Notebook Computer Ethernet LAN Option User's Manual

Notice

This device has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This device generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this device does cause harmful interference to radio or television reception, which can be determined by turning the device off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- ❑ Reorient or relocate the receiving antenna
- ❑ Increase the separation between the device and receiver
- ❑ Connect the device into an outlet on a circuit different from that to which the receiver is connected
- ❑ Consult the dealer or an experienced radio/television technician for help

Caution

Changes or modifications to this device not expressly approved by the manufacturer could void the user's authority, which is granted by the Federal Communications Commission, to operate this device.

Notice: Canadian Users

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

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Preface

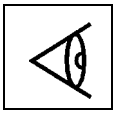
The Notebook Computer Ethernet ® LAN Adapter provides an interface channel between your notebook computer and local area networks (LAN) that comply with the IEEE Specification 802.3 for 10Base5 (thick Ethernet cable) and 10BaseT (twisted pair cable).

Your new Ethernet Adapter provides the necessary NDIS and NETBIOS drivers and has been tested for compatibility with many popular LAN software such as NetWare™ and LAN Manager

Ethernet LAN Adapter features include

- ❑ Measures only 6.5 by 2.6 by 1.4 inches and weighs only 8 ounces
- ❑ Has 120-pin AT bus connector to attach to your notebook computer
- ❑ Supports 10BaseT twisted pair installations
- ❑ Provides 15-pin AUI D-sub connector for an external transceiver to support thick and thin coaxial cable with an external ac adapter
- ❑ Switch-selectable input/output address and interrupt
- ❑ Uses only 750 mA, +5 volt power, supplied by notebook computer; manual power switch conserves power when not in use
- ❑ Has connector for optional external PS/2-compatible keyboard

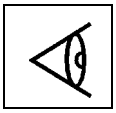
Preface



Note: This manual is intended as a supplement to the documentation supplied with your network system software. That documentation should be used as the primary reference source for information about your network.

This manual explains how to install and use your Ethernet LAN networking hardware and how to create a network. A section on networking concepts and a glossary of networking terms are also included to help you establish a local area network.

This manual assumes you are familiar with your personal computer. If you haven't already done so, read and follow the instructions in your computer manual for the set-up, configuration, and software loading of your system.



Note: Check for a README.DOC file on the *Ethernet LAN Utilities* floppy furnished with the kit for any late information about your Ethernet LAN Adapter.

Kit Contents

Check the contents of your package. In addition to this manual, the carton should include the following.

- ❑ Ethernet LAN Adapter
- ❑ 3.5-inch floppy with drivers, utilities, and diagnostics program
- ❑ 12-Vdc power adapter

Choosing a Network Driver

The network driver you choose depends on the network operating system you are using.

If you are using NetWare, use the NE2000 drivers that come with that network operating system.

If you are using LAN Manager or an OEM version such as 3+ Open or LAN Server, use the NDIS drivers included on the *Ethernet LAN Utilities* floppy.

Because of widespread software support for NE2000 adapters, you may have the option of using either the NE2000 drivers shipped with your network operating system or the drivers provided on your *Ethernet LAN Utilities* floppy. If that is the case, it is probably better to use the drivers on the *Ethernet LAN Utilities* floppy since they support a wider range of configuration options for your Ethernet LAN Adapter.

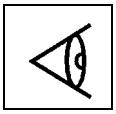
Conventions and Symbols

Throughout this manual, the following conventions are used to distinguish elements of text:

SMALL CAPS	Used for directory names, commands, command options, switches, and literal portions of syntax that must appear exactly as shown
italics	Used to denote Setup Program items and settings, key words, and references to other publications
Monospace	Used for prompts and menus that display during operation of your computer, including prompts (text generated by the computer) and entries you are supposed to type on the keyboard
Bold	Used for keys, key sequences, and drive designator prompts

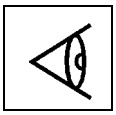
Preface

Several international symbols are used throughout this manual to advise you of important information.



This symbol indicates a **Note** concerning operating procedures or information you should know to help you operate your Ethernet LAN Adapter.

This symbol alerts you to a **Warning** or **Caution** that can prevent you from causing injury to yourself or damage to your equipment.



This symbol tells you that more information about the same subject is continued on the next page.

1
Network Planning

This chapter tells you about:

- ❑ Ethernet network concepts, hardware, and software
- ❑ Coaxial cable networks
- ❑ Twisted pair networks
- ❑ Combination network cabling schemes
- ❑ Evaluating your network requirements

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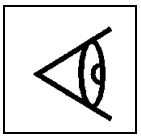
Planning Overview



Note: If the network is already planned or implemented, and You are familiar with network terms and components in thick-, thin-, or combination-cabled Ethernet networks, then you can skip to Chapter 2. Otherwise, continue reading this chapter.

The successful operation of a network requires correct network layout and implementation. This chapter is intended to provide enough information to allow the design and installation of Ethernet networks using the three most popular forms of connecting media-thick-cable coaxial cable, thinwire coaxial cable, and twisted pair.

If you are not attaching to an already installed network, before connecting your Ethernet LAN Adapter to your notebook computer, you should have already planned your network, selected your network system software, and familiarized yourself with the documentation for that network software (especially as it pertains to installing drivers for NE2000-compatible Ethernet adapters).

Caution: Because existing LANs can easily be disrupted by incorrect connections, you should consult the system administrator for the network before proceeding.

About Network Hardware and Software

Any Ethernet network consists of certain basic hardware and software elements. The main hardware elements include:

- A connecting medium of some kind, such as coaxial or twisted pair cable
- Computers containing Ethernet adapters such as this me
- Specialized interconnection units, from simple splicing connectors to more sophisticated devices such as transceivers and repeaters

These hardware elements provide a highly specified physical and electrical "channel" through which the various devices communicate. However, before the network can be used, the computers must be running the same network-oriented System software, often called a *network operating system*. Just as a computer operating system lets PC users and their applications take advantage of the PC's hardware, the network operating system lets users and their applications take advantage of the network's hardware connections.

The remainder of this chapter explains terms and concepts regarding the hardware and media used in Ethernet networks. For information about the capabilities and use of the network operating system you have chosen, refer to the system's documentation.

General Ethernet Concepts

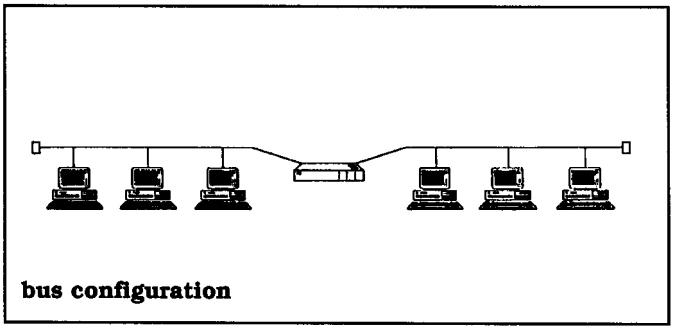
Computers on a network communicate with each other via wire or other media. There are two typical classes of cable used to connect the computers:

- *Coaxial cable*, either *thin-wire* (like cable TV coaxial cable), or larger, more expensive thick cable
- *Twisted pair*, which is high quality, telephone cable (2or 4-pair, typically)

Coaxial Ethernet networks and twisted pair Ethernet networks have a different basic structure, or *topology*, described briefly in the next section.

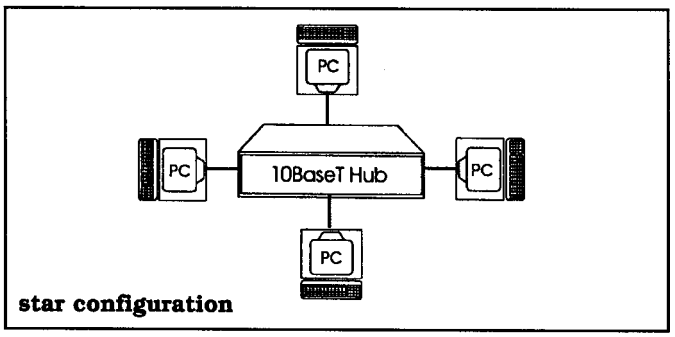
Network Topology-Bus vs. Star

Ethernet coaxial cable networks use what is commonly called a "bus" topology. In a purely coaxial cable network, each computer, o*node*, is connected at intervals to a main cable. This main cable serves as a network bus that is "tapped into" by each node, as shown below.



bus configuration

Ethernet twisted pair networks use what is commonly called a "star" topology. In a purely twisted pair network, each computer, or node, is connected to a central connection point called a *hub* or *concentrator.* This yields an arrangement that looks similar to a starburst pattern as shown in the following figure.



star configuration

Failed Connection Modes-Twisted Pair vs. Coaxial Cable

The low wiring cost, ease of installation, and potential for dual phone/network use provided by twisted pair cabling are only some of the advantages of twisted pair networks over coaxial cable networks. One major advantage involves the effect of a *failed connection* on the two types of networks.

In a coaxial cable network, if a single connection fails, the *entire network* may be disabled. In a twisted pair network, though, the effect is much more limited.

If the connection failure occurs between a node and the hub, only that node is disabled; the remainder of the network is unaffected (except for the inability to access that node). If the failure occurs in the link between two hubs, the two hubs continue to operate separately, although they are isolated from each other's network resources.

If a hub itself fails or loses power, all nodes connected to that hub are disabled, but any other hubs on the network continue operating. However, the failed hub's resources will be unavailable. Furthermore, if the failed hub was connected between two other hubs, those hubs will be isolated from each other after the failure.

10BaseT twisted pair networks also provide an additional resource, called *link status*, that eases maintenance and troubleshooting. 10BaseT hubs and adapters transmit a link status pulse at frequent intervals. As long as the adapter and hub continue receiving the pulse (transmitted by the other device) within the expected interval, each "knows" that the link between the hub and the node is intact.

Most 10BaseT hubs and adapters (including this one) provide a green LED, called *link status* indicator, that stays on as long as the link is intact. If the link fails, the link status indicator goes off, indicating the failure. This greatly eases problem isolation.

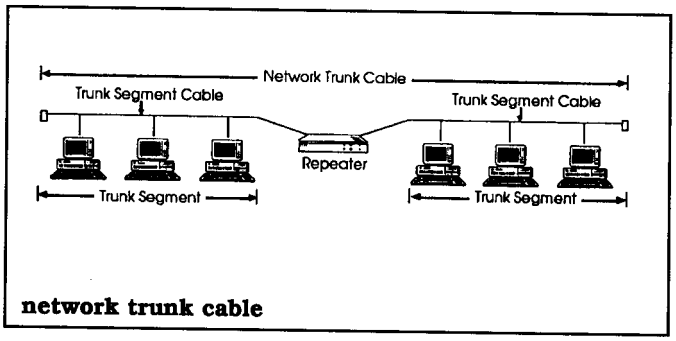
Coaxial Cable Network Setup

This section discusses the hardware, terminology, and rules for coaxial cable Ethernet networks.

General Coaxial Cable Network Concepts

As discussed earlier, Ethernet coaxial cable networks use what is called a "bus" topology. In a purely coaxial cable network each computer, or *node*, is connected at intervals to a main cable.

Together the computers and the main cable are called a trunk segment. The *trunk segment* cable does not have to be one continuous cable. It can be a series of cable lengths connected together. However, each trunk segment is limited in length and the number of stations it can support, and it must be terminated at each end.



To extend the size of the network beyond the limits of a single trunk segment, two or more trunk segments can be linked together using a device called a *repeater*. A repeater connects two trunk segments and strengthens the electrical signals.

When separate trunk segments are connected together by repeaters, the sum of all individual trunk segments is called the *network trunk cable*. The length of network trunk cables is also limited.

As briefly discussed earlier, there are two]kinds of Ethernet coaxial cable. The first, called *standard Ethernet*(or thick cable, or 10Base5) allows the longest cable lengths, but uses expensive thick coaxial cable and requires costly transceiver modules. The second, called *thinwire Ethernet*(or Cheapernet, thin coaxial cable, or 10Base2) uses standard coaxial cable similar to cable television coaxial cable.

Networks may be made up of only one coaxial cable type or combinations of both. Coax network segments can also be combined with twisted pair segments. In all cases, limits on maximum lengths and number of connections must be followed.

The IEEE standards used to determine how networks must be constructed when using only one type of coaxial cable connection are listed in the following table. Rules applying to twisted pair and to combinations of different connection types are addressed in later sections of this chapter. Note that the Ethernet Adapter is designed to meet or exceed the IEEE standard specifications indicated in the table.

IEEE 802.3 Ethernet Coaxial Cable Standards

	10Base5 Ethernet (Thickwire)	**10Base2 Thin Coaxial Cable (Standard)***	**10Base2 Thin Coaxia Cable (Extended)**
Data Rate	10M bits	10M bits	10M bits
Cable Length per Trunk Segment	500 m	185 m	300 m
Nodes per Trunk Segment	100	30	100

IEEE 802.3 Ethernet Coaxial Cable Standards (continued)

	1OBase5 Ethernet (Thickwire)	IOBase2 Thin Coaxial Cable (Standard)*	IOBase2 Thin Coaxial Cable (Extended)*
Min. Distance Between Nodes	2.5 m	.5 m	.5 m
Max. Number of Trunk Segments	5	3 (+2 repeater-only)*	3(no repeater-only)*
Max. Network Trunk Length	2500 m	925 m	900 m
Cable Type	dbl. shield 0.4-inch coaxial cable	sgl. shield 0.2-inch coaxial cable	sgl. shield 0.2-inch coaxial cable
Transceiver Type	external with drop cable	built in or external	built in or external
Capacitance per Tap	4pF	8pF	8pF
Typical Connector	clamp-on	BNC	BNC

* See next section for details

Standard Length and Extended Length Thin Coaxial Cable Networks

As briefly described earlier, a thin coaxial cable network consists of one or more trunk segments. A trunk segment is defined as the distance between one terminated end of a cable and the other terminated end. Connected to the segment may be user workstations and/or up to two repeaters.

If a segment includes user workstations, it is called a *user segment* or *node segment.* If a segment contains only two repeaters, one connected at each end and no user workstations, it is called a *repeater-only segment or repeater* link segment. This special type of segment is used to extend the distance between two user segments.

Networks using thin coaxial cable connections can be cabled using either the *standard length* (185-meter) or *extended length* (300-meter) specifications.

Standard length cabling limits the length of each thin coaxial cable segment to 185 meters, whereas extended length cabling extends the length of a thin coaxial cable segment to 300 meters.

Extended length cabling also expands the limit on users per segment from 30 to 100. However, the gains in users and trunk lengths do require some additional restrictions.

First, if *any* segment in a network uses extended 300-meter thin coaxial cable cabling, then *all* thin coaxial cable adapters, transceivers, and repeaters in the *entire* network must support 300-meter thin coaxial cable (and, for devices requiring manual selection, be configured for 300-meter operation).

Second, extended length networks *cannot* contain any repeater-only segments.

Coaxial Cable Network Setup

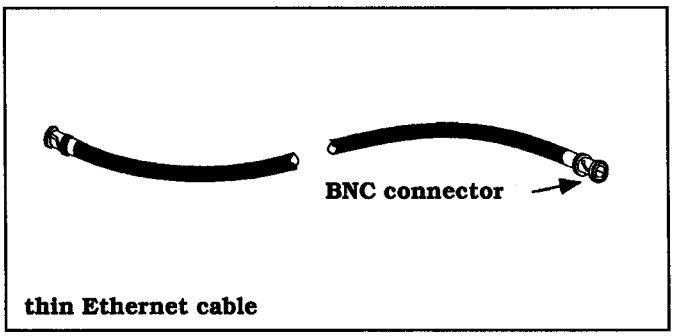
Thin Ethernet Cable Network Hardware

The following hardware is needed to set up a thin coaxial cable network.

Ethernet Adapter - An internal plug-in card or a standalone external box used to control the data flow, timing, and electrical signal from each connection. The Ethernet adapter provides either a BNC output directly to the thinwire network or a 15-pin DB connector which can be connected to an external thinwire transceiver via a transceiver drop cable.

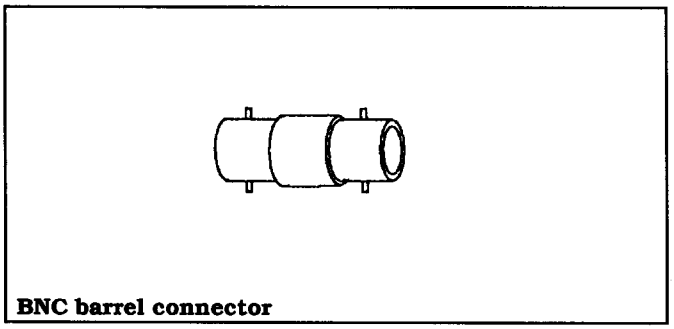
BNC Connectors - BNC connector jacks and connector plugs are used throughout a thinwire network to connect network hardware. After the studs are aligned and the plug is fully seated on the jack, the plug must be rotated 90 degrees to lock it in place.

Thinwire Ethernet Cable - Thinwire Ethernet cable is 0.2inch, RG-58A/U, 50-ohm coaxial cable which looks very much like television cable wire. It is available with standard BNC connector plugs installed on each end. Thinwire Ethernet cable is also available from industry suppliers in bulk quantities; however, bulk cable does not come with connectors installed. Connectors must be installed on bulk cable by a trained technician.



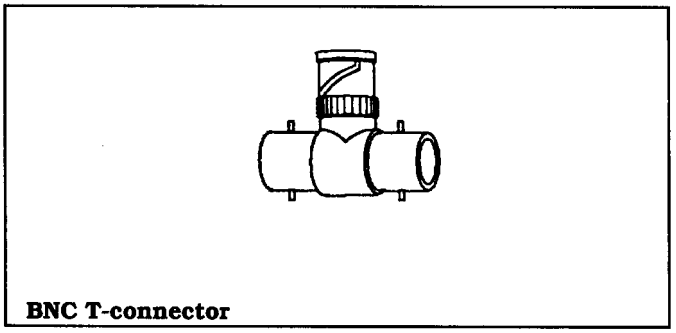
Coaxial Cable Network Setup

BNC Barrel Connectors - BNC barrel connectors are used to join two lengths of thinwire Ethernet cable.



BNC barrel connector

BNC T-Connectors - These connectors are used to connect each thinwire node to the trunk segment. The two opposing jacks of the T-connector act as a barrel connector and join two lengths of thinwire Ethernet cable. The remaining plug attaches to the BNC connector jack on the Ethernet Adapter installed at the network node.

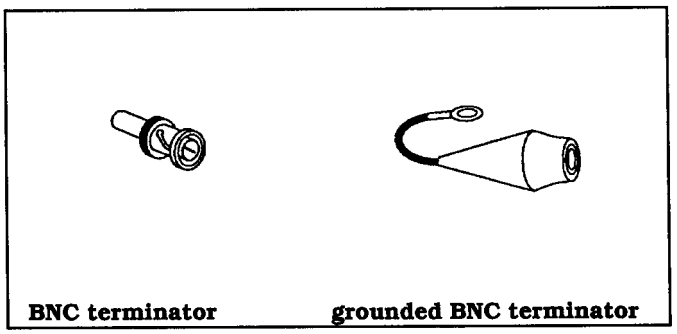


BNC T-connector

BNC Terminator - A BNC 50-ohm. terminator is used to "terminate" the network at certain spots and block electrical interference on the network. It is attached to one of the two jacks on a T-connector when no other length of cable will be attached to that jack.

Coaxial Cable Network Setup

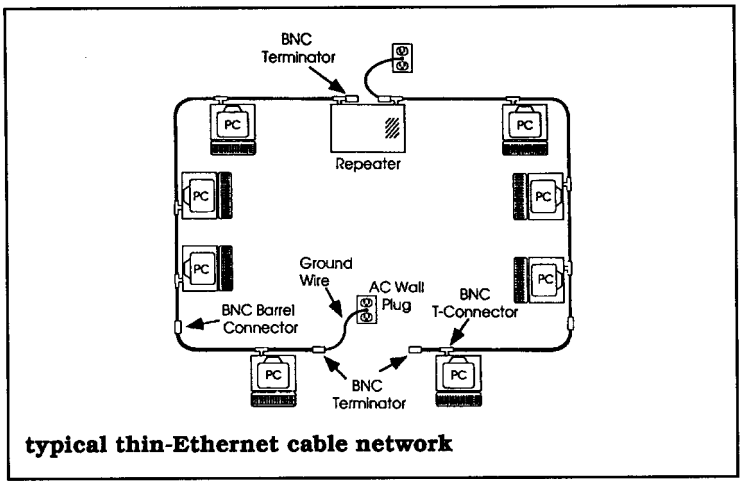
The thinwire network must be grounded at least once by a grounded BNC terminator. Grounding BNC terminators come with a grounding wire attached. BNC terminators with and without grounding wires are both necessary to properly install an Ethernet network.



BNC terminator **grounded BNC terminator**

Thinwire Cable Network Layout and Rules

Listed below are rules you must follow when installing a thinwire Ethernet network. As you review this summary, you may want to refer to the table entitled "IEEE 802.3 Ethernet Coaxial Cable Standards" earlier in this chapter.



typical thin-Ethernet cable network

Thinwire Rules, Standard 185-Meter

The following rules apply to standard 185-meter thinwire networks.

- Maximum number of trunk segments: three user segments, plus up to two repeater-only segments
- Maximum trunk segment length: 600 feet (185 m)
- Maximum network trunk cable length: 3000 feet (925 m)
- Maximum number of stations connected to one trunk segment: 30 (repeaters count as one station on both trunk segments to which they are attached)
- Minimum cable length between T-connectors: 1.5 feet (0.5 m)
- A terminator must be attached to each end of each trunk segment. One of the two terminators must be grounded.
- Keep barrel connector splices to a minimum.Use unspliced cable lengths between stations wherever possible. The fewer connections you make in your cable, the more reliable the network will be.

Considering that thinwire Ethernet cable is approximately 75 percent less expensive than thick cable and can be installed by untrained personnel, you are likely to choose to use thinwire in most networks that you are sure will be less than 5000 feet.

Thinwire Rules, Extended 300-Meter

The following rules apply to extended 300-meter thinwire networks.

- ❑ Maximum number of trunk segments: three user segments (repeater-only segments*are not* allowed)
- ❑ Maximum trunk segment length: 975 feet (300 m)
- ❑ Maximum network trunk cable length: 2920 feet (900 m)
- ❑ Maximum number of stations connected to one trunk segment: I 00 (repeaters count as one station on both trunk segments to which they are attached)
- ❑ Minimum cable length between T-connectors: 1.5 feet (0.5 m)
- ❑ *All* adapters and repeaters connected to the network must support 300-meter extended length segments.
- ❑ A terminator must be attached to each end of each trunk segment. One of the two terminators must be grounded.
- ❑ Keep barrel connector splices to a minimum. Use unspliced cable lengths between stations wherever possible. The fewer connections you make in your cable, the more reliable the network will be.

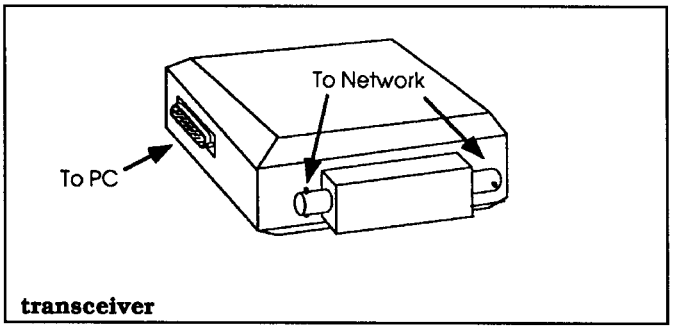
Thick-Cable Network Hardware

The following hardware is needed to set up a thick-cable network.

Ethernet Adapter - An internal printed-circuit card or a stand-alone external box which is used to control the data flow, tirning, electrical signal, etc. from each connection. Your Ethernet LAN Adapter provides a 15-pin DB connector, which is sometimes called an *AUI* (attachment unit interface) connector. This connector is attached to an external transceiver via a transceiver drop cable (also called an*AUI* cable).

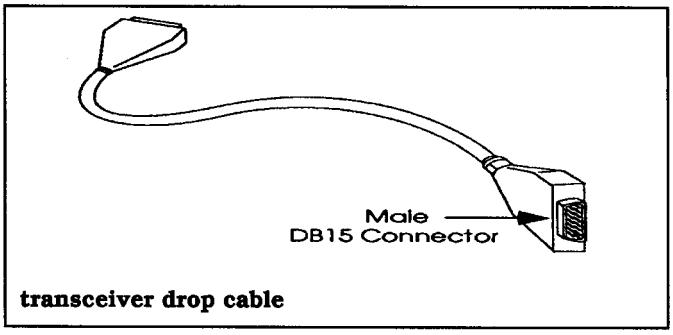
Coaxial Cable Network Setup

Transceiver (MAU) - Stations on a thick-cable network communicate with the network through external transceivers attached to the main cable of the network. A transceiver may also be called a*MAU* (medium attachment unit). Any thick-cable Ethernet-style (IEEE 802.3) external transceiver can be used on a thick-cable network.



transceiver

Transceiver Drop Cable (AUI Cable) -This is a special cable used to connect Ethernet adapters to external transceivers on a thick-cable Ethernet network. It may also be called an *AUI cable.* Normally, a transceiver drop cable is shipped with each transceiver.

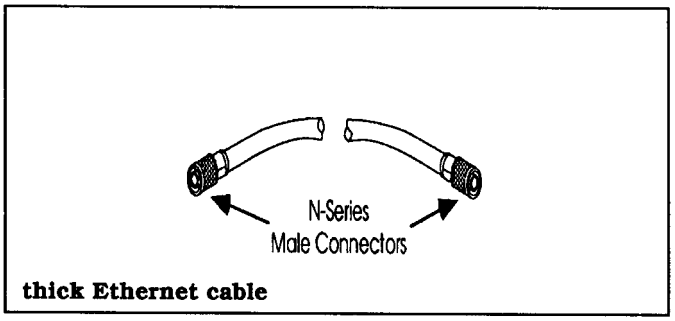


transceiver drop cable

Coaxial Cable Network Setup

Thick Ethernet Cable - Thick Ethernet cable is 0.4-inch diameter, 50-ohm coaxial cable. You may use the following types of thick cable:

- ❑ Belden 9880, Belden 89889
- ❑ Montrose CBL5688, Montrose CBL5713
- ❑ Malco 250-4315-0004, Malco 250-4314-0003
- ❑ Inmac 1784, Inmac 1785

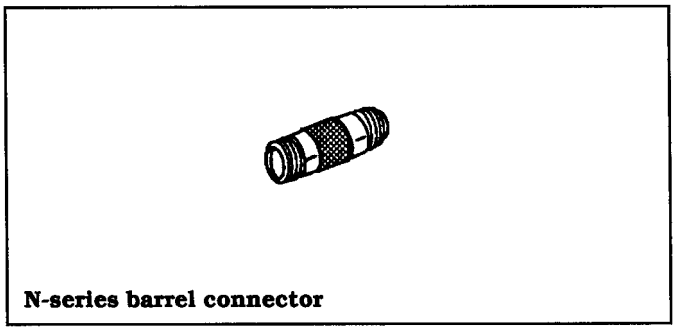


thick Ethernet cable

Thick Ethernet cable is available in various pre-cut lengths with standard 0.4-inch diameter N-series male connectors installed on each end. Thick Ethernet cable is also available in bulk quantities. However, bulk cable does not come with connectors installed. Connectors must be installed by a trained technician. N-series male connectors are installed on both ends of thick Ethernet cable lengths.

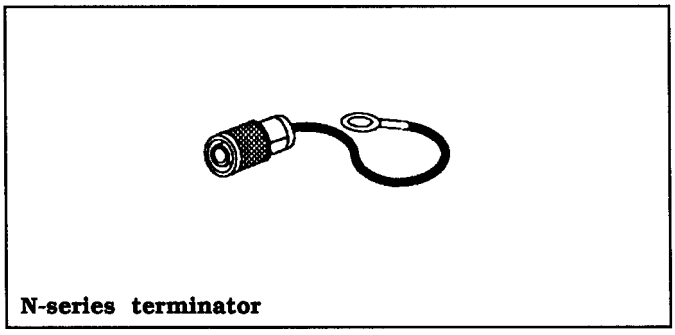
Coaxial Cable Network Setup

N-Series Barrel Connectors - N-series barrel connectors are used to join two lengths of thick Ethernet cable.



N-series barrel connector

N-Series Terminator - An N-series 50-ohm terminator is used to "terminate" the network at certain spots and block electrical interference on the network. It is attached to one of the two jacks on a transceiver when no other length of cable will be attached to that transceiver. The thick cable network must be grounded at least once by a grounded Nseries terminator. Grounding N-series terminators come with a grounding wire attached. N-series terminators both with and without grounding wires are necessary to properly install an Ethernet network.

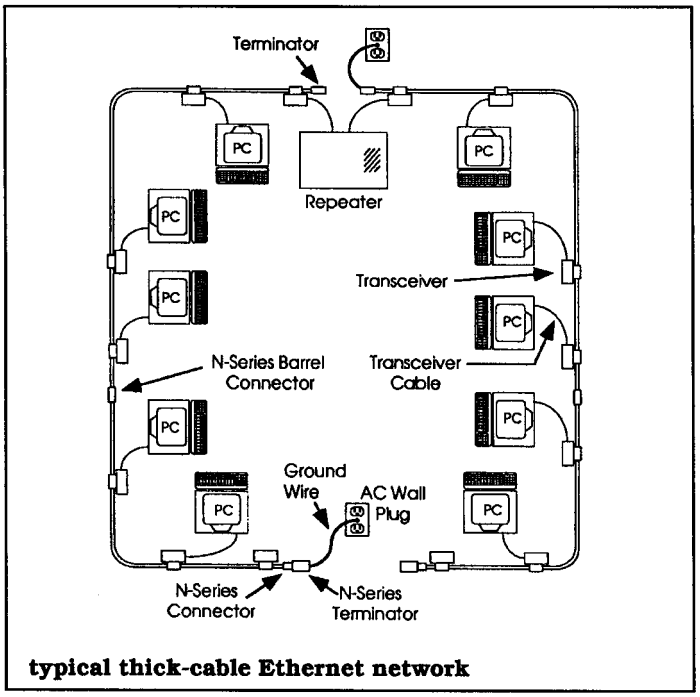


N-series terminator

Coaxial Cable Network Setup

Thick-Cable Network Layout

Listed below are the rules you must follow when installing a thick Ethernet network. As you review this summary, you can refer to the table "IEEE 802.3 Ethernet Coaxial Cable Standards" earlier in this chapter.



typical thick-cable Ethernet network

Thick-Cable Rules

The following rules apply to thick-cable networks.

- Maximum number of trunk segments: 5
- Maximum trunk segment length: 1,650 feet (500 m)
- Maximum network trunk cable length: 8,250 feet (2,500 m)

Coaxial Cable Network Setup

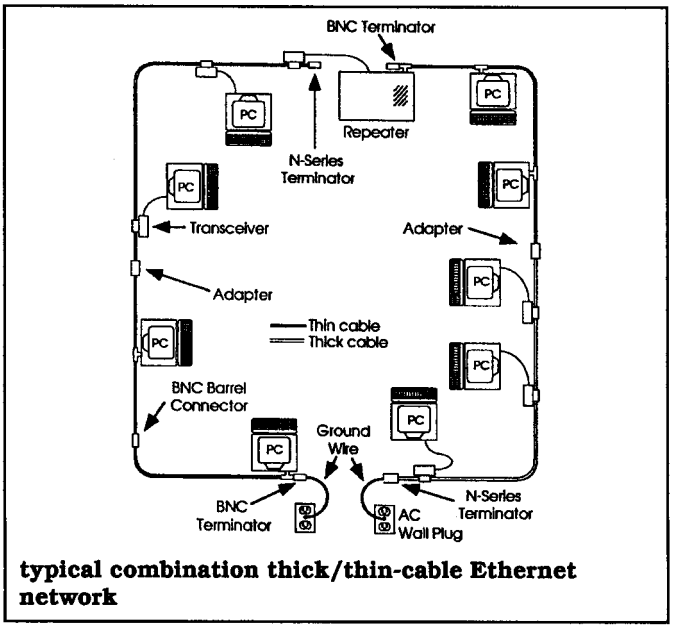
- ❑ Maximum number of stations connected to one trunk segment: 100 (repeaters count as one station on both trunk segments to which they are attached.)
- ❑ Minimum cable length between transceivers: 8 feet (2.5 m)
- ❑ Maximum transceiver cable length: 165 feet (50 m)
- ❑ Attach a terminator to each end of each trunk segment. One of the two terminators must be grounded.
- ❑ Keep barrel connector splices to a minimum. Use unspliced cable lengths between stations wherever possible. The fewer connections you make in your cable, the more reliable the network will be.

Combination Thinwire/ Thick Cable Networks

In some installations you may want to consider installing a combination of thinwire and thick Ethernet wire. Thinwire cable is 75 percent less expensive than thick cable. Thick cable can be used over greater distances before a repeater is required. By laying out your network to use thick Ethernet cable for interconnections between trunk segments, longer networks can be constructed.

Combination Networks Using Repeaters

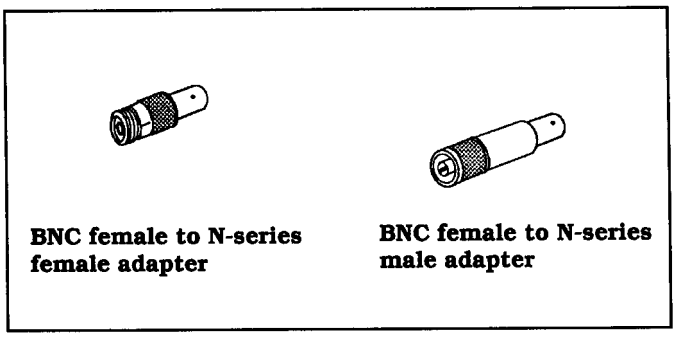
One way to create a combination thinwire/thick-cable network is to join a thinwire trunk segment to a thick-cable trunk segment with a repeater. Up to five dissimilar trunk segments (using four repeaters) can be joined in this way. To create this kind of network, simply build each trunk segment according to the instructions included in this manual and then link the segments together with repeaters.



typical combination thick/thin-cable Ethernet network

Combination Networks Without Repeaters

Another way to create a combination network is to use both thinwire cable and thick cable within the same trunk segment. The only additional hardware necessary for a combination network are adapters. Adapters are used to connect thinwire and thick cable together. Two kinds are shown in the illustration: a BNC female to N-series female adapter and a BNC female to N-series male adapter.



Combination thinwire/thick-cable trunk segments are usually between 300 meters and 1000 meters long. The minimum length is 300 meters because trunk segments shorter than 300 meters can be built exclusively with thinwire cable.

To calculate the maximum amount of thinwire cable you can use in one combination trunk segment, use this simple equation:

$$333 - \frac{L}{3} = t$$

where

L = the length of the trunk segment you want to build in meters
t = the maximum length of thinwire cable you can use in meters

Combination Thinwire/ Thick Cable Networks

For example, if you want to build a trunk segment 700 meters long and you want to minimize the cost of hardware by using as much thinwire cable as possible, you would use the following equation:

333-700/3 or 333 - 233 = 100 meters

You could use up to 100 meters of the less expensive thinwire cable. You would use thick cable for the remaining 600 meters of cable required in your trunk segment.

Twisted Pair (10BaseT) Ethernet Network Setup

This section discusses the hardware, terminology, and rules for twisted pair networks.

Twisted Pair General Concepts

As discussed earlier, Ethernet twisted pair networks use a " star" topology in which each computer, or *node*, is connected to a central connection point called a *hub* or *concentrator*.

Together, the computers and the central hub are called a *hub segment*. Each hub is limited in the number of nodes it can support. The theoretical number of nodes is quite high, but a large number of nodes requires complex wiring and is costly.

The hub serves as a repeater as well as a central connecting point. To extend the size of the network beyond the limits of a single hub, two or more hub segments can be linked together using a twisted pair cable (for distances less than 100 meters) or coaxial cable for longer distances (assuming both hubs have direct coaxial cable or AUI interfaces).

Networks may be made up of only twisted pair cable or can be linked with coaxial cable segments. In all cases, limits on maximum lengths and number of connections must be followed. Rules applying to combinations of different cable types are discussed in later sections of this chapter.

Twisted Pair (10BaseT) Ethernet Network Setup

Twisted Pair Cable Considerations

Twisted pair cable is the same type of unshielded cable typically used for high-quality phone wiring in commercial environments. The cable actually consists of wires that are twisted together in pairs. For example, four-wire cable (also called *two-pair cable*) contains two pairs of two wires each, with each pair twisted together. The twisting of wires into pairs is done to make the cables more immune to electrical interference.

10BaseT twisted pair connections use only four wires (that is, two pairs). Most phones also use no more than four wires (two pairs). Thus, by using four-pair or greater cables, the same cable can usually be used for phone and network connections.

Because many commercial phone installations already provide eight, high-quality wires (four pairs) in a standard phone wall jack, the twisted pair Ethernet connections may be run over existing wiring.

However, note that not all phone cable is truly twisted pair; thus, not all phone cable can be used for network wiring. For example, the very inexpensive cable called *silver satin* is ***not*** acceptable for network use.

Note also that existing phone wiring may be installed near elevators, fluorescent lights, and other strong sources of electrical interference that normally do not affect phone signals, but do disrupt network signals. Twisted pair cannot prevent interference from such strong sources, so cables run near such sources may not be suitable for network use.

Twisted Pair Network Hardware

The following hardware is needed to set up a twisted pair network.

Ethernet Adapter - An internal printed-circuit card or a stand-alone external box is used to control the data flow, timing, electrical signals, etc. from each connection. Some Ethernet adapters provide an RJ-45 connector that connects directly to the twisted pair network. On others, a 15 pin DB connector (AUI connector) is connected to an external transceiver (MAU), and this transceiver is then connected to the hub via twisted pair cable.

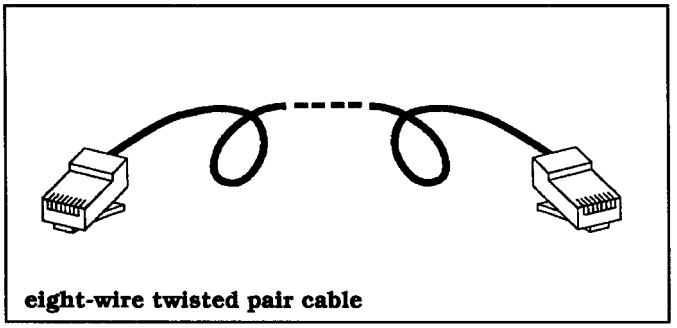
RJ-45 Connectors -RJ-45 connector jacks and connector plugs are used throughout a twisted pair network to connect together network hardware. They are connector plugs that are secured to connector jacks by pushing the plug into the jack until the plastic retaining latch clicks into place, similar to standard modular telephone wire connectors.

Twisted Pair Ethernet Cable -Twisted pair cable is fairly inexpensive, unshielded eight-wire cable. You can use any of the following types:

- ❑ AT&T PDS or DIW-type cable
- ❑ 10BaseT
- ❑ IBM Type 3

Complete twisted pair cable specifications are provided in the Appendix, and other cabling considerations are discussed in Chapter 3.

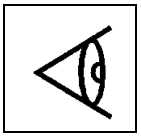
Twisted Pair (10BaseT) Ethernet
Network Setup



eight-wire twisted pair cable

Existing twisted pair telephone wiring is often routed to a centrally located wiring closet with a connection box called a *modular splice block* or *punchdown block* (so called because a special tool is used to punch each wire down between the jaws of a retaining clip).

Twisted pair cable is available in various lengths with standard RJ-45 connector plugs installed on each end. Twisted pair cable is also available from industry suppliers in bulk quantities; however, bulk cable does not come with connectors installed. Connectors must be installed on bulk cable by a trained technician.

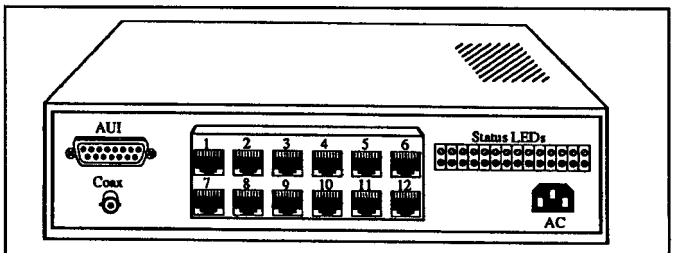


Note: Quad, multiconductor, or silver satin phone cables are not sufficiently resistant to electrical interference, and are unacceptable for network use.

Simple twisted pair extensions can be made by connecting two lengths of twisted pair cable with a modular splice connector, which provides back-to-back RJ-45 female connectors. To splice the two cable lengths, insert the male RJ-45 connector on the end of one cable into one of the splice connector's female connectors and insert the male RJ-45 connector on the end of the second length of cable into the other female connector.

Note: If you use modular splice connectors, they must be 10BaseT-compatible. Some telephone-type modular splice connectors do not connect the proper wires between the two cable lengths.

Twisted Pair Hub (Concentrator) -A repeater hub, or concentrator, provides a central point for connecting cables from the nodes in the hub segment. These range in size from units with 10 or fewer RJ-45 connectors (sometimes called ports), to larger units with 30 or more ports. The hub also acts as a repeater, conditioning and strengthening signals, and can connect other twisted pair hub segments or coaxial cable trunk segments. Some hubs provide only RJ-45 connectors for this function; others provide a BNC connector and/or a DB 15 AUI connector that can be coaxial cable-connected (via an AUI cable and a transceiver) to other network segments.

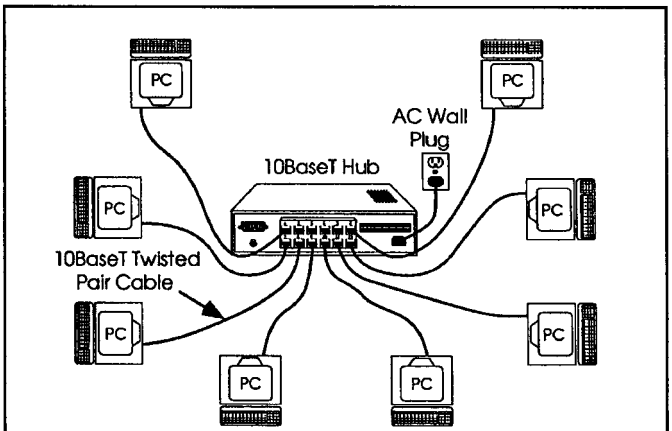


connector panel of typical twisted pair (10BaseT) hub (concentrator)

Twisted Pair (10BaseT) Ethernet Network Setup

Twisted Pair Network Layout

The following figure shows a typical twisted Pair Ethernet network layout.



typical 10BaseT twisted pair Ethernet network

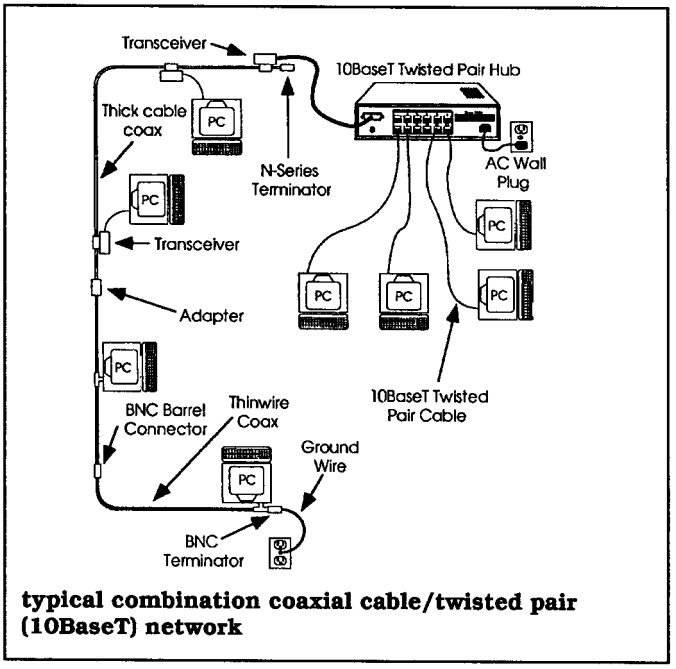
You must adhere to the following rules when installing a twisted pair network.

- ❑ Maximum node-to-hub cable length: 330 feet (100 m)
- ❑ Use adequate quality cable, wired correctly for network use (existing telephone lines usually are not).
- ❑ Maximum nodes per network: 1024
- ❑ Keep cable splices to a minimum. Use unspliced cable lengths between stations wherever possible. The fewer connections you make in your cable, the more reliable the network will be.

Combination Twisted Pair/Coaxial Cable Networks

In some installations you may want to consider installing a combination of twisted pair and coaxial cable Ethernet cables. For example, if you have an existing coaxial cable network, it may be desirable to expand it using twisted pair connections.

On the other hand, if you are building a new network, you may find that some nodes cannot be placed within the maximum 100-meter cable distance from the hub, and you must use coaxial cable for that segment. Also, you may find that you are not able to locate hubs within 100 meters of each other, and must connect them using coaxial cable instead of twisted pair.



typical combination coaxial cable/twisted pair (10BaseT) network

Combination Twisted Pair/Coaxial Cable Networks

Combination Networks Using Transceivers (MAUs)

One way to create a combination twisted pair/coaxial cable network is to join a twisted pair hub to a thick-cable trunk segment using a thick-cable transceiver (MAU). You could run a cable from the hub's DB15 AUI port to the AUI port of the transceiver, and then attach the transceiver into the coaxial cable network. To create this kind of network, simply build each network segment according to the instructions included in this manual and then link the segments together via a transceiver.

Some hubs also provide a built-in transceiver and a BNC connector for direct attachment to thinwire coaxial cable networks. To connect this type of hub into the thinwire network, use a T -connector just as you would with a PC using a thinwire Ethernet adapter.

Evaluating Your Network Needs

Now that you know the advantages and disadvantages of the various Ethernet cabling schemes, consider the following questions as you define your particular network needs.

- ❑ How large an area must the cabling system cover?
- ❑ How many trunk segments will best suit the physical layout of the site?
- ❑ How many stations (file servers, bridges, hubs, or workstations) will be connected to the cabling system?
- ❑ Where will hubs and/or repeaters be located?
- ❑ How far apart will the stations be?
- ❑ What potential growth in size and number of connections must the system accommodate?

Designing Your Network Layout

Draw your network plan, labeling each piece of hardware to be included (stations, cables, transceivers, repeaters, terminators, etc.). Keep in mind the rules given in this chapter.

Measure the distances between all components and make sure they fall within the specified parameters. Ensure that the location you choose for file servers has adequate room for any peripheral devices (printers, external disk drives, or other options) to be attached.

Installing Your Network

Now that you have read the suggestions and rules to follow when building an Ethernet network, you can map it out and acquire any additional equipment you might need to complete its installation.

Then you are ready to install and configure your Ethernet LAN Adapters for each of the nodes.

2
Installing and Testing the Adapter

This chapter tells you about

- ❑ Configuring your Ethernet LAN Adapter for your network
- ❑ Connecting the computer, the Adapter, and the network
- ❑ Testing the installation
- ❑ Installing the software drivers

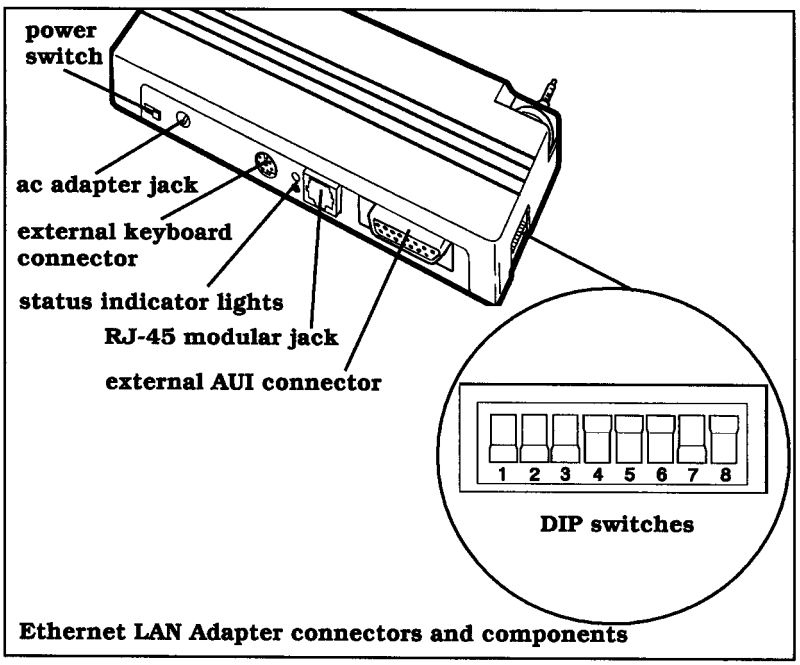
Contents

Configuring Your Ethernet LAN Adapter

Before you can attach the Ethernet LAN Adapter to your notebook computer, you must configure it for your network by setting the eight DIP switches on the Adapter body.

Setting the DIP Switches

On one short side of the adapter body (shown in the following figure) is an eight-position set of DIP switches. These switches configure the adapter's input/output (I/O) address, interrupt request (IRQ), and media interface. When a DIP switch is in the up position, it is open (off); when it is in the down position, it is closed (on).



Ethernet LAN Adapter connectors and components

I/O Address Selection

DIP switches I and 2 control the I/O address location of the adapter. The following table lists the switch settings and the corresponding I/O address.

Ethernet Adapter DIP Switches 1 and 2, I/O Address

IO Address	SW1	SW2
300*	closed	closed
320	closed	open
340	open	closed
360t	open	open

*If the I/O address is 300 and the PS/2 mouse port is enabled in the Setup Menu, the computer will be disabled. Use I/O address 320 or 340 if the PS/2 mouse port is enabled in the Setup Menu.

dag The I/O address 360 conflicts with the parallel port (LPTI). Use the I/O address 320 or 340 or disable LPT1.

Media Selection

DIP switch 3 selects the type of connection used in your LAN. If the LAN consists of twisted pair using the RJ-45 phone jack type connector on the back of the adapter, switch 3 must be down (closed).

If the LAN is connected to an external transceiver or multiport for thick or thin Ethernet cable, switch 3 must be up (open). See the paragraph entitled "Connecting to the Network" for more details on the media type.

Interrupt Request (IRQ) Selection

DIP switches 4, 5, and 6 control the adapter's IRQ. Switch 4 must be closed to select IRQ5. Switch 5 must be closed to select IRQ9. Switch 6 must be closed to select IRQ10. When one of these three switches is closed, the other tw***must*** be open for proper operation.

Indicator Light Switches

DIP switches 7 and 8 control the indicator light status for the type of Ethernet connection to the adapter. If the adapter is connected to a 10BaseT Network, then SW7 should be closed and SW8 open to allow the green indicator light to function as the Link Status indicator light used to indicate 10BaseT link integrity. If the adapter is connected to a StarLAN- IO hub or an external tranceiver through the AUI connector, then SW8 should be closed and SW7 open to disable this indicator light since the Link status indicator light is not valid for this type of connection.

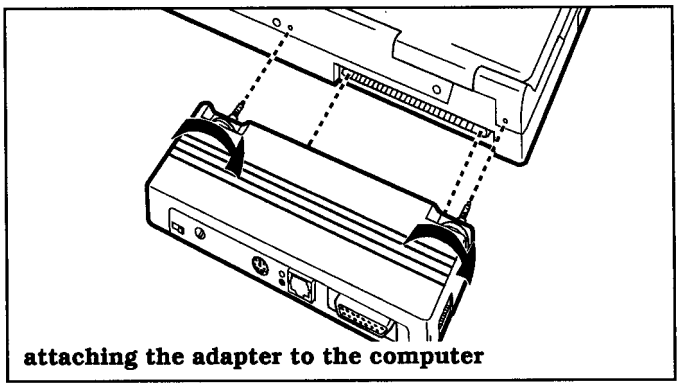
The Ethernet LAN Adapter has five connectors and a power switch as shown in the previous figure. This section describes how to connect the adapter to your computer and connect the LAN to the adapter.

Connecting the Adapter to Your Computer

Connect the Ethernet LAN Adapter to your notebook computer as follows.

1. Turn off the computer and disconnect the power cord.

2. Carefully plug the 120-pin connector on the Adapter into the 120-pin connector (usually labeled "Expansion bus") on the back of your notebook computer. Make certain the connector is plugged in correctly and the thumbscrews are aligned with the threaded holes in the back of the computer.



attaching the adapter to the computer

3. Tighten the thumbscrews by carefully turning them clockwise (facing the rear of the computer).

Caution: Do not attempt to lift or transport the notebook computer with the Adapter connected; damage can result.

Power Switch

On the narrow side of the adapter opposite the 120-pin connector is the slide switch labeled **Power** to control power to the adapter. This conserves battery power when the adapter is not connected to the network, but is still attached to your computer.

Set the adapter's **Power** switch to the ON position when the adapter is connected to the LAN.

Connecting the Adapter to the Network

The Ethernet Adapter can be connected to the network through either an RJ-45 telephone type jack or the 15-pin DB 1 5 connector located on the Adapter.

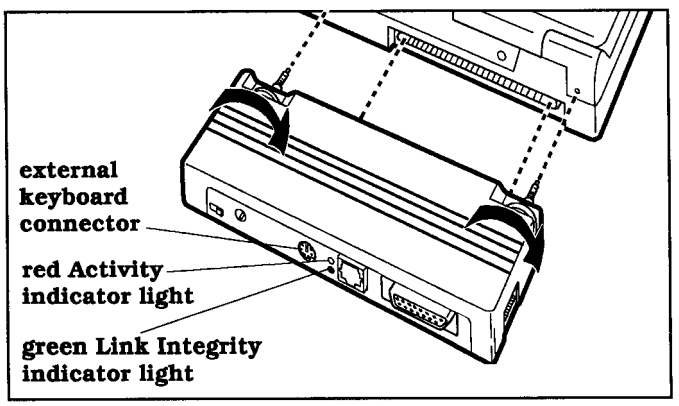
Note: Moving, twisting, or bending the network cable while it's attached to the adapter can cause problems such as disconnecting from the network. See the troubleshooting section in Chapter 4 for more information.

Twisted Pair Connection

The RJ-45 jack connects the adapter to a twisted pair network. The RJ-45 male connector on the node end of the cable connects to the RJ-45 jack on the Adapter. Insert the cable connector so that it fully seats in the RJ-45 jack, that is, the plastic latch snaps into place.

The green **Status** indicator light on the adapter should come on, indicating there is proper connection between the hub and the node adapter. If the **Status** indicator light does not turn on, run the diagnostics as explained in Chapter 4 of this manual.

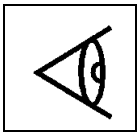
The red **Traffic** indicator light comes on when data is being sent or received by the adapter.



The RJ - 45 jack also connects the computer to a StarLAN- IO hub in the same manner as the twisted pair described previously. However, if DIP switches 7 and 8 are set properly, the **Link Integrity** indicator light remains on constantly and is not an indication of the link status.

External AUI Connection

The 15-pin DB 1 5 connector, labeled the **External AUI,** connects the adapter to an external transceiver or multiplexer for thick or thin ethernet cabling.



Note: If connecting to a thin ethernet network (10Base2) you must purchase a thin coax MAU.

For the Ethernet LAN Adapter to communicate via an external transceiver, the ac power adapter furnished with the Ethernet Adapter must be connected to the power jack located next to the adapter's **Power** switch. The ac power adapter is needed to supply + 12 volt power to the transceiver.

When connected to a multiplexer, the ac power adapter may or may not be required. Contact your network manager to determine if your installation requires + 12 volt power on the external AUI connector.

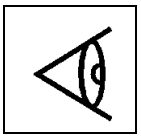
You can determine for yourself if power is needed by operating the LAN with the ac power adapter connected. When communication on the network is established, disconnect the adapter and observe if communication is still possible.

Connecting an External Keyboard to the Adapter

Also located on the Ethernet Adapter is a six-pin mini-DIN keyboard connector labeled **Ext. Kybd** for attaching a PS/2compatible external keyboard. To use a standard 101-type keyboard, you also need a six-pin mini-DIN-to-five-pin standard DIN adapter plug, available at most computer stores.

Testing the Adapter Installation

After you install and configure the Ethernet LAN Adapter and connect the Adapter and computer to your network, you can test it as follows.



Note: The unit must be correctly connected to the LAN to pass the test. The test cannot be run without the LAN connected.

The driver software you will use with the Ethernet Adapter should not be enabled when running these tests.

1 . Be sure the DOS prompt is displayed and the *Ethernet LAN Utilities* floppy is inserted in your notebook computer's drive A.

2. If the MS-DOS **A:\>** prompt is not displayed, type

A:

and press the **Enter** key.

3. At the MS-DOS A:\>prompt, type

UTILITY\ENTEST

and press the **Enter** key. (Type UTILITY\ENTEST MONO if you are using a monochrome monitor). The diagnostics startup menu appears.

4. At the Diagnostics main menu, with the *Diagnostics* field highlighted, press the **Enter** key. The IRQ and I/O Address Selection menu appears.

5. Enter the IRQ and I/O address settings of your Ethernet Adapter and press the **Enter** key when the cursor is in the *I/O Address:* field.

Testing the Adapter Installation

The diagnostics test will begin and run for a brief period. When the tests are done, a message appears indicating the status of the tests.

If the unit passed all tests, install the software driver as described in the next section. Otherwise, check your installation and configuration and repeat the diagnostics.

If the tests still fail, refer to the Troubleshooting procedures in Chapter 4.

Determining the Adapter's Network ID Number

To determine the Adapter's network ID number, after running the complete set of tests, look on the last line of the diagnostics screen. This ID number is unique to each adapter and is used like a password on some LAN systems. The adapter's 12-digit ID number is displayed just after the*Normal Operation Setup*field. Your LAN manager may need this ID number to activate the adapter.

Installing the Software Drivers]

This section describes how to install the Ethernet Adapter software drivers for use with several popular LAN manager products.

Novell Netware

Novell Netware requires two driver files, IPX.COM and NET. COM. This set of files operates on two levels, one drives the actual ethernet hardware and one provides access to the network. The lower level, or hardware driver Me is called IPXCOM and is specific to the model of ethernet adapter being used. The upper level, or network driver, is called NET. COM. It communicates with the hardware driver (IPX.COM) rather than the hardware itself. To access a Novell network, you will need to create an IPX.COM file and select the correct NET.COM for your DOS version. Use NET2.COM for the DOS 2 series, NET3.COM for DOS 3xx, and so forth.

1. Install the Ethernet Adapter as instructed earlier in this chapter.

2. Locate the correct version of NET. COM from your Netware Installation diskettes.

3. IPX.COM will need to be created specifically for your ethernet adapter. AR files necessary for this process are included with the Novell Netware LAN software diskettes.

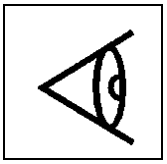
4. Depending on the version of Netware being used, this process is called GENSH (Generate Shell) or SHGEN (Shell Generate). See the section in your Novell Netware manuals concerning "DOS Workstation Installation" for instructions on creating an IPX.COM for your ethernet adapter.

5. When generating the IPX file, select the Novell NE2000 Ethernet Card as the compatible driver file to link into IPX.COM.

6. The SHGEN process will request the desired IRQ and BASE ADDRESS figures. These must match the current switch settings on the Ethernet Adapter.

7. If it ever becomes necessary to change the IRQ and BASE I/O Address settings of your adapter, it may be possible to reconfigure IPX.COM without actually creating a new IPX.COM. Later versions of IPX.COM, allow the IRQ and BASE I/O parameters to be altered temporarily at run-time, without creating a new IPX.COM. The following parameters are available on most versions of IPX.COM.

IPX /I	:Show current configuration
IPX /D	:Show all IRQ & BASE I/O options
IPX /O#	:Select a given IRQ & BASE I/O configuration where O# is the letter 'O' followed by a number code supplied by IPX /D.



Note: NET4.COM will not operate with DOS 5. To access Netware while running under DOS 5 will require either NET5.COM or NETX.COM. NETX.COM is contained in newer versions of Netware and is designed to work with all DOS versions. Contact your Netware vendor to obtain this updated file.

3Com 3+Open LAN Manager

3Com's 3+Open LAN Manager (version 1. 1) does not have an automated installation procedure for new hardware and drivers, so the following manual installation procedure is required.

1 . Install the Ethernet Adapter as instructed earlier in this chapter.

2. Install the 3+Open LAN Manager on your server, OS/2 workstations, and DOS workstations as instructed in the *3+Open Installation and Setup Guide and Release Notes*. For each of these installations, select one of the network adapters listed in the installation menu. You will modify this later.

3. Depending on the equipment in which you are installing drivers, insert the *Ethernet LAN Utilities* floppy into your notebook drive A and do the following.

- ❑ For the server, copy the \MSLANMAN.OS2\DRIVERS\NE2000.OS2 driver file to the \30PEN\SERVER\LANMAN\DR1VERS directory.
- ❑ For OS/2 workstations, copy the \MSLANMAN.OS2\DRIVERS\NE2000.OS2 driver file to the \30PEN\0S2WKSTA\LANMAN\DRIVERS directory.
- ❑ For DOS workstations, copy the \MSLANMAN.DOS\DRIVERS\NE2000.DOS driver file to the \30PEN\DOSWKSTA\LANMAN\DRIVERS directory.

4. Depending on the equipment in which you arc installing drivers, copy the protocol files as follows.

- ❑ For the server, copy the PROTOCOL.S22 file from the \30PEN directory of the *Ethernet Adapter* Utilities *and Drivers* floppy by typing at the MSDOS **C:\>** prompt

  COPYA:\30PEN\PROTOCOL.S22 \30PEN\SERVER\ LANMAN\DRIVERS
  and pressing the **Enter** key.

- ❑ For OS/2 workstations, copy the Ethernet Adapter PROTOCOL.S22 file from the \30PEN directory of the Ethernet *Adapter Utilities and Drivers* diskette:

  COPY A: \30PEN\PROTOCOL. S22 \30PEN\OS2WKSTA\ LANMAN\DRIVERS

- ❑ For DOS workstations, copy the Ethernet Adapter PROTOCOL.DS2 file from the \30PEN directory of the Ethernet Adapter Utilities and Drivers diskette:

  COPY A: \30PEN\PROTOCOL.DS2 \30PEN\DOSWKSTA\ LANMAN\DRIVERS

5. Edit the STARTUP.CMD file (for OS/2 workstations and the server) and the AUTOEXEC.BAT file (for DOS workstations) to determine if they contain NET USE commands which create drive "overlays" of installed fixed disk drives on your computer. If the Me does contain NET USE drive letters which conflict with your fixed disk drives, modify the NET USE drive letters so that they do not conflict with your system's fixed disk drive letters. Save any changes you make.

6. Edit the CONFIG.SYS file to modify the selected hardware driver from its current selection to NE2000.OS2 for the server and OS/2 workstations or to NE2000.DOS for DOS workstations. For servers the modified line should read:

DEVICE = C:\30PEN\SERVER\LANMAN\DRIVERS\NE2000.OS2

For OS/2 workstations the modified line should read:

DEVICE = C:\30PEN\OS2WKSTA\LANMAN\DRIVERS\NE2000.OS2

For DOS workstations the modified line should read:

DEVICE = C:\30PEN\DOSWKSTA\LANMAN\DRIVERS\NE2000.DOS

Be sure you save any changes you make.

7. Edit the PROTOCOL.INI Me in two places. For servers the filename is

\30PEN\SERVER\LANMAN\DRIVERS\PROTOCOL.INI

For OS/2 workstations the filename is

\30PEN\OS2WKSTA\LANMAN\DRIVERS\PROTOCOL.INI

For DOS workstations the filename is

\30PEN\DOSWKSTA\LANMAN\DRIVERS\PROTOCOL.INI

a. Add this text near the beginning of the file (in the "ADAPTERS" section):

```
[NSC2000-NTF]
; protocol. ini section for the Ethernet
Adapter
        IOBASE =0xAAA
        INTERRUPT =I
        DRIVERNAME = MS2000$
```

where
AAA" refers to your base I/O address and
“I" refers to the interrupt you are using.

This text is available on the*Ethernet LAN Utilities* floppy in the file \30PEN\PROTOCOL.S22 for OS/2 servers or workstations or \30PEN\ PROTOCOL.DS2 for DOS workstations. Modify the IOBASE and INTERRUPT parameters to match those of your installed Ethernet Adapter.

b. Change the BINDINGS entry in the [NBP] section of the "PROTOCOLS" data entries near the end of this file from the selected hardware to NSC2000-NIF. The modified entry will look like:

BINDINGS =NSC2000-NIF

Be sure to save any changes you make.

8. Reboot the system for the changes to take effect.

Microsoft LAN Manager

The following procedure may be different for other OEM versions of LAN Manager. Refer to the *Microsoft LAN Manager* Installation Guide for more detailed installation instructions.

1. Run the SETUP program from the hard disk LANMAN directory (for OS/2) or LANMAN.DOS directory (for DOS).

2. Select the Action menu's "Import network drivers" command and select the National Semiconductor Ethernet Adapter driver from the list of drivers on the *Utility/Drivers* diskette.

3. Select the Action menu's “View/modify” command and "Remove" the currently installed hardware device driver.

4. Select the National Semiconductor Ethernet Adapter device driver from the list of available device drivers and "Add" the device driver to the list of installed device drivers.

5. Select the Action menu's "Save" command to save the selected driver setup.

6. Select the Exit menu's "Exit" command (or press the **F3** key) to exit the SETUP program.

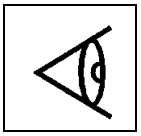
7. Use a text editor to modify the PROTOCOL.INI file as described below in the PROTOCOL.INI reference section. The PROTOCOL.INI file is in the LANMAN directory (for OS/2) or LANMAN.DOS directory (for DOS). If you are not using the default IOBASE address or INTERRUPT number on the Ethernet Adapter, you must change these values in the PROTOCOL.INI file.

NDIS PROTOCOL.INI Reference

This section describes the PROTOCOL.INI keywords used for the Microsoft Ethernet Adapter NDIS device driver v 1. 00.

IOBASE - This keyword describes the I/O base address used by the adapter. The values of IOBASE the Ethernet Adapter supports range from 300H to 360H in increments of 20H. The IOBASE default is 300H.

INTERRUPT - This keyword describes the interrupt used by the adapter. No other device installed in the computer may use this interrupt. Its value must match the jumper setting described in the*Microsoft LAN Manager Installation Guide*



Note: INTERRUPT must be set to 5.

DRIVERNAME - This keyword describes the device driver's name. The default is MS2000$ for the Ethernet Adapter.

The following PROTOCOL.INI fragment is a typical example:

```
[NSC2000-NIF]
        Drivername MS2000$
        Interrupt
        IOBase = 0xAAA
```

where
"AAA" corresponds to the I/O address set by DIP switches
1 and 2.

NETBIOS for the Ethernet Adapter

NETBIOS Compatibility

The NETBIOS from other manufacturers may not be compatible with the NETBIOS furnished on your *Ethernet LAN Utilities* floppy. This NETBIOS is compatible with the NETBIOS provided by Performance Technology, Inc.

Performance Technology provides interoperable NETBIOS support for NE 1000 and NE2000 adapters, as well as Western Digital WD8003 and WD8013, Pure Data PD8023 and PD8023-16, Worn 3C503 and 3C505, and Xircom's Pocket Ethernet Adapters and adapters compatible with them.

In addition, the interoperable NETBIOS for both XENIX and OS/2 are available for some of the above adapters including this Ethernet Adapter.

For more information about the NETBIOS, contact Performance Technology at (512) 349-2000.

Installing the NETBIOS

Use the MS-DOS COPY command to copy NETBIOS.EXE from the Ethernet *LAN Utilities* floppy to the root directory on drive C as follows.

At the notebook computer's MS-DOS **C:\>** prompt, type

COPY A:\NETBIOS.EXE C:\NETBIOS.EXE

and press the **Return** key.

NETBIOS for the Ethernet Adapter

NETBIOS Options

Usage: NETBIOS

: /LN	*run as adapter 1 for bridge*
/SES:	*set number of sessions (default 32)*
/NAM.:	*set max number of names (default 17)*
/LP:	*set base port address (default 300)*
/LI:	*set IRQ number (default 3)*

Moving the Adapter Between Computers

If you want to move the Ethernet Adapter between notebook computers, note that the adapter retains its configuration settings even when removed from the computer. This means you must verify that no I/O Base, IRQ, or ROM Base conflicts exist in the destination computer's hardware. If so, change the necessary configuration settings ***before*** installing the adapter on another notebook computer.

3
Cabling the Network

This chapter tells you about:

- ❑ Types of cable to use in the network
- ❑ Connecting the cables

Once you've configured and tested the Ethernet LAN Adapter as described in previous chapters, you're ready to finish installing the network. This involves connecting together the network cables and devices.

Contents

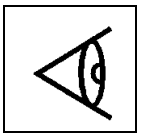
Using Twisted Pair Cabling

If you are installing a new twisted pair network or adding a node into an existing one, it is important that you use the correct type of twisted pair cable, and that it be wired correctly.

You may use any of the following types of wiring:

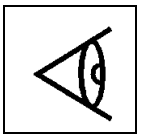
- ❑ AT&T PDS or DIW-type cable
- ❑ 10BaseT
- ❑ IBM Type 3

Detailed cable specifications are provided in the Appendix of this manual.



Note: Quad, multiconductor, or silver satin phone cables are not sufficiently resistant to electrical interference and are unacceptable for network use.

The cable must also be wired correctly, that is, the correct wires in the cable must go to the correct pins on the connectors. The Appendix includes a diagram showing connector pin and wire assignments.



Note: The connectors on most existing phone systems using twisted pair cable are not wired correctly for use with 10BaseT connectors, and must be rewired to be used for LAN cabling.

Existing twisted pair phone wiring is often routed to a centrally located wiring closet with a connection box called a modular splice block or punchdown block (so called because a special tool is used to punch each wire down between the jaws of a retaining clip). These blocks are used to make correct wiring connections between phone systems and the individual wires within the twisted pair cables. These blocks can also be used to connect wiring from network nodes to network hubs.

However, if you use a punchdown block, be sure that all connections are secure and electrical contact is adequate. Otherwise, the block can cause network problems.

If you choose to install a new splice block, you may want to consider the newer designs, which use wire-wrap connection and gold contacts instead of the older style punchdown blocks.

Connecting the Cables

Once you've connected the Ethernet LAN Adapter to your notebook computers, connect the computers within the network using the cables to complete the network installation. Consider these general guidelines:

- If installing multiple trunk segments or hubs, build one segment or hub at a time.
- Avoid crimping the cables. Also avoid placing cables near heat sources such as lights or in areas where they could be stepped on or otherwise bent.

Cabling a Thick-Cable Network

If you plan to use only thick cable, install each trunk segment in the following order.

1. Place the stations and peripherals in their planned locations, according to your network plan.

2. Place the transceivers according to your network plan (one transceiver for each station).

3. Connect the transceivers together with lengths of thick cable.

4. Attach the female DB15 connector on the transceiver cable to the transceiver. You will notice that the female DB15 connector has a hold-down clip to prevent accidental disconnection. Slide this clip to " open," attach it to the transceiver, and slide the clip back to lock.

5. Attach the male DB15 connector on the other end of the transceiver cable to your Ethernet adapter and secure it.

6. Attach an N-series terminator to each end of the trunk segment. One terminator should have a grounding wire attached.

7. Ground one of these two terminators by attaching the end of the grounding wire to an earth ground. If the grounding wire is too short to reach the outlet, use 16- or 18-gauge insulated wire to extend the grounding wire.

8. To join two trunk segments together, connect one end Of each trunk segment to the same repeater. Trunk segments are connected to repeaters in the same way they are connected to stations-by means of a transceiver and a transceiver cable,

Cabling a Twisted Pair Network

The order of the steps you follow to assemble each hub segment of a twisted pair network is not important.

One method is to place your network stations and peripherals first.

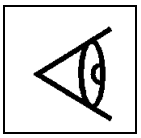
Next, place your hub in a location that is reasonably central to the devices that will become nodes. At this stage, with all adapters configured and installed in their respective systems, you may turn on the computers and the hub.

Next, run cable (or adapt existing cable, if possible) between the node locations and hub location, carefully labeling each cable according to the node to which it will be attached.

Then insert the male RJ-45 connectors on the cables into ports on the hub, being sure they are fully seated (so the plastic latch clicks into place).

Finally, connect the RJ-45 male connectors on the node end of the cables to the RJ-45 port on each of the node adapters.

As you cable each computer to the hub, the green **Status** indicator light on the Ethernet LAN Adapter should come on. If it does, there is a proper connection between the node and the hub. If it does not come on, there is a problem with the card or the cabling. Refer to Chapter 4 for troubleshooting procedures.



Note: The red **Traffic** indicator light comes on only when data is actually being sent or received by the Ethernet LAN Adapter.

Once you have checked the operation of all nodes on this hub segment, you can cable the hub to any other network segments, either via coaxial cable or twisted pair, as described in Chapter 1.

Cabling a Combination Network I

If you plan to use a mixture of thinwire, thick cable, and/or twisted pair in the same network, read the discussions in Chapter I of this manual before cabling your network. Be sure to follow the limits and rules that apply to your network layout. Remember to use adapters, repeaters, or hubs to connect thinwire, thick-cable, and twisted pair.

4
Diagnostics and Troubleshooting

This chapter tells you about

- How to interpret the two indicator lights on your Ethernet LAN Adapter
- How to run diagnostics
- Recommended procedures for troubleshooting

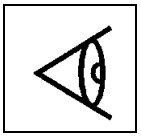
Contents

Interpreting the indicator Lights

The two status indicator lights on the Ethernet LAN Adapter have the following meanings when used in a 10BaseT network:

Green Status Indicator Light

The green indicator light labeled **Status** is used in conjunction with the 10BaseT link integrity function. When this indicator light is on, it means there is a proper connection between the adapter and the hub. Specifically, it means the adapter is receiving the link pulses sent by the hub.



Note: If the link status is okay, the green **Status** indicator light should be on constantly and not blinking.

Some hubs, but not all, have a corresponding indicator light for each port, which indicates proper connection with the node. Specifically, when the hub indicator light is on, it means the hub is receiving the link pulse sent by the node.

It is possible for one of these indicator lights to be on but not the other. For example, if the receive wire pair from a node is broken but the transmit wire pair is intact, the node indicator light would be off and the hub indicator light would be on.

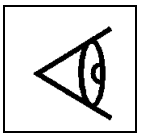
If you changed switches 7 and 8 on the Ethernet Adapter to disable Link Status for use with an older StarLAN- IO hub, then the Link Status indicator light indication is not valid.

Red Traffic indicator light

The red indicator light labeled **Traffic** on the control panel turns on whenever data is being sent or received by the board. Therefore, it may be off much of the time and flash occasionally, depending on node activity.

A diagnostics utility is included on the *Ethernet LAN Utilities* floppy provided with the Adapter. The diagnostics utility can help you isolate the sources of any problems, including cabling integrity in a coaxial cable network.

Make a working copy of the diagnostics programs. Copy the files onto a floppy disk and insert the copy into the floppy drive of the computer with the Adapter connected, or copy the program files to the computer's hard disk.



Note: For reliable results, you should disable the driver you arc using with the Ethernet LAN Adapter during testing. This may require you to modify your CONFIG.SYS or AUTOEXEC.BAT files or boot from a DOS boot disk, depending on how your driver is activated.

Running Diagnostics

Once the adapter is connected to the notebook computer and configured, run the diagnostics as follows.

1. Connect the Ethernet Adapter to a properly terminated network.

2. Insert the *Ethernet LAN Utilities* floppy into drive A of your notebook computer.

3. At the MS-DOS **C:\>** prompt type

A:

and press the **Enter** key.

4. At the MS-DOS **A:\>** prompt type

CD UTILITY

and press the **Enter** key to change to the Utility directory.

5. Type

ENTEST

and press the **Enter** key (type ENTEST -MONO if you are using a monochrome monitor). The diagnostics startup menu appears.

6. Select the IRQ and I/O address settings of the board on which you are going to run the diagnostics. Begin the diagnostic test by pressing **Enter** once the cursor is in the I/O address field.

The diagnostics test begins and runs for a brief period.

Note the results of the test. See the following section for interpretation of the test results.

Interpreting Diagnostics Results

If results displayed on your screen indicate the board has passed the test, you can essentially eliminate a settings conflict or a hardware failure as the source of a problem.

If the results indicate cabling problems, check all cables to make sure they are secure and correctly installed (see Troubleshooting section), and then rerun the diagnostics.

If the Adapter fails the test, check the documentation for other optional devices in the computer to determine if their settings may conflict with the adapter. First check the base I/O settings, and then double check the IRQ settings; if you discover a conflict, change the settings of one of the options.

Determining the Adapter's Network ID Number

To determine the adapter's network ID number, after running the complete set of tests, look on the last line of the diagnostics menu. The adapter's 12-digit ID number is displayed after the Normal Operation Setup field.

Troubleshooting

Network problems can arise from many causes. in order of frequency, the most likely causes are:

1. Improper cabling or bad connections

2. Incorrect adapter or driver configuration

3. Incorrect adapter installation

4. A failed adapter (or hub in a 10BaseT network)

The following logically sequenced procedure for isolating and correcting problems is suggested.

1. Ensure that the adapter is connected correctly to the notebook computer and the power is set to ON.

2. Make sure that the DIP switch settings for the I/O address and the interrupt correspond to the diagnostics settings.

3. If you are on a 10BaseT network, check the **Link Status** indicator lights on the adapter and hub.

Be sure both the computer and hub are switched on. If the indicator lights on both are indicating correct Link Status (see the earlier Status indicator light section in this chapter), the cabling is most likely correct and you should continue to the next step. Otherwise, verify that all connections are secure, and again check the indicator lights. Also verify that the cable used is adequate for 10BaseT use (see the Appendix).

4. Run the Diagnostics utility described earlier in this chapter.

This utility checks the adapter's integrity and, in a coaxial cable network, cabling integrity (within the trunk segment). To run and interpret the diagnostic tests, follow the instructions provided earlier in this chapter.

If all Diagnostics menu tests pass, skip to step 8.

If tests indicate an adapter problem, skip to step 6.

If tests indicate the board is good, but coaxial cabling is bad, proceed to step 3.

5. Check coaxial cable connections.

Verify that all connections are secure, including any connections to an external transceiver (if one is attached to the adapter's External AUI port). Also ensure that the cabling is not twisted or bent. Check that all trunk segments are correctly terminated at each open end (see Chapter 3 for details). Finally, verify that the cable used is adequate for Ethernet use (see the Appendix).

6. Check the board configuration.

Verify that the configuration settings do not conflict with the I/O address or IRQ (interrupt) level of another device in your system.

7. Check the adapter's installation.

If the adapter is not securely connected to the computer, the configuration program may not "see" the adapter.

8. Check the driver configuration.

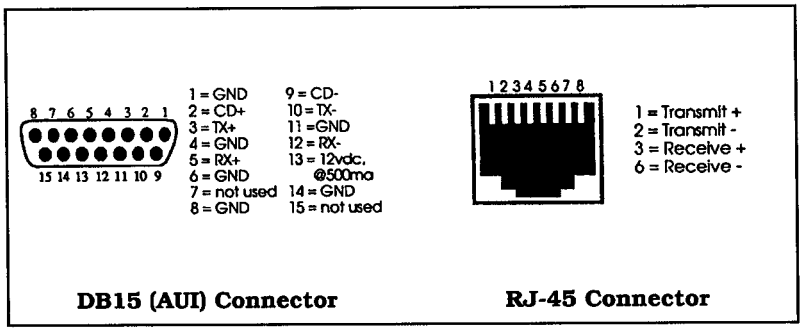
Verily that the driver is configured for the same settings as the adapter. Also verify that it is the correct driver.

9. Try a different Ethernet Adapter, if available.

If you have access to another adapter that is known to be working, configure the good adapter to the same settings as the questionable adapter, and then replace the questionable adapter with the good adapter. If the new adapter works, the adapter you removed has probably failed. Notify your authorized dealer.

If these procedures do not isolate the problem, contact technical support as described in the Warranty section at the end of this manual.

Adapter Connector Diagrams



Twisted Pair Cabling Specifications

General

- ❑ Unshielded, twisted-wire pairs (2 pairs)
- ❑ 22, 24, or 26 gauge
- ❑ Impedance (characteristic) at 10 MHz: 85 to 1 10 ohms
- ❑ Maximum attenuation at 10 Mhz: 11.5 dB/100m
- ❑ Maximum attenuation at 5 Mhz: 7.2 dB/ I 00m

Recommended Cable (or equivalent)

AT&T D-inside wire (DIW and PDS)

4-pair, non-plenum	DIW 4/24 W1000
4-pair, plenum	C-plenum 4 R1000
25-pair, non-plenum	DIW 25/24 R1000
25-pair, plenum	C-plenum 25 R1000

IBM Type 3	
6-pair twisted	Belden - 9566
2-pair twisted	Belden - 9562
4-pair twisted	Data Set Cable Company - 240

General Specification

Network Interface:	Ethernet IEEE 802.3 (10BaseT, 10Base2)

Connectors:

External transceiver:	DB- 1 5 (15-pin female)
Unshielded Twisted Pair:	RJ-45, 10BaseT compliant

Cabling/Operating Distances:

Thin Ethernet:	See the specifications for your external transceiver.
10BaseT Ethernet:	twisted pair wiring, compliant with 10BaseT maximum hub/PC length 100 meters (328 feet)
Hub Compatibility:	All 10BaseT Hubs:StarLAN10 hubs
Software Drivers Provided:	NDIS (DOS,OS/2); NetbIos

Software Compatibility:

NetWare 2.OA, 2.1, 386, LAN Manager and OEM versions such as LAN Server, 3+ Open, LAN Manager/X (workstation only), StarGroup LAN Manager (workstation only); Vines; PC/TCP; standard NetBIOS environments such as PC LAN, MS Net, 10Net, PowerLAN, LANtastic

Technical Specifications

Diagnostic LEDs:	Status, Traffic
Hardware Interrupts:	IRQ, -5, 9, 10
*Base I/O Addresses:	*300H,*320H,*340H,*360h

*Options available when using NE2000 drivers. If using National Semiconductor NDIS or NetBIOS drivers, all I/O and IRQ options are available.

Buffer Memory:	16KB, I/O mapped
Data Transfer:	Programmed I/O
Environmental Operating Range:	Altitude: 10,000 feet maximum Temperature: 0 - 50° C Humidity: 10 - 90 percent, non-condensing
Power Requirements (typical):	5 VDC: 3.75 Watts maximum 12 VDC: 4.50 Watts maximum
Electromagnetic:	FCC Class A

Glossary

The following brief glossary of terms may help you understand the language of networking and connectivity. This is by no means all inclusive but serves as a basic guide in understanding the function and operation of networking devices.

address - a set of numbers that uniquely identifies a node on a network, a location in computer memory, or a packet of information transmitted over a network.

architecture - the manner in which hardware and software is structured or how the various components fit together.
Network architecture defines the functions and descriptions of data formats and procedures used for communication between nodes.

bandwidth - the difference, expressed in hertz (Hz), that is, cycles per second, between the highest and the lowest frequencies of a transmission channel-, a measure of the information capacity of the transmission channel.

baseband - a scheme for sending signals over a wire, where only one signal uses a particular cable, and that signal uses a the available bandwidth of the cable.

bridge - equipment which connects different LANs, allowing communication between devices on separate networks. Bridges connect LANs that use the same protocol as compared to *gateways* that connect LANs that use different protocols.

broadband - a scheme for sending signals over a wire, where multiple signals share the wire at one time; each of the signals uses a portion of the total available bandwidth.

Glossary

buffer - storage space in RAM or in a separate device used to compensate for differences in the speed of data transmission. Computers can send data faster than most devices can accept or process the data. A buffer is used to temporarily "store" data from the computer so it can be sent to another device at a slower rate without having to slow the computer.

Cheapernet - a low-cost, flexible companion system to standard Ethernet. It offers an alternative baseband cabling system that provides full Ethernet capability for personal computers, workstations, and local networks in offices and other local work areas (also called *Thinwire Ethernet*).

collision - the result of two workstations trying to use a shared transmission medium (cable) simultaneously. The electrical signals they are both trying to send bump into each other, ruining the signals. After a collision, both stations must re-transmit their data.

conditioning - the "tuning" or addition of additional equipment to improve the transmission characteristics of a network line so that it meets specifications for higher speed transmission.

CRC (Cyclical Redundancy Check) - a method of detecting errors in a message by performing a mathematical calculation on the bits in the message, then sending the results of the calculation along with the message. The receiver performs the same calculation on the message data as it receives it and then checks the results against those transmitted with the message. If the results don't match, the receiver asks the sender to send again.

CSMA/CD (Carrier Sense Multiple Access with Collision Detection) - a method of having multiple workstations access a transmission medium by sensing collisions on the medium and delaying transmission in the event of a collision.

error checking - the process of checking for errors or determining the integrity of transmitted data. See *CRC.*

Ethernet - A CSMA/CD system, utilizing coaxial cable, developed by Xerox Corporation; one of the most popular baseband LANs in use.

IEEE (institute of Electrical and Electronic Engineers) - a publishing, standards-making body responsible for many industry networking standards, including the 802 series.

LAN (Local Area Network) - a data communications network spanning a limited geographical area that provides communications between computers and associated peripherals.

Network Operating System (NOS) - the algorithms and code that controls or manages the various procedures, communication, handling, and administration of a LAN.

network interface controller - electronic circuitry that connects a workstation to a network. Usually a card that fits into one of the internal expansion slots of a PC or an external box or peripheral that connects to an external port. It works with the network software and computer operating system to transmit and receive messages on the network.

network trunk cable - a group of separate trunk segments connected together by repeaters.

nodes - points on a network where connectivity is made or where service is provided. Nodes may be used interchangeably with workstations.

Glossary

packet - a group of bits, including address, data and control elements, that are switched and transmitted together. Think of a packet as one sentence or one group of numbers being sent at the same time.

protocol - a set of rules for communicating between computers. These rules govern format, timing, sequencing, and error control. Without these rules, the computer would not be able to make sense of the stream of incoming bits.
Example: TCP/IP

repeater - a device used to extend the size of a network beyond its normal limits by linking two or more trunk segments . The repeater forms a passageway between trunk segments and strengthens the electrical signals.

server - a unit containing files, which are shared by everyone connected to the LAN. Servers can offer anything from simple data storage to gateways and protocol conversion. Usually the network operating system resides on the server.

trunk segment - a combination of nodes and cable lengths that are connected together between two terminated ends.

workstation - a term used with networks to describe the clients serviced by servers. Workstations can be desktop or notebook computers or higher performance computers used for engineering design and manufacturing purposes.