Networking
Basics

*Simple Solutions for
Small Networks*

intel®

NETWORKING BASICS
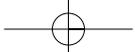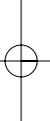
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Note: **The Warranty Registration Card and WallMount Templates are located in the center of this book.**

Contents

Introduction

This guide has been written specifically to answer questions frequently asked by first-time small business network planners. It uses basic language and explanations to eliminate the mystery often associated with networking. As a new term is introduced, its description is included at the end of the section. A glossary of networking, computer and Internet terms is at the back of this book for reference.

Review this guide to learn about the products and layouts that best serve small network needs. Even if you don't use some of this information today, as your business network grows, you will be able to reference this guide. You will also find this guide helpful if you are upgrading networking software or cabling, or when adding a new piece of hardware to your network.

Whatever your level of networking expertise, Intel can help you make responsible and informed choices as you plan, install, expand or troubleshoot your network. More information about networking can be obtained from Intel, your retailer, consultant, advisor, or commercially available books.

What is a Network?

A network is simply the most cost-effective way to share a collection of communication equipment such as servers, computers, printers, and modems, that has been connected together by cables. A network helps people work collectively, not just individually.

Networking is all about sharing data, software, and peripherals such as printers, modems, fax machines, Internet connections, CD-ROM and tape drives, hard disks and other data storage equipment. A small network may be as simple as just two computers linked together by cable. A large network can link hundreds or thousands of computers and peripherals together in various configurations. This book will explore the issues of small networks.

A variety of equipment may be used in a network. Depending on how many computers and other equipment you need to connect, your choice of networking devices will vary. Later in this guide, we explain the role of each of these networking products and how they fit into a network.

You may want to review the network layouts to understand when and where these products are used and how they can help expand your network. Maintaining standards will ensure the best performance possible. *Don't worry—it's easier than you think!*

Server
A server can be as simple as a dedicated computer providing file storage, or as complex as a high capacity computer containing several hard disk drives, and a tape backup and CD-ROM drive. It can be used to help share resources such as printers, fax machines, modems, and connections to the Internet. It is often used to store database information, multiple software programs for access by "client" computers, work files on its large hard drive, and archive files. Computers connected to a server are called "clients."

Why Do I Need A Network?

A network will actually save you time and money! In today's business, the need for information is expanding so quickly that networking is no longer a luxury; it's an affordable necessity.

To be successful, businesses must share information and communicate not only within their company, but to the outside world. Networking makes this happen in the simplest and most economic way. Additionally, a network can eliminate the need to buy extra printers, modems, file storage, etc.: all of these items can be shared on a network. Even an outside line for Internet access can be shared over a network. It's obvious why a network is important—even essential—for growing businesses.

What Makes It Work?

Ethernet refers to the most common networking system. When Ethernet was established, certain standards were set. All messages sent over an Ethernet network include exact codes within the transmission that allow another device to accept them. Information is sent in small bursts of data, called "packets," to ensure that the send and receive operation is completed correctly.

Ethernet
A networking system originally developed in 1973 by Xerox and formalized in 1980 by DEC, Intel, and Xerox which transmits data at 10Mbps using specific methods.

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Network Layout

Network layout (also called "topology") refers to the way a network is physically designed.

There are three basic network layouts. The two most common for a local area network are the "Star" and "Bus." A "Ring" topology is another type, but far less common. Star and Bus topologies are explained and diagrammed in this section.

(LAN) Local Area Network
A network in a localized (not remote) location that allows users to share information, equipment, and resources.

Star topology
A networking setup used with 10BASE-T cabling and a hub. (Also called UTP or twisted-pair.) Each item on the network is connected to the hub like points of a star.

Bus topology
A networking setup in which a single cable, such as network coaxial cable, referred to as coax (or thin Ethernet), is used to connect one computer to another in a chain to carry data over a network.

Star Layout

As its name implies, this layout resembles a star. At the center of each star is a hub or switch that connects to each separate node directly via a thin, flexible cable (10BASE-T cable). One end of the cable plugs into the connector on the network adapter card (either internal or external to the computer) and the other end connects directly to the hub or switch.

Basic Star Layout

Installation is simple, inexpensive, and fast because of the flexible cable and the modular connector. The number of nodes you can connect to a hub is determined by the hub. There is a limit to the number of nodes you can add on a network (a maximum of 1024 nodes.). The star layout becomes a workgroup and can operate independently or can be connected to other workgroups.

If you would like to learn about cabling and connectors, see *Cabling: Network Pipeline.*

Benefits of a Star Network

- Inexpensive cabling.
- Fast installation.
- Workgroups communicate easily.
- Expansion is as simple as adding a new workgroup.
- Expansion using a switch or bridge actually improves performance across the network.
- Ability to handle failed connections quickly without disrupting the entire network.
- 10BASE-T cabling provides status information to the status lights on your hub, simplifying troubleshooting.

Drawbacks

- You are limited to a maximum of 100 meters (328 feet) between the node and the hub.

Node
A server, computer, printer, modem, fax machine, auxiliary hard drive or other equipment capable of communicating with a networking device (such as a hub or switch).

10BASE-T cable
A popular Ethernet cable using twisted-pair wiring with RJ-45 plugs at each end. Category 3 10BASE-T cable is used with standard 10 Mbps Ethernet networks.

Network Adapter Card
One of several PC cards designed for different computer types, it installs easily into your computer. Connector choices are BNC and/or RJ-45 to link the card to your network. Provided software converts your data into a format usable over an Ethernet network. 10 and/or 100Mbps cards are available.

Hub
Also referred to as a "repeater" or "concentrator", its primary function is to receive and send signals along the network between the devices connected to it. All communication across the hub is "broadcast" to all connected nodes simultaneously.

Mbps
Millions of bits per second.

Switch
A switch is more sophisticated than a hub and functions more efficiently because it "learns" network addresses automatically, providing a "private line" to the network. A node or a fully populated hub can be connected to a switch.

Workgroup
Nodes connected to a single hub or switch to form a small communication group for the purpose of networking.

Bus Layout

The bus layout, sometimes called a backbone, is a linear setup that connects all of the computers in the network or workgroup in a single line on a single cable. The data signal is transmitted to the entire population of nodes, one after another.

A single coax cable, referred to as a segment, is used to connect the network together. A barrel connector (called a BNC) attached to each network adapter card allows the cable to connect directly to each computer, then on to the next computer, attaching to the hub's BNC (coax) connector, when a hub is used.

Each node taps into the cable as shown below.
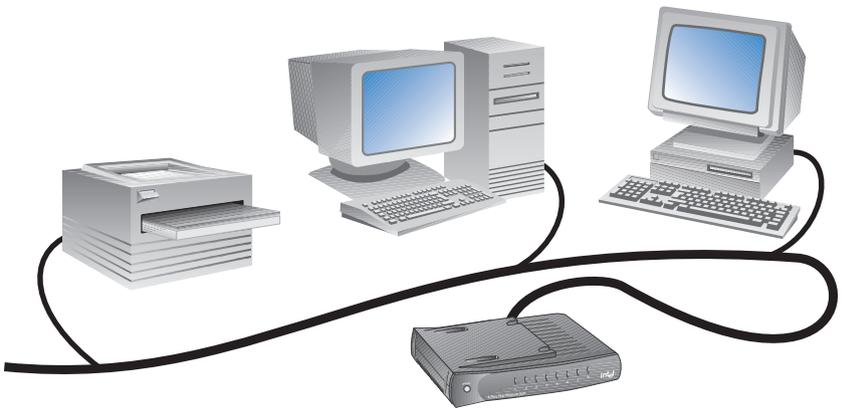
Basic Bus Network

Benefits of a Bus Network

- Very reliable cabling.
- Simple network expansion.
- Does not require a hub or other central equipment.

Drawbacks

- Standards restrict this network type to no more than 30 node connections on the network.
- Total length of the network must not exceed 185 meters (607 feet).
- If one connected node goes down, the entire network goes down.
- Troubleshooting is difficult.

Coax
Thin or thick network quality cable used in Ethernet networking. It resembles cable TV or antenna cabling and must be rated for network use. Look for the marking RG-58/U.

Server-Based and Peer-to-Peer Networks

Now that you have an understanding of these layouts, you can better understand two other broader network configurations that are based on these same layout principles.

Server-Based Networks

A server-based network maintains the "server" as the manager of the network, with all nodes connected to the server, whether connected to a hub in a star or bus layout. In this way, the server can house and administer software, file sharing, file saving, allocation of printers, fax machines, modems, and other communication connections. A server-based network can also be set up using the bus layout.
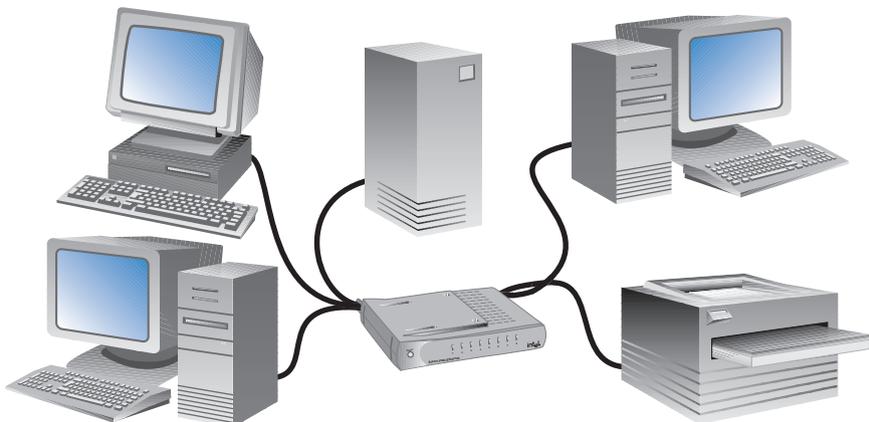
Typical Server-Based Network

The server acts as an arbitrator; each node talks to the server when requesting information, then the server locates the information either internally or on the connected clients and sends the information to the requesting client.

Peer-to-Peer Networks

This network design uses only the computers that are connected, and does not rely on a server. Each computer has its own hard drive and, between each of the computers, you may have a CD-ROM drive, a tape back-up system, an auxiliary hard disk, a data/fax modem, and one or more printers. Each node has the ability to talk directly to any node on the network that has the information or service it needs.

Typical Peer-to-Peer Star Network

Typical Peer-to-Peer "Bus" Network

With this network type, you can optimize your usage of the various resources by sharing them within your network. The star layout works well with this type of network because all nodes are connected directly to the hub, making connections easy. A bus layout may also be used with this kind of network.

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Cabling: Network Pipeline

Network cabling, or wiring is the physical link between all nodes and networking devices on your network. Cabling is available in three basic varieties: twisted-pair (UTP), thin Ethernet (coax), and thick Ethernet. The two most common types for small networks are the twisted-pair and thin Ethernet.

The Intel InBusiness products use twisted-pair cabling because it is the most economical and easily maintainable Ethernet media. Many Intel products are available with RJ-45 ports (for twisted-pair cabling), and/or BNC connections (for network coax cable). Cables and connectors are described in detail in this section.

When planning your network, the cost of cabling should always be a factor. The cable you choose for your network today will likely be in place for a long time. If you are planning on expanding the network or moving into Fast Ethernet products, you may want to start with a higher grade of cable now.

Twisted-Pair
A cable used for both network communications and higher-grade telephone communications. Also known as UTP (unshielded twisted-pair) or STP (shielded twisted-pair), and 10BASE-T/100BASE-TX cable. Used primarily in "Star" networks. Uses RJ-45 connectors.

Thin Ethernet Coax
Usually quarter-inch black coaxial cable, identified by type such as RG-58/U. Sometimes called network coax, 10BASE 2, or thinnet cable. Uses BNC connectors.

Thick Ethernet
Also called standard Ethernet, or thicknet, it is used with 10Mbps baseband networking. It is often used as a backbone cable. Thick Ethernet is heavy, stiff, and difficult to install, and is the most expensive wired cabling used. Uses BNC connectors.

Fast Ethernet
An Ethernet networking system that transmits data at 100 Mbps. Known as 100BASE-TX, it is similar to 10BASE-T Ethernet, only 10 times faster and of higher quality.

What is UTP?

UTP (unshielded twisted-pair or "stranded" cabling) comes in both Category 3 (10BASE-T for 10 Mbps networking) and Category 5 (100BASE-TX for 100 Mbps Fast Ethernet networking). It is thin, flexible and easy to use with the common RJ-45 connector.

The two main advantages of twisted-pair networks are the low cost of the cables, and the ease of installation in a star network.

Another major advantage is its ability to quickly resolve failed connections. In a twisted-pair network, if a connection fails somewhere on the network between a node and the hub, only that node is disabled; the rest of the network is unaffected (except for the inability to access that node). Usually, replacing one segment of cable at the failed node will fix the problem. 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.

When it comes time to expand your network, twisted-pair cable is particularly useful. Using a commercially available twisted-pair "crossover" cable, you can connect your existing hub directly to another hub, switch or bridge without complication. (See also "RJ-45 Straight-through Ports" and "RJ-45 Crossover Ports.")

Unlike coax cable, twisted-pair cable with RJ-45 connectors will provide connection information between your computer and the network connection. This status will usually be displayed by a light on your hub.

This cable type is used with a Star topology. Remember, each segment of wire must not exceed 100 meters (about 328 feet).

Quality Cable Standards

Networking standards specify cable types for use in 10 Mbps and 100 Mbps Ethernet networks. Category ratings depict the quality or ability to carry data; the higher the category, the better the cable, and therefore, more reliable data. UTP cable should be stamped with the rating (category) clearly marked on the plastic covering.

Your home phone cabling is likely a Category 1 and uses RJ-11 connectors; smaller than the RJ-45 used in networking. Some commercial installations use Category 3 cabling for telephone connections. Network connections cannot be made with Category 1; use only Category 3 or 5.

Category 3 UTP
Category 3 is used for network and data transmission operating at 10 Mbps. Category 3 should never be used with 100 Mbps Fast Ethernet networks.

Category 5 UTP

Category 5 is required for network and data transmission operating at 100 Mbps (Fast Ethernet). This cable grade can be used successfully for 10 Mbps operation, but it is slightly more expensive than Category 3. If you will be upgrading to 100Mbps in the near future, you should consider installing your network with Category 5 cable now.

Coax Cabling

Coax cabling is similar to but higher quality than cable TV or antenna cabling. There are two types of coax cable used on a network: thin (10BASE 2) and thick (10BASE 5). Because 10BASE 5 is rarely used in small networks, only thin Ethernet is being described. Remember, in a coax bus or backbone network, if a single connection fails, the entire network may be disabled.

10BASE-2

10BASE-2 (or network coax bus or backbone cable) is also called thinnet. Thin coax cable is similar to but of higher quality than your home TV and VCR cable. The cable should be clearly marked with RG-58/U stamped on the casing. It is usually quarter-inch coax cable and connects to your network with a BNC connector.

Thinnet is reasonably flexible and is very reliable. While it is more expensive than 10BASE-T cable, it is often the choice for small to medium networks using a bus topology.

Connectors and Ports

RJ-45 Connectors

10BASE-T cable uses RJ-45 connectors that connect to RJ-45 connector ports on most Intel InBusiness networking products. RJ-45 connectors are similar in design to your modular telephone connectors; just a little larger. They click quickly and easily into the port, making a very secure connection.

BNC (coax) Connectors

A BNC connector is a high quality connector found on high-end electronic equipment. It is somewhat similar to the "RCA jack" found on most newer TV's and VCR's. The BNC connector must be aligned carefully, pushed into place and twisted clockwise to lock in place, making a very secure connection. BNC/coax cable connections do not provide connection status information between your computer and the network connection. Terminate all open ends of a BNC connector to prevent signal bounce.

RJ-45 Straight-Through Ports

A straight-through port is the standard port on most hubs, switches, bridges, etc. It may also be called a 10BASE-T port. It allows direct connection from a node to the connecting equipment. The media used is a 10BASE-T cable with RJ-45 modular connectors. You cannot tell by looking at the port whether it is a standard or crossover port. Your manufacturer's documentation will detail the ports and inform you of port types being used.

RJ-45 Crossover Ports

A crossover port is usually marked with an "X" for easy identification. This specially configured RJ-45 port is provided on some networking devices to allow easier connection when cascading (connecting) from one hub or switch to another; for example, when connecting multiple hubs or multiple switches, allowing expansion of the network. When using a device with a crossover port, a standard, straight-through cable is all that is required.

The equipment manufacturer's documentation will inform you when this special type of port is present on your networking device and what type of cable is needed.

BNC (coax) Ports

The BNC connection on some networking devices is provided to facilitate connection to a coax cable (also called 10BASE 2 or thinnet).

Networking Devices Defined

This section presents a brief description about general networking products. If you are planning your first network or expanding a current network, read about these products to become familiar with the options available, and how they can improve the performance of your network, then proceed to "Designing Your Own Network." beginning on page 21.

You may also want to review "Keeping Your Network Valid" beginning on page 18. It includes tips on networking products and layout that will help prevent undesirable network slowdowns and keep your network operating at its peak performance.

More detailed information about specific products, including the Intel InBusiness™ networking products, is included later in this book.

Network Adapter Cards

Network Adapter Cards (also called Network Interface Cards, or NICs) are the first and most basic item needed to begin your network.

Some newer computers have cards already built into the system. If your computer does not, you can add one of these small PC boards to your computer in a matter of minutes. The cards install into a slot on your motherboard, just like a sound card or modem card. Several types are available; make sure you get the one made for your computer type. Your adapter card supplier can advise you on what type will work with your computer.

A network interface card provides the necessary link between your computer and your network. It converts your data into a format that an Ethernet network can accept and read. These small cards contain the connectors needed to link your computer to either a hub or another computer. Configuration software comes with the adapter to enable your computer type to work with the network.

NIC cards are available in 10 Mbps and dual function 10/100 Mbps cards. Dual function 10/100 Mbps cards are the most cost effective if you are connecting to a 10 Mbps network now but planning to move to a Fast Ethernet 100 Mbps network in the near future.

Hubs

Hubs (also called a wiring hub, or concentrator) are the central connectivity point in a star network, workgroup or subnet. A hub allows each node to communicate with all other connected nodes. Connected nodes provide their own power, and the hub has its own power supply. Hub status lights help to monitor the network. Most hubs are plug and play; no software is necessary to install. Two or more hubs can be connected to enable network expansion easily and inexpensively. Hubs can also be connected together by a bridge.

Within Ethernet standards, there is a limit on the number of hubs that can populate a network. A switch can help segment networks that are becoming too large, and will actually improve performance on your network. Hubs are available for both 10 and 100 Mbps networking.

Bridges

Bridges are used to connect separate workgroups (subnets) together. Most bridges identify and keep track of the location of the nodes on each network and allow only necessary traffic to pass through. The bridge directs the destination and source of information.

If a packet of information is flawed, the bridge filters or drops the packet, but if it contains all the proper source, destination and other information, it will forward the packet. Bridges can even connect both 10 Mbps and 100 Mbps speed networks together.

Switches

A switch is a key component for expanding networks, like combining a bridge and hub together, because it divides a large network into smaller segments. Adding a switch often improves the speed of a network that has become bogged down and overused, and helps eliminates network errors.

A switch also enables a network transmission to be directed to a specific node on the network instead of being transmitted to all users, like on a hub. The type of transmission control on the Intel InBusiness™ 8-Port Switch monitors the network activity, sends the data, and tests it to ensure a complete transmission. This is called "store-and-forward." More information on segmenting your network with a switch is available in the section "Keeping Your Network Valid" on page 18.

Repeaters

Repeaters are used in a star topology when the distance in a network expands to the point that it exceeds Ethernet networking standards but still must grow. A repeater is similar to a hub with the exception that it amplifies and retimes the signals being sent across the network. Repeaters monitor connected workgroups. When a malfunction occurs in a workgroup, a repeater will disconnect the malfunctioning computer from the network. The same problem in a bus topology would disable all nodes attached to that segment.

Routers

Routers filter network traffic and connect different protocols to ensure that the file is routed to the correct location. Because of this filtering, a router is slower than a switch or bridge, but will perform a valuable function if filtering is required. Unlike direct hubs and switches, routers can offer network management services, such as zone configuration and control.

Servers

A server can be a low or high capacity computer that provides various resources. A typical server contains several hard disk drives, a tape backup and a CD-ROM drive. It can be used to help share resources such as printers, fax machines, modems, e-mail and connections to the Internet. It is often used to store database information, files, file backup, and multiple software programs (site licensed) for access by "client" computers. Computers connected to a server are called "clients." The functions of the server can be administered and controlled, and can provide security to network users. Several types of servers are available either singly, in any combination, or in total: file and print server, application server, mail server, directory services server, and communications server.

PC Card Adapters

Laptop computers can connect to an Ethernet network with the help of a small insertable card, similar in size to a credit card. A small connector on one end of the card connects to the PC Card slot of a laptop. A connector on the opposite end connects directly to the Ethernet network hub. PC Cards are also made with data/fax and modem operation.

Communications Products

Communications products include fax cards, modems, PC Card adapters for mobile computers, and Internet connections. Products specifically designed for use with faster ISDN lines are commercially available now. These products, and devices that combine several of these features together, will become a significant cost and time benefit for the network user. Particularly in a small office environment where space and equipment is at a premium, sharing these services through a single communications server is highly desirable and cost-effective.

What is a Network Operating System?

A network operating system, or NOS, can range from simple software features built into Windows* 95, Windows NT*, or Macintosh* OS, or more complicated network operating systems like Novell* or LANtastic*. Its special application allows computers and other equipment on the network the ability to communicate and send and receive information. If you have transferred information between computers using Windows 95 or the Mac OS, you have already worked with a network operating system.

Helpful Networking Tips

Ethernet standards specify what constitutes a valid network. Remember that when you stay within the standards that were set, your network will operate with few, if any, errors. The three most common things that create network problems are incorrect cabling, overpopulation of the network (node count), and overextended network cabling distance.

You will want to refer to the diagrams under "Keeping Your Network Valid" later in this section. Two diagrams are presented; a valid network operating within standards, and an invalid network that has exceeded Ethernet standards.

Initial planning of your network, or expanding your network following these standards, will keep your network running more efficiently. The basic rules to follow are outlined in this section.

Three Important Network Considerations

Wiring
Consider the wiring or cabling you are using for your network. The wrong quality or type for your network can cause network difficulty.

Count
Consider the number of nodes you are attaching to your network. Too many nodes within a workgroup, or too many hubs within a network without segmenting them with a switch, will cause frequent collisions and errors on your network.

Distance
Consider the distance between the nodes on your network. If the overall distance of your network exceeds Ethernet standards it will cause timing errors that will slow down your network.

Helpful Tips

- Each computer connected to the network requires a Network Adapter Card.

- The easiest and most popular Ethernet topology is the star topology, which is required when using 10BASE-T cabling.

- A 10BASE-T Ethernet network uses Category 3 or 5 twisted-pair cable with RJ-45 connectors on each end.

- With 10BASE-T wired networks, a maximum of 5 wiring segments is allowed between any connected computer within the LAN. Lay out your network on paper and count each wiring segment to verify compliance. See "Keeping Your Network Valid" to see how to expand your network and stay in compliance.

- 10 Mbps hubs can be connected together using Category 3 or 5 twisted-pair cable. Computer-to-switch or computer-to-hub distance must not exceed 100 meters (328 feet).

- 100 Mbps connections can be connected using Category 5 twisted-pair cable. Computer-to-switch or computer-to-hub distance must not exceed 50 meters (164 feet).

- Switches and hubs can also be connected through a backbone using 10BASE 2 thin coax cable with BNC connectors. Maximum backbone length must not exceed 185 meters (602 feet).

- Two LAN segments can be connected together using a bridge.

- Fast Ethernet 100BASE-TX wired networks can have only 2 wiring segments between any connected computer within the LAN. See "Keeping Your Network Valid" to see how to expand your network.

- A backbone counts as one segment. Connected segments count separately.

- Any switch placed within the LAN starts the count over, thereby allowing expansion of the network while maintaining Ethernet specifications.

- A switch is a key element in being able to expand your network and still maintain compliance. Improperly segmenting or overpopulating your network will cause collisions and poor network performance.

Other things can occasionally go wrong too. So, if you've determined that none of the above items are causing a problem, call your network equipment manufacturer to help determine where to look next.

Keeping Your Network Valid

This is a valid network even though there are five hubs, because a switch is in the key location to keep this network valid.

In this example, the valid wire count between computers A and B is only 3. Here's why. Instead of another hub, a switch has been added to the network. The switch starts the count over, which keeps the count within standards. A switch or bridge must follow two connected hubs. If all hubs on this network were fully populated with directly connected computers, it would contain 40 computers with more room to grow. This switch currently directly connects three hubs, but could grow to directly connect up to eight hubs, while still maintaining standards.
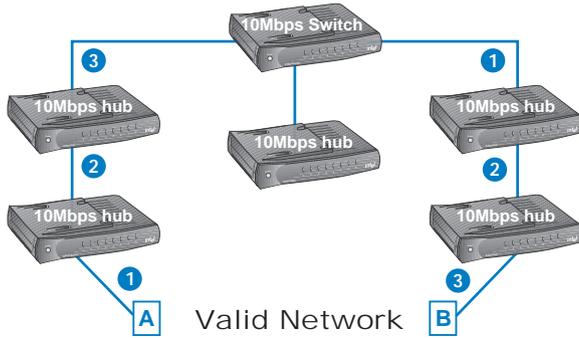
Valid Network

This is an invalid network that contains only five hubs. However, in this example, the wiring count between computer A and B is 6, violating Ethernet standards. Here is why.

Following two connected hubs, no switch or bridge is installed. The wiring count exceeds five causing delayed and weak signals from computer A to computer B. Even though if is a smaller network than the first example, it has already exceeded Ethernet standards.

Invalid Network
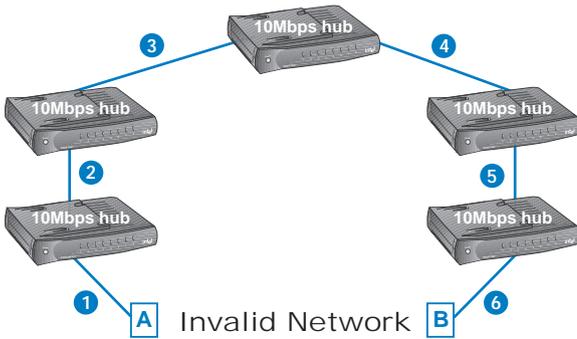
TWISTED-PAIR NETWORK CABLE GUIDE

CABLE TYPE	TOPOLOGY	QUALITY	CONNECTOR TYPE	LENGTH MIN.	MAX.	MAX. NO. OF NODES ON A LAN
10BASE T	10 Mbps Star	Cat. 3	RJ-45	2.5 Meters (8 ft.)	100 Meters (328 ft.)	1024
100BASE-T	100 Mbps Star	Cat. 5	RJ-45	2.5 Meters (8 ft.)	100 Meters (328 ft.)	1024
Crossover Cable	10 Mbps or 100 Mbps (cascade)	Cat. 3 Cat. 5	RJ-45	N/A	100 Meters (328 ft.)	N/A

COAX NETWORK CABLE GUIDE

NAME	TOPOLOGY	QUALITY	CONNECTOR TYPE	LENGTH MIN.	LENGTH MAX.	MAX. NO. OF CONNECTIONS ON A LAN
10BASE 2 Also known as: Thin, Thinnet, or Backbone	Bus or Backbone 10 or 100 Mbps	RG-58/U	BNC	.5 Meter (23 inches)	185 Meter (607 ft.)	30

NETWORKING 5-4-3 Rule:

A thinnnet LAN can have as many as five cable segments (not exceeding the maximum length), connected by four hubs or switches, yet only three sections can have computers attached. Both ends of a BNC must be terminated to prevent singal bounce.

Designing Your Own Network

Now that you've learned the basics of a network, how a network functions, and details about cabling requirements, you can begin designing a network of your own.

Anyone can design a network successfully by planning carefully and following basic networking guidelines.

How Most Networks Are Started

First networks are usually pretty basic and very easy to install. They are most often started because of a need to share files and programs between a few computers, and the need to share a printer. Here's an example of how this works.

Starter Network with Network Interface Cards Installed

This simple network has many advantages:

- One simple connectivity point: the hub
- Easy, inexpensive cabling: twisted-pair cabling
- Quick, simple installation that establishes communication across your new network within minutes: plug and play

Start with a basic hub for your small network; one with more ports than you need right now. Then, when you're ready to expand, you won't have to buy another hub right away. Your network can continue to expand as needed without having to replace anything. This type of network is very cost efficient—now and for years to come.

Growing Your Network

When you are ready to grow your network further, here's all you have to do.

- Connect nodes to the first hub until it is full, then begin connecting nodes to a second hub.
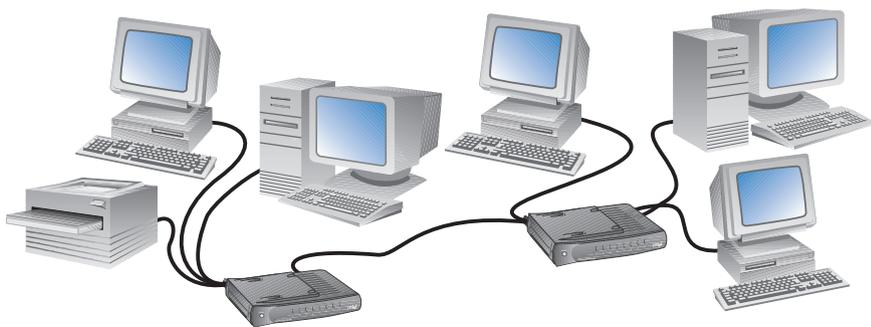
Connecting Two 10 Mbps Subnets Together

If the two subnets need to communicate, connect the hubs together or add a bridge or switch.

- At any time, you can add a node or two. When a printer, CD-ROM, tape backup system, fax/data modem, etc., is connected to the computers on your network, you can share these items without connecting them directly to the hub. One highly prized addition would be a single Internet connection that the entire network can share. Just plug it into the hub.

- A major cost-saving advantage is that the hub and cabling you chose has not become obsolete.

- This expansion with workgroups connected to hubs will last you a long time. No network equipment has become obsolete, even though you have expanded several times.

The Next Expansion Step

- The next step may be to add a server that combines many of the shared services, by putting the services all in one box.

- As your network continues to grow, a switch may need to be added to help segment the network and keep your network within Ethernet standards.
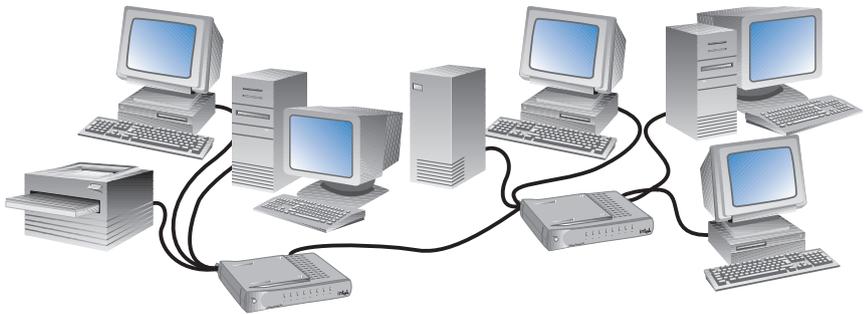
Adding a Server to Your Workgroups

Getting Started On Your Own

This *Networking Basics* book was designed to give you all the basic information you need to put a network together.

If you've already decided you need a network, you have probably already made a list of what services you need from a network such as file and software program sharing, equipment sharing, speed, communication equipment, types of computers to be connected, etc. If you've done this already, good job! Always start with this basic information.

> *You're in luck! Intel products have been designed for the easiest possible setup, use, and carefree operation possible.*

1. Begin by establishing where each piece of current equipment will be located and what will be added.

- Draw a floor plan noting equipment placement.
- Make a few notes on distance. You will need that later when planning cabling and checking to see if you have stayed within the guidelines of Ethernet networking. Remember, when you expand outside the limits, you will be disappointed in the performance of your network.

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2. Create a list of items you will need.

- Don't forget network adapter cards. Note the type of equipment that will need a card (including details such as type of operating system and type of computer) so you can get the specific type required. There are more than a dozen types available. Watch for connector types to ensure you get the connectors you need.

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- Have you decided on cabling? When setting up a star network you'll need Category 3 10BASE-T (for 10 Mbps Ethernet) or Category 5 100BASE-TX cable (for either 10 Mbps or 100Mbps Fast Ethernet). The speed of your network will determine the type and quality of your cable.

- Check how many segments of cable you will need, and lengths of each cable. This will give you an idea of how many hubs, switches, or bridges you may need, if any.

Remember, If you have less than 8 items to connect, one 8-port hub will do nicely—and it uses the simplest of cabling: 10BASE-T (or 100BASE-TX for Fast Ethernet) with modular RJ-45 connectors.

3. Have you chosen a Network Operating System?

- If you're using Windows NT, you already have networking operating software in your computer.

- Is it on all computers to be networked?

- Follow the instructions in the provider's manual when setting up your network.

4. Finally, look at all the equipment, distances and workgroups.

- Is the network layout the best for my network size?

- Will people be able to communicate within their workgroups and to the rest of the network as needed?

- Review "Helpful Networking Tips" beginning on page 16 if you are unsure, paying particular attention to cable lengths, overall network distance and number of nodes and hubs on the network.

5. If you have complied with all the issues of maintaining Ethernet standards, you are ready to proceed.

- Acquire all necessary equipment and cables.

- Follow your plan carefully.

Solving Problems

This section explains what to look for first if your network is experiencing difficulty, and offers simple answers to common problems.

What to Check Right Away

Before anything else, check all cable and power connections to determine if they are the source of any problem.

- RJ-45's (10BASE-T connectors) should be securely seated.
- A bad cable should be replaced immediately.
- If you're using BNC (coax) connectors, each connection must be locked securely in place.
- All open ends of a BNC bus network must have 50 ohm terminators installed.

The computer and the connecting networking device (hub, bridge, switch, etc.) must be plugged in and powered on for a connection status (link) light to function.

Cable quality and lengths must be within standards. Keep cable lengths as short as possible to improve networking performance. When connecting multiple 10 Mbps hubs together, follow cabling diagrams provided by the manufacturer exactly.

When connecting using the Out to Hub/X port, Intel InBusiness products do not require a special cable; a standard "straight-through" cable is all that is required for this connection (sometimes called cascading or daily-chaining). Follow the manufacturer's connection diagrams exactly when cascading and making connections to your network equipment.

Intel Products

Intel InBusiness™ products are designed with ease-of-use, quality, and value. When expanding an existing network, or starting from scratch, Intel's networking products and excellent technical staff are there to help.

Intel offers a complete line of standard Ethernet and Fast Ethernet networking products. A brief description of Intel small-business networking products is included in this section.

Stackable Networking Products

The Intel InBusiness networking products provide everything that small offices need to easily share resources and increase productivity. Designed specifically for small networks, the Intel InBusiness products provide all the benefits of networking without the complexity.

Intel InBusiness™ Product Family

Unique Design for Small Networks
The unique, super-compact form of Intel InBusiness products is perfect for small networks. The SureStack™ locking connectors make it easy to connect other Intel InBusiness products in one convenient and attractive stack. This built-in feature means that this family of products can be grouped into one stack placed horizontally or vertically, or even mounted on a wall. The small size makes desktop or shelf placement easy.

Plug and Play

Intel InBusiness products are designed for plug and play installation, making them easy enough to install in minutes. Simple port labeling makes it easy to identify and make proper connections.

Cable Management Ring

The exclusive CableKeeper ring allows you to draw cables neatly out of the way, eliminating the confusing mess of cables associated with some networking products.

Products for Every Connection

Intel InBusiness products are part of a complete line of networking products designed specifically for small networks. Other Intel networking products include Ethernet adapters, hubs, bridges and routers; everything you need to install a network and begin sharing resources.

FREE Technical Support

All Intel InBusiness products come with free technical support for 90 days after the initial call. One-on-one, friendly technical support is available during normal business hours and additional weekend hours.

Networking Products

Internet Station

The Internet Station is Intel's answer to "How can everyone on my network gain simple, affordable access to the Internet?" With a single service provider account and Intel's Setup Wizard, your networked group can share a single dedicated modem; whether analog or high-speed ISDN. Two other modems can also be connected to the Internet Station and shared for bulletin board connections or data and fax transmissions. One serial connection and two PC card slots are included. InstantIP™ technology configures your computer to the Internet Station in minutes easily and inexpensively. A browser software program is included.

5- and 8-Port Hubs

Intel InBusiness 5- and 8-Port Hubs are designed so you can easily create your own small network or expand an existing one. Hubs are the perfect solution for sharing computers and other resources. These hubs include an "Out to Hub/X" port for easy cascade connections.

8-Port Switch and Switch Plus

Intel InBusiness switches are designed for small networks needing extra-performance. Because these switches are 10BASE-T, it won't be necessary for you to replace cabling and network adapters to increase the performance of your network. Both include the "Out to Hub/X" port for easy cascade connections. The Plus model also includes two 10/100 Mbps auto-sensing bridge ports for easy cascading to other 10 or 100 Mbps networking computers or servers. (These ports can also connect to hubs, bridges or switches using a crossover cable.)

4- and 8-Port Fast Ethernet Hubs and Fast Hub Plus

Intel InBusiness 4- and 8-Port Fast Ethernet Hubs are perfect for adding 100Mbps performance to your network. Designed for users who transfer large files, use databases or multimedia applications, or who otherwise burden their network, These Fast Ethernet hubs are designed for today's demanding fast Ethernet network needs. These products include the "Out to Hub/X" port for easy cascading. The Fast Hub Plus model adds a 10/100 auto-sensing bridge port. This makes it easy to connect to a 10 or 100 Mbps networking computer or server using a standard cable. Or, connect to a hub, bridge, or switch using a crossover cable.

NetportExpress™ *Print Servers*

Connect any printer anywhere on your network to print from any computer on the network. Set up the Intel NetportExpress print servers using the Windows management software or setup from your Web browser. Available for 10 Mbps Ethernet or 100 Mbps Fast Ethernet operation, and in single-port and 3-port models.

Network Adapter Cards

PCI Bus Network Adapter

Intel EtherExpress™ PRO/100 LAN adapters provide top network performance and reliability for your desktop computers and servers that support the PCI bus architecture. They can be installed in any PCI slot and connect to either 10BASE-T or 100BASE-TX networks. This flexibility allows your network to run at 10 Mbps now and migrate to 100 Mbps as your needs evolve.

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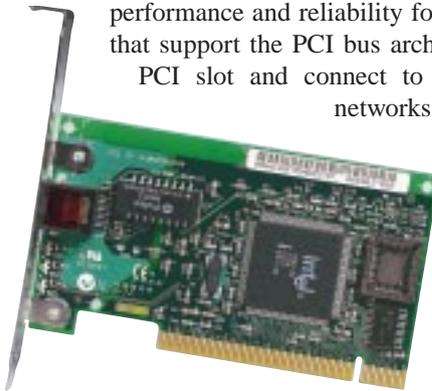
PC Card Mobile Adapters

Intel EtherExpress PRO/100 mobile adapters provide fast, flexible network connections for your portable PCs. All adapters auto-sense network speed for plug and play connections to 10 and 100 Mbps Ethernet LANs so you get the full advantage of Fast Ethernet speeds where available, and are still able to connect easily to 10 Mbps segments.

Intel EtherExpress PRO/100 Mobile Adapter LAN+Modem56 PC Card

Get complete LAN and modem support in a single high-performance card. Flexible 10/100 connectivity gives you full LAN support at the office and the 56K modem ensures peak performance over standard telephone lines on the road. Access email, send faxes and download information fast.

EtherExpress PRO/100 Mobile Adapter - 16-Bit PC Card

This card gives you the flexibility of 10/100 LAN connectivity for your portable PC using the 16 bit PCMCIA slots. As your network migrates to Fast Ethernet, your portable PC can plug right into any node of your Ethernet network.

EtherExpress PRO/100 Mobile Adapter - 32-Bit Card Bus

Maximize the network performance of your portable PCs that use Card Bus slots. This 32-bit bus-master architecture provides top performance LAN connectivity to your 100BASE-T or 100BASE-TX network.

Compatibility

Intel's Network Adapter Cards are available for 10 Mbps and 100 Mbps networks. Install 10/100 Mbps cards if you need 10 Mbps connection now and plan to upgrade to 100 Mbps network systems later.

Before introducing any networking device into your network or office equipment system, Intel recommends you review the current product literature to ensure product compatibility.

The hubs, bridges, and switches in the Intel InBusiness product line comply with most popular networking protocols. The Intel InBusiness Internet Station complies with TCP/IP, as required for Internet compatibility.

Below is a comprehensive list of the protocols and operating systems supported by Intel InBusiness products. Not all protocols are supported by every product. Please review current product literature on specific products for up-to-date information on protocols supported by each individual products to ensure compatibility.

Protocols Supported

- TCP/IP
- IPX
- NetBIOS/NetBEUI
- AFP
- DECnet
- A/UX
- NetWare NCP and IPX

Server Compliance

- Windows NT Server
- Novell NetWare* 3.x, 4.x Server
- IBM LAN Server

Operating Systems Supported

Intel InBusiness products are compatible with all popular operating systems including:

- Windows 95
- Windows NT Workstation
- Windows NT Server
- LAN Manager*
- Windows for Workgroups
- Windows 3.11
- DOS
- Novell NetWare 3.x, 4.x client
- IBM LAN Server
- UNIX SCO
- LANtastic*

Compliance and Certification Statements

FCC Radio Frequency Interference—Class A
NOTE: This equipment 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 when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equip-ment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Industry Canada Compliance Statement
This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled: Digital Apparatus, ICES-003 of Industry Canada.

This product is compliant with Safety requirements for Information Technology Equipment and Certified by Underwriters Laboratories Inc to be in compliance with UL 1950 3rd Ed./CSA 950-95, IEC 950 A1/A2/A3/A4 and classified to meet EN 60950 A1/A2/A3 requirements.

This product complies with the European Union Directives 89/336/EEC (EMC) and 73/23/EEC (LVD) by meeting the requirements of standards EN 55022 (1992), EN 50082-1 (1991) and EN 60950 A1/A2/A3.

If a modem is to be inserted or attached to this product, be sure to read the information provided with the modem and follow the instructions for installation.

Doing Business with Intel

Warranty Registration

Locate the Warranty Registration card in the center of this book. Fill in the requested information and mail the postage-free card today. Register your Intel InBusiness networking product today to receive free product support for 90 days after your initial call. This will also enable us to notify you when updates and enhancements are available.

Electronic Support Sources

Automated Electronic Help Services
You can reach Intel's automated support services 24 hours a day, every day, at no charge. These services contain up-to-date information about Intel products. You can access installation instructions, troubleshooting information and general product information.

These sites have troubleshooting, software updates, installation notes, and product information.

World Wide Web
Customer Support Message Forum: news://cs.intel.com
or   http://cs.intel.com
Customer Support: http://support.intel.com

Intel FTP
Server hostname: ftp.intel.com
Customer Support files: ftp.intel.com/pub/support
Download files: ftp://download.intel.com
Customer Support files: ftp.intel.com/pub/support

Bulletin Board Service
Dial in by modem at 8-N-1, and up to 14.4Kbps for software updates.

US and Canada: 1-503- 264-7999
Europe: l +44-1793-432955
Worldwide: 1-503-264-7999

FAX Services
Have documents sent to your fax machine or fax board.

North America: 1-800-525-3019 or 1-503-264-6835
Europe: +44-1793-432-509

If you are unable to find the information you need on one of our electronic services, you may need to call a Customer Support specialist. For a list of all Intel support centers, the telephone numbers, and the times they are open, download document 9089 from one of the automated services.

Support for Intel InBusiness™ Products

If you don't have access to automated services, contact your local dealer or distributor, or, call +1-916-377-7000 from 7:00 a.m. to 8:00 p.m. U.S., Monday through Friday and Saturday from 7:00 a.m. to 3:00 p.m. Pacific time.

Technical Support for your Intel InBusiness product is free for 90 days after your initial call. Following the 90-day free support, you can purchase a support plan. For details about Intel Support Service, download document 8549 from one of the automated services or call 1-800-404-2284. Ask the Technical Support representative for details.

Telephone Technical Support

Intel has technical support centers worldwide. Many of the centers are staffed by technicians who speak the local languages.

North America
Support hours are Monday through Friday between 7 a.m. and 8 p.m., and Saturday between 7 a.m. and 3 p.m., Pacific time. Call **1-916-377-7000.**

Europe
Support hours are Monday through Friday between 08:00 and 17:00 (UK time) and 09:00 and 18:00 (Continental Europe)

English	**+44 1793 404900**
French	**+44 1793 404988**
German	**+44 1793 404777**
Italian	**+44 1793 404141**

Asia-Pacific Region
Support hours are Monday through Friday 06:00 to 17:00. (Singapore local time)

Australia (Sydney)	**1-800-649-931**
Hong Kong	**+852020844-4456**
Korea	**+822-767-2595**
Singapore	**+65-831-1311**
Taiwan	**+886-2-718-9915**

In these regions, you may also contact your local dealer or distributor. Or, call the North American Service Center at **1-503-264-7354**.

Returning Products

North America Only

If the Customer Support Group representative determines that the product is defective, an RMA number will be issued to you. Call 1-800-404-2284 for assistance. The RMA number must be clearly visible on the outer package. Intel cannot accept any product for return without an RMA number visible on the package.

All Other Regions

Return material authorization will be handled via the dealer, or distributor where the product was purchased.

Warranty Statements

Read the following warranty statements to make sure you understand the warranty provisions for your product.

Intel InBusiness Internet Station
(**All regions except Europe**)

LIMITED HARDWARE WARRANTY
ONE-YEAR WARRANTY

Intel warrants to the original owner that the product delivered in this package will be free from defects in material and workmanship for one (1) year following the latter of: (i) the date of purchase only if you register by returning the registration card as indicated thereon with proof of purchase; or (ii) the date of manufacture; or (iii) the registration date if by electronic means provided such registration occurs within 30 days from purchase. This warranty does not cover the product if it is damaged in the process of being installed.

THE ABOVE WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NONINFRINGEMENT, OR ANY WARRANTY ARISING OUT OF ANY PROPOSAL, SPECIFICATION OR SAMPLE.

This warranty does not cover replacement of products damaged by abuse, accident, misuse, neglect, alteration, repair, disaster, improper installation or improper testing. If the product is found to be otherwise defective, Intel, at its option, will replace or repair the product at no charge except as set forth below, provided that you deliver the product along with a return material authorization (RMA) number (see below) either to the company from whom you purchased it or to Intel. If you ship the product, you must assume the risk of damage or loss in transit. You must use the original container (or the equivalent) and pay the shipping charge. Intel may

replace or repair the product with either a new or reconditioned product, and the returned product becomes Intel's property. Intel warrants the repaired or replaced product to be free from defects in material and workmanship for a period of the greater of: (i) ninety (90) days from the return shipping date; or (ii) the period of time remaining on the original one (1) year warranty.

This warranty gives you specific legal rights and you may have other rights which vary from state to state. All parts or components contained in this product are covered by Intel's limited warranty for this product; the product may contain fully tested, recycled parts, warranted as if new. For warranty information call one of the numbers below.

Returning a Defective Product (RMA)
Before returning any product, contact an Intel Customer Support Group and obtain an RMA number by calling:

North America only: **+503 629-7000**

Other regions except Europe:
Return material authorization will be handled via the dealer, or bistributor where the product was purchased.

If the Customer Support Group verifies that the product is defective, they will have the Return Material Authorization Department issue you an RMA number to place on the outer package of the product. Intel cannot accept any product without an RMA number on the package.

LIMITATION OF LIABILITY AND REMEDIES

INTEL SHALL HAVE NO LIABILITY FOR ANY INDIRECT OR SPECULATIVE DAMAGES (INCLUDING, WITHOUT LIMITING THE FOREGOING, CONSEQUENTIAL, INCIDENTAL AND SPECIAL DAMAGES) ARISING FROM THE USE OF OR INABILITY TO USE THIS PRODUCT, WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, TORT, OR UNDER ANY WARRANTY, IRRESPECTIVE OF WHETHER INTEL HAS ADVANCE NOTICE OF THE POSSIBILITY OF ANY SUCH DAMAGES, INCLUDING, BUT NOT LIMITED TO LOSS OF USE, BUSINESS INTERRUPTIONS, AND LOSS OF PROFITS, NOTWITHSTANDING THE FOREGOING, INTEL'S TOTAL LIABILITY FOR ALL CLAIMS UNDER THIS AGREEMENT SHALL NOT EXCEED THE PRICE PAID FOR THE PRODUCT. THESE LIMITATIONS ON POTENTIAL LIABILITIES WERE AN ESSENTIAL ELEMENT IN SETTING THE PRODUCT PRICE.   INTEL NEITHER ASSUMES NOR AUTHORIZES ANYONE TO ASSUME FOR IT ANY OTHER LIABILITIES.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

Intel InBusiness Hubs and Switches
(**All regions except Europe**)

LIMITED HARDWARE WARRANTIES
LIMITED LIFETIME WARRANTY

Intel warrants to the original owner that the hub or switch product delivered in this package (excepting power supply and fan) will be free from defects in material and workmanship for the lifetime of the original owner beginning on the date or purchase, providing the original owner registers as described below. This warranty does not cover the product if it is damaged in the process of being installed. You must register by returning the registration card included with proof of purchase, in order to obtain this warranty.

LIMITED WARRANTY

Intel warrants to the original owner that power supply and fan in the hub or switch product delivered in this package will be free from defects in material and workmanship for three (3) years following the latter of: (i) the date of purchase only if you register by returning the registration card as indicated thereon with proof of purchase; or (ii) the date of manufacture; or (iii) the registration date if by electronic means provided such registration occurs within 30 days from purchase. This warranty does not cover the product if it is damaged in the process of being installed.

THE ABOVE WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR ANY WARRANTY ARISING OUT OF ANY PROPOSAL, SPECIFICATION OR SAMPLE.

This warranty does not cover replacement of products damaged by abuse, accident, misuse, neglect, alteration, repair, disaster, improper installation or improper testing. If the product is found to be otherwise defective, Intel, at its option, will replace or repair the product at no charge except as set forth below, provided that you deliver the product along with a return material authorization (RMA) number (see below) either to the company from whom you purchased it or to Intel. If you ship the product, you must assume the risk of damage or loss in transit. You must use the original container (or the equivalent) and pay the shipping charge. Intel may replace or repair the product with either a new or reconditioned product, and the returned product becomes Intel's property. Intel warrants the repaired or replaced product to be free from defects in material and workmanship for a period of the greater of: (i) ninety (90) days from the return shipping date; or (ii) the period of time remaining on the original limited lifetime warranty.

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This warranty gives you specific legal rights and you may have other rights which vary from state to state. All parts or components contained in this product are covered by Intel's limited warranty for this product; the product may contain fully tested, recycled parts, warranted as if new. For warranty information call one of the numbers below.

Returning a Defective Product (RMA)
Before returning any product, contact an Intel Customer Support Group and obtain an RMA number by calling:

North America only: **+503 629-7000**

Other regions except Europe:
Return material authorization will be handled via the reseller only.

If the Customer Support Group verifies that the product is defective, they will have the Return Material Authorization Department issue you an RMA number to place on the outer package of the product. Intel cannot accept any product without an RMA number on the package.

LIMITATION OF LIABILITY AND REMEDIES

INTEL SHALL HAVE NO LIABILITY FOR ANY INDIRECT OR SPECULATIVE DAMAGES (INCLUDING, WITHOUT LIMITING THE FOREGOING, CONSEQUENTIAL, INCIDENTAL AND SPECIAL DAMAGES) ARISING FROM THE USE OF OR INABILITY TO USE THIS PRODUCT, WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, TORT, OR UNDER ANY WARRANTY, IRRESPECTIVE OF WHETHER INTEL HAS ADVANCE NOTICE OF THE POSSIBILITY OF ANY SUCH DAMAGES, INCLUDING, BUT NOT LIMITED TO LOSS OF USE, BUSINESS INTERRUPTIONS, AND LOSS OF PROFITS, NOTWITHSTANDING THE FOREGOING, INTEL'S TOTAL LIABILITY FOR ALL CLAIMS UNDER THIS AGREEMENT SHALL NOT EXCEED THE PRICE PAID FOR THE PRODUCT FOR THE PRODUCT. THESE LIMITATIONS ON POTENTIAL LIABILITIES WERE AN ESSENTIAL ELEMENT IN SETTING THE PRODUCT PRICE.   INTEL NEITHER ASSUMES NOR AUTHORIZES ANYONE TO ASSUME FOR IT ANY OTHER LIABILITIES.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

Intel InBusiness Internet Station
(**Europe**)

LIMITED HARDWARE WARRANTY
ONE-YEAR WARRANTY

Intel warrants to the original owner that the product delivered in this package will be free from defects in material and workmanship for one (1) year following the latter of: (i) the date of purchase only if you register by returning the registration card as indicated thereon with proof of purchase; or (ii) the date of manufacture; or (iii) the registration date if by electronic means provided such registration occurs within 30 days from purchase. This warranty does not cover the product if it is damaged in the process of being installed.

THE ABOVE WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF SATISFACTORY QUALITY, FITNESS FOR A PARTICULAR PURPOSE, OR NONINFRINGEMENT, OR ANY WARRANTY ARISING OUT OF ANY PROPOSAL, SPECIFICATION OR SAMPLE.

This warranty does not cover replacement of products damaged by abuse, accident, misuse, neglect, alteration, repair, disaster, improper installation or improper testing. If the product is found to be otherwise defective, Intel, at its option, will replace or repair the product at no charge except as set forth below, provided that you deliver the product along with a return material authorization (RMA) number (see below) either to the company from whom you purchased it or to Intel. If you ship the product, you must assume the risk of damage or loss in transit. You must use the original container (or the equivalent) and pay the shipping charge. Intel may replace or repair the product with either a new or reconditioned product, and the returned product becomes Intel's property. Intel warrants the repaired or replaced product to be free from defects in material and workmanship for a period of the greater of: (i) ninety (90) days from the return shipping date; or (ii) the period of time remaining on the original one (1) year warranty.

All parts or components contained in this product are covered by Intel's limited warranty for this product; the product may contain fully tested, recycled parts, warranted as if new. For warranty information call one of the numbers below.

English	**+44 1793 404900**
French	**+44 1793 404988**
German	**+44 1793 404777**
Italian	**+44 1793 404141**

Returning a Defective Product (RMA)
Return the product to the place of purchase for a refund or replacement.

LIMITATION OF LIABILITY AND REMEDIES

INTEL SHALL HAVE NO LIABILITY FOR ANY INDIRECT OR SPECULA-TIVE DAMAGES (INCLUDING, WITHOUT LIMITING THE FOREGOING, CONSEQUENTIAL, INCIDENTAL AND SPECIAL DAMAGES) ARISING FROM THE USE OF OR INABILITY TO USE THIS PRODUCT, WHETHER ARISING OUT OF CONTRACT, NEGLIGENCE, TORT, OR UNDER ANY WARRANTY, IRRESPECTIVE OF WHETHER INTEL HAS ADVANCE NOTICE OF THE POSSIBILITY OF ANY SUCH DAMAGES, INCLUDING, BUT NOT LIMITED TO LOSS OF USE, BUSINESS INTERRUPTIONS, AND LOSS OF PROFITS, NOTWITHSTANDING THE FOREGOING, INTEL'S TOTAL LIABILITY FOR ALL CLAIMS UNDER THIS AGREEMENT SHALL NOT EXCEED THE PRICE PAID FOR THE PRODUCT. THESE LIMITATIONS ON POTENTIAL LIABILITIES WERE AN ESSENTIAL ELEMENT IN SETTING THE PRODUCT PRICE. INTEL NEITHER ASSUMES NOR AUTHORIZES ANYONE TO ASSUME FOR IT ANY OTHER LIABILITIES.

This Limited Hardware Warranty shall be governed by and construed in accordance with the Laws of England and Wales. The courts of England shall have exclusive jurisdiction regarding any claim brought under this warranty.

Intel InBusiness Hubs and Switches
(**Europe**)

LIMITED HARDWARE WARRANTIES
LIMITED WARRANTY

Intel warrants to the original owner that the hub or switch product delivered in this package (excepting power supply and fan) will be free from defects in material and workmanship for the lifetime of the original owner beginning on the date or purchase, providing the original owner registers as described below. This warranty does not cover the product if it is damaged in the process of being installed. You must register by returning the registration card included with proof of purchase, in order to obtain this warranty.

LIMITED WARRANTY

Intel warrants to the original owner that power supply and fan in the hub or switch product delivered in this package will be free from defects in material and workmanship for three (3) years following the latter of: (i) the date of purchase only if you register by returning the registration card as indicated thereon with proof of purchase; or (ii) the date of manufacture; or (iii) the registration date if by electronic means provided such registration occurs within 30 days from purchase. This warranty does not cover the product if it is damaged in the process of being installed.

THE ABOVE WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF SATISFACTORY QUALITY, FITNESS FOR A PARTICULAR PURPOSE OR ANY WARRANTY ARISING OUT OF ANY PROPOSAL, SPECIFICATION OR SAMPLE.

This warranty does not cover replacement of products damaged by abuse, accident, misuse, neglect, alteration, repair, disaster, improper installation or improper testing. If the product is found to be otherwise defective, Intel, at its option, will replace or repair the product at no charge except as set forth below, provided that you deliver the product along with a return material authorization (RMA) number (see below) either to the company from whom you purchased it or to Intel. If you ship the product, you must assume the risk of damage or loss in transit. You must use the original container (or the equivalent) and pay the shipping charge. Intel may replace or repair the product with either a new or reconditioned product, and the returned product becomes Intel's property. Intel warrants the repaired or replaced product to be free from defects in material and workmanship for a period of the greater of: (i) ninety (90) days from the return shipping date; or (ii) the period of time remaining on the original limited lifetime warranty.

All parts or components contained in this product are covered by Intel's limited warranty for this product; the product may contain fully tested, recycled parts, warranted as if new. For warranty information call one of the numbers below.

English	**+44 1793 404900**
French	**+44 1793 404988**
German	**+44 1793 404777**
Italian	+44 1793 404141

Returning a Defective Product (RMA)
Return the product to the place of purchase for a refund or replacement.

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LIMITATION OF LIABILITY AND REMEDIES

INTEL SHALL HAVE NO LIABILITY FOR ANY INDIRECT OR SPECULA-
TIVE DAMAGES (INCLUDING, WITHOUT LIMITING THE FOREGOING,
CONSEQUENTIAL, INCIDENTAL AND SPECIAL DAMAGES) ARISING
FROM THE USE OF OR INABILITY TO USE THIS PRODUCT, WHETHER
ARISING OUT OF CONTRACT, NEGLIGENCE, TORT, OR UNDER ANY
WARRANTY, IRRESPECTIVE OF WHETHER INTEL HAS ADVANCE
NOTICE OF THE POSSIBILITY OF ANY SUCH DAMAGES, INCLUDING,
BUT NOT LIMITED TO LOSS OF USE, BUSINESS INTERRUPTIONS, AND
LOSS OF PROFITS, NOTWITHSTANDING THE FOREGOING, INTEL'S
TOTAL LIABILITY FOR ALL CLAIMS UNDER THIS AGREEMENT SHALL
NOT EXCEED THE PRICE PAID FOR THE PRODUCT FOR THE PRODUCT.
THESE LIMITATIONS ON POTENTIAL LIABILITIES WERE AN ESSEN-
TIAL ELEMENT IN SETTING THE PRODUCT PRICE. INTEL NEITHER
ASSUMES NOR AUTHORIZES ANYONE TO ASSUME FOR IT ANY OTHER
LIABILITIES.

This limited hardware warranty shall be governed by and construed in accordance
with the Laws of England and Wales. The courts of England shall have exclusive
jurisdiction regarding any claim brought under this warranty.

More Networking Terms

10BASE-T cable
A popular Ethernet cable using twisted-pair wiring with RJ-45 plugs at each end. Category 3 10BASE-T cable is used with 10 Mbps Ethernet networks.

10 Mbps
10 Megabits per second; standard Ethernet operating speed. (Also called bandwidth.)

100 BASE-TX cable
An Ethernet cable system using Category 5 twisted-pair wiring with RJ-45 plugs at each end. Used with 100 Mbps Fast Ethernet networks.

100 Mbps
100 Megabits per second; Fast Ethernet operating speed. (Also called bandwidth.)

address learning
Each node on a network has a unique node address automatically assigned to it (embedded in the adapter card). Switches "learn" this address to enable accurate transmission to and from each node.

auto partitioning
A feature on some network devices that isolates a node within the workgroup when the node becomes disabled, so as not to affect the entire workgroup or network.

backbone
A central network cable system that connects a number of other networks. A backbone network is often constructed using thin Ethernet.

baud
An older term meaning the rate of speed of a modem. Baud is often confused with bps, or bits per second. (Actually, a 1200 bit per second modem runs at 300 baud.)

bandwidth
The term bandwidth is loosely used in networking terminology to describe the rate at which a network can transfer data. Standard Ethernet operates at 10 Mbps. Fast Ethernet operates at 100 Mbps.

BNC
A high grade locking connector used with thin and thick Ethernet cabling.

bridge
Bridges are used to connect two or more network segments together so that equipment on the networks can communicate. (See also switch.)

broadcast
A network transmission sent to all nodes on the network.

broadcast storm
Network messages that overload the network capacity. Broadcast storms also occur when old and new TCP/IP routers are on the same network.

bus topology
A networking setup in which a single cable, such as thin Ethernet, is used to connect one computer to another like a daisy chain to carry data over a network.

cascading
Connecting hubs together with 10BASE-T cabling. Sometimes requires a crossover cable. Also called daisy-chaining.

Category 3 cable
A 10BASE-T unshielded twisted-pair cabling type commonly used in today's 10 Mbps Ethernet networks.

Category 5 cable
A higher grade of unshielded twisted-pair cabling required for networking applications such as 100 Mbps Fast Ethernet. It is most commonly found in buildings that were wired within the last five years.

client
A computer connected to a network or shared resource server.

client software
Web browsers such as Internet Explorer*, Navigator*, Mosaic*, etc., are all client software programs used for accessing the Internet. Each client must have software compatible with the server in order to communicate properly.

Client/Server
A network computing system in which individual computers (clients), use a central computer (server) for such services as file storage, printing, and communications. (See peer-to-peer.)

coaxial cable
Thin or thick coax cable used in Ethernet networking, usually in a bus topology or backbone use. (Also called 10BASE 2 or thinnet.)

collisions
Two packets sent over the network segment simultaneously will collide and be rejected. Ethernet will automatically resend them at altered timing to ensure proper receipt.

communications software
Software (such as email and faxing software) that allows users to send or receive data remotely.

CPU
The term Central Processing Unit started out meaning the brain or processing chip of the computer and has evolved to mean the box of the computer. On a network, known as a node.

crossover cable
A cable in which the receive and transmit lines (input and output) are crossed. Crossover cables are sometimes needed to connect hubs together.

crosstalk
Signal noise passed between network cable or devices.

data transmission speed
The number of bits that are transmitted per second over a network cable.

dedicated server
A computer on a network that is assigned to function only as a resource server and cannot be used as a client.

device
In this book, device refers to a piece of networking equipment such as a hub, switch, repeater, bridge, router, etc.

driver
A software program that allows a computer system to communicate with other equipment. The driver manipulates the hardware in order to transmit data to the equipment.

email
Method of sending electronic messages using modem and communication software.

Ethernet
Networking standards originally developed in 1973 by Xerox and formalized in 1980 by DEC, Intel, and Xerox which transmits data at 10 Mbps using a specified protocol. The most popular LAN technology in use today. (See Fast Ethernet.)

Ethernet address
Each Intel InBusiness product and networking devices such as Network Adapter Cards, has its own unique Ethernet address pre-programmed. The address is obtained automatically when required by network transmission. This number identifies the node or networking device as a unique communication item and enables direct communications to and from that particular computing device.

Fast Ethernet
An Ethernet networking system which transmits data at 100 Mbps.

fax software
Communication software that allows users to create, send, receive, and print documents as faxes from their personal computer.

file server
A dedicated network computer used by client computers to store and access software and work files.

filtering process
An Ethernet switch or bridge process that reads the contents of a packet and discards it if it does not need to be forwarded.

filtering rate
A filtering rate is the rate at which an Ethernet device can receive packets and drop them without any loss of incoming packets or delay in processing.

full-duplex
Two-way simultaneous communication. The ability to send and receive electronic signals at the same time.(See half-duplex.)

half-duplex
One way communication at any one time. The send and receive portions of electronic communication are separate. Half-duplex is the standard mode.

hardware
Components of a computer system including monitors, hard drives, CD-ROMs, printers, keyboards, a mouse, portable hard drives, modems, etc.

hop count
A term used when counting components and sections of wire in an Ethernet network to determine whether Ethernet compliance has been met.

hub
Also referred to as a "repeater" or "concentrator", its primary function is to receive and send signals along the network between the nodes connected to it. In a LAN, a hub is the core of an Ethernet star network. A hub can be either an active or passive wiring hub. Its useful management capability isolates nodes from disruption on the network. (See repeater.)

Internet
A worldwide network of information which can be accessed by a modem and communication software through an Internet Service Provider.

internetwork
A large, multi-segment network that includes communication between two networks or two types of networks. Bridges or routers are the devices that join LANs.

Intranet
While similar to the Internet, this is a private, network within a company or other organization that does not run on the Internet. It usually looks just like the Internet, but is separated by a firewall. It is usually set up with locations and pages and functions with th email system. It is used for a variety of inter-company purposes including posting company policy, announcing job openings, listing engineering projects and schedules, meeting announcements, posting sales, benefits coordination, etc.

IP
Internet Protocol. TCP/IP protocol for packet forwarding. (See also TCP/IP)

IPX
(Internet Packet eXchange.) A Novell NetWare protocol similar to IP (Internet Protocol).

ISA
Industry Standard Architecture. The most common bus architecture on a DOS based computer. Also called classic bus. A unique network interface card slot specifically designed for an ISA card on the motherboard of a computer.

ISDN
Integrated Services Digital Network. Digital switching and carrying data, voice, computer transmissions, music and video at speeds exceeding that of traditional analog telephone lines.

kilobit
One thousand bits of data. 240 kilobits per second means 240,000 bits of information are being transmitted per second over a network (240 Kbps).

LAN
Stands for Local Area Network. A network in a localized (not remote) location that allows users to share files, printers and other print services.

LEDs
Light emitting diode. Small indicator lights on electronics and networking devices that provide indication of status and other information about the device.

media
In this book, networking wiring such as 10BASE-T and 100BASE-TX UTP cable, and coax cable is referred to as media. Other media includes radiowave and fibre optic.

Megabit
One million bits of data. (10 Megabits per second, or Mbps, means that 10 million bits of data are being transmitted over the network per second.)

modem
An acronym from "modulator and demodulator." It converts analog to digital and digital to analog signals. A communications product that sends computer transmission over a standard telephone line at preset speeds.

NetBIOS/NetBEUI
The acronym for NetBIOS is "network based input/output system." The acronym for NetBEUI is "NetBIOS extended user interface." Often used in Microsoft's LAN Manager and Windows NT protocols.

network
The means by which computers and other networking devices are connected together so that print services, files, equipment, and software applications may be shared.

NIC
Network Interface Cards, also called adapter cards. They serve as the interface between the computer and the network cable for sending and receiving data.

node
Computing equipment such as a computer, printer, modem, server, etc. that is connected in a LAN containing the capability of communicating with other network nodes, and networking devices such as hubs, switches, routers, bridges, etc.

Network Operating System
NOS. A special application that allows computers and other devices on the network to send and receive information.

packet
A unit of transmitted information that follows specific protocols and contains codes that include precise sending and receiving of information from one networked node to another.

PC Card
Communication cards roughly the size of a credit card that fit into the small PC Card slot of portable computers or other networking devices. Formerly called PCMCIA cards, these adapters offer Ethernet access, data/fax/modem capability and other services to portable computers.

PCI
Peripheral Component Interconnect bus architecture. This is a 32/64 bit local bus architecture on the motherboard of a computer inside a PC or Macintosh, designed by Intel. It is used to connect network interface cards. Its operation is faster than an ISA or EISA bus.

peer-to-peer
All connected computers on this network type communicate directly without the use of a dedicated server. (See Client/Server.)

peripherals
Equipment such as disk drives, CD-ROM drives, modems, printers, fax machines, keyboards, etc. that are connected to a computer.

Plug and Play
An identifying specification in the PC market that assures the user that the product is as simple or automatic to install as possible; both hardware and software installation.

port
A connector on your computer or networking device that is used to attach the cabling. A connector type includes RJ-11 (telephone connection), RJ-45 (communications connection), and BNC (locking-type connector for coax or backbone connections). A typical port would be used to connect the adapter card in your computer to the hub, or the modem to your Internet Station, or any of the connections on a hub, switch, or router.

protocol
A set of procedures or rules for sending and receiving information on a network.

repeater
A network device that regenerates signals so they can extend the cable length.

ring topology
A basic networking topology where all nodes are connected in a circle, with no terminated ends on the cable, like token ring.

RJ-11
A standard telephone connector.

RJ-45 plug
The connector on the end of 10BASE-T or 100BASE-TX twisted-pair cabling; looks much like a telephone plug.

RJ-45 jack
The connector on the back of a computer or printer that accepts the RJ-45 plug; looks much like an RJ-11 telephone jack, but is larger.

ROM
Read Only Memory.

router
A complex network device used to connect two or more networks together. A router reads information sent along the network and determines its correct destination.

segment
With Intel InBusiness products, we mean the length of cable on a network between two terminators.

serial port
Communications path through which data is transferred in bytes. Only one wire each is available for transmitted and received data; character bits are sent sequentially between two nodes, one at a time.

server
A computer that provides shared resources to network users.

server-based network
A network in which all client computers use a dedicated central server computer for network functions such as storage, security and other resources.

shared data
Files on the server that can be shared across the network.

shared Ethernet
Standard 10BASE-T Ethernet method of sending data to a hub which then rebroadcasts this data to every node or port on the network until it reaches all nodes. (See switched Ethernet.)

shared resources
Files, printers, peripherals and other services that can be shared across the network.

signal bounce
When a bus topology network cable has not been properly terminated at each end of every open cable, the signal from the network will travel from one end of the cable to the other and then will continually bounce back the way it came.

star topology
A networking setup used with 10BASE-T or 100BASE-TX cabling. Each node on the network is connected to the hub like points of a star. (See bus topology.)

store-and-forward
The most accurate data transferring technique used by switches, it examines each packet of a transmission to verify accuracy, and ensure bad or misaligned packets are eliminated, then sends good packets to their destination. When the network is busy, packets are stored until the network is able to carry the traffic and packets are transmitted without error.

subnet
A network segment connected by hubs or repeaters. Subnets can stand alone, can be connected to other subnetworks to form a small LAN, or can be connected to a larger network.

switch
Similar to but more sophisticated than a hub, a switch learns network addresses automatically, providing a private line to the network. A node or a fully populated hub can connect to a switch. A switch is a key component in network expansion (See also bridge.)

switched Ethernet
Unlike shared Ethernet, it provides a "private" connection between two nodes on a network, speeding up the rate at which data is sent along the network and eliminating collisions. (See Shared Ethernet.)

TCP/IP
Transmission Control Protocol/Internet Protocol. Originally two separate protocols, now they are almost always used together. The term TCP has evolved to mean the family of common Internet protocols used by industry. It is the protocol for the Internet. It became widely accepted first in UNIX environments. It is a networking protocol with the ability to connect many widely different elements.

terminator
A 50 ohm resistor at each open end of an Ethernet coax cable that absorbs energy to prevent reflected energy back along the cable (signal bounce). It is usually attached to an electrical ground at one end.

thicknet cable
Also called standard Ethernet, used with 10 Mbps baseband networking. Often used in a backbone topology or network.

thin Ethernet cable
Usually quarter-inch black coaxial cable, identified by type as RG-58/U. Sometimes called 10BASE-2 or thinnet cable.

topology
A wiring configuration used for a network; think of it as a layout or structure. Examples are the ring, star, bus, and so on.

transceiver
Derived from transmitter/receiver, a transceiver is a device that sends and receives signals, and can connect a computer to the network, such as a network adapter card. It often provides packet collision detection, too.

twisted-pair cable
A cable used for both network communications and telephone communications. Also known as UTP (unshielded twisted-pair), it comes as 10BASE-T and 100BASE-TX cable.

UTP
Unshielded twisted-pair. Also referred to as 10BASE-T or 100BASE-TX network cable.

WAN
Wide Area Network. A very large sophisticated network that extends beyond a single building, and often extends across a city, state or farther.

workgroup
Nodes connected to a hub or switch to form a small communication grouping on the network. For instance, a LAN might have the five accounting people in one workgroup, the shipping/receiving department in another, etc.

WWW
World Wide Web. Sometimes referred to as W3. It is an incredible body of accessible information available on the many computers around the world and attached to the gargantuan computer networks called the Internet. The Internet's multimedia service contains countless areas of information, documentation, entertainment, as well as business and personal home pages.