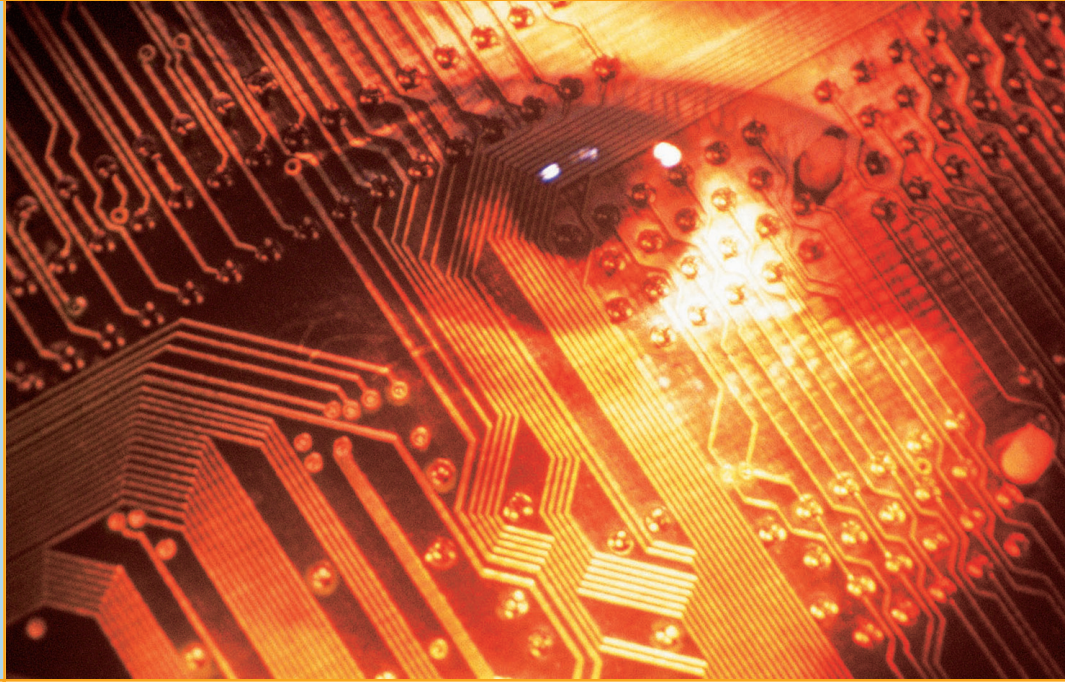


chapter  
1

# Introducing Basic Network Concepts

*"In the beginning, there were no networks. Life was bad."*

—MIKE MEYERS



**In this chapter, you will learn how to:**

- Identify human and computer networks
- Describe the benefits of networks
- Distinguish between the different types of networks

**N**etworks are everywhere—or so it seems. You can hardly do anything with data that does not involve a network. Like the human networks that we are all part of, computer networks let us share information and resources. In business, the reliance on networks is even more pervasive than in homes or schools. Networks help individuals and businesses alike save money, but they also help create income. Without a doubt, networking within the home will catch on over the next few years as it has in business. Soon, nearly all individuals in even moderately developed nations will have networked components throughout their homes. Those that don't will be *netologically* disadvantaged because they will not be able to learn or to function at the same level as those who are networked.

In this chapter, you'll begin by relating networks to situations and concepts you already know. Once you have a basic understanding of what networks are and what they can do, it helps if you can actually begin working with them. In fact, it is so helpful to learn the ropes of networking through hands-on guided practice that that's what is planned for you here. You will play the role of an employee in a fictional company, and you'll have to learn on the job. The more you *become* the person, the more you will learn about the need for and operation of computer networks.

## ■ Understanding Networks

Although you are probably taking this class to learn about computer networks, and some of you probably already know how important networks are to businesses that want to survive, we will begin this discussion as though you are an employee in a netologically disadvantaged (my term for those who have minimal network awareness) company. You might actually be an employee working for such a company and trying to help it out of that predicament, or you may know of people or companies that are in this sort of struggle.

Lauren has recently been hired as the computer manager for SinkRSwim Pools. Lauren is a certified networking administrator, but her new company unfortunately has only outdated computers. The owner recognized that the company's lack of growth was directly tied to the employees' lack of computer skills, so in her first meeting after being hired, Lauren was given the authority to purchase the additional computers and create the network she had proposed to the owner in her initial job interview. The owner gave her a six-month timeline in which to implement networking at SinkRSwim Pools in such a way that the workers will understand its use and welcome the new knowledge it requires. She was also informed that the thought of learning new computer skills frightened some long-term SinkRSwim Pools employees. The owner expects Lauren to help them become more at ease with the computers so they will be more likely to learn the necessary skills.

Lauren's first goal is to ease the workers' fears by teaching them about computers and showing them how a need for networks develops naturally. Lauren knows that if her fellow employees understand the concept of networking, the computer network will more likely be successful in the company. Lauren has decided to review basic network concepts with her coworkers as she works with them on their new computers.

## Human Networks

In its broadest sense, a **network** consists of two or more entities, or objects, sharing resources and information. Although this book is about computer networks, there are networks that don't involve computers, and those networks are everywhere. You have grown accustomed to working with them, possibly without even knowing it.

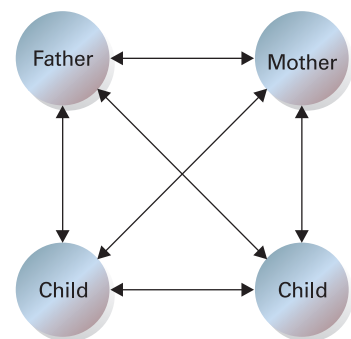
It may not matter to you that, in a basic sense, sharing (giving or getting) is a fundamental aspect of networking. You just know that you do it.

### Family Network

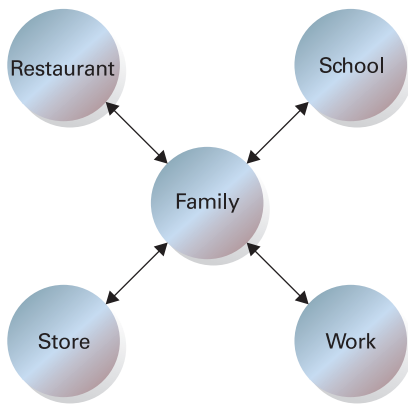
Most people belong to a family network in which related people share their resources and information. This sharing is bi-directional because even the youngest family members share information of some sort. As the family grows, so does the network.

### Peer Network

Outside the family, there is a community that offers a wider array of resources than the typical family can provide. Naturally, it makes sense to



- A network connects members of a family together.

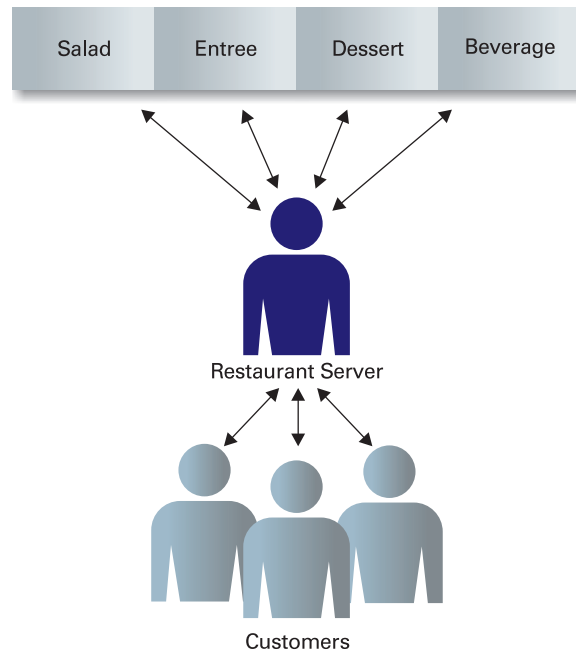


- The family network connects with the greater community.

connect the family to this community to take advantage of the wealth of resources available around town. This type of information/resource sharing can be as simple as loaning a hammer to a neighbor, car-pooling with work associates, or helping a friend with his or her homework. All of these activities involve sharing, or trading, resources. This kind of network is represented by a two-way relationship, a give and take among equals or peers.

### Restaurant Network: The Client and the Server

So, in any type of human network, there's a lot of giving and taking. You're already more accustomed to the client/server perspective in networking than you realize. For instance, when you go to dinner at a restaurant, you become a customer, or **client**, enjoying the food and drink prepared and served to you by the restaurant. On the other hand, the waiter works as a **server**, controlling and providing his customers with access to resources in the form of placing orders for and delivering food items. The server knows that requests will be made of him (access is sought when an order is placed) and that he will service those making the requests (access is granted when the order is delivered).



- In a dining situation, it is easy to know whether you are supposed to be serving or being served.

### Contact Network

Anyone who has looked for a job knows that one of the best ways to find a job is to network. That is, create a list of friends and associates who will help you find the perfect job. The more people you meet and get to know, the better your chances of obtaining work. As you develop and nurture your career, this contact network will serve you best because your role in it will



In sidebars and the end-of-chapter exercises throughout this coursebook, you will be working with a real-world company called Technology Education and Acquisition Center of Houston (TEACH) that is currently undergoing a sudden expansion. In fact, it has just posted an announcement in the local newspaper, listing several available management positions within the company. It seems there is an opportunity to acquire another highly successful facility in another part of the state, and all the current employees are moving. Later in the chapter, you will find yourself role-playing as one of the replacement candidates vying for one of the company's high-paying positions.

change as you gain more experience. Soon, you may be able to help the people who helped you. And as your personal and professional networks grow, so do your opportunities.

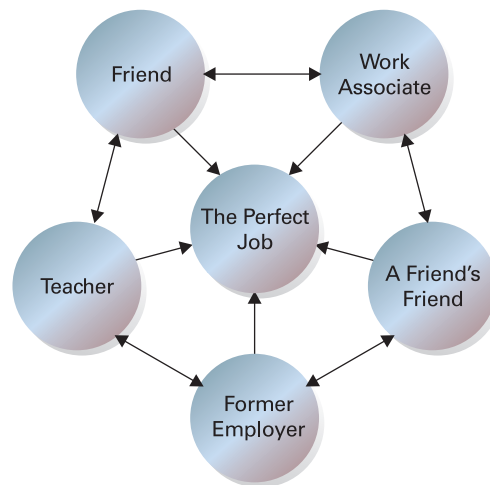
These examples of human networks should help you understand that networking is common between people and is not just an activity restricted to computers. However, this book will focus on computer networks—connecting computers and having them communicate with each other.

## Computer Networks

A **computer network** consists of two or more computing devices that are connected in order to share the components of your network (its resources) and the information you store there, as shown in Figure 1.1. The most basic computer network (which consists of just two connected computers) can expand and become more usable when additional computers join and add their resources to those being shared.

The first computer, yours, is commonly referred to as your **local computer**. It is more likely to be used as a location where you do work, a **workstation**, than as a storage or controlling location, a server. As more and more computers are connected to a network and share their resources, the network becomes a more powerful tool, because employees using a network with more information and more capability are able to accomplish more through those added computers or additional resources.

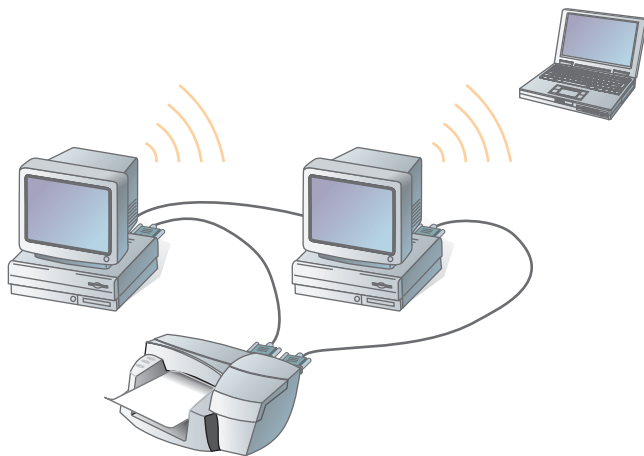
The real power of networking computers becomes apparent if you envision your own network growing and then connecting it with other distinct networks, enabling communication and resource sharing across both networks. That is, one network can be connected to another network and become a more powerful tool because of the greater resources. For example,



- The more people in your network, the better your chances of finding that perfect job.



For the remainder of this text, the term *network* will be used to mean *computer network*.



- **Figure 1.1** A computer network can be as simple as two or more computers communicating.



## Cross Check

### Identify Your Networks

You have already seen that you have been involved in networks for a long time and that computer networks are important tools for businesses. Use what you have learned as you answer the following questions:

1. Which basic human network best represents the interaction between you and your classmates in a discussion about your homework assignments?
2. If your lab had only stand-alone computers, what would be needed to convert it to a networked classroom?

you could connect the network you and your classmates develop for this course to similarly constructed networks from other introductory networking classes if you wanted them to share your information and networked resources. Those classes could be within your own school, or they could be anywhere in the world. Wherever that newly joined network is, the communication and resource sharing activities in that new network could then be shared with anyone

connected to your network. All you have to do is join that new network's community or allow its members to join yours.

In addition, a company's cost of doing business can be reduced as a result of sharing **data** (defined as a piece or pieces of information) and resources. Instead of having individual copies of the data at several locations around the company, and needing to keep all of them similarly updated, a company using a network can have just one shared copy of that data and share it, needing to keep only that one set of data updated. Furthermore, sharing networked resources (like printers) means that more people can use a particular resource and a wider variety of resources (like different printers) can be used by each network user. Any time a company can do more with less, or buy fewer items to do the same job, its total costs are reduced, and it is able to make more money per dollar spent.

## Network Plan

Networking computers first and tracking the connections later can quickly become confusing and unmanageable as you try to find which computer communicates with and shares resources with which other computers. In your human network, do you share everything with your friends? In your family network, would you want your parents or guardians to know your every thought? You have your information-sharing plan in your head, and it is important to keep track of it so you don't make a mistake and share something where it was not intended.

Similar concerns must be considered while designing a computer network. Before you even connect your first computers together, you should have a plan. A **network plan**, therefore, is a formally created product that shows all the network's components and the planned connections between them. Such a plan is also used to manage the various types of information. Your plan should show what types of information are stored where, and who is allowed to use each type.

### Information Management

Your network plan should help you manage the information gathered, stored, and shared between your users. If you were given an empty three-drawer filing cabinet and told to use it to organize your company's information, you would have an excellent (although manual) example of a filing system that needs a plan. Having an overall guide that tells you who will

be allowed access to the three drawers will help determine what you store in each one. Once you have that part of the plan, you could put the least-used information in the bottom drawer, the more-used in the middle drawer, and the most-used in the top drawer so that it is easier for your users to access their information. Knowing who needs to know what, and its corollary—who does not need to know what—lets you determine whether to lock a particular drawer, too.

Even when we discuss implementing a three-drawer manual filing system, the importance of having a network plan ahead of time becomes evident. If you put the limited-access material in a drawer open to all employees, how do you keep it secure? Additional security measures (like adding a lock to a drawer, or moving the secure information somewhere else) may be required later.

A networking plan could tell you that as specific types of sensitive data (like medical, personal, or payroll information) are gathered or grouped, they should be stored higher in the hierarchical structure (ranked from most sensitive to least sensitive), and this can save you time in the end. That plan should specify that the access requirements are stricter for sensitive data and reduce the number of people able to use specific types of information.

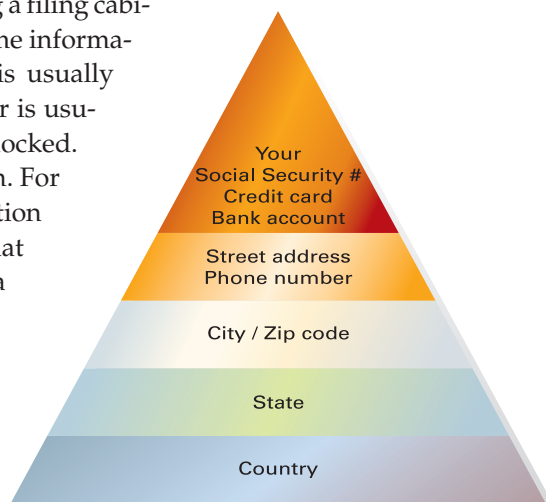
The distribution side of the networking plan, as opposed to the accumulation side of the plan discussed above, should spell out that the more an individual has access to the data in storage, the less they should be able to share groups of information entrusted to them. For example, you may not mind sharing your first name, but you would probably object to an instructor openly distributing all information in your school records to anyone requesting it.

### Information's Importance

If you think about the manual filing system we discussed using a filing cabinet, an important computing concept is easy to recognize. Some information is more important or more sensitive than the rest. It is usually obvious in real filing cabinet systems, because the top drawer is usually where the most sensitive information is stored, and it is locked. Few people in an organization have access to that information. For example, credit card or Social Security numbers are information that should be given the highest level of security—access to that information is given only to a limited number of people in a company. On the other hand, some information, such as Web pages, newsletters, and product information, is created for everyone to see, even outside a company. Figure 1.2 shows how this kind of information is organized into a **hierarchy of information**, where the most detailed information is found at the top and the more general, less secure information is located at the bottom. How much information would you be willing to provide about yourself to a perfect stranger? Country of birth? Sure. State of residence? Why not? But you might have second thoughts about advertising your street address or phone number to a stranger.



The **format**—or the strict requirements placed on the order and structure of how you enter data—is very important. The number 123456789, for instance, could be either a zip code or a Social Security number. If it is formatted as 123-45-6789, you know that it is a Social Security number. What would you do if you were told that your life depended on your making a payment to the bank on the date 010203? When would that payment be made? Would the payment date change if that date were in the year-month-day format? Of course it would, and the payment would be long overdue. Format, then, is important!



• **Figure 1.2** The hierarchy of information—The more specific the information becomes, the more restricted it should be. What kind of data would you be willing to give to a stranger?



## Cross Check

### Thinking About a Network Plan

You have just learned about the need to describe information management and data hierarchies in your network plan. It can be equally important when you receive data to know that such a plan is in place. Use what you have learned about creating a network plan as you answer the following questions:

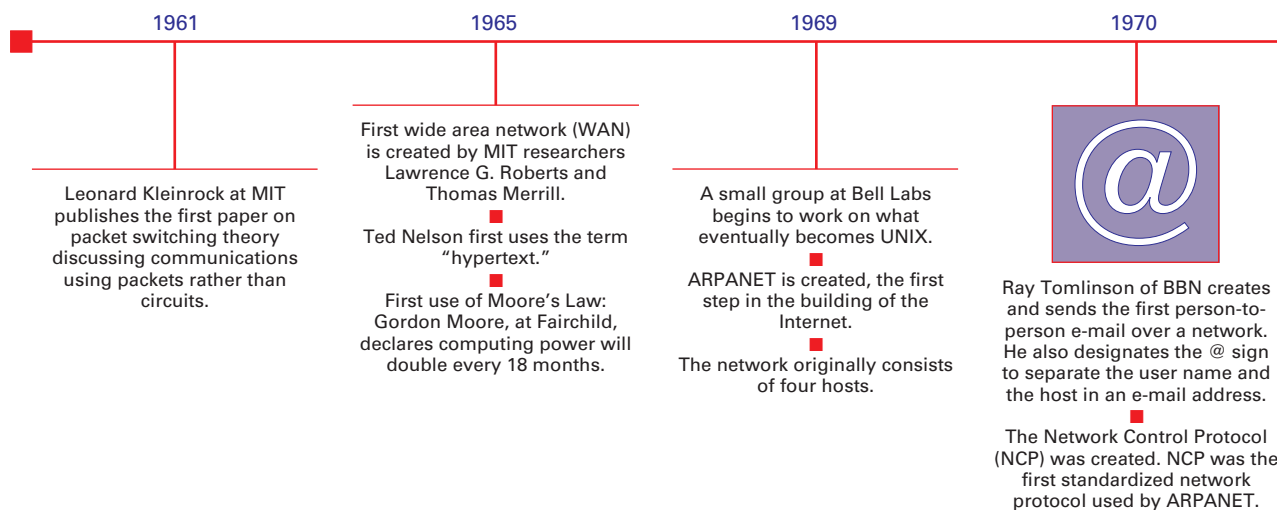
1. If you knew that your school's (or your employer's) plan stipulated that sharing sensitive information was to be strictly controlled, and you agreed with those controls, how would that knowledge affect the degree of data sensitivity that you would be willing to share over that network's resources?
2. Although you might choose to share some (or all) of your personal information with selected classmates, would you feel comfortable if you thought your instructor planned on sharing your whole file freely with everyone in your class without your permission?
3. Even if it were not yet true, would the thought of your instructor sharing your information freely affect the amount of information you shared when someone else in authority on the network requested sensitive data?

The collection and proper manipulation of many seemingly unimportant pieces of information, and the effective tracking of them, makes information management on networks so important, just as when you are maintaining a manual filing system. A single piece of information in a data field, such as your first name, can seem unimportant. However, by combining your first name with other pieces of related information, like your last name, address, age, gender, and phone number (stored in other data fields), the pieces can be put together to create a data record, which can accurately describe something (or someone) that is important—like you. Finally, combining similar records (such as records describing all your classmates) creates a file that, because it contains sensitive information from more than one source, is more sensitive than a single record.

Information sharing, therefore, has serious security issues to be considered, and network access to data must be evaluated carefully so that only those who need it can access it.

## ■ Identifying the Benefits of Networks

Ricky finds himself pondering the question, "What are networks used for?" He is the second person brought aboard SinkRSwim Pools to enhance its

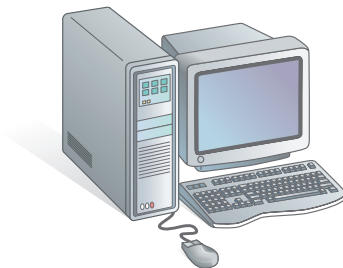


network use. Remember, that's where Lauren is creating a network to replace the company's outdated computers. Ricky volunteered to help Lauren explain the benefits of networking to the company's workers as part of his computer class project at school. The workers already have the new computers Lauren ordered and are happily doing more with them, but Ricky is helping Lauren network them and is encouraging the workers to use the network.

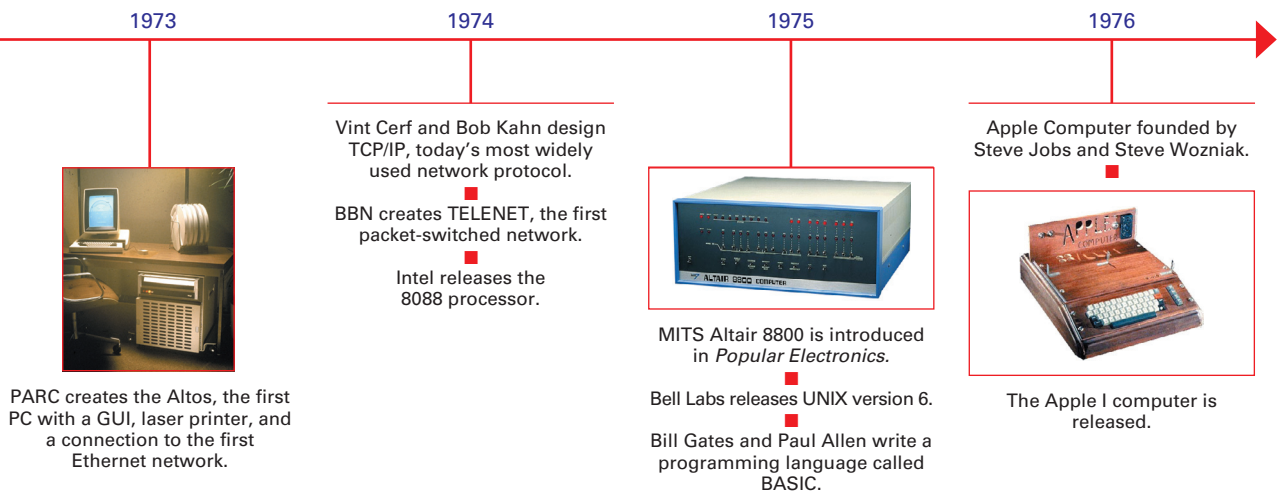
Ricky remembers Mike's words at the opening of this chapter: "In the beginning there were no networks. Life was bad." This may have meant one thing to Mike when he said it, but the beginning for these workers is right now. They haven't had networks, and they don't see why they should need them. Ricky decides to discuss the historical development of computers and show how they helped other businesses.

In the early days of the personal computer (PC), during the late '70s and early '80s, often a PC was used as a **stand-alone computer** and operated independently from other computers, as shown in Figure 1.3. When, over the span of just those few years, their use proliferated and more PCs were found relatively close to each other, users began sharing information. The information was either printed out or copied from one computer to another using backup or storage devices, such as tapes, disks, or other digital storage media.

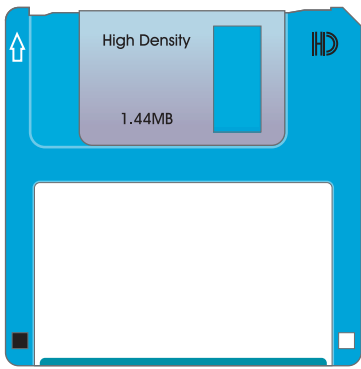
The printout or the storage device was then physically carried to another computer where the information was reentered or copied from the portable media into the next computer. This process was referred to as a **sneakernet** because users actually had to walk from computer to computer. It was



• **Figure 1.3** Stand-alone computers are operated independently.







- One sneakernet alternative was the floppy disk, which was used to transfer data between computers that were not networked.



### Inside Information

#### Computers Assist Communication

*Without computers, TEACH personnel would have a difficult time keeping up with all that is going on in the company. Even though they are in close proximity to each other, the executive section and the training section constantly communicate over the network. All employees send electronic mail, have Internet access, and keep current with company policies because they use their network's capabilities fully.*

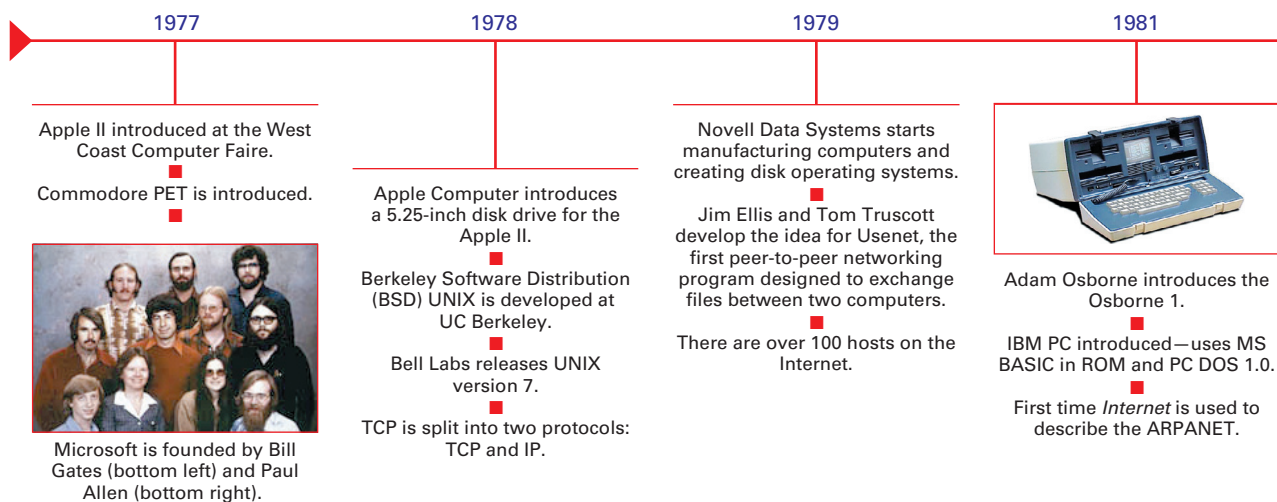
probably the cheapest type of network—unless the computers were large distances apart or the information needed to be shared among many computers. Other drawbacks to sneakernets were that printouts were often bulky, and the storage devices could hold a relatively small amount of data compared to the large amount of output users produced.

Once computers were connected by networks, information sharing increased dramatically. People found that more data helped them make better decisions, and companies started saving money. Many original networks were designed to facilitate communication, but they were quickly expanded as businesses noticed increased productivity and reduced costs.

## Sharing Information

Computers increase your ability to communicate. Once you begin working with a computer, you are likely to become more productive. However, what do you do with that increased productivity if you are not connected to anyone? Communication requires not only someone with information to share but also someone on the other end with whom to share it. Companies don't benefit by creating sheer volumes of output—they benefit when the increased output helps them make better decisions or increases the likelihood of increased income. Having your computers networked allows you to do both with your newfound increases.

The initial reason for developing most computer networks was to assist users with sharing their increased output, especially between computers in the same general vicinity, as shown in Figure 1.4. However, users wanted not only to share information with others, they wanted to communicate about that information after someone else had it, too. In addition to transmitting the user's original information, computer networks enabled those users to discuss what was being transmitted, and this resulted in even more communication. Additional network communications techniques thus came into being, such as e-mail and video conferencing. Furthermore, with the increases in the sizes of networks, sharing no longer had to be concerned with proximity. The use of networks has effectively erased distance and





• **Figure 1.4** Computer communication—Two computers in the same general vicinity should be able to communicate.

time constraints. You can communicate almost instantly to anywhere in the world that is connected to your network.

Networks are an effective way to communicate. Using networks, companies can send the same information to large numbers of employees or customers quickly and efficiently. Examples include company newsletters and announcements for employees, as well as advertisements and purchase information for customers. Also, individual employees are more likely to communicate with larger numbers of individuals both inside and outside the company using **e-mail**, an electronic means of communicating that is similar to mail but done on computers, usually over the Internet, over networks. E-mail is the most commonly used feature of the Internet, and its use is growing dramatically. In fact, e-mail is fast becoming the primary choice for much of our daily communication.

## Sharing Resources

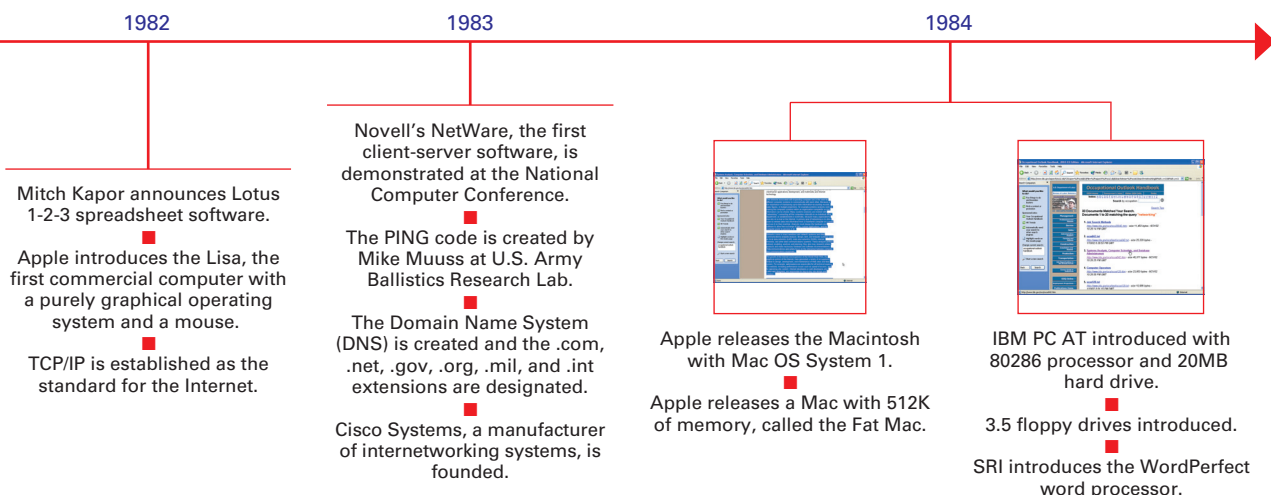
In the sneakernet era, users spent huge amounts of time attempting to share their resources. They had to physically distribute files that others needed. Expenditures for printers and other attached computer components rose



The ability of networks to be joined together to form larger networks has resulted in what is called the *Internet*—a worldwide collection of connected computers able to communicate with each other.



You should be aware that there is next to no privacy when sending e-mail. Your electronic message can not only be intercepted and read anywhere along its route to your ultimate recipient, but it can later be forwarded, without your permission, to any number of additional recipients. You should, therefore, use care in what you say as well as how you say it.



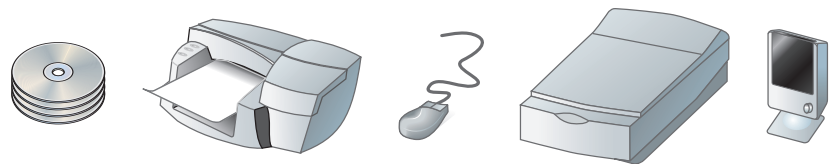
rapidly while the individual components themselves were not being used to their full capacity. On top of that, the hard disk storage on each local computer began filling up, partly because everyone had a copy of every document. One copy of that data, and even the applications that produced it, could more efficiently be stored in a single location and shared over a network.

The ability to share resources was another reason networks were created, and it is still one of the main purposes for using networks. The inevitable technology creep (the continuing need for additional investment in technology that is required to stay current) extends the computer user's involvement in technology because companies expect employees to learn new systems as they are installed. Companies also look for ways to make the best use of their investments by sharing the purchased resources among multiple departments. Let's look at some of the resources that are commonly shared over computer networks.

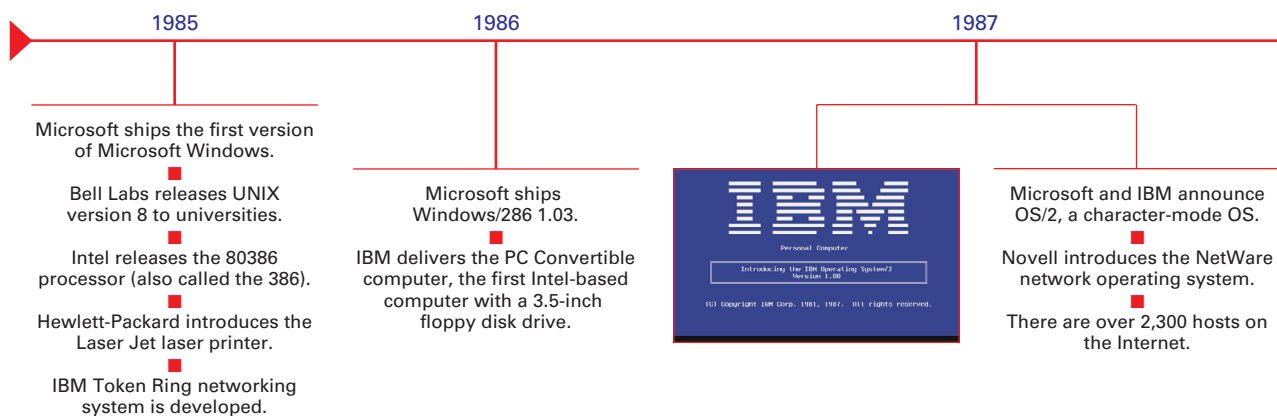
## Peripherals

Many companies start with multiple stand-alone computers. Not too long after the initial computer purchase, however, additional components that attach to a computer, called **peripherals**, like printers, scanners, and speakers, are purchased and are connected to that computer to expand its use (see Figure 1.5). When there are multiple users and computers, it soon becomes apparent that the peripheral devices are seldom fully utilized. Money can be saved if some of these peripherals are shared, instead of having to purchase a separate set for each computer. Networking enables the sharing of peripherals.

The ability to share printers was very often enough of a cost savings for companies to invest in implementing and supporting a simple network. The company could then also realize additional cost savings as it shared additional



• **Figure 1.5** Common network peripherals



peripheral devices, such as faxes, modems, scanners, plotters, and virtually any other device that connects to computers. Sharing peripherals often ends up producing significant cost savings and more than justifies the expense of adding a network.

## Storage

Data was being loaded on the computers of every fledgling network user as they expanded their network use. Users quickly ran out of space on their own local computers, so the people in charge of the networks began devising ways to store data centrally so that it was accessible to any user who needed it. Large amounts of storage capacity, usually in fast, very powerful computers, were set up to act as storage locations for this data where access to it could be controlled by the person storing the data.

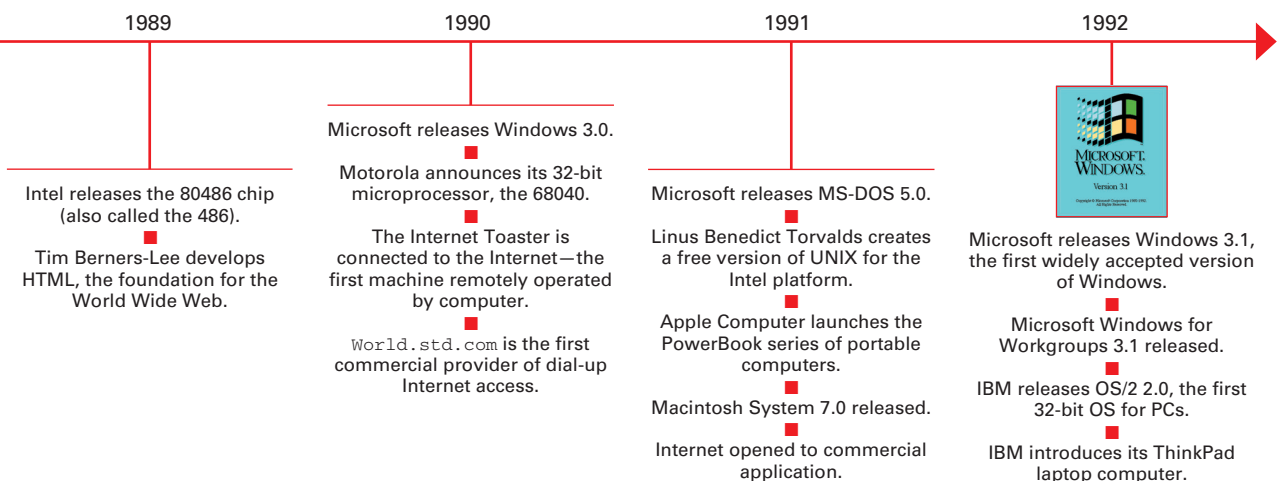
## Applications

Cost and space savings are achieved when computer users can centrally store their software **applications**—the computer **programs** (organized sets of computer instructions) that make a user's computer do what needs to be done. Applications, such as those used for preparing taxes, creating text documents, or playing computer games, have grown in complexity and size and often take up considerable local storage. Installing an application once on a network and then sharing it cuts down on the storage space required when multiple users need the same application.

Unfortunately, there are still several problems with this type of arrangement. Some applications work fine with different setups for each user (different choices for screen settings and other custom features), but normally all such settings must be the same for all users. Sometimes, applications still function better when installed on a user's local computer.

## Assisting Collaboration

Once you have digital information and the ability to share it instantly with others over networks, you can have multiple people working on the same process collectively. Much of the initial communication about computer-produced products that occurred during and immediately after the sneakernet era dealt



with coworker **collaboration**, with coworkers discussing each other's work or possibly even exchanging opinions about what other users had created. Those early computer users found that once they created something and sent it out for review, the comments returned often led to important adjustments that would improve the original product. Such collaboration assisted the widespread use of computers because it provided a tangible benefit that businesses could associate with the increased costs of installing computers in the first place.

Many software makers took this early form of collaboration into consideration and added that feature to the capabilities of their software. The newest versions of the applications included in Microsoft's Office suite (such as Word, Access, Excel, and PowerPoint) allow multiple users to access and make changes to the same document at the same time. That way, all users can work together on the original document, and changes made by any collaborating member are immediately posted within the document. A more powerful implementation of this concept can be found in an application designed to facilitate collaboration, such as Microsoft's Terminal Server (see <http://www.microsoft.com/windows2000/technologies/terminal/default.asp> for more information).

## Facilitating Centralized Management

Just connecting computers to a network meant that some sort of similarity existed among them (or else the computers would not be able to communicate), and a maintenance capability may have been available in the early networks. However, it wasn't until much later (in the mid '90s) that maintenance personnel started using networks to assist with the management tasks associated with the network's operation and maintenance.

It came about as a direct result of standardization and interoperability, which meant computers worked the same way and could work with each other. This was a drastic change to the original networks, where all the different networked components had different computer programs, or **software** (a set of instructions that control the operation of a computer) running them. Having more similarities meant lower support costs. These savings were usually due to **economies of scale** brought about by buying more similar computers and obtaining a lower per-unit cost. Companies soon began

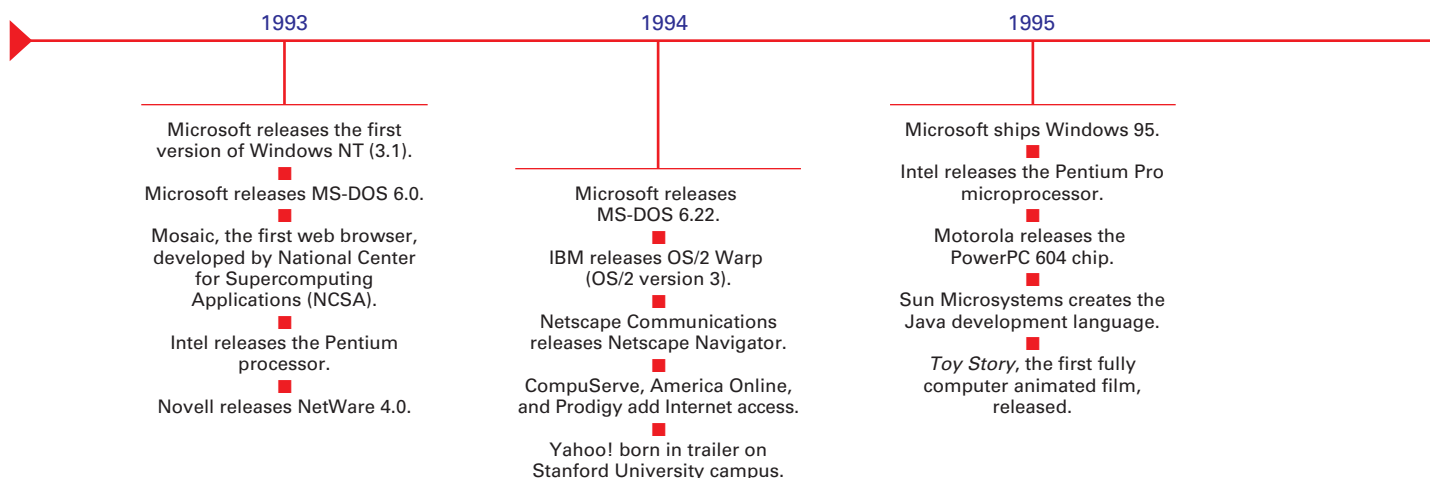


### Inside Information

#### Networks Help

##### Trainers

*TEACH trainers are a creative bunch when it comes to developing training materials. They also like to share their work so they can get everyone else's opinions about it before they go into production with their courses. Before networks, that discussion was handled using the sneakernet procedure and was greatly inhibited. It was just too much trouble to get that information out to everybody, wait for their input, and then incorporate it back into the documents before using them. It was not practical if there was any kind of time constraint, and there always was.*



directing technicians to purchase similar equipment to obtain the benefit of those savings. Once that happened, the network could be used to help maintain those similar components, and this further increased efficiency and reduced the total amount companies would spend on a particular component over that equipment's usable lifetime, called **total cost of ownership (TCO)**.

## Managing Software

Using the network helped reduce software costs. Savings occurred when all users on a network used the same software and when software was bought in bulk quantities for a discount. Centralizing the installation of that software also reduced operation costs because the installations could be accomplished remotely—over the network. The computer programs that were needed to perform the installations were stored on servers and made accessible over the network. The maintenance personnel would then simply log on to the network from a client computer and install the needed applications using the installation software stored on the server.

Within the past few years, even more savings have been achieved by having the centralized server initiate the software installations or updates on the client computers without the need for maintenance personnel to actually visit any of the clients.

## Maintaining the Network

Purchasing similar equipment for use on the network meant that network maintenance costs were reduced because there were fewer dissimilar components. Maintenance workers no longer had to attend numerous training sessions on many different components, which meant they could spend more time maintaining the actual components.

## Backing Up Data

Along those same lines, a network minimizes the time spent backing up (saving extra copies, called **backups**) of necessary files. In the event of a hardware or software failure that causes information or applications to be lost, vital information and necessary applications can be restored if sufficient backups exist. The backup process is normally a regular activity in a company,

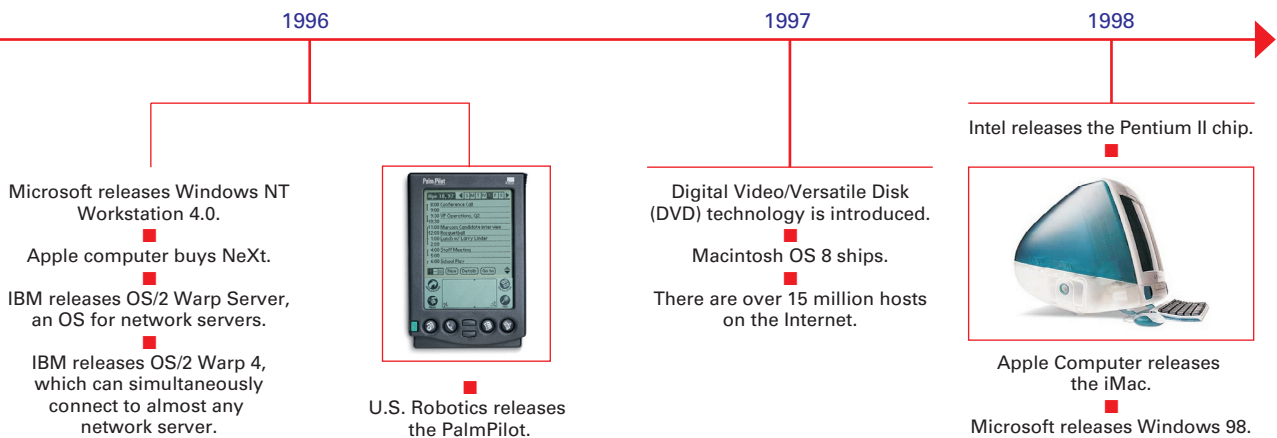


## Inside Information

### Maintenance

#### Enhanced over Network

*Even when everyone was located in a single facility, and more so later when they expanded, the TEACH maintenance personnel were spending far too much time and money keeping equipment operating properly. Without a network, they had to visit each computer every time anything had to be done. Additionally, there was no incentive for employees to use even vaguely similar software to perform their work. Despite the fact that they were a training facility, the time spent keeping the maintenance technicians trained on all those different pieces of software and the numerous individual computer components was just getting out of hand.*



and all transactions between scheduled backups are recorded so that the files can be restored as completely as possible. Technicians can access the backup files and recorded transactions from a central location without having to physically visit the source computers.

## ■ Distinguishing Between Network Classifications

Lauren may have been hired into her networking administration position at SinkR Swim Pools by a forward-thinking company owner, but she has to remember that it was that forward-thinking manager who kept his workers away from the increases in technology and did not furnish them with computers until now. She knows that even though she was given a budget, she will still have to get her network approved by her new boss. Therefore, Lauren will only get the network she has designed by increasing her new boss's knowledge about the different types of networks and convincing him that the network is necessary as designed. She decides to explain the different ways networks can be classified so she can elicit his input and support to come up with the choice she has already decided upon for the company's network.

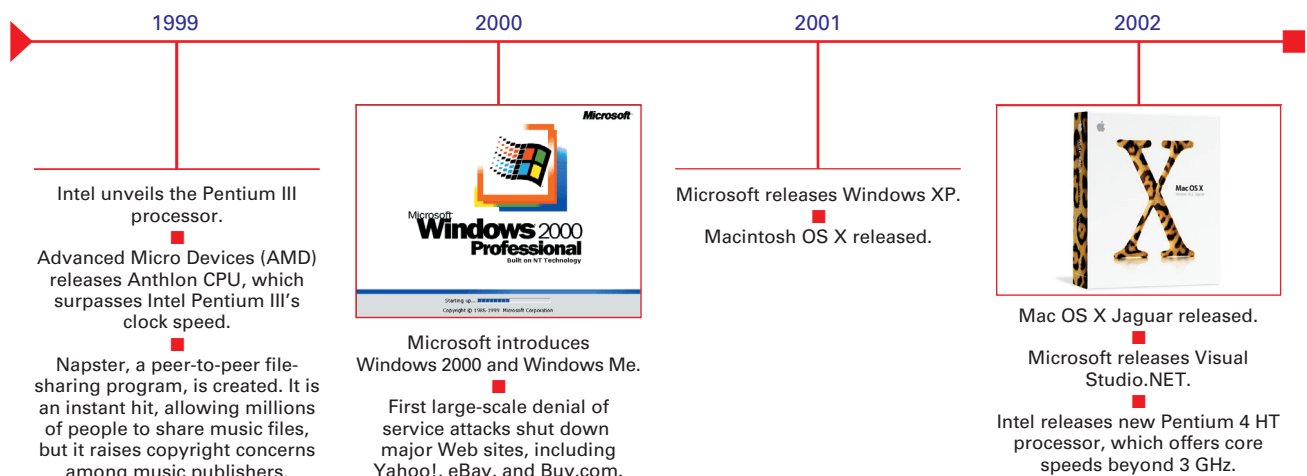
## Classifying Networks by Their Geography

Networks are frequently classified according to the geographical boundaries the network spans. Two basic geographical designations for networks—local area network (LAN) and wide area network (WAN)—are the most common. A third designation, metropolitan area network (MAN), is also used, although its use has become clouded (because it might not be a clear-cut classification anymore) as networks continue connecting to the Internet.

These three classifications, unlike the other methods used to describe networks, are based upon the specific levels of technology they use when going from one level to the other. The three geographical classifications are discussed next because the geographical concepts and the increased emphasis they place on technology as you go from one level to the next still apply.



There is much current debate about the usefulness of any of the three geographical classifications (LAN, MAN, or WAN) now that the Internet can effectively join all computers.

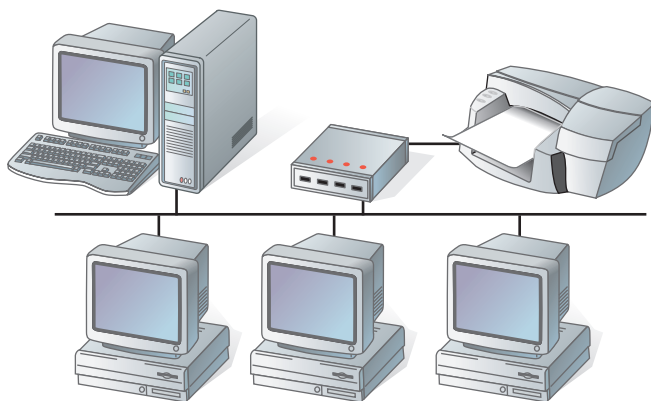


## Local Area Network (LAN)

If the network is contained within a relatively small area, such as a classroom, school, or single building, as shown in Figure 1.6, it is commonly referred to as a **local area network (LAN)**. This type of network has the lowest cost and least overall capability of the three geographic classifications. Because the pieces of equipment in a LAN are in relatively close proximity, LANs are inexpensive to install. Despite their decreased capability, however, their closeness and resultant low costs typically result in the use of the fastest technology on a LAN. Thus, this network classification usually has the highest speed components and fastest communications equipment before the other network classifications see such equipment using the same speeds. This is because it takes less overall investment to get the smaller network running the faster equipment. LANs, therefore, are commonly considered the building blocks for creating larger networks.

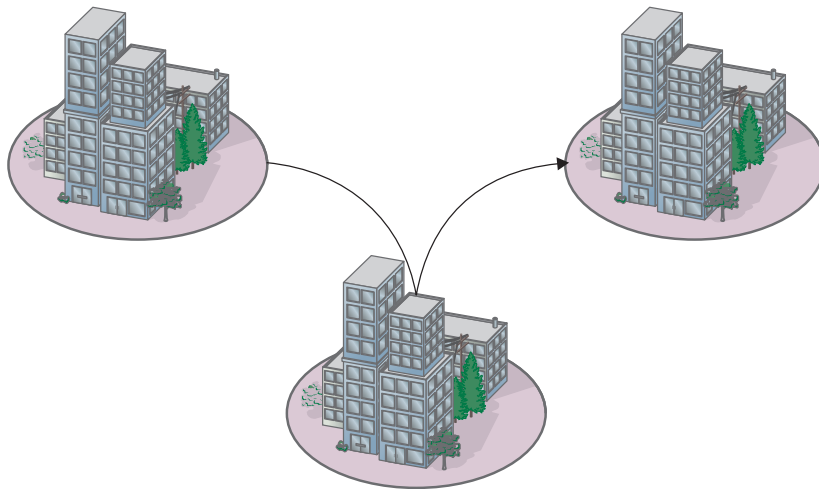
## Metropolitan Area Network (MAN)

As the computers get further apart, a LAN becomes more difficult to install, and additional measures such as additional communications equipment may need to be employed. When the network spans the distance of a typical metropolitan city, as shown in Figure 1.7, it can be referred to as a **metropolitan area network (MAN)**. Although this term is beginning to lose its popular use, the concept of the network outgrowing its local confines and requiring additional resources still applies. Much of the same technology, such as the fast networking components and communications equipment used in LANs, can be used in MANs, but more are required, so this classification is not quite as technologically advanced as are LANs. Although the speeds achieved in a MAN are typically as high as in a LAN, it requires high-speed connections, such as fiber optics. Increasing the distance and the technology levels increases the relative installation and operation costs of MANs.



• **Figure 1.6** A LAN covers a relatively small distance.





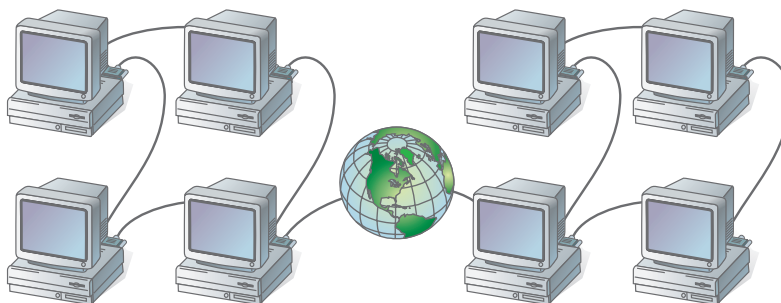
• **Figure 1.7** The MAN covers a somewhat wider area than a LAN.

### Wide Area Network (WAN)

The MAN outgrows its usefulness when the network must expand beyond the confines of the typical metropolitan area. When the network spans a larger area, as shown in Figure 1.8, it is classified as a **wide area network (WAN)**. Because of the extensive distances over which WANs communicate, they use long-distance telecommunications networks for their connections, which increases the costs of the network. The Internet is just a giant WAN.

### Classifying Networks by Component Roles

Another method used to classify networks focuses on the roles the networked computers play in the network's operation, and more specifically on which computer controls that operation. There are two basic types of role classifications for networks—peer-to-peer networks and server-based networks. The difference between the two revolves around which computer is in charge of the network. A third classification, client-based networks, has come into existence because of the increased capabilities of the typical client computer.



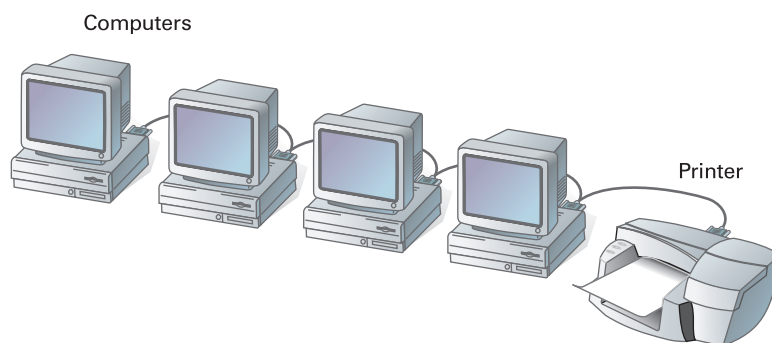
• **Figure 1.8** The WAN covers an extremely wide area and involves numerous transmission technologies.

## Peer-to-Peer Networks

A peer is considered an equal. All computers on a **peer-to-peer network** can be considered equals, as shown in Figure 1.9. That is to say, no one computer is in charge of the network's operation. Each computer controls its own information and is capable of functioning as either a client or a server depending on which is needed at the time.

Peer-to-peer networks are popular as home networks and for use in small companies because they are inexpensive and easy to install. Most **operating systems** (the software that runs the basic computer functionality) come with peer-to-peer networking capability built in. The only other cost involved with setting up a peer-to-peer network comes into play if a computer does not have a network interface card, or NIC (the device that physically connects your computer to your network's cabling), already installed.

Typical initial peer-to-peer networking involves no security measures. Rather, each peer simply shares its resources and allows others open access to them. In fact, a peer-to-peer network becomes difficult to manage when more and more security is added to the resources. This is because users control their own security by adding password protection to each share they create. **Shares** are any resources users control on their computers, such as document folders, printers, and other peripherals. Each shared resource can actually have its own password. Someone wanting access to numerous shared resources has to remember many passwords. Security on a peer-to-peer network can quickly become complex and confusing.



• **Figure 1.9** A peer-to-peer network. Peer-to-peer networks have no centralized control.



## Try This!

### Determine Organizational Needs

It's time to determine the computer and networking needs of your company. Try this:

1. Refer to the TEACH organizational chart (see Lab Project 1.3, at the end of this chapter) and analyze it to determine how many computers the organization should have for its executive, supervisory, and support personnel.
2. Use the organizational chart itself, or a copy of the chart, to mark the location of each management workstation with the letter *W* enclosed in a green circle. For now, disregard the possible use of portable computers in your assessment.
3. Using the geographical classification possibilities, determine the TEACH network's classification and mark the location of where you would put servers. Mark the server locations with the letter *S* enclosed in a red triangle.
4. At the bottom of the TEACH organizational chart, write the total number of servers and workstations you determined were necessary based upon your analysis.

While peer-to-peer networks are inexpensive to set up, they are extremely limited in scope. The accepted maximum number of peers that can operate on a peer-to-peer network is ten. They are, therefore, not appropriate for larger, more secure networks.

### Server-Based Networks

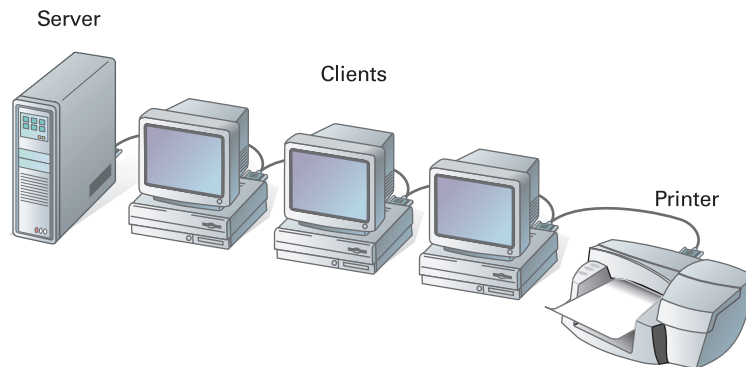
Unlike peer-to-peer networks that operate without central control and are difficult to secure, a **server-based network** offers centralized control and is designed for secured operations, as shown in Figure 1.10. While there are still both clients and servers on a server-based network, a dedicated server controls the network. A **dedicated server** is one that, for all practical purposes, operates solely as a server.

A dedicated server on a server-based network services its network clients by storing data, applications, and other resources, and then providing access to those resources when called for by a client. When a client requests a resource such as a document, the server sends the whole resource (the document) over the network to the client, where it is processed and later returned to the server for continued storage.

Dedicated servers can also control the entire network's security from one central location or share that control with other specially configured servers. This central network control also contributes to the economies of scale discussed under the "Facilitating Centralized Management" section earlier in this chapter (using similar equipment results in cheaper equipment prices and fewer training costs) and makes the server-based network the dominant networking model used in networks today.



Most servers can actually operate as clients but rarely ever do, because such use may interfere with their server capability, and they are usually not in an accessible location. Typically, once a server is set up, it is secured in a location where users cannot access it. Only the network administrator should have access to a server. Therefore, users do not operate it as a workstation, and the client functionality of servers is rarely employed.

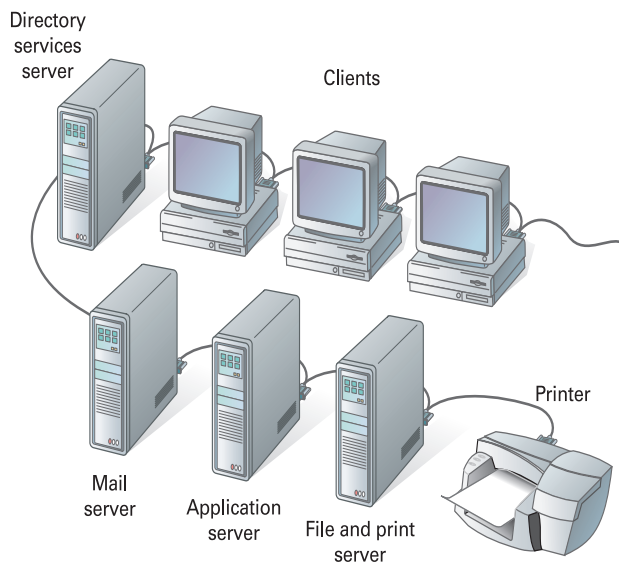


• **Figure 1.10** A server-based network. Server-based networks involve centralized control.

## Client-Based Networks

**Client-based networks** are a further refinement to the concept of a server-based network that relieves the heavy burden on the network's capacity resulting from frequent server-performed transactions. A client-based network takes better advantage of the server's powerful processors and of the increasingly powerful computers used in typical workstations. A client-based network utilizes a client workstation's power in processing some functions locally while requesting additional processing from a server whenever it is needed for increased speed.

Client-based network servers process requests from clients and return just the results, rather than sending the original resource to the client to be processed and returned after computations are complete. Client-based networks, therefore, take advantage of the powerful processing capabilities of both the client and the server, as shown in Figure 1.11. This type of arrangement may include application servers (where entire computer programs are shared from the server) and communications servers (where e-mail and other communications media are operated).



- **Figure 1.11** A client-based network. A client-based network takes advantage of the power of both the server and the client alike.

# Chapter I Review

## ■ Chapter Summary

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After reading this chapter and completing the Try This! exercises, you should understand the following facts about networking:

### Identify Human and Computer Networks

- A network consists of two or more entities sharing resources and information.
- Examples of basic networks include your human network, school lunchrooms, restaurant dining, and business contact development.
- The capability to share is enhanced when information is stored on computers.
- Computer networks consist of two or more computers that are connected and able to communicate.
- Networked computers share resources and information.
- Powerful networks result when additional computers are added to the communication possibilities.
- As more and more data becomes available over a network, some kind of a control system must be established.
- The hierarchy of data should be used in network planning.
- Access to data stored higher up in this chain is more strictly controlled, which means fewer people can view that data.
- *Data* is defined as a piece or pieces of information.
- The collection, proper manipulation, and effective tracking of data makes information management on networks so important.

### Describe the Benefits of Networks

- Computers operated independently from others are known as stand-alone computers.
- *Sneakernet* was the term used for running data from one computer to another on disk.
- Most computer networks develop to facilitate communication, initially to share output and later to communicate through e-mail.

- The ability to share resources is another main purpose for initiating networks.
- Peripherals are additional components that attach to computers to expand their use.
- Sharing peripherals, such as printers, often offered enough of a cost savings for companies to invest in networks.
- Large computers can be set up as storage locations where data is offloaded and access to it is controlled by the person storing the data.
- Installing an application on a network and then sharing its use cuts down on the storage space required when multiple users need the same application.
- Coworkers discussing each other's work, or collaboration, assisted the widespread use of computers.
- Networks help centralize the management of software and maintenance of computers, such as installing upgrades and backing up data.

### Distinguish Between the Different Types of Networks

- Networks are frequently classified according to the geographical boundaries spanned.
- A network contained within a relatively small area, such as a classroom, school, or single building, is commonly referred to as a local area network.
- A network that spans the distance of a typical metropolitan area is sometimes referred to as a metropolitan area network.
- A network covering a larger area than a single city is classified as a wide area network.
- Another method used to classify networks focuses on which computer controls the network's operation.
- All computers on a peer-to-peer network can be considered equal.
- Peer-to-peer networks are popular as home networks and for use in small companies because they are inexpensive and easy to install.
- Server-based networks offer central control and are designed for secured operations.

- A dedicated server operates solely as a server by storing data, applications, and other resources, and providing access to those resources when called for by a client.
- Client-based network servers process requests from clients and return just the results.
- Client-based networks take advantage of their own powerful processors as well as the increasingly powerful computers used as typical workstations.

## ■ Key Terms List

<b>applications</b> (11)	<b>format</b> (5)	<b>programs</b> (11)
<b>backups</b> (13)	<b>hierarchy of information</b> (5)	<b>server</b> (2)
<b>client</b> (2)	<b>local area network (LAN)</b> (15)	<b>server-based network</b> (18)
<b>client-based networks</b> (19)	<b>local computer</b> (3)	<b>shares</b> (17)
<b>collaboration</b> (12)	<b>metropolitan area network (MAN)</b> (15)	<b>sneakernet</b> (7)
<b>computer network</b> (3)	<b>network</b> (1)	<b>software</b> (12)
<b>data</b> (4)	<b>network plan</b> (4)	<b>stand-alone computer</b> (7)
<b>dedicated server</b> (18)	<b>operating systems</b> (17)	<b>total cost of ownership (TCO)</b> (13)
<b>economies of scale</b> (12)	<b>peer-to-peer network</b> (17)	<b>wide area network (WAN)</b> (16)
<b>e-mail</b> (9)	<b>peripherals</b> (10)	<b>workstation</b> (3)

## ■ Key Term Quiz

Use terms from the Key Terms List to complete the following sentences. Not all the terms will be used.

1. A(n) \_\_\_\_\_ consists of two or more entities, or objects, sharing resources and information.
2. A(n) \_\_\_\_\_ controls and provides access to resources.
3. The \_\_\_\_\_ is the plan used when controlling data access in the higher levels of accumulated data storage.
4. When strict requirements are placed on the order and structure of how data is entered, that information's \_\_\_\_\_ is said to be important.
5. A computer operating independently from other computers is called a(n) \_\_\_\_\_.
6. The process of physically carrying data from one computer and entering it into another computer came to be known as a(n) \_\_\_\_\_.
7. Additional components attached to a computer to expand its use are called \_\_\_\_\_.
8. A user's own computer is commonly referred to as a(n) \_\_\_\_\_.
9. The lowest geographical network classification, also considered the building block when creating larger networks, is the \_\_\_\_\_.
10. The role-based network classification where all computers can be considered equal and no one computer is in charge of the network's operation is a(n) \_\_\_\_\_.

## ■ Multiple Choice Quiz

1. A network consists of what minimum number of entities sharing resources and information?
  - a. One
  - b. Two
  - c. Three
  - d. Ten
2. In network terms, your ability to decide whether to share your food in the school's lunchroom

- puts you mostly in which of the following positions?
- Client
  - Client/server
  - Peer-to-peer
  - None of the above
- A waiter in a restaurant fulfills which of the following roles?
    - Client
    - Server
    - Peer
    - All of the above
  - Which of the following is required before a computer network is present?
    - Two or more computing devices
    - Connections between devices
    - Electronic resources and information to share
    - All of the above
  - What should be done before connecting the first computers when initiating cross communication between computers?
    - Plan
    - Request permission
    - Grant permission
    - Expand
  - Which of the following is true regarding the hierarchy of data?
    - Data stored higher should be shared freely
    - Access requirements are stricter at lower levels
    - More people should have access to the highest level
    - The higher your access, the less you should share
  - Whether a nine-digit number is easily recognized as a zip code or a Social Security number is determined by which of the following?
    - Its magnitude
    - The sum of the digits
    - Its format
    - Its use
  - Which of the following is the most often used feature of the largest known WAN?
    - Exchange music
    - E-mail
    - Games
    - Centralized maintenance
  - Which of the following *cannot* be considered a peripheral device?
    - Computers
    - Printers
    - Modems
    - Scanners
  - Which of the following is *not* a purpose for a network?
    - Assist collaboration
    - Share resources
    - Inhibit communication
    - Centralize management
  - The cost savings usually brought about due to buying increased numbers of an item involves:
    - Economies of scale
    - Network collaboration
    - Communicated price comparisons
    - Client/server relations
  - Which of the following is *not* a reason for reduced maintenance costs when using networks?
    - Fewer dissimilar components
    - Training
    - Backups
    - Less frequent software upgrades
  - Which of the following is a geographical network classification?
    - Client
    - WAN
    - Server
    - Peer-to-peer
  - Which of the following describes a network where all computers are considered equal with no one computer in charge?
    - Client
    - WAN

- c. Server
  - d. Peer-to-peer
15. The Internet can be classified as a giant:
- a. LAN
  - b. WAN
  - c. Server
  - d. Client

## ■ Essay Quiz

1. Let's say that you were the one hired by SinkRSwim Pools in this chapter instead of Lauren. If a coworker asked you to explain yourself after you used the phrase *network of computers*, what would you say to her? Elaborate so that a novice would understand completely.
2. Chaos is happening within your network. Security was discussed when you started working at your current job, but not much emphasis was placed on it at first. Now, confidential company information is appearing in competitors' planning sessions. You remember the warning you were given by your supervisor about devising a plan. Fully discuss the concept that a hierarchy of data must be established.
3. Assume that you are a member of the TEACH organization's training department. Make out a purchase order requesting that a new training lab in the TEACH training center be joined to the network. Fully explain on your purchase order why it is necessary to join this new lab to the network and what existing components the lab will rely upon once it is connected.
4. Explain the concept of a *network client* and, after analyzing the TEACH organizational chart once again, determine the maximum number of network clients you would expect to have on that company's entire network.
5. Ricky is still out there helping Lauren enlist the cooperation of the SinkRSwim Pools workers by having them become network users. Help him come up with convincing arguments that will make those workers want to join their new workstations to the network as soon as they take delivery. Remember, they are computer novices and do not yet have access to their computers, and don't forget to be convincing.

## Lab Projects

### • Lab Project 1.1

In this project, you are going to use your personal information and apply for the TEACH employment opportunity discussed later in Lab Project 1.3. You will be developing a resume and a job application form. The steps that follow identify the information you need in your resume, along with an example of an application format that has been used at TEACH in the past. Plan how you will complete both your resume and the application form, and then create both items manually. Remember that although you are applying for a job that interests you, someone else may be selected. You should ensure that your qualifications make you eligible for at least two alternative positions.

You will need the following:

- Bright blue and black ink pens.
- Blank 8½ × 11 paper.
- A ruler for creating straight edges.
- Your own personal information gathered in this chapter.
- The research information you gathered about the networking profession.
- Your job and school history (made up, if you wish).
- Three references (made up, if you wish).



Then do the following:

- 1 Design your own application form using the best sample you can find on the Web as a guide if you'd like. Create the form yourself, by hand, with bright blue lines and black-ink printed lettering, and make it look as professional as you can.
- 2 After you have chosen the TEACH position you would most like to fill, complete your form as an actual TEACH application, using at least the following information on your newly created form.

### • Lab Project 1.2

Now you will create a resume and submit it, along with the application you created in Lab Project 1.1, to your instructor. Using those resumes and application forms, your instructor will choose the company president. All other positions in TEACH will be filled by that new president, acting as the hiring official, by choosing from the remaining applications according to your instructor's criteria discussed in class.

You will need the following materials:

- Your application form from Lab Project 1.1.
- A lab computer running a suitable word processing application and connected to a suitable printer.
- A data or distribution CD to use in your test of the Startup disk you create.

Then create a resume using the following TEACH resume information and action verbs list.

**TEACH Resume Information** Your TEACH resume is a one-page "word snapshot" of yourself that you share with potential employers when trying to convince them to invite you in for an interview. It should be neat, clear, and concise, and should accurately portray all your qualifications for the position you are seeking. You should use action words as much as possible in your resume to show what you did and the results of your actions.

TEACH's format includes a requirement that you clearly state your objective concerning which job

#### Be sure to include:

Name (last, first, middle initial)

Street address

City, state, zip code

Phone number

Education—List in reverse chronological order all classes taken in the past year, giving teachers' names, grade for the class, and the school.

References—List at least three character references (excluding anyone related to you or under 25 years of age).

State whether or not you are physically capable of performing the work required to fill the position you have chosen.

you would like to obtain. Your finished resume will also have a one-inch margin formed by a black inked box that you must draw by hand.

- 1 Include the following major categories in your resume:

Objective	Education History
Employment History	Job Qualifications
Hobbies	Personal Information
Computer Expertise	

- 2 Strive to use action verbs in your resume; here are some samples you might use:

accomplished	achieved
analyzed	coordinated
created	designed
directed	eliminated
established	evaluated
improved	initiated
launched	motivated
organized	performed
planned	proposed
reduced	reorganized
revised	simplified
solved	supported
translated	

- 3 Use your own discretion when creating your resume layout. Do some research to become aware of the current resume philosophy regarding the length and data you want to show. Remember, though, that your resume

is a snapshot of you and what you are bringing to the company. Occasionally, you will run into an interviewer who is intimidated by what you have on the table, and you must be aware of that, too.

- 4 Submit your completed application and your resume to your instructor when requested.
- 5 Plan to be present when your application is reviewed by the hiring official—your instructor or designated lead student—and prepare

### • Lab Project 1.3

You now know what networks are, and what their purposes can be in typical companies. You have also been partially introduced to the fact that you will become a working member of a fictional company—TEACH in this case. It is time to better introduce you to TEACH's personnel and relate the company's present network status to what you have learned.

A company's organizational chart can often be used to reveal network requirements. Refer to TEACH's organizational chart, shown in the following illustration. When reading the following sections, locate each person's position within the company

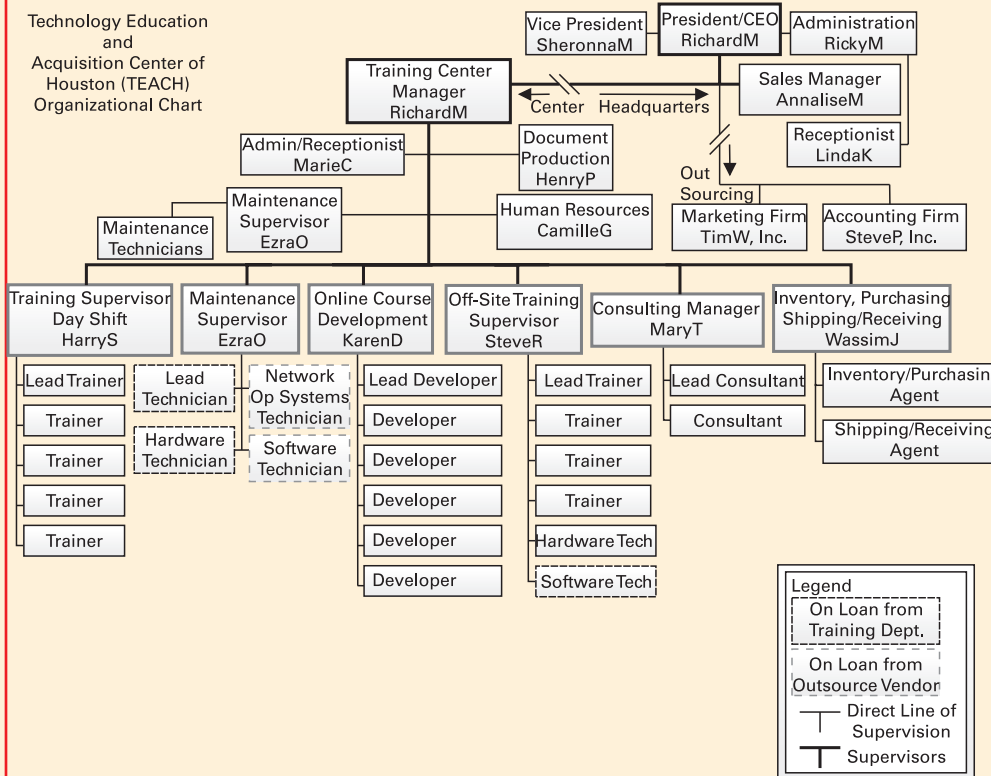
yourself for that review by asking yourself hypothetical sets of questions about the position you have chosen.

**Note:** If you want to apply for a particular position but know that you do not meet the job prerequisites, you may have to role-play just enough so that you qualify for that position, but don't get carried away and spoil the application process by claiming unrealistic years of experience or technical expertise that would actually make you over-qualified.

as it is discussed. Remember, this scenario is fictitious. You may also have to refer back to this TEACH organizational chart after you have your position so you can confirm your job relationships based on your location within the organization. You should also note that the names used indicate the user login name conventions you should set up with your network.

**Headquarters** The president and chief executive officer (CEO), RichardM, spent years working in the training industry before starting the new TEACH corporation. Just over ten years ago, RichardM and

the vice president, his wife SheronnaM, started the company and formed the executive management of TEACH when the previous occupants of the training center requested a bailout. Many things have changed since that time, but the corporation remains a family operation with their son, RickyM, the head of corporate administration, and daughter, AnnaliseM, the manager of the sales department. AnnaliseM recently worked as a teacher in the public school system for many years and came back to TEACH to help increase sales. The last employee at the corporate office is the receptionist,



LindaK, who performs much of the company's data entry while acting as the focal point for all customer on-site interaction.

**Training Center** All other corporate activities are accomplished in the separately maintained training center section. These include training-center management (two shifts), document production, off-site training development, maintenance, web development, content development, processing, inventory control, center administration, and operation of an independent consulting department. RichardM, temporarily also acting as the training manager, brought with him to the center significant previous management training and experience, and a high level of involvement in computer technology. RichardM's night-shift manager until just recently was HarryS, who was promoted two months ago from the manuscript-processing department. HarryS and his trainers just came back to the day shift until after the present sales slump and business needs again require a night shift's coverage.

EzraO is the center's maintenance department supervisor, where he also supervises the document production section run by HenryP. Both EzraO and HenryP have been with the company from its formation in 1992. KarenD, the online course development manager, has a master's degree in computer science and has worked directly with RichardM on many projects in the past. CamilleG is the human resources manager, assists with inventory control, and has significant experience with training center operations at all levels. MaryT is the training center's consulting manager.

SteveR was just recently put in charge of off-site training. Inventory control, purchasing, and shipping/receiving are handled by WassimJ, who recently transferred to the center from one of the vendors that previously supplied TEACH off-site trainers. Training-center administration functions are handled by MarieC, who also acts as the purchasing representative, controlling all input and output documents. In addition, there are 20 hourly employees working at the center in their respective departments.

Now that you have some background information about TEACH, you should be aware of the company's employment needs and begin thinking about being "hired" into one of those impending va-

cancies. In this activity, you will view the announced vacancy in TEACH and begin investigating and making some decisions about which position will best fit your desired network involvement.

You will need the following materials:

- The TEACH Help Wanted advertisement (shown below)
- Access to the Internet (in the classroom, at home, or somewhere on campus)
- A copy of your own personal information gathered earlier in this chapter

Then read the TEACH employment announcement below and decide which of the listed jobs you might be able to apply for based upon what you want to do in this course. Remember, you will be assuming that role for the rest of the course. However, you can later apply for another position that is more advanced. List two alternative choices.

### Help Wanted

Small technology training center in need of entire training team to replace a recently transferred group of highly qualified, dedicated trainers. Positions available immediately include: (1) Training Center Maintenance Supervisor to supervise four technicians and oversee operation of four server bays, (2) Online Development Supervisor to oversee six employees and manage operation of two web servers, (3) Swing-shift Training Manager, (4) Production Manager to control in-process printing activities involved with training material development, (5) Inventory Control agent, (6) Receptionist, (7) Sales Manager, (8) Consulting Manager, (9) Administration Manager, (10) Purchasing Manager, (11) Human Resources Manager, (12) Vice President, (13) and a substitute President/CEO. Additionally, a new marketing consulting firm, accounting firm, and legal firm are needed for outsource responsibilities. A manager capable of operating an off-site education department and another to initiate and maintain a new Research and Development Department are also needed.

Interested Individuals should apply in person at TEACH.

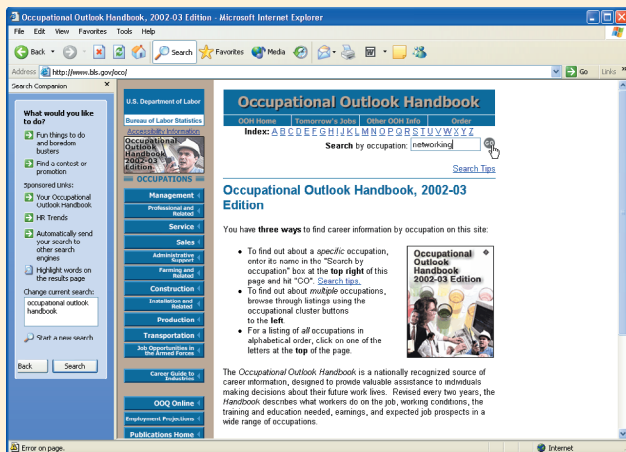
A hand-designed application and a TEACH-oriented resume must be submitted.

- 1 Open your Internet browser and initiate a search using the words "Occupational Outlook Handbook" as shown in the following illustration. This will search the Internet and return information that may assist you with deciding which job will best suit you. Your

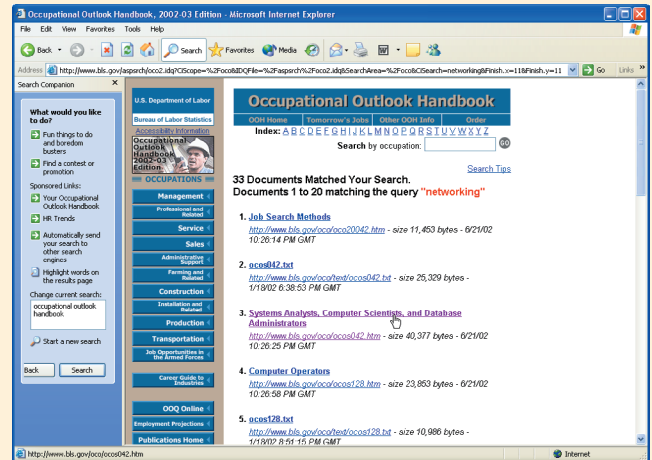
computer's desktop and your Internet browser will likely look different from those used in this and all other exercises throughout this text. That should not affect your results.



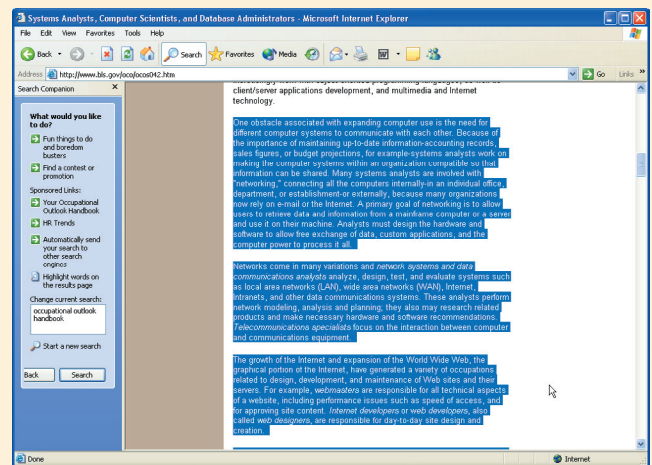
- 2 Scroll through the returned results and locate the one for *Occupational Outlook Handbook*. It will likely be the first one in your list. Click the Occupational Outlook Handbook's link to go to that site. If, for some reason, it is not returned in your search, enter `http://www.bls.gov/oco/` in your browser's address field and press the ENTER key.
- 3 Click the Occupational Outlook Handbook's link to go to that site. Once there, enter the term "networking" in the Search by Occupation window field in the upper-right hand corner of the web site, as shown next.



- 4 Scroll to and click the return link entitled Systems Analysts, Computer Scientists, and Database Operators/Administrators.



- 5 Read the article on this group of computer careers. Pay particular attention to the section on networking, shown in the following illustration, and the other sections on Working Conditions, Employment, Training, Job Outlook, and Earnings. Apply what you read to the decision you are trying to make regarding your TEACH employment possibilities.



- 6 Prepare a summary of this site's information, and submit a copy of your work to your instructor, along with four other summaries of similar sites you locate by following the links at the bottom of this initial site. Keep your information handy in case you need it again during this course. Additional links you might use to obtain information are `http://computerjobs.com` and `http://www.dice.com`.