Interconnecting micros, minis and mainframes into Local Area Networks (LANs) for the purpose of resource sharing and peer-to-peer communications can improve user productivity within office environments.

The IBM Token-Ring Network is a network system that allows interconnection of PCs and their associated devices, in addition to allowing interconnection of PCs to minicomputers and mainframes.

The IBM Token-Ring Network conforms to the IEEE 802.5 Token Ring Access Method standard. Other token ring networks conform to this standard as well.

The topology of the IBM Token-Ring Network is known as a "star-wired ring" The devices on the ring are attached to a single, unidirectional loop, and the loop is wired in a physical star. See Figure 1.

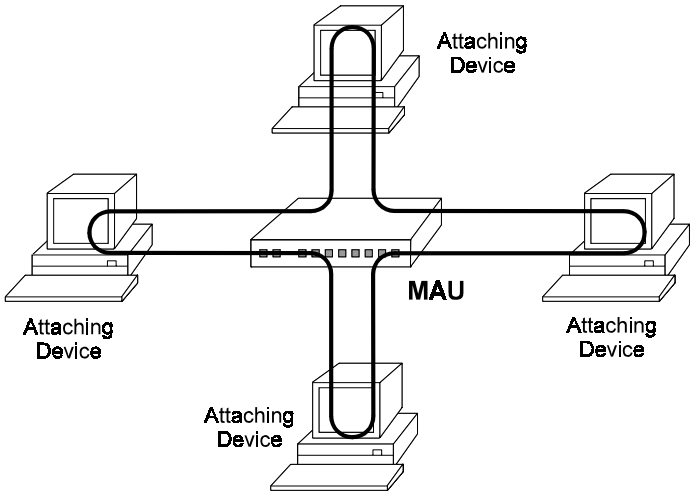

Figure 1. Star-wired topology

Each device on the ring is known as an *attaching device*. Each attaching device is connected to a wiring concentrator, or multistation access unit (MAU). The cable between the MAU and the attaching device is known as a *lobe*.

The purpose of a MAU is to isolate its attaching devices from the main data path of the ring. In this way, a problem occurring on the device side of the MAU will not usually affect the operation of the entire ring. Also, concentrating station connections in a small area aids troubleshooting.

A PC interfaces the network through the use of a token ring *adapter*, which is a card installed in the PC. When the adapter receives the token and has no data to transmit, it electrically regenerates the token and sends it to the next device on the line.

The term *token* comes from the access scheme of the network. A unique bit sequence, or token, is continuously passed from device to device in sequence. Only one token is on a ring at one time. When a device needs access to the network, it must wait until it receives the token. The device will then append to the token the data it wishes to transmit, and the token becomes a *frame*. After the frame is transmitted to its destination, it returns to the original sender, which confirms that it was received. The sending station then releases a free token. (In a 16 Mb ring, the sequence can be slightly different from what is given here, but the basic concepts are the same.) The first token is made by the first device turned on in the network.

To gain access to the network, the adapter in an attaching device presents a small current to the MAU. When the MAU senses this current, a relay is opened and the attaching device is connected to the ring.

The network consists of the adapters, the MAUs and the cabling that connects them.

One or more of the devices (for example, a powerful PC or an AS/400) are typically designated as file servers; other workstations can then access or download files from the servers. The token ring can use communications software such as E-mail to facilitate communications among workstations on the ring.

Using IBM Cabling System Type 3 cable (unshielded twisted pair), up to 72 attaching devices (printers, processors, controllers) may be attached to a single ring.

Using Type 1 or Type 2 cable, up to 260 attaching devices may be attached to a single ring.

With Type 3 cabling, up to eight MAUs may be used in a single ring. With Types 1 or 2 cable, up to 33 MAUs may be used.

Many more devices may be interconnected using Andrew source-routing token ring bridges (between rings) and gateways (between token ring and non-token ring communications environments, such as the IBM 5250 system).

1.2 Andrew MAUs

Features

- Full compatibility with the IBM Token-Ring Network.
- Inexpensive Type 3 cable may be used in addition to Types 1 and 2 cable. You may also use UTP or STP 100 ohm Category 5 cable. You have a choice of RJ45 connectors or data connectors.
- Diagnostic LEDs are standard on all models.
- Terminal (lobe) ports on *Plus* Series MAUs are initialized with a front panel pushbutton, eliminating the need for a separate port setup tool.

1.3 Related Publications

The following is a partial list of publications which contain information on token ring networks and detailed information on planning and installation. When using these documents, remember to use cable length specifications from **Chapter 3**, **Installation**, when installing your Andrew MAUs.

Andrew Token Ring Network Planning Guide, Bulletin 1565

Andrew Token Ring Repeater User's Guide, 402-0075-01

Andrew Fiber Optic Token Ring Repeater User's Guide, 402-0101-01

IBM Token-Ring Network Introduction and Planning Guide, GA27-3677-1

IBM Token-Ring Network Installation Guide, GA27-3678

IBM Token-Ring Network Telephone Twisted-Pair Media Guide, GA27-3714-4

CHAPTER TWO Hardware

2.1 Specifications

Power:

No external power source is required.

Data Rate:

4 and 16 Mbps. Type 3 cable may be used at 16 Mbps when Andrew CTD-416C media filters are used at the workstation or other attaching device.

Cable: See **Section 2.4, Cable Specification.**

Standard: All models meet the IEEE 802.5 Standard.

Connectors:

8224 *Plus*, 8228 *Plus*, 8216 *Plus*, 8228 *E*: female RJ45. These connectors will accept either RJ45 or RJ11 male connectors.

8224-DC *Plus*, 8228-DC *Plus*, 8228-DC *E*: data connectors (IEEE 802.5 Medium Interface Connectors)

Battery: (*Plus* series only, for operation of port reset feature) 3V lithium, Duracell 1/2 AA SE or equivalent. Field-replaceable.

Operating Temperature: 0° C to 55° C

Humidity: Up to 95% non-condensing

2.2 Models with RJ45 Connectors

	Weight	*Height*	*Width*	*Depth*
8224 *Plus*	2.0 lbs. (.90 kg)	1.72 in. (4.37 cm)	11.36 in. (28.85 cm)	6.00 in. (15.24 cm)
8228 *Plus*	2.7 lbs. (1.21 kg)	1.72 in. (4.37 cm)	17.25 in. (43.82 cm)	6.00 in. (15.24 cm)
8228 *E*	2.7 lbs. (1.21 kg)	1.72 in. (4.37 cm)	17.25 in. (43.82 cm)	6.00 in. (15.24 cm)
8216 *Plus*	3.25 lbs. (1.46 kg)	1.72 in. (4.37 cm)	17.25 in. (43.82 cm)	6.00 in. (15.24 cm)

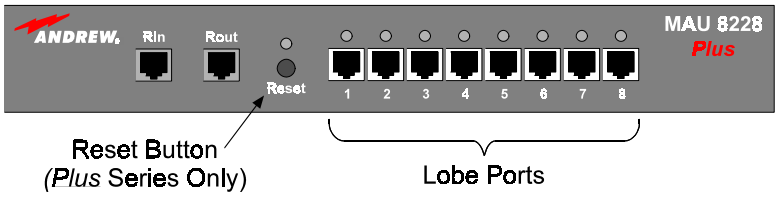

Figure 2. MAU 8228 Plus front panel

These MAUs have female RJ45 shielded lobe connectors. The connectors labeled Ring In and Ring Out are for attachment to the token ring. 8224 models have four station connectors for attachment to devices; 8228 models have eight station connectors; model 8216 has sixteen station connectors.

All models have one LED for each terminal port. When a terminal port LED is illuminated, it indicates that the device attached to that port is connected to the token ring.

Lobe Port Initialization

The station ports can be in an incorrect state for station attachment, and if they are, the MAU will be inoperable until the ports are reset. The two sections below describe port initialization for *Plus* series and *E* series MAUs.

Reset Button (*Plus* Series only)

The Reset button on the front panel of *Plus* Series MAUs is used to align the relays in the station ports so they are ready for operation. This feature is powered by a replaceable battery.

To operate the port reset feature, press the Reset button. When the LED above to the Reset button illuminates, it indicates that the battery is operable and that all inactive station ports will be aligned. Ports with active stations on them will not be disturbed.

Port Initialization Tool (*E* Series only)

E Series MAUs require a port initialization tool to reset their ports. Order the Andrew TRI-700 port initialization tool, part number 301-0313-01.

RJ45 Connectors

The diagram below shows the transmit and receive pins in the female RJ45 connectors.

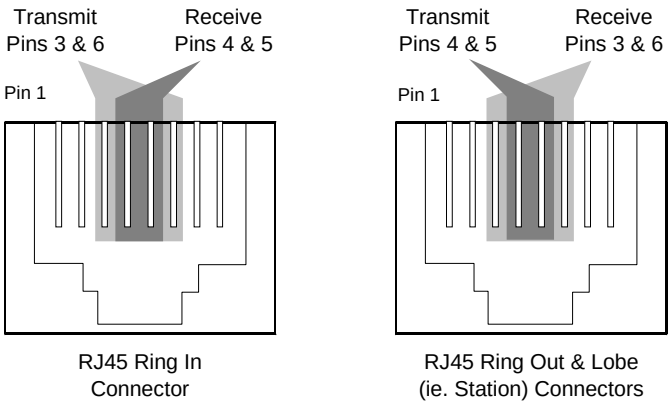

Figure 3. RJ45 connector transmit & receive pins

RJ11 male connectors may be used instead of RJ45 male connectors on the twisted pair cables used in the network. Both types will work in the female connectors on the MAUs. Whether RJ45 or RJ11 male connectors are used, the transmit and receive pins are always the four center pins in the connector, as shown in Figure 3.

IMPORTANT NOTE:

The cable used with your MAUs must have at least two twisted pairs of wire for data, no matter what cable type is used. This means a minimum of four separate wires, whether or not you will use all four. The cable must be wired straight-through, as shown in Figure Do not connect transmit and receive wires in the same twisted pair of wires; Figure 4 shows how to avoid this.

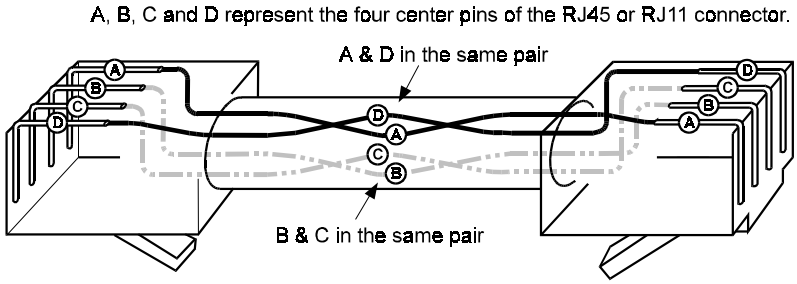

Figure 4. Correct RJ45 connector and cable wiring

Automatic Wrap of Ring In and Ring Out

When no connector is inserted into Ring In or Ring Out ports, the port will automatically wrap, or loop back, to utilize the backup path. The backup path is described in **Section 3.1, Installation Background**.

2.3 Models with Data Connectors

	Weight	***Height***	***Width***	***Depth***
8224-DC *Plus*	2.0 lbs. (.90 kg)	1.72 in. (4.37 cm)	11.36 in. (28.85 cm)	6.00 in. (15.24 cm)
8228-DC *Plus*	3.0 lbs. (1.35 kg)	1.72 in. (4.37 cm)	17.25 in. (43.82 cm)	6.00 in. (15.24 cm)
8228-DC *E*	3.0 lbs. (1.35 kg)	1.72 in. (4.37 cm)	17.25 in. (43.82 cm)	6.00 in. (15.24 cm)

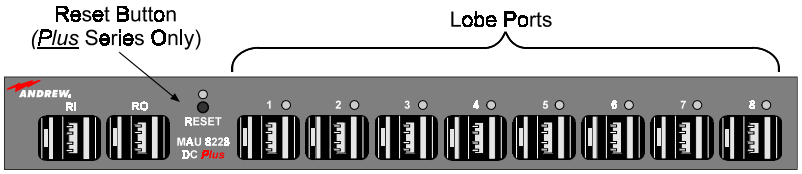

Figure 5. MAU 8228-DC Plus front panel

These MAUs have data connectors, which are also known as IEEE 802.5 Medium Interface Connectors. Two connectors are labeled RI (Ring In) and RO (Ring Out) for connection to the token ring, and there are either four or eight numbered connectors for station connection.

There is an LED for each terminal port. When a terminal port LED is illuminated, it indicates that the device attached to that port is electrically connected to the token ring.

Lobe Port Initialization

The station ports can be in an incorrect state for station attachment, and if they are, the MAU will be inoperable until the ports are reset. The two sections below describe port initialization for *Plus* series and *E* series MAUs.

Reset Button (*Plus* Series only)

The Reset button on the front panel of *Plus* Series MAUs is used to align the relays in all inactive station ports so they are ready for operation. This feature is powered by a replaceable battery.

To operate the port reset feature, press the Reset button. When the LED above to the Reset button illuminates, it indicates that the battery is operable and that all inactive station ports will be aligned. Ports with active stations on them will not be disturbed.

Port Initialization Tool (*E* Series only)

E Series MAUs require a port initialization tool to reset their ports. Order the Andrew TRI-700 port initialization tool, part number 301-0313-01.

Data Connectors

The transmit and receive pins of the data connectors on a MAU front panel are shown in Figure 6.

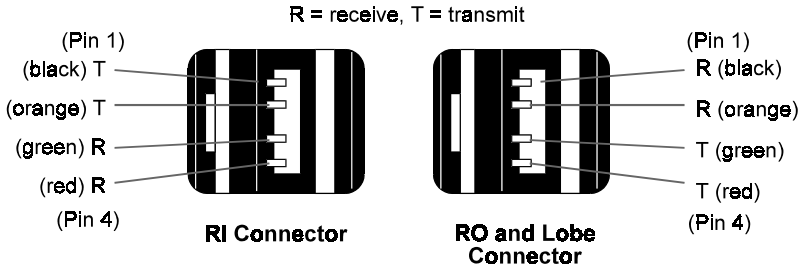

Figure 6. Data connector transmit and receive pins

The cables used with the MAUs must be straight-through, as shown in Figure 7.

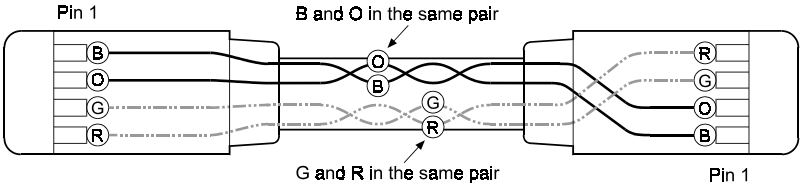

Figure 7. Straight-through data connector and cable wiring

Important Note:

Do not connect transmit and receive wires in the same twisted pair; Figure 7 shows how to avoid this.

Automatic Wrap of Ring In and Ring Out

When no connector is inserted into Ring In or Ring Out ports, the port will automatically wrap, or loop back, to utilize the backup path. The backup path is described in **Section 3.1, Installation Background**.

2.4 Cable Specifications

Category 5 Cable

This cable has been defined by the EIA/TIA as the cable of choice for data applications up to 100 Mbps. See EIA/TIA specification #568 A/B for building wiring recommendations.

- UTP and STP available
- 22 and 24 gauge generally available
- Impedance 100 ohms ± 15% from 512 kHz to 100 MHz
- Maximum attenuation is 67.0 dB per 1,000 at 100 MHz.

Type 3 Cable

The Type 3 cable used with Andrew MAUs should be standard twisted pair telephone building wire. Recommended wire gauge is 24 or 22 AWG, Belden 9562 or equivalent. The following requirements should be met:

- Solid copper twisted pairs, with at least two twists per foot
- A maximum DC resistance of 28.6 ohms per 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 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

NOTE:

Commonly available consumer telephone cable, sometimes called "flat cable" or "silver satin," should not be used. This type of cable can drastically reduce the cable lengths possible in your network. Exceptions to this are the patch cables used to connect MAUs in the same wiring closet in 4 Mbps networks; they may be made of this type of cable, but they should be no more than three feet in length. In 16 Mbps networks, however, silver satin of any length should not be used.

Electrical Interference

Because Type 3 cable is unshielded, care must be taken to avoid areas of electrical disturbance. Some examples of sources of electrical disturbance are:

- Fluorescent lights
- Power cables
- Electric motors
- Radio transmitters

Type 1 and Type 2 Cable

Type 1 is the IBM Cabling System term for shielded twisted pair data cable. It consists of two twisted pairs of 22 AWG solid conductor wire enclosed in a tinned copper braid shield, and it's covered with an appropriate sheath. The sheath material varies according to whether or not the cable will be used in an environmental air duct. There is also a variety of Type 1 for outdoor use.

Type 2 cable is the same as Type 1 cable in that it has two shielded twisted pairs of 22 AWG wire for data communication. It differs from Type 1 in that the cable sheath also contains four twisted pairs of unshielded 22 AWG solid conductor wire for telephones.

Types 1 and 2 cable must be used with data connectors (also known as IEEE 802.5 Medium Interface Connectors) because of the need to terminate the cable shielding.

Types 1 and 2 cable and data connectors are available from IBM distributors and from other suppliers such as Belden or Alpha.

CHAPTER THREE Installation

3.1 Installation Background

This section gives general information on planning the network using Andrew MAUs, and later sections will cover the installation of individual models.

Before installing your MAUs and attaching devices, it is very important that the network be carefully planned. The most important factors for the physical part of the network are:

- Main ring length and distance between MAUs
- Length of the lobes attaching MAUs to devices
- Number of wiring closets
- Verifying that the proper type of cable is used (see **Section 2.4, Cable Specifications**.)
- Safeguarding against electrical interference, especially when Type 3 cable is used.

A copy of the floor plans of the buildings that will use the token ring network will help greatly in planning the installation. For more information, see **Section 1.3, Related Publications.**

NOTE:

When using Type 3 cable with 4 Mb token rings, Andrew CTD-440C Media Filters must be used to take full advantage of the lobe lengths stated in this chapter. When using Type 3 cable at 16Mb, Andrew CTD-416C Media Filters must be used. Using another brand of media filter may result in decreased lobe length.

Main Ring

When multiple MAUs are used in a token ring network, the *main ring* consists of the cable between the MAUs. The length of the main ring is critical to proper network operation. The main ring does not include the cable from MAUs to their attaching devices (these cables are called *lobes*).

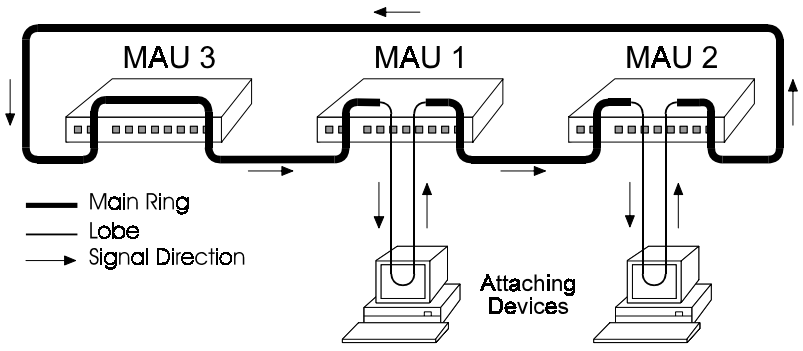

Figure 8. Main Ring

If there is only one MAU for the entire ring, the main ring can be considered to have no length for installation purposes.

Backup Path

In a normal configuration, there is an unused pair of wires in the twisted pair cable used in the network. This extra pair of wires, used with a backup circuit inside the MAUs, is called the *backup path*.

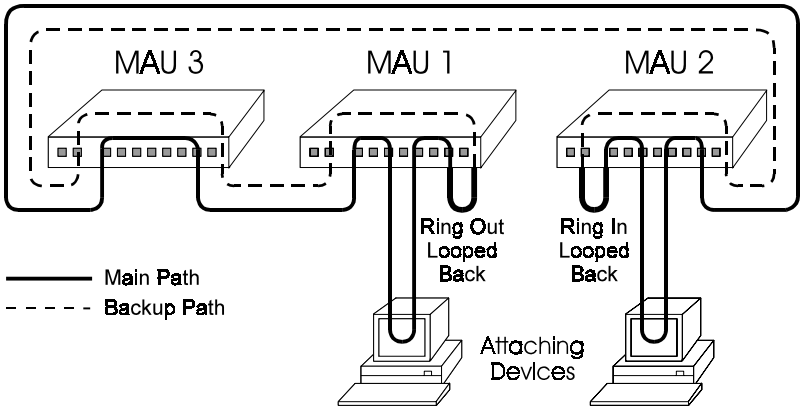

Figure 9. Backup path

The backup path is designed to enable the network to continue to operate while a problem such as a faulty cable or MAU is being repaired.

For example, if a breakdown occurs in the cable between MAU 1 and MAU 2 as in Figure 9, the rest of the ring will remain in operation if the backup path is used. Note that when the backup path is utilized, it becomes part of the main ring and its length must be included in the main ring length. In most situations, the network should be designed to allow the backup path to be used. The backup path is automatically used by *Plus* series MAUs when no connector is inserted in Ring In or Ring Out ports.

The length of the main ring is critical to the proper operation of the token ring network. If the network is designed without taking the length of the backup path into consideration, the backup path may not be usable if it is needed. It may force the signal to be transmitted so far that it becomes unreadable due to attenuation.

When the network is first activated at the start of a business day, it may consist of only one active attaching device connected to the main ring. For this example, assume that the attaching device is on the longest lobe.

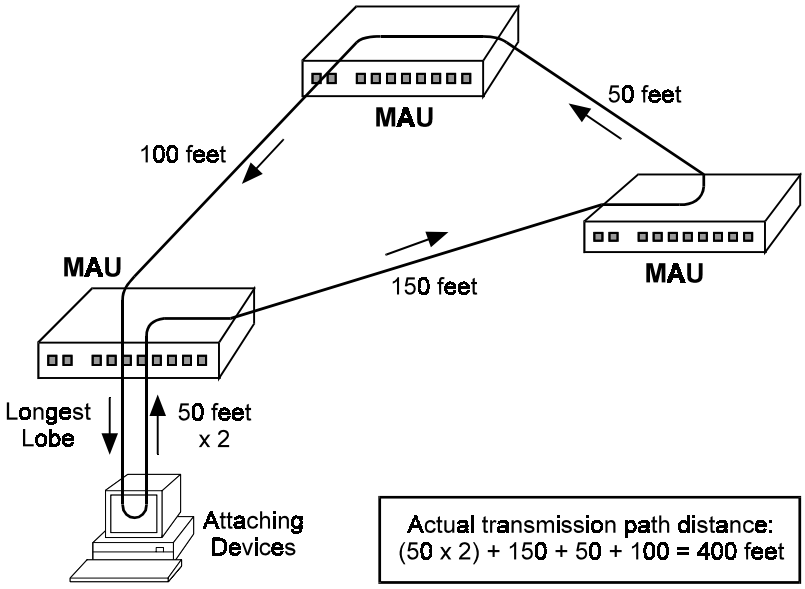

Figure 10. Main ring and first device. The backup path is not in use

The signal generated by the attaching device must travel up its lobe to the main ring, around the entire main ring, and back down the lobe to the device without being regenerated. If the backup path were being utilized with the shortest section of cable removed, the path would be much longer.

Usually, the longest possible transmission path occurs when the backup path is being utilized with the shortest section of cable removed, and when the station on the longest lobe is the only active station on the network. The longest possible distance must be assumed when planning the network.

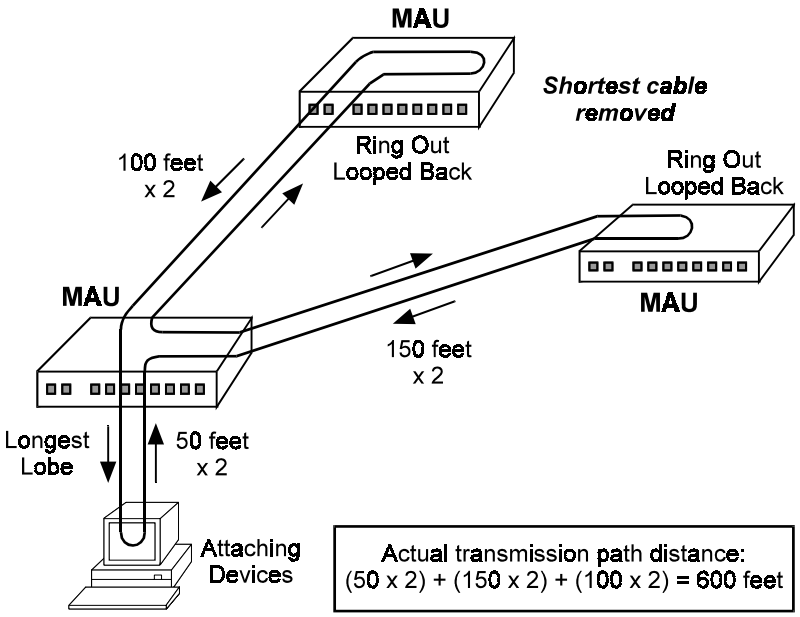

Figure 11. Transmission distance using the backup path

Adjusted Ring Length

In networks which use more than one MAU, *adjusted ring length* (ARL) is the total length of the cable connecting MAUs (the main ring) minus the shortest inter-MAU cable. Patch cables less than three feet in length are not included in this calculation. See the diagram below.

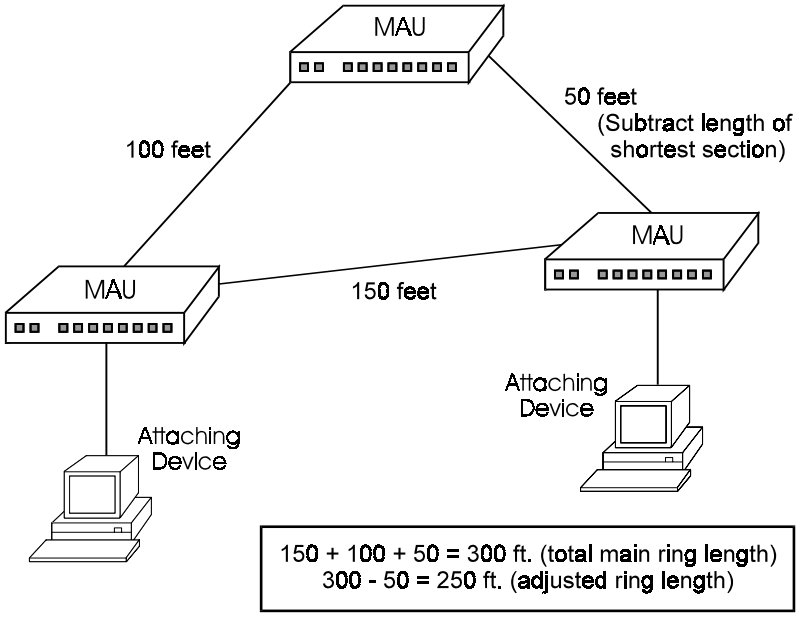

Figure 12. Adjusted ring length

The use of ARL is intended to simplify network planning. The length of the longest lobe in the network is added to ARL, and the sum is compared to a chart later in this chapter to determine maximum ring size. See **Section 3.2, Calculating Distances**.

Lobe Length

The distance between each attaching device and its MAU is very important in network planning. Maximum lobe lengths are a function of several factors, and they will vary depending on how the network is configured. See **Section 3.2, Calculating Distances**.

Cable Type

Type 1, Type 2, Type 3, or Category 5 cabling may be used with Andrew *Plus* series and *E* series MAUs. Usually, Type 3 or Category 5 100 ohm cable is used with RJ45-equipped MAUs, and Types 1 or 2 cable are used with data connector-equipped (DC) MAUs.

Plus series and *E* series MAUs can be used in either 4 Mb or 16 Mb token rings. Maximum distances will be less in 16 Mb rings.

Repeaters

Andrew Repeaters can vastly increase the geographic distance of a 4 or 16 Mb network. If there is more than one wiring closet in the ring, repeaters are recommended between each wiring closet. If they are used, the length of the main ring can often be disregarded, and maximum lobe lengths can be achieved. Andrew copper wire repeaters can transmit the network signal up to 1200 feet on Type 3 cable and up to 2400 feet on Types 1 or 2 cable. Andrew fiber optic repeaters can transmit the network signal up to 10,000 feet on fiber optic cable.

If repeaters will be used, it will affect the installation of MAUs. Follow the installation instructions given in the ***Andrew Token Ring Repeater User's Guide*** or ***Fiber Optic Token Ring Repeater User's Guide***.

Bridges

Bridges can help organize the rings of a network and enhance performance from the viewpoint of network users.

Andrew Token Ring Bridges are available in local and remote versions, and they provide the capability to extend your network around the world. They also provide increased network control and management functions, based on their complete IBM compatibility.

16 Mb Token Rings

Andrew *Plus* series and *E* series MAUs can be used in 16 Mb token rings on Types 1, 2, 3, or Category 5 cabling. Category 5 cable is generally preferred for this application because of its ability to support data rates up to 100 Mbps. This provides some margin for future upgrades.

3.2 Calculating Distances

A simplified distance calculation method based on maximum cable length follows:

The sum of the ARL (adjusted ring length, defined in **Section 3.1, Installation Background,** and in the **Glossary**) plus the cable length of the longest lobe in the ring must be less than or equal to the distance given for your network's configuration in one of the tables in Figures 14 through 19. Expressed as a formula, this is:

ARL + longest lobe ≤ maximum distance for your configuration (from the appropriate table)

NOTE:

The distances given in the tables for Type 3 cable will require Andrew media filters between the adapters and the network cable. Using another brand of media filter may result in decreased lobe length. For 4 Mb rings, use CTD-440C media filters; for 16 Mb rings, use CTD-416C media filters.

Example

This example illustrates a proper network plan using *Plus* series MAUs. All cable distances given assume that 24 gauge Type 3 cable is used in the network. See Figure 3.

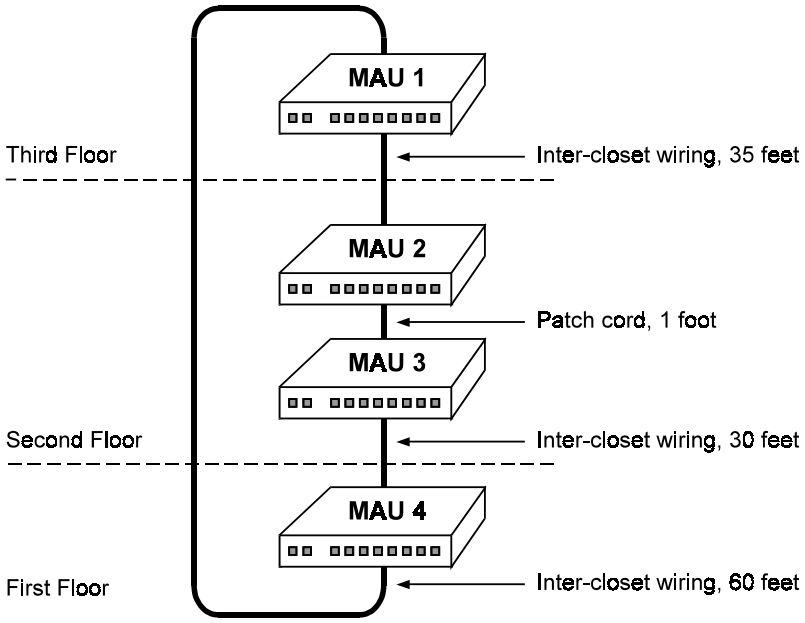

Figure 13. Example

Assume that a network is desired which has devices located on three floors of a building, and four MAUs will be used. Using the cable lengths shown in Figure 13, the total length of the main ring is 125 feet (35 + 30 + 60). The patch cable connecting MAUs 2 and 3 has been ignored. Its length is insignificant, and it is assumed that if it goes bad it will be replaced instead of looping the ring onto the backup path. The ARL is 95 feet (total main ring length minus the shortest segment: 125 – 30).

The maximum distance for this network is 435 feet, as taken from the chart in Figure 14 (24 gauge Type 3 cable, four MAUs and three wiring closets). This means that the maximum lobe length allowed on this network is 340 feet (435 – 95). Each lobe on this network can be up to 340 feet in length.

More Installation Information

If you need more information on installing token ring networks, see **Section 1.3, Related Publications**.

Completing the Installation

Once the network has been thoroughly planned and all wiring has been routed to the work areas where network devices will be located, follow the procedure given in **Section 3.4, Completing the Installation**.

3.3 Distance Charts

The charts on the following pages are used with the distance formula given in **Section 3.2, Calculating Distances.**

4 Mb Distance Charts

Type 3 Cable

Number of MAUs	Number of Wiring Closets				
	1	2	3	4	5
	19 Gauge				
1	600 (183)				
2	585 (181)	575 (175)			
3	570 (174)	560 (171)	550 (168)		
4	555 (169)	545 (166)	535 (163)	525 (160)	
5	540 (165)	530 (162)	520 (158)	510 (155)	500 (152)
6	525 (160)	515 (157)	505 (154)	495 (151)	485 (148)
7	510 (155)	500 (152)	490 (149)	480 (146)	470 (143)
8	495 (151)	485 (148)	475 (145)	465 (142)	455 (139)
	22 Gauge				
1	550 (168)				
2	535 (163)	525 (160)			
3	520 (158)	510 (155)	500 (152)		
4	505 (154)	495 (151)	485 (148)	475 (145)	
5	490 (149)	480 (146)	470 (143)	460 (140)	450 (137)
6	475 (145)	465 (142)	455 (139)	445 (136)	435 (133)
7	460 (140)	450 (137)	440 (134)	430 (131)	420 (128)
8	445 (136)	435 (133)	425 (130)	415 (126)	405 (123)
	24 Gauge				
1	500 (152)				
2	485 (148)	475 (145)			
3	470 (143)	460 (140)	450 (137)		
4	455 (139)	445 (136)	435 (133)	425 (130)	
5	440 (134)	430 (131)	420 (128)	410 (125)	400 (122)
6	425 (130)	415 (126)	405 (123)	395 (121)	385 (117)
7	410 (125)	400 (122)	390 (119)	380 (116)	370 (113)
8	395 (120)	385 (117)	375 (114)	365 (111)	355 (108)
	26 Gauge				
1	470 (143)				
2	455 (139)	445 (136)			
3	440 (134)	430 (131)	420 (128)		
4	425 (130)	415 (126)	405 (123)	395 (121)	
5	410 (125)	400 (122)	390 (119)	380 (116)	370 (113)
6	395 (120)	385 (117)	375 (114)	365 (111)	355 (108)
7	380 (116)	370 (113)	360 (110)	350 (107)	340 (104)
8	365 (111)	355 (108)	345 (105)	335 (102)	325 (99)

Figure 14. Maximum distances in feet (meters) using Type 3 cabling

4 Mb Distance Charts

Type 1 or Type 2 Cable

Number of MAUs	Number of Wiring Closets				
	1	2	3	4	5
1	1220 (372)				
2	1190 (636)	1170 (357)			
3	1160 (354)	1140 (347)	1120 (341)		
4	1130 (344)	1110 (338)	1090 (332)	1070 (326)	
5	1100 (335)	1080 (329)	1060 (323)	1040 (317)	1020 (311)
6	1070 (326)	1050 (320)	1030 (314)	1010 (308)	990 (302)
7	1040 (317)	1020 (311)	1000 (305)	980 (299)	960 (293)
8	1010 (308)	990 (302)	970 (296)	950 (290)	930 (283)

Figure 15. Maximum distances in feet (meters) for Type 1 or Type 2 cabling

Type 5 Cable, 24 Gauge

Number of MAUs	Number of Wiring Closets				
	1	2	3	4	5
1	990 (300)				
2	964 (290)	944 (285)			
3	937 (280)	917 (275)	898 (270)		
4	911 (275)	891 (270)	871 (260)	851 (255)	
5	884 (265)	865 (260)	845 (255)	825 (250)	805 (240)
6	858 (260)	838 (250)	818 (245)	799 (240)	779 (235)
7	832 (250)	812 (245)	792 (230)	772 (230)	752 (225)
8	805 (240)	785 (235)	766 (230)	746 (225)	726 (220)

Figure 16. Maximum distances in feet (meters) for Type 5 cabling, 24 gauge

16 Mb Distance Charts

Type 3 Cable

Number of MAUs	Number of Wiring Closets				
	1	*2*	*3*	*4*	*5*
	19 Gauge				
1	221 (67)				
2	215 (66)	212 (65)			
3	210 (64)	207 (63)	204 (62)		
4	205 (62)	202 (62)	199 (61)	196 (60)	
5	200 (61)	197 (60)	194 (59)	191 (58)	188 (57)
6	195 (59)	192 (59)	189 (58)	186 (57)	183 (56)
7	190 (58)	187 (57)	184 (56)	181 (55)	178 (54)
8	184 (56)	182 (55)	179 (55)	176 (54)	173 (53)
	22 Gauge				
1	215 (66)				
2	210 (64)	207 (63)			
3	205 (62)	202 (62)	200 (61)		
4	200 (61)	197 (59)	195 (59)	191 (58)	
5	195 (59)	192 (59)	189 (58)	187 (57)	183 (56)
6	190 (58)	187 (57)	184 (56)	182 (55)	179 (55)
7	184 (56)	182 (55)	180 (55)	176 (54)	174 (53)
8	180 (55)	177 (54)	174 (53)	172 (52)	169 (52)
	24 Gauge				
1	210 (64)				
2	205 (62)	202 (62)			
3	200 (61)	197 (60)	195 (59)		
4	195 (59)	193 (59)	189 (58)	187 (57)	
5	190 (58)	188 (57)	184 (56)	182 (55)	179 (55)
6	186 (56)	183 (55)	180 (55)	176 (54)	174 (53)
7	181 (55)	178 (54)	174 (53)	172 (52)	169 (52)
8	176 (54)	173 (53)	170 (52)	167 (51)	165 (50)
	26 Gauge				
1	189 (58)				
2	184 (56)	182 (55)			
3	180 (55)	178 (54)	175 (53)		
4	176 (54)	173 (53)	171 (52)	168 (51)	
5	172 (52)	169 (52)	166 (51)	164 (50)	161 (49)
6	167 (51)	165 (50)	162 (49)	160 (49)	157 (48)
7	162 (49)	160 (49)	158 (48)	155 (47)	153 (47)
8	158 (48)	156 (48)	153 (47)	151 (46)	148 (45)

Figure 17. Maximum distances in feet (meters) for Type 3 cabling

16 Mb Distance Charts

Type 1 or 2 Cable

Number of MAUs	Number of Wiring Closets				
	1	2	3	4	5
1	427 (130)				
2	416 (127)	410 (125)			
3	406 (124)	399 (122)	392 (119)		
4	396 (121)	389 (119)	382 (116)	375 (114)	
5	385 (117)	378 (115)	371 (113)	364 (111)	357 (109)
6	375 (114)	368 (112)	361 (110)	354 (108)	347 (106)
7	364 (111)	357 (109)	350 (107)	343 (105)	336 (102)
8	354 (108)	347 (106)	340 (104)	333 (101)	326 (99)

Figure 18. Maximum distances in feet (meters) for Type 1 or Type 2 cabling

Type 5 Cable, 24 Gauge

Number of MAUs	Number of Wiring Closets				
	1	2	3	4	5
1	429 (130)				
2	409 (120)	396 (120)			
3	389 (115)	376 (110)	363 (110)		
4	370 (110)	356 (105)	343 (100)	330 (100)	
5	350 (105)	337 (100)	323 (95)	310 (90)	297 (90)
6	330 (100)	317 (95)	304 (90)	290 (85)	277 (80)
7	310 (90)	297 (90)	284 (85)	271 (80)	257 (75)
8	290 (85)	277 (80)	264 (80)	251 (75)	238 (70)

Figure 19. Maximum distances in feet (meters) for Type 5 cabling, 24 gauge

3.4 Completing the Installation

Rack Mounting

Brackets are included with 8-port models that allow rack, shelf and wall mounting. The diagrams below show the position of the brackets for these different applications.

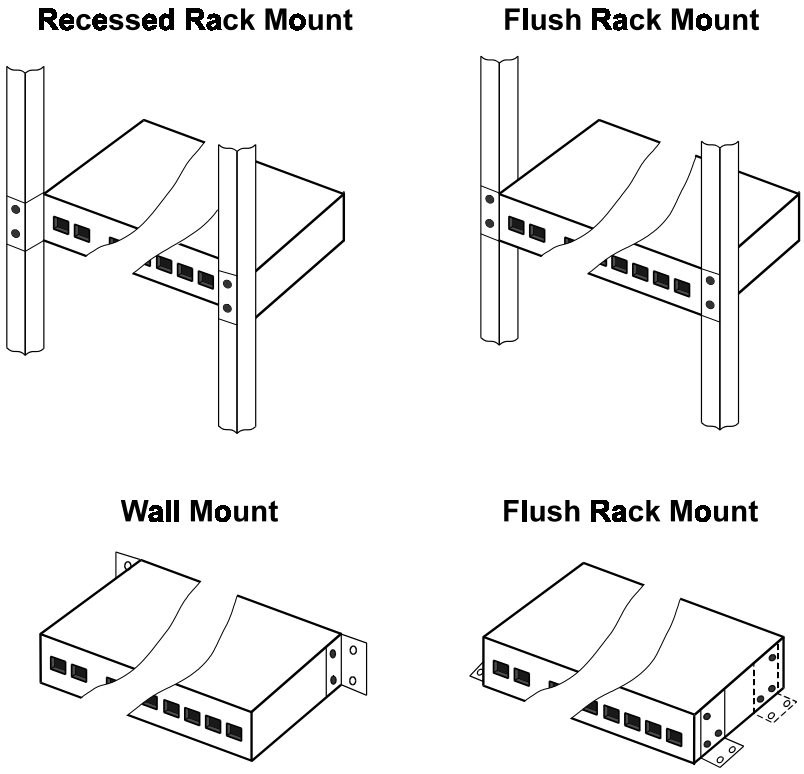

Figure 20. Mounting options for 8-port or 16-port MAUs

Station Port Initialization

The station ports can be in an incorrect state for station attachment, and if they are, the MAU will be inoperable until the ports are reset. The two sections below describe port initialization for *Plus* series and *E* series MAUs.

Reset Button (*Plus* Series only)

The Reset button on the front panel of *Plus* Series MAUs is used to align the relays in the station ports so they are ready for operation. This feature is powered by a replaceable battery.

To operate the port reset feature, press the Reset button. When the LED above to the Reset button illuminates, it indicates that the battery is operable and that all inactive station ports will be aligned. Ports with active stations on them will not be disturbed.

Port Initialization Tool (*E* Series only)

E Series MAUs require a port initialization tool to reset their ports. Order the Andrew TRI-700 port initialization tool, part number 301-0313-01.

Installation Procedure

Once the network has been thoroughly planned and all wiring has been routed to the work areas where network devices will be located, use this procedure to finish the installation.

1. If RJ45-equipped MAUs are used, attach Andrew CTD-440C media filters to the network ports on the adapter cards in the attaching devices (unless the adapters are equipped with media filters). Plug the network cable into the appropriate connector in the media filters. For 16 Mb applications on Type 3 cabling, use CTD-416C media filters.
2. Plug all terminal cables into the appropriate terminal connectors on the MAUs.

NOTE:

Make sure that thorough documentation is kept on all network devices, their locations, their sequence on the ring, and their associated MAU ports.

3. If the ring is not running, connect the MAUs to the main ring using the Ring In and Ring Out connectors. (Ring in receives the cable from the previous MAU; Ring Out connects to the cable going to the next MAU.) Bring up the ring and make sure that the attaching devices are powered on and are set up to request network access.

   If the ring is already operating, the new MAUs may be installed by attaching Ring In and Ring Out cables to the appropriate MAU connectors, as long as the ring is not broken for more than five to ten seconds.

CAUTION:

If the main ring is broken for more than five to ten seconds, the ring will be completely disabled and will have to be reinitialized. Data loss may occur.

4. All terminal port LEDs should illuminate if the ports have devices attached and if the devices are powered on and are set up to request network access.

   If the MAU does not seem to be operating properly, see **Chapter 4, Problem Determination.**

CHAPTER FOUR Problem Determination

Andrew MAUs are designed for ease of use. By using the following guide, most problems can be quickly isolated and corrected.

Procedure

If an attaching device is validly connected to the network, the terminal port LED on the MAU will be on, and the attaching device should be able to communicate properly on the network.

If the attaching device does not operate properly, first check to see that the device is powered on and is set up to request network access.

Next, check to see if the terminal port LED on the MAU is on. If it is on, the problem is likely to be one of the following:

- The token ring adapter card in the attaching device is not operating properly.
- The software in the token ring adapter card is not set up correctly.
- There is a problem in the network itself. If this is the case, there will probably be trouble elsewhere in the network.
- The building wiring has improper connections.

If the terminal LED is not on, verify that the lobe is not too long. Proper lobe lengths are covered in **Chapter 3**, **Installation**.

If the lobe cable is the proper length, verify that its condition is good, and that it is properly connected at both ends. Also verify that the cable transmits straight through and does not "cross over." See **Section 2.2, Models with RJ45 Connectors**, or **Section 2.3, Models with Data Connectors,** for diagrams of straight through cabling.

If the lobe cable is all right, the terminal port on the MAU can be tested by connecting the lobe to a terminal port that is known to be good.

If these things are found to be correct, check the cable lengths and cable conditions in the main ring.

If you need help other than what has been provided in this User's Guide, call Andrew Technical Support at 800-8 ANDREW between the hours of 6 AM and 5 PM Pacific time.

GLOSSARY

adapter the card installed in a PC which allows the PC to access the token ring network.

ARL adjusted ring length. This is the total length of the cable connecting MAUs in a single token ring, minus the shortest inter-MAU segment.

attaching device each device directly connected to the token ring. Examples: a PC, a midrange computer such as an IBM AS/400, and a front end processor for a mainframe computer.

backup path in a normal configuration, there is an unused pair of wires in the twisted pair cable used in the network. This extra pair of wires, used in conjunction with a backup circuit inside the MAUs, is called the backup path. It can be used to provide an alternate path if part of the ring is inoperative. See **Section 3.1, Installation.**

category 5 cable defined by the EIA/TIA for data applications up to 100 Mbps. See cable specifications in **Section 2.4, Cable Specifications.**

frame when an attaching device appends data to the network token, the token becomes a frame.

lobe the cable between an MAU and an attaching device.

loopback cable used with RJ45-equipped MAUs when there is only one MAU for a ring. It connects ring in to ring out.

main ring the cable between the MAUs in a ring.

MAU Multistation Access Unit. This is the wiring concentrator in a token ring network.

station synonym for attaching device.

terminating plug this is used in either the ring in or ring out connector on an MAU to utilize the backup path. Also called a wrap plug.

token a unique bit sequence that is passed from station to station in sequence on a token ring network. Any device wanting access to the network will append data to the token, making it a frame.

token ring a local area network (LAN) that uses the IEEE 802.5 Token Ring Access Method.

type 1 the IBM Cabling System term for shielded twisted pair cabling. See **Section 2.4, Cable Specifications.**

type 2 same as type 1, except that the cable includes several pairs of ordinary telephone wire enclosed in the same outer sheath as the shielded data cable. See **Section 2.4, Cable Specifications.**

type 3 the IBM Cabling System term for unshielded telephone twisted pair wire. See **Section 2.4, Cable Specifications.**