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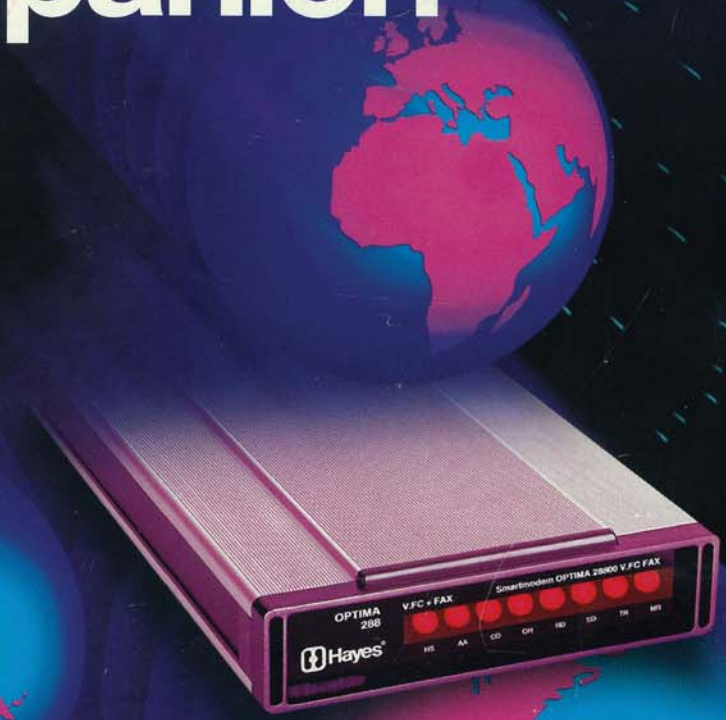

by Caroline M. Halliday

Foreword by Dennis Hayes, President & Founder, Hayes Microcomputer Products, Inc.

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Hayes

Official Hayes Modem Communications Companion

by Caroline M. Halliday

Foreword and Introduction by
Dennis Hayes
President and Founder
Hayes Microcomputer Products, Inc.

IDG Books Worldwide, Inc.
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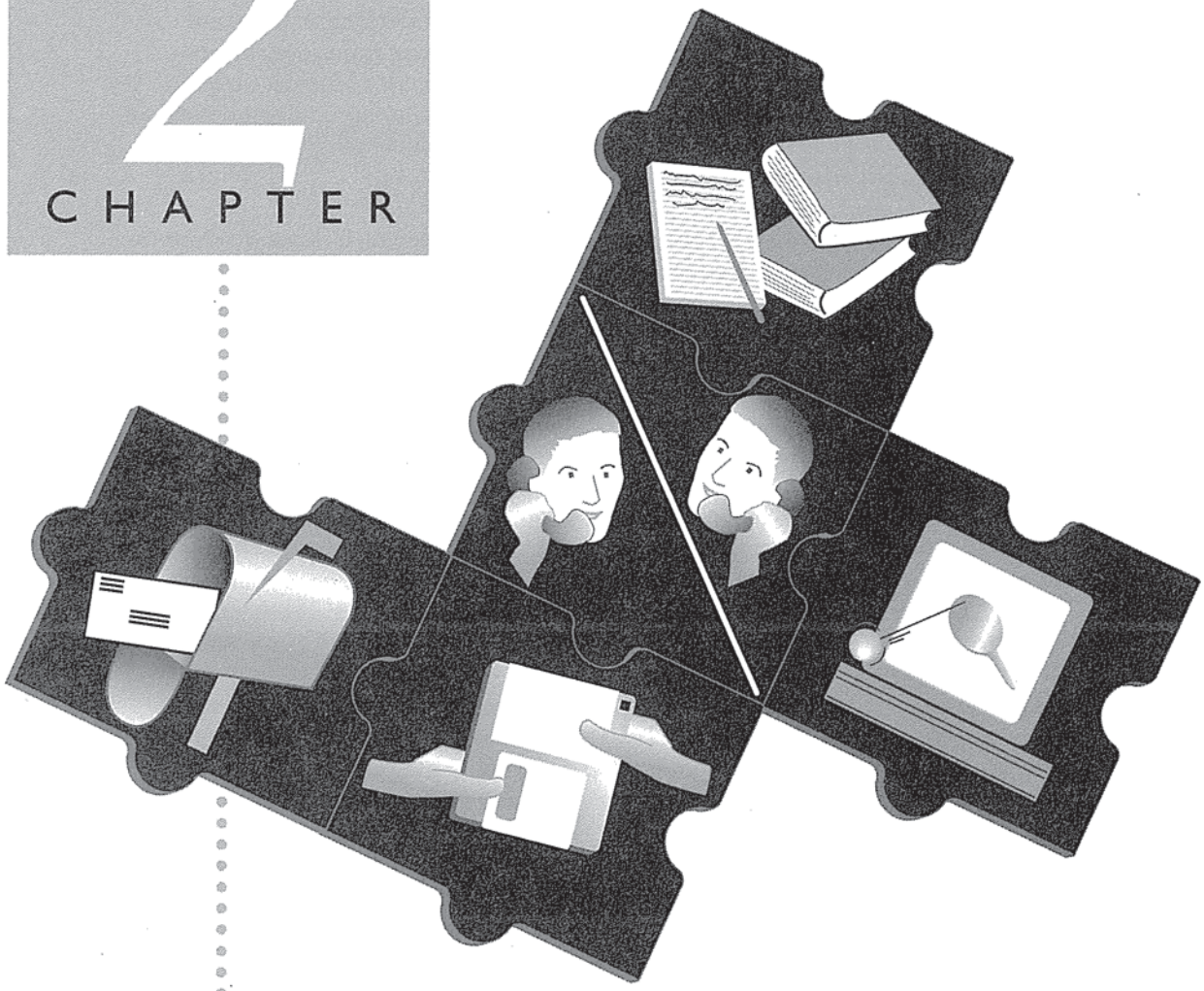


Understanding the Communications World

This chapter introduces the concept of human communications and telecommunications. You will learn about the following topics:

- Understanding human communications
- Understanding telecommunications
- Appreciating the many reasons for communicating
- Knowing what you need to communicate

Defining Communications

As humans, we no longer depend on our ability to hunt, kill, and keep away animal predators but instead have established an elaborate set of social skills and methods of interacting for survival. In many ways, we still use our hunting and survival skills, but we depend heavily on communications rather than actually killing our prey. We typically define successful people as those who have made better business decisions, can manage more people, and have accumulated more money. The respected "tribal" leader is no longer the man who has killed the most animals, but now is the person who has the most control of money, people, and data.

We also continue to be social animals and communicate in many different ways. The most obvious is speech, but mime, body language, and the written word are also important elements, as well as the more recent radio, television, and computer communication.

Data communications, or *telecommunications*, where information is transferred between two computers, is a logical extension of human communications skills. We are by nature inquisitive and have extended our skills, moving from semaphore to telegraph, telephone, and the current computer electronics era. There is little doubt that this evolution will continue, and the next generation will have even more data at its fingertips.

Communications on a computer can seem like a daunting field that you will never understand. Even a PC expert may find all the new terminology intimidating. However, once you have learned a couple of basic items, PC communications is easier to understand than many other PC concepts.

Before discussing computer communications, let's briefly consider human communication in general. These analogies illustrate successful and unsuccessful communication. As I introduce you to the various telecommunications techniques throughout the rest of the book, I will restate the "human" equivalent so that you have a quickly understandable comparison.

Let's first consider communication between two people. One person signals in a way that must be understood by the receiving person. Despite the apparent simplicity of this scenario, many different parameters need to be satisfied for successful communication. For example, the two people need to be within earshot, speak the same language, and be ready to listen and talk to each other.

In conversation, the sending and receiving often occurs at the same time in both directions. One person smiles as the other says something funny, or one person's

blood pressure rises as another person shouts abuse. You have direct feedback as to whether your message is being received as you desire and, if necessary, can alter your response until the desired effect is found.

As humans, our speech involves a lot of body language, voice intonation, and other signals that impart more than the words themselves. Some forms of communication remove some of the human senses and reduce the ease of communication. For example, the telephone removes sight from the interchange. Unless the receiving person provides verbal feedback, you cannot tell whether your message is being understood or misinterpreted. Some people, including myself, continue to use hand signals while on the telephone even though they cannot be heard or seen by the receiver.

Other forms of communication can still involve two people but are less direct, such as letter writing. One person writes a letter and mails it; at a later time, the recipient reads the letter. Parameters similar to those for direct communication must be satisfied, such as language barriers and correct routing of information (equivalent to being within earshot). This indirect approach can also have problems if that information is lost along the way or misinterpreted or if the situation changed between its being sent and received.

Mail, like the telephone, removes senses from the communication, both sound and vision. However, its indirectness—the information is not read as soon as it is written—is a tremendous advantage. You can read what you have written before sending it and reconsider your phrasing. Ultimately, however, the indirectness means you are unable to see the recipient's immediate reaction.

Strictly speaking, books are also a form of communication that involves two people. The author has written material that is mass produced and read at a later time. As before, the communication requires correct routing of information and no language barrier, but you can also look at this form of communication in a different way.

The author has gathered and arranged related material that is intended to be seen as a single entity by the reader. A major application for telecommunications involves the electronic equivalent of a library. You browse through "book" titles and select topics of interest so that you can withdraw books or abstracts from books for later reading. In this communications example, the emotional response of the reader is less important than the usefulness of the material itself. The best communication is achieved by the "library" that has the most accurate and accessible indexing system.

Most types of communication are variations on the three basic forms: conversation, mail, and books. These have direct equivalents in telecommunications: chatting, messaging, and databases.

The Potential for Communications

Webster's Ninth New Collegiate Dictionary defines *telecommunication* as "communication at a distance (as by telephone or television)" and *teleconference* as "a conference among people remote from one another who are linked by telecommunication devices (as telephones, televisions, or computer terminals)."

Although accurate, this definition only hints at the reality and potential for telecommunications with your PC. Even if you know little about computers, you can appreciate the potential by considering what you can do with television and existing technology. The telecommunication problems you will run into have parallels with typical telephone, television, and VCR use.

You can use an antenna and pick up local television stations, or you can connect to a cable television company and pick up more stations. If you use a satellite dish, however, you have many more television stations from all around the world available at the click of a button (or two).

Not only can you get access to more television stations, but with newer televisions, you can also watch more than one channel at once, get better quality sound, bigger (and smaller) pictures, and automate your watching by having the television turn off after a predefined time or blocking out specific channels.

If you add a VCR, your resources multiply. You can watch prerecorded tapes, record your own tapes, watch the television while recording another channel, get higher resolution pictures on your television, and program the VCR to turn on and off automatically. Now add a video camera, and you can videotape your family and friends, record events that are remote from your VCR, and bring them into your home.

Each of these devices has more options and gizmos each model year, and whatever you buy now will be outdated in a couple of years. If you wait a while before purchasing, you will be able to do more things than present equipment will permit. However, while you wait, you are missing out on many possibilities.

Telecommunications on your PC is comparable. Armed with a modem, communications software, and a phone line, you have access to limitless resources bounded only by your imagination. The field is so wide that generalizations are essential.

As discussed previously, communications can be divided into three main topics: speech, mail, and books. Telecommunications has equivalents: chatting, messaging, and databases.

You can use your modem, communications software, and phone line to communicate with another modem that is attached to another computer. You can, for example, call a friend or business colleague. Depending on your communications software, you can "chat" with your friend by typing on your keyboard and waiting for him to type a response, send a message to the other computer so that your business colleague will read it when she returns to her computer, transfer files between the two computers, or look something up on your friend's computer.

However, except in special circumstances, you are unlikely to want to communicate only with a particular friend. All around the world, in rapidly increasing numbers, online services supply the same features as the simple scenario of communicating with a friend but on a much grander scale.

Online services, covered in detail in Part IV, are computers with modems and specialized communications software that act as repositories for the database information and messages that are exchanged between modem owners. Most have multiple phone lines, and several, if not thousands, of people can be calling the same computer at the same time. Some systems even include features that allow you to "chat" or play games with other people who are currently calling the same computer.

As with many new technologies, a large variety of terms are used for similar items. *Online services* is a general term that encompasses such well-known commercial services as CompuServe as well as the estimated 200,000-plus *bulletin board systems* (BBSs) available in the U.S. Although many of these BBSs are run as hobbies from basements, do not assume that they are amateurish. Each online service is unique and offers different features and contents.

Databases

The most popular application for online services is the collection of software. People want to extend their personal software libraries, and literally millions of computer files are available online. You simply call up the online service and transfer the file to your computer.

The types of files available online are even more varied than the people who run the services. Many programs, utilities, and data are free for the taking. For example, one file may be a template to create newsletters in Microsoft Publisher, another may contain a spreadsheet model template for calculating your mortgage payments in Lotus 1-2-3, and another may be clip art. Each file was created by someone and transferred to the online service for anyone to access and use.

The First BBS

Across the nation, thousands of people sign on to bulletin board systems everyday to perform a wide range of tasks, from downloading important business information to ordering groceries. The inventors of the first BBS didn't have such commercial uses in mind on a snowy Chicago day in 1978. Ward Christensen and Randy Suess were simply two snowbound computer hobbyists who needed an easier way to transfer data to one another than sending cassette tapes in the mail.

The preceding summer, Dennis Hayes shipped the first hobbyist modem, the 300-baud internal modem. Hayes built the first Smartmodems on his kitchen table in small production runs of five. The Smartmodem was the missing component needed to make the connection between computers and telephone lines easily. In the setup manual, Hayes wrote that modems could be used for a number of applications, including establishing a bulletin board.

Christensen and Hayes knew each other from industry meetings. So, when Christensen called Hayes on that snowy Saturday, Hayes agreed to donate a modem for use in their history-making project.

Christensen and Suess then developed software and hardware for the first BBS in a short two weeks. Two years earlier, Christensen had written software to allow him to "beep" the contents of a floppy disk to a cassette tape by using an acoustic coupler. Although Christensen didn't know it at the time, he had just invented the 128-byte Xmodem standard, which is still used today.

While Suess worked on the hardware side, Christensen wrote a bulletin board program patterned after corkboard bulletin boards used to post information for a computer club. With that program finished, all the components — computer, phone line, modem, and software — came together to produce the first, and to this day, the oldest BBS in the world.

The most important file type found in online services is called *shareware*. These commercial products, often of a very high quality, are distributed by using the shareware principle, which means you can obtain and copy these programs for no charge. You can use them for a limited period to see whether they fit your needs. If they do, you pay the registration fee to the original author. If you do not find the program useful, you simply delete it from your computer and owe nothing.

Shareware programs, like programs found in retail and mail-order outlets, vary in quality. However, you have to pay only if you actually like the product. Even if you do not like the product, you are more knowledgeable about what to look for in another company's product.

I find that about half of the programs I use on a regular basis are shareware and are much better than typical commercial equivalents because they fit my needs more closely. This is due in part to the fact that I can actually try them out before purchase.

In particular, I find that shareware products, such as communications programs, bookkeeping programs, electronic databases, and virus detectors, often incorporate valuable additions much more quickly than do their commercial counterparts. For example, if I am concerned that my antivirus program is out of date, I can get the latest update within minutes by using telecommunications.

Programs found online really do include the full gamut. Games are extremely popular, as are utility programs, but you can find almost anything you need. If you cannot find it, ask by leaving a message and you are very likely to be directed to several files fitting your needs.

Do not overlook telecommunications as an economical means of file distribution as well as file collection. For private use, you can rapidly distribute updated sales reports, new form layouts, and other data by using your modem instead of an overnight courier service or mail. The data arrives almost instantaneously for the cost of a phone call.

For more public consumption, you can rapidly get your program seen by more people than is possible through traditional selling channels. Do not assume that if you use the shareware approach you will not get registrations. If your product is any good, people will register. Recent reports estimate that the top shareware antivirus program manufacturer made $2 million in profits in a single quarter. Although multimillion-dollar enterprises are in the minority, many shareware authors make a reasonable living by supporting and updating their programs. Shareware is also distributed by other methods, but the primary sources are online services and disk vendors that charge a small disk-copying fee.

The other more specialized application for online databases is research. Some online services are organized as huge reference libraries. You pick a topic and gradually focus in on the data you are looking for. For example, you may need to know how and why the economy of China has changed over the last 100 years, or you may need to know current financial information for your stock portfolio.

By accessing the most appropriate online service, you can sift through enormous databases and rapidly focus on the information you need. When you find the data, you will be able to extract only the information you need and ignore the rest.

Some companies offer a service in which their staff will do the searching for you. You might use this, for example, as a newspaper clipping service, where you hire a company to read particular newspapers and magazines and provide copies of articles mentioning your company's or your competitors' name. Because the search is done electronically (most newspapers and magazines are now available in electronic form), searching can be much more accurate and inclusive than depending on a human to spot the names.

Messages

Apart from files, most online services include a messaging system. *Messages* are usually divided into *topics*, often known as *conferences*. You look at the conferences or topics, choose the ones of interest to you, and read the messages being sent. You can also type in your own message in response to someone, or you can start a new series of messages. Topics or conferences are very diverse and are not necessarily computer related. A few examples are politics, cooking, word processing, science fiction, and geology.

Messaging is typically designed for public discussion. Although messages can be marked as private, they are not private in the sense that they cannot be read by anyone. They can be read by the computer operators who run the computer system. You might use a private message to invite a fellow computer user to a movie, but you would not disclose confidential information that you didn't want anyone other than the recipient to read.

Messages are a mainstay on online services. They come in various guises but can provide more diverse and rapid information than other means. Many PC vendors, such as Hayes, Borland, Microsoft, and WordPerfect, have their own conferences on at least one popular online service. You can read information about upcoming products, get detailed qualified technical support, and find out what other people are complaining about or praising in a new product.

You can also contact many vendors by using their bulletin boards. When you purchase a computer product, the documentation often includes the phone number for a BBS. A vendor's BBS may include tips on configuration, updated documentation, or even full technical support resources. Companies with BBSs include Hayes, Microsoft, and Symantec. Online With Hayes, for example, enables users to read information about new products, obtain technical support, and download files (800-874-2937).

Some online services offer variations on the messaging system. You can do online shopping, make airline reservations, find the weather, or obtain stock market information, for example. This is an area where there is a blurring between using the online service as a database and using it as a messaging system.

Online services also provide interest at a variety of levels. You can find local, regional, national, and international information if you look in the right places. In many cases, all of these services are only a local phone call away.

Messages are intended to be an open forum type of mail. However, private mail, known as *electronic mail* or *e-mail*, is also available on some online services. These services, or this aspect of a service, are equivalent to the U.S. Postal Service or a courier

service providing a mechanism for private delivery of your mail. In these cases, neither the online service operators nor other subscribers to the online service can read the information.

You can send your message to anyone who subscribes to the same service as you do or who subscribes to a service that can exchange data with your service. This interchange of data between services is an evolving feature that is gradually becoming less of an issue as more services can interconnect.

With e-mail, you write a message to be sent to a particular person or group of people, and the service distributes the information. Depending on the service, the message can be text only, or you may be able to attach a binary file, such as a program, to the message so that the file and message are sent together.

Some e-mail services offer more than mail service to their subscribers. MCI Mail, for example, will send a message to the addressed person. However, if the person is not an MCI Mail subscriber, the message will be printed and mailed via U.S. mail from the closest service location to the recipient. In many cases, this is faster than using U.S. mail directly and, for short messages, costs less than an overnight courier service. It is also more convenient.

Before using one of these services, be sure to understand whether anyone else, such as the system operator, is able to read your mail. Although you probably do not care if someone reads that you are holding a meeting in Chicago on Tuesday, you may care if others learn that you are about to make a hostile takeover of a competitor. This can be important when you are sending mail from one service to another because the receiving service may not offer the same privacy as the sending service.

Another major application for telecommunications and mail is PC faxes. You can use a PC fax modem, which is now often incorporated into the modem board in your computer, in the same way you would use a stand-alone fax machine. You choose what you want to send from your computer and send it via the fax software. In this case, the receiving computer is a fax machine and may or may not be a PC fax modem. Chapter 3, "Understanding the Technology," details the differences between a data modem and a fax modem. However, for this chapter, you need to understand that a PC fax modem provides a method of sending data to a potentially non-PC end user and that the fax received is a graphical representation of the text or material sent. You would not use a fax modem to communicate with an online service.

You need to understand that the data you send is not limited to being read the instant it is sent. The computer or remote fax is a storage medium, equivalent to a mail box. The information is read or retransmitted only when the receiver is ready.

Chatting

The database and messaging information found on online services share both a big advantage and a big disadvantage. You can access any of the information at any time of the day or night, but you are not directly interacting with the sending person.

However, direct interaction, known as *chatting*, is available in various forms on many online services. Some online services offer conferences where you can "chat" with other people online. Suppose, for example, that when you are online, you choose to look at a chat conference. You would type the command to join the conference and a message would appear on everyone's screen in this conference saying that you joined. You would then watch for a few moments while you read what everyone is discussing. Suppose the topic is local restaurants. A typical message may ask "Where do I go for good seafood?" When you want to add your input, you type your comment at the keyboard, and your comment is shown to everyone in the chat conference.

While discussing local restaurants may seem trivial, another section of the same conference might include a guest "speaker," such as a famous author, politician, or industry leader, giving you the opportunity to ask questions of people you would not normally be able to meet. This type of chatting is often advertised by the service. When you connect with the service, a list of upcoming "events" shows you who will be chatting when.

Interactive games are an increasingly popular application for online chatting. Unlike ordinary computer games in which you pit yourself against a computer opponent, with *interactive games*, you call an online service with your modem and participate in computer games where the other players are also "humans" calling in from their respective computers. This is like a computerized version of the very popular Dungeons and Dragons role-playing games. The games offered, however, are not all mystical characters. There are also plenty of opportunities to drive a tank and shoot your opponents, for example.

Another minor application for chatting online may occur when you call a BBS, especially if it is a small local BBS. The system operator, the person who runs the BBS, may see that you are having difficulty doing something or may want to respond to a message you are leaving immediately, and will chat with you by interrupting the bulletin board software and typing a message to you on the screen.

I regularly call a couple of local bulletin boards very early on Saturday mornings. The system operator of one of them (run from the local vet's office!) does system maintenance at about the same time as I call. He often breaks in to have a quick chat. We discuss, for example, what we have read in the trade journals or what new software or hardware we have seen or bought. This is unlikely, if not impossible, on many of the large online services.

Technology potential

Technology is changing so rapidly that even the most detailed description of online applications barely scratches the surface of the potential.

In the same way that PCs have completely changed the way we do business and how we need to present ourselves to look "professional," telecommunications has and will continue to change the way we use our computers.

Consider, for example, how word processors changed mass mailing. You now regularly receive mail with your name seamlessly included in the address and main text of a letter, as if it had been written specially for you. You can do similar things with telecommunications. With a single phone call, you can communicate with hundreds of thousands of people. It's up to you what you want to say to them or hear from them.

First BBS Teleconference to the USSR

"Greetings from the United States of America. This moment shall go down in history because it marks the beginning of the Global User Group, a momentous occasion." With these words, the first International BBS Teleconference involving uncensored access to the then-USSR was conducted on June 15, 1990.

It all started when Paul Curtis, systems operator for GLOBALNET, the worldwide electronic bulletin board system of the Association of PC User Groups (APCUG), wrote a White Paper in April 1989 describing the possibilities and opportunities for reducing tensions among nations of differing political and economic systems. With the help of GLOBALNET sponsor Borland International and equipment donations from other U.S. software and hardware manufacturers, Curtis' possibility became a reality.

The first BBS teleconference to Russia used Hayes modems and was held at the First International Computer Forum in Moscow. At the Moscow site, the entire teleconference was projected on a large screen so that the audience could observe the proceedings and ask questions. "There was such disbelief that such a thing could even take place or that the technology could make it possible," Curtis remembers.

Through this historic event, channels of communication were opened between the East and the West that had never been opened before. "The combination of communicating and computing is an empowering technology," emphasized Curtis.

Using Modems in One of the First Closed Loop Traffic Systems

If you've ever been stuck in traffic because of a malfunctioning traffic light, you can appreciate the role Hayes modems played in helping to revolutionize traffic control systems.

Until the early 1980s, traffic control was monitored by urban traffic-control systems that only connected traffic-control boxes at intersections to a mainframe computer. These systems were expensive and often inefficient. Complaints about traffic light malfunctions had to be checked through the mainframe or in person.

Cities needed a decentralized system that would allow traffic-control monitoring at the desktop. In the early 1980s, Transyt Corporation in Tallahassee, Florida, developed such a system. Using Hayes Smartmodems, Transyt's Closed Loop System connected intersections on the airport loop road in Atlanta to PCs operated by the city's traffic-monitoring team. Hayes modems, installed in traffic-control boxes near the intersections, allowed the traffic team to monitor traffic lights, change traffic patterns, and watch intersections on the airport loop without leaving their desks or logging on to a mainframe.

The Transyt Closed Loop System was a huge success, and the Transyt Corporation currently has approximately 2,000 systems installed internationally. More than 11 years after the first installation, the primary communications link from the office to the field continues to be the Hayes modem.

What You Need to Communicate

To communicate, you ultimately need at least two people: one to send information and one to receive it. Telecommunications is similar in that you need to send information and have it received.

As a general rule, a telecommunications link has five elements: the sending computer, sending modem, telephone link, receiving modem, and receiving computer. The electronic devices that you use to connect your computer with another computer are called *modems* (short for *mo*dulator/*demo*dulator). The transmitting modem accepts signals from the sending computer and translates (*modulates*) data into a form that can be sent on a telephone line. The receiving modem, attached to the other end of the phone line, translates (*demodulates*) the received data and passes the signals to the receiving computer. The receiving modem may be attached to a printer rather than to a computer.

A modem can be an external device, the proverbial "black box," or a device installed inside your computer. Chapter 3, "Understanding the Technology," introduces modems and their purpose in more detail. For this chapter, you need to understand that you link two modems together and control them from computers to make a telecommunications link.

As a modem owner, you will need communications software. This software does two things: it controls the connection and is responsible for sending or receiving the desired data. This connection control involves controlling the link between the modem and the computer as well as the link between the modems. Chapter 1 explains how Dennis Hayes realized the value of being able to control a modem by sending it commands from software, cofounded Hayes Microcomputer Products, and created the PC modem industry. This allows you, the computer operator, the ability to control the modem via software commands.

Most modems come with communications software. Some of these programs are very elementary and provide only the minimum required to make a connection, and others are flexible and versatile enough to fit all of your communications needs. If you prefer, you can purchase communications software from a third-party company or another modem manufacturer.

The typical stumbling block for most new modem users is establishing the first connection and transferring the first file. The ease of doing this is directly related to the communications software. Before you give up telecommunications as a very technical and overwhelming topic, try and judge whether your frustration is due to communications software that is unnecessarily difficult to use.

Communications software has two primary purposes. First, it controls the modem. Second, it sends and receives your data to and from another modem. The modem must be controlled to make it operate with appropriate parameters (equivalent to talking the same language in human communication) as well as to establish and maintain the link between the two modems (equivalent to dialing the correct phone number and keeping the phone off the hook).

The receiving computer must also use communications software to control its modem and open the way to allow the data to be received. The receiving computer does not have to be the same type of computer as the sending computer, nor does it have to be running the same communications software. But the two modems must be able to communicate with each other for the communications link to work. The receiving device can be a printer, and the printer can accept the control codes and data sent from the originating computer to print a document. In this case, the printer sends data back to the originating computer and signals its status.

With the two modems, and consequently the two computers, linked, you use the communications software to send data to and receive data from the other computer. Regardless of whether you are chatting, messaging, or using a database, the communications link involves sending and receiving data between two modems that are controlled by computers with communications software.

The automation possible with computers can remove the need for a second person to be active in a telecommunications link. However, it does not usually remove the need for a second computer. In many cases, such as when you call an online service, you are able to control the communications software attached to the remote modem (the modem at the other end of the phone line). You instruct the online service to accept your message or file without direct interaction with anyone at the service.

Using a PC fax modem instead of a data modem is a similar conceptual connection. The fax software on your computer controls the PC fax modem. It sends signals to the fax modem that make the fax modem adjust its parameters or establish a connection with another fax modem and send or receive data. Although you may have a PC fax modem and a data modem as a single expansion board or device, you actually have two separate devices: a data modem and a fax modem. A telecommunications link can either link two faxes together or can link two modems together. You use communications software to link two data modems together and fax software to link two faxes together.

Strictly speaking, the term modem means modulator/demodulator. Types of modems include data modems, fax modems, and voice modems. As is typical with PC terminology, the terminology has become abbreviated, and *data modems*, which are used to transmit data from one place to another, are known simply as modems. Now that fax modems are also available for the PC, the terminology is more confusing. A *fax modem* can send data that conforms with the fax standards from one place to another.

If you think about it, the term fax is meaningless. Does it refer to the hardware, the paper, the action of transmitting, or the printed document? A stand-alone fax machine is actually a fax terminal, because it is a terminal device capable of sending and receiving faxes. When installed in a PC, the equivalent device lacks the terminal capabilities but includes the modem features for sending and receiving documents to fax communication standards.

In this book, the term *modem* is used to mean *data modem*, and the term *fax modem* relates to the electronic device installed or attached to a PC that can receive and send facsimiles of documents.

Summary

This chapter introduced the concept of telecommunications. Telecommunications between computers is an extension of human communications. By considering the three main means of human communication—conversation, mail, and books—you can understand the three main types of telecommunications—chatting, messaging, and databases.

You use telecommunications to transfer data between two computers. The other computer can be the same as or completely different from yours. You make your computer communicate with your modem. Your modem communicates with another modem, which in turn communicates with its computer. For the connection to be successful, the two modems must be able to communicate with each other.

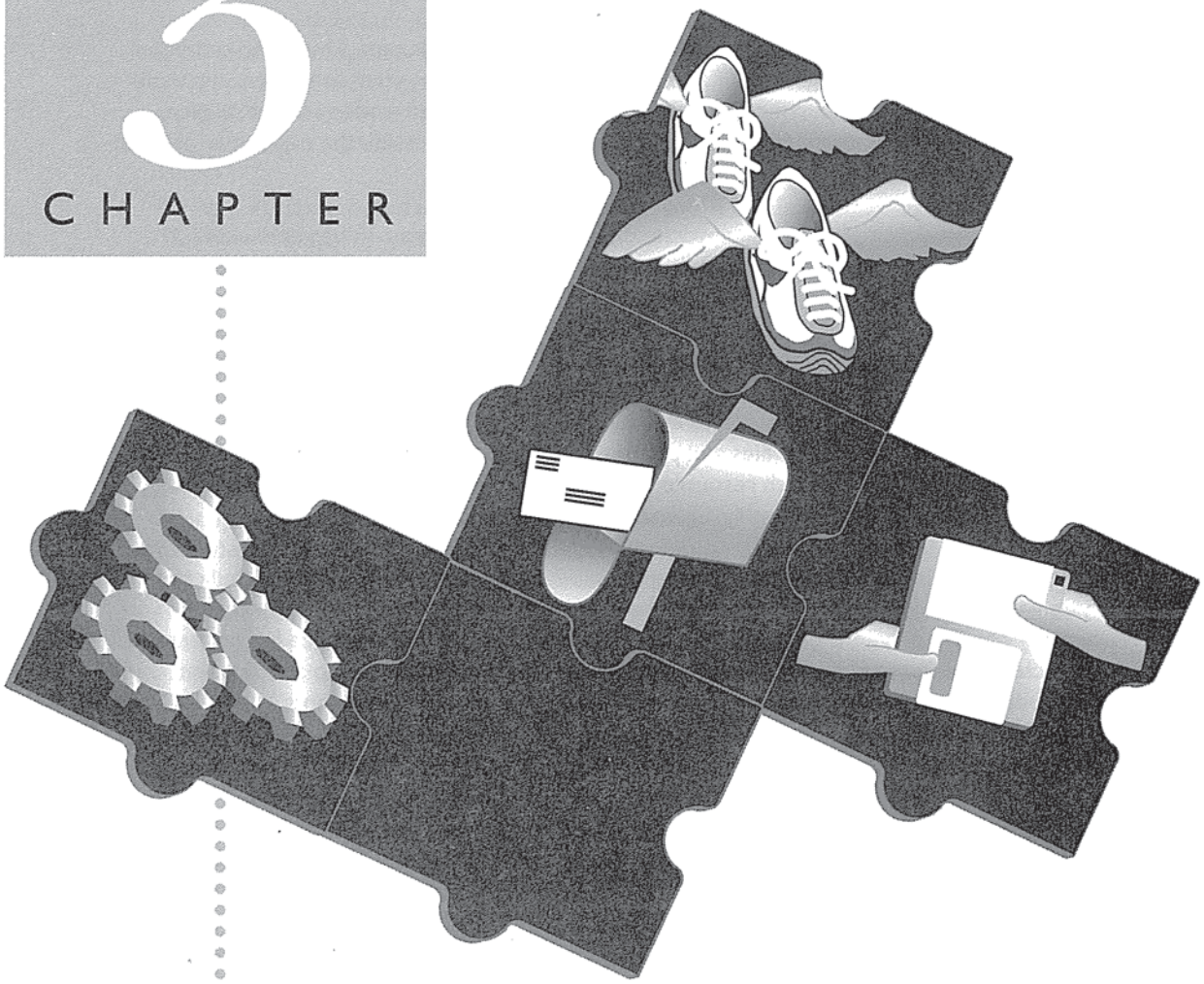
Chatting is equivalent to holding a conversation with another person. When connected to another computer, you type on your keyboard, and someone else types on his/her keyboard in response. *Messaging* is when you type a series of sentences, a "message," that is stored on another computer and can be read by the recipient. Messaging lacks the direct interaction available with chatting but is the most typical way of interacting when online.

Much data stored online is in databases and can be divided into two general types. One database type is a collection of files and programs that you can gather by using your modem. The other is more of a research resource that you search for pertinent information on a particular topic. This type is roughly equivalent to a sophisticated encyclopedia.

Online services include large-scale commercial services, such as GEnie, as well as bulletin board systems. A typical commercial service can handle thousands of users calling at once; a BBS typically handles only tens of concurrent users. However, each online service has an individual character and offers unique features. A data modem is typically referred to as a modem, and a fax modem is a modem that can transmit and receive facsimiles of documents.

Chapter 3 builds on the knowledge gained from this chapter to introduce the specifics of telecommunications as it applies to PCs.

CHAPTER 3



Understanding the Technology

This chapter introduces telecommunications technology. You learn about the following topics:

- Understanding data modem and fax modem communication
- Understanding data modem and fax modem hardware
- Knowing your data modem and fax modem software
- Understanding remote control software

This information provides the basic knowledge to enable you to take advantage of the *Official Hayes Modem Communications Companion.* Subsequent chapters are more specialized and will focus on one or more of the topics covered in this chapter. The terminology introduced in this chapter will be assumed in later chapters.

Introducing Modem Communications

As explained in Chapter 2, a telecommunications link involves five main elements. A computer with communications software is linked to a modem. The modem is linked to a phone line and subsequently to another modem. This remote modem is in turn linked to another computer with communications software or to a printer.

The two computers, two communications software programs, and the two modems do not need to be the same. In fact, you do not actually have to use a phone line to link the two modems; a cable will serve but obviously has distance limitations.

The key to a communications link is making the two modems communicate with each other. This involves making the communications software at each end of the connection control the modems appropriately so the modems will interact.

Introducing a modem

To understand modem communication, you need to understand the basics. A *modem* (*mo*dulator/*demo*dulator) is a piece of electronic hardware that you attach to your computer. As shown in Figure 3-1, it can be an external box that is connected to your computer by a cable, or as shown in Figure 3-2 and Figure 3-3, it can be an internal device that is plugged into your computer directly.

Note: Many newer modem models include a PC fax modem as standard. If you purchase a data and fax modem, you have essentially bought two different devices in a single unit. You have the ability to connect by using the modem portion or the fax modem portion of the data and fax modem. This section of the chapter refers only to the data modem. Fax modems and their software, because they are used for different purposes than data modems, are detailed in subsequent sections.

Figure 3-1: An external modem, the Hayes OPTIMA 96 + FAX96 is a data and fax modem combined in a single unit.

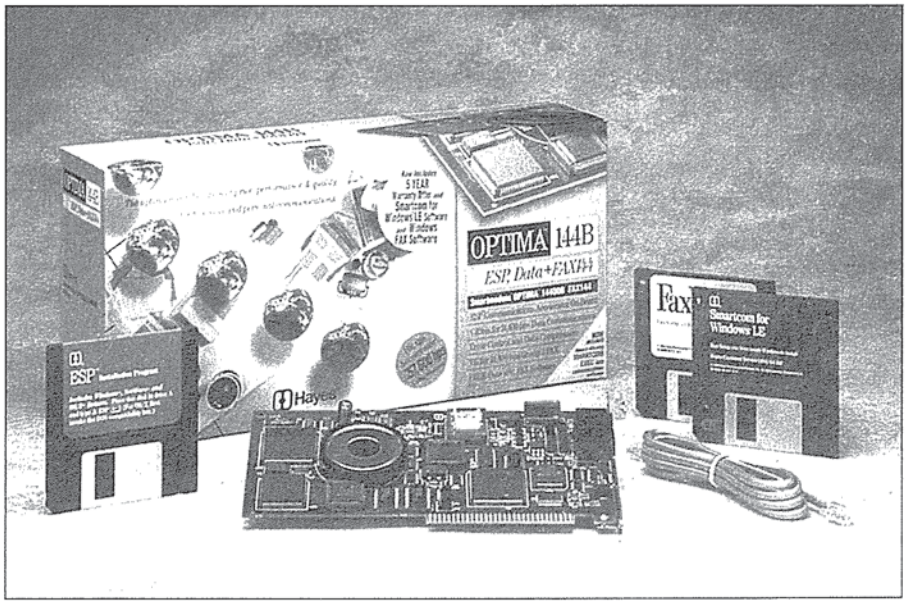


Figure 3-2: An internal modem, the Hayes OPTIMA 144B + FAX144 is a data and fax modem with a communications accelerator combined in a single expansion board.

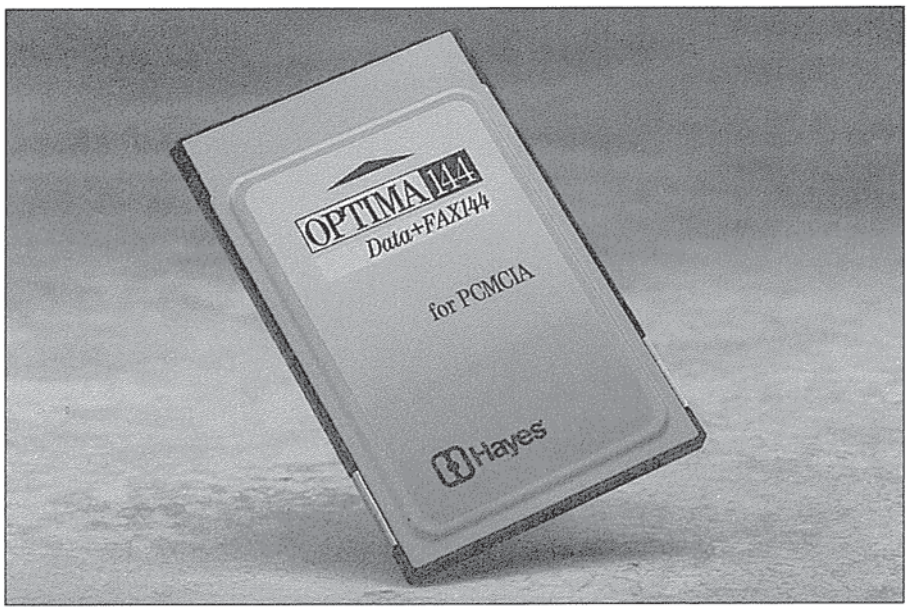


Figure 3-3: A PCMCIA modem, the Hayes OPTIMA 144 + FAX144 is a data and fax modem combined on a PCMCIA expansion board used in some laptop and notebook computers.

As an external unit, a modem is typically a small rectangular box with a series of LEDs (light-emitting diodes) along the front and a series of connectors and an on/off switch on the back. Most modems also include a separate power supply, a small black cube with an incorporated electrical plug, that you plug into the electrical outlet and the rear of the modem.

An external modem typically has two or three other connectors. The larger connector, known as a *DB25 connector,* is the data connector that accepts the cable linking your computer and the modem. You will need a cable that can join this connector to a serial port on your computer.

Serial ports are covered in detail in Chapter 4, "Selecting Your Equipment." For this chapter, you need to understand that your modem is controlled by your computer via this cable.

The other one, or two, connectors are *RJ-11 phone jacks.* These are the same as the connectors typically found on telephones and telephone outlets. They are used to connect your modem to the phone line and possibly to another telephone extension.

Do not be embarrassed if you did not realize that you need to connect the modem to the phone line. It may be very obvious once you know, but an acquaintance of mine spent more than an hour trying to help someone call a BBS with a new modem and software without thinking to ask whether the modem was connected to a phone line.

A modem's electronic circuitry includes a microprocessor. You control the modem from your computer by using communications software, which sends two types of information to the modem: data and modem commands.

A special sequence of characters, known as the *escape sequence*, switches the modem into command mode so that it is ready to accept instructions. These instructions tell the modem to perform such tasks as the equivalent of picking up the phone receiver, dialing a phone number, and making a connection with another modem.

A modem can accept many more commands than those necessary to simply dial the telephone. Successful telecommunication involves many more parameters and coordination between the two modems. Commands can set the desired speed of data transfer between the modems, the number of times the phone should ring before the modem answers, and the form of modem status information that is sent back from the modem to the computer.

Chapter 5, "Understanding Your Modem," explains the essentials of these commands; but for this chapter, you need to understand that the modem is a microprocessor-controlled box that interfaces between your computer and your phone line. You control it from communications software on your computer. The modem can accept commands when in command mode and can send and receive data to the other computer when not in command mode.

Linking the computer to the modem

Your PC is a digital computer. A bit of data has one of two discrete levels, on or off, also known as high or low, or one or zero. The patterns generated by your PC, the sequences of ones and zeros, make up the data that you see as characters on the video screen, numbers in a spreadsheet, or keystrokes on the keyboard, for example.

In a telecommunications link, you are sending digital data from one computer to another. However, the telephone system is an analog system designed to accept the human voice. Although parts of it take advantage of digital electronics technology to move the speech more efficiently, the telephone system in its current form is intended for speech and not a series of ones and zeros. Analog signals do not have discrete levels like the zeros and ones in digital signals, but can have any value between the minimum and maximum.

An ordinary light switch provides an approximate analogy. The on/off switch is considered digital because the light bulb is either on or off. If you replace the light switch with a dimmer switch, the light bulb's glow is considered analog because its brightness can have a variety of levels between on and off.

You can think of your PC as a microprocessor with memory and a series of devices attached to it. The devices include the keyboard and display. However, the PC system architecture allows you to add other devices, such as a printer or mouse, via standard connections, known as serial and parallel ports. Most printers, for example, are connected to your computer via the parallel port.

A modem is a serial device and is attached to the PC's microprocessor via serial port. Unfortunately, despite the simplicity of the concept, attaching a modem to an available serial port in a way that everything continues to work in your PC is not necessarily simple. Chapter 4 shows logical approaches to making your modem installation easy.

If you have an internal modem, the modem is plugged into the computer and the modem acts as a serial port. If you have an external modem, the electronics that make up the serial port are located in your PC and you connect a cable from a serial port to the modem.

Your communications software sends the digital data to be transmitted to the other computer to the modem via the serial port, and the modem translates this data into an analog form that can be transmitted efficiently along the phone line to the receiving modem. The receiving modem translates the analog data back into digital data and passes this digital data on to the receiving computer via the serial port.

Your communications software also sends digital data to the modem to control the modem. The modem is able to determine when the data is to be used for control and when it is to be transmitted.

Introducing the link between two modems

So far, you have learned that the PC sends digital data to the modem via the serial port and the modem can translate this into an analog form that can be sent down the telephone line for the receiving modem to translate back again. The translation from digital data to the analog form is known as *modulation*, and the translation from the analog form to digital data is known as *demodulation*.

You no doubt have encountered the term modulation in radio and television transmission. Consider the AM and FM bands on your radio. AM is the abbreviation of *amplitude modulation,* and FM is the abbreviation of *frequency modulation.* Television is also transmitted by using modulation techniques. You listen to a particular radio station by setting your radio's tuning circuits to a particular frequency where the radio station transmits its signal, for example, 98.1 MHz FM.

You can think of the modulation process as the radio station transmitting a steady signal, known as the carrier signal (98.1 MHz in the example) and then superimposing the music and speech on top of this carrier. The way the music and speech are superimposed is the modulation technique. In the same way, the sending modem modifies (modulates) a tone or tones by the digital data. The receiving modem recovers the digital data from the modulated tone or tones.

Your radio picks up the signal transmitted by the radio station (the carrier and music or speech combined). The radio can strip away (demodulate) the carrier signal from this combined signal and leave the music and speech. The music and speech are then sent to the radio's speaker for your listening pleasure.

The modulation techniques used by modems are more complex than the radio example and, depending on the particular communications standard being used, may even involve no carrier signal being sent. However, you can think of the procedure as the sending modem modulating (encoding) the data in some known way and sending the digital data in a form suitable for analog phone lines. The receiving modem, because it knows how the data was modulated, can perform the reverse and demodulate the data to change it into digital form for transmission to the receiving computer.

For a successful communications link, the two modems must be able to communicate with each other. The receiving modem must know, for example, what modulation method or methods are being used, what the carrier signal frequency or frequencies are, how fast the data is being sent, and the form of the data.

In the same way that there are a variety of PCs manufactured by different manufacturers and with different microprocessors and performances, there are different modems that conform with different standards and operate at different speeds. To someone who has been involved only with PCs, telecommunications standards can seem unnecessarily complicated. The PC industry has become so large that it has been able to create its own unique standards, or variations on more universal standards, that are commonly accepted. It is easy to assume that there are no other computer standards. However, telecommunications is not isolationistic and, unlike computers, can be used to link.

PC owners, for example, have a tendency to dismiss mainframe computers and Amiga personal computers, for example, as remote and irrelevant. Standards that apply to mainframes or Amigas may not seem to have any significance to a PC owner. Owners of IBM PC-compatible systems and Apple Macintosh computers often have similar views about the importance of each other's standards.

However, it is vital to realize that telecommunicating has been around longer than PCs, is not a PC standard, and is independent of the computers attached to the modems. Early telecommunication standards, still in use today, were different in the U.S. from the rest of the world. However, the more-recent communications standards, now the most common primary standards, are truly international.

The communications standards dictate details such as the carrier signal frequencies, how the data is modulated, and how fast data is transmitted. Your modem will conform with at least one of these standards, and you can communicate with another modem that conforms with the same standard. Chapter 5, "Understanding Your Modem," explains the relevant specifics of some of the communications standards.

To create a communications link, both modems must be working to the same standard or they will not be "speaking the same language." The modem and communications software can automate the creation of a successful link. The bleeps, clicks, and hisses you hear when your modem makes a connection are part of the automated linking procedure. Chapter 5 explains the important aspects of this automation.

Introducing Communications Software

You need communications software to make your modem operate. This software may have been supplied with the modem, or you may have purchased it elsewhere. The software must serve two basic purposes but will probably include many additional features.

When you run the communications software, you issue commands that control your modem. These set such items as the speed you want the modem to try and connect at and whether to answer the telephone line when it rings. Other commands make the modem do the equivalent of picking up the phone, listening for a dial tone, and dialing a phone number.

When another modem answers the phone, the two modems establish a communications link. This connection is a negotiation procedure trying to find the highest common standard at which both modems can communicate. Once found, the two modems use this standard, and you can start to communicate with the other computer.

You also use communications software to send data from one computer to the other via the established communications link. You can type on your keyboard and have the characters control the other computer, or you can transfer a file between the computers. When you have finished communicating, you tell the communications software to instruct the modem to hang up the phone, and the modem terminates the phone connection.

Communications software comes in many forms, ranging from the most elementary to the most sophisticated. You can compare the range with the range of word processors available. A word processor at its most simple is a text editor.

At its simplest, when in a text editor, you type characters on the keyboard; they appear on-screen and can be stored in a file. Different fonts and special formatting, such as centering or automatic word wrapping at the end of a text line, may not be available. Even inserting, moving, or copying text may require knowledge of some esoteric command names and methods. These programs are usable but are not particularly user-friendly.

At its most sophisticated, a word processor can do advanced desktop publishing. You can use lots of fonts, reformat whole manuscripts with a single command, insert and manipulate graphics with ease, and produce masterpieces with every bell and whistle possible. These programs are undoubtedly the best if you need most of their features.

Hundreds of word processors fall between the extremes. The most suitable one is the one that includes at least all the features you need or will want in the near future but is easy to use with logical commands.

Communications software is comparable. You will be more successful rapidly with communications software that is beyond the most basic, because you will find it much easier to use. On the other hand, you do not need to rush out and buy the most sophisticated program unless you need a particular feature.

Chapter 8, "Beyond the Basics," and Chapter 9, "Making the Most of Your Modem and Software," introduce all the features a communications program needs to be reasonably easy to use and perform all the communications tasks. When you understand these features, Chapter 10, "Streamlining Your Communications," shows the extra features you can look for in a communications program that make telecommunicating easier, faster, and more streamlined.

Introducing Fax Machine Communication

The popularity of fax machines has expanded dramatically in the last few years. Faxing is an economical way to transfer printed material almost instantly from one location to another.

Like a modem, a fax machine is a microprocessor-controlled device that links with another fax machine via a telephone line. The telecommunications link is similar to that shown in Chapter 2. A computer is linked to the fax modem, which is in turn linked to the phone line, another fax modem, and another computer.

Unlike modems, which are available only as computer peripheral devices, many fax machines are stand-alone units and do not attach to a computer. Most of these incorporate a telephone and may include an answering machine as well. These fax units combine the computer and modem portions of the connection.

A modem is designed to link you with another computer and communicate directly with that computer. A *fax machine,* as its full name *facsimile machine* suggests, produces a replica of a document found on the sending fax machine on the receiving fax machine's paper. The methods used to generate the data for sending and printing at the receiving end are totally different than for modem communication.

When the fax machine sends a fax document, you can think of it as a scanner and modem. The scanner portion reads the page for transmittal as a series of dots, one line at a time. This data is sent from the scanner portion to the modem portion as a series of ones and zeros representing the presence or absence of a dot on the original document.

The modem portion modulates this data into a form suitable for transmission on the phone line. This modulated data conforms with a telecommunications standard. However, the standards used for fax transmittal are different from the standards used for data modem transmittal.

The receiving fax machine can be thought of as a modem and printer. The modem demodulates the transmitted data and passes the series of ones and zeros to the printer portion. The printer portion of the receiving fax machine takes the data and either prints or does not print a dot in the corresponding place on the page to replicate the original document.

PC fax modems are a further development from stand-alone fax machines. Rather than needing to print a document or graphic before it can be transmitted to another fax machine, PC fax modem boards send the document directly from the PC without the need for printing first and then passing it through a fax machine. Similarly, when receiving a fax document on your PC fax modem, rather than it being printed, the image of the page is stored in a file on your computer.

As shown in Figure 3-4, you can purchase PC fax modems as expansion boards that fit into your PC and provide fax machine services.

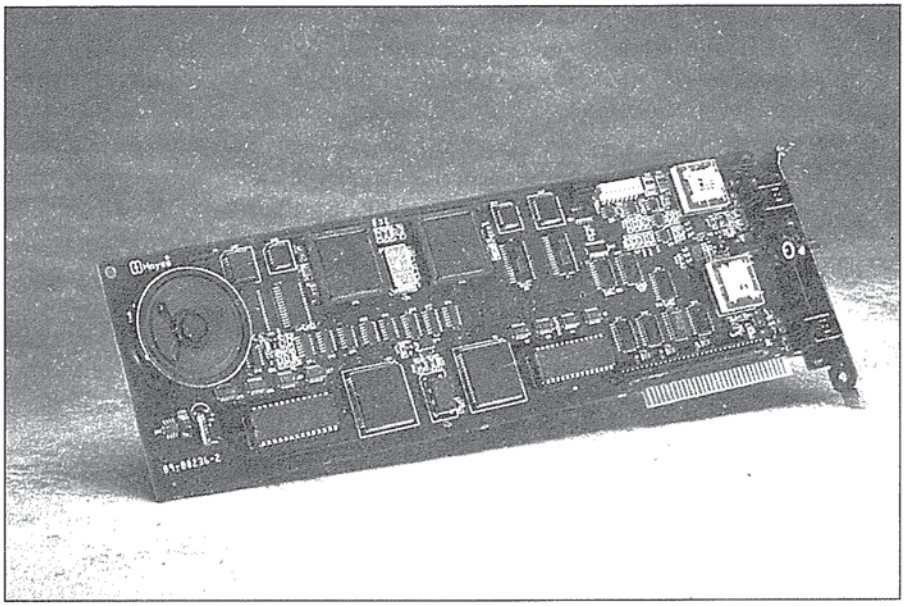


Figure 3-4: The Hayes JT FAX 144B Dual, a PC fax modem that provides similar services to a stand-alone fax machine but is controlled from the PC to support high-density enhanced fax servers as well as LAN fax servers on gateway applications.

However, many new modems also include fax modem features so you can purchase a combined unit on a single expansion board, or as an external unit.

To avoid confusion between when to use a modem and when to use a fax modem, consider the two features — the data modem and the fax modem — as two separate items, even though they are located on a single expansion board or external case and use the same cables. You cannot, for example, use communications software to send a fax document and you cannot use a fax machine to send a computer file.

Fax machines (whether stand-alone or PC fax modems) are preferable in some situations, and modems are preferable in others. Knowing when to use which device is important.

Think of a fax machine as a device that can replicate a document or graphic by scanning the document and sending the scanned image to the other fax machine for printing. The receiving fax modem may be located in another computer, or it may be a stand-alone fax machine. A modem can send electronic files and characters to another computer.

When you receive a fax document, even if you receive it via your PC fax modem and it is stored on your computer, you have a series of dots that make up a scanned image. You do not have text; you have a picture of text.

Chapter 7, "Understanding Your Fax Modem," introduces how to use your fax modem and Chapter 11, "Making the Most of Your Fax Modem," shows how to make the most of your fax modem and its software.

Introducing Fax Modem Software

If you have a stand-alone fax machine, the buttons and displays serve as the controls for it. A PC fax modem, even though it includes a microprocessor, is controlled by fax modem software installed on your computer.

The fax modem software has two main purposes: preparing your document for transmittal or display and controlling the fax modem board for transmittal or receipt.

First consider sending a document. The fax modem software is responsible for converting your document or graphic image into a series of scanned lines made up of dots and spaces. In a stand-alone fax, a scanning head actually views the page and detects dark and light areas on a scanned line. In a PC fax modem, the software performs an equivalent function.

Note: This is not the same as reading your text. The PC fax modem software takes your document regardless of its type and reads it as a series of a narrow lines, called *scan lines.*

The fax modem board's control for transmittal or receipt of documents is equivalent to that of a data modem, except that different communications standards are used.

The fax modem software tells the fax modem board to perform such functions as the equivalent of taking the phone off the hook, dialing the phone number, and establishing a mutually compatible communications standard with the receiving fax machine.

When connected, the document is transmitted between the two fax machines. If the receiving fax machine is a stand-alone unit, the document is reproduced one scan line at a time as the data is transmitted. If the receiving fax modem is a PC fax modem, the document is reconstructed electronically and is stored as a single graphic file on the computer.

Fax modem software, like communications software, is available in a variety of different flavors, but you are most likely to use the software supplied with your fax modem board. The commonality between modems doesn't exist between fax modem boards, so you need fax modem software that supports your particular fax modem board.

Some PC fax modems come with very basic fax modem software, and others are supplied with more-advanced software. Some PC fax modems also come with extra utilities that can help with file conversion so that your fax document can be loaded in other PC programs.

The basic fax modem software can send a graphic file to the specified phone number and receive faxes when the phone rings and a fax transmission is detected. More-advanced fax modem software may allow you to send the same document to multiple people by one selection or to group your commonly used lists of recipients. The utility software may include programs to convert from one graphic format to another or may include an OCR (optical character recognition) program that can convert your graphic file into text.

The typical home user can make do with less-advanced fax modem software and supplement the functionality by using other PC software such as graphic conversion programs or OCR programs available from other vendors. Unlike communications software, where there are literally hundreds of extra things beyond the basics that can be added to the software, far fewer bells and whistles can be added to fax modem software.

However, the business user can purchase more-specialized software for specific applications needs, such as using a fax modem as a fax-back server, which gives an automated fax response to a phone call. For example, some companies have automated telephone numbers you can call, and they automatically fax you sales literature.

The appeal of fax machines is their ubiquitous presence in so many locations, including rest stops on interstate highways, hotels, and businesses of all sizes. You do not need a computer to send a fax. In many situations, a fax document is considered written confirmation; consequently it is used for quotations, purchase orders, and many other business applications. It has become the equivalent of permanent voice mail. Rather than leaving a telephone message, people send confirming faxes.

Introducing Remote Control Software

Another interesting application for modems is remote control software. This is an extension of more-typical modem communication. You link the two computers as you would for a normal telecommunication connection and can operate the remote computer (the one at the far end of the telephone connection) as if it were in front of you.

For example, remote control software enables you to call your office computer from home and use all of the usual application programs, such as word processors and spreadsheets, that are located on the office computer. You see on your home monitor the same thing as on your office computer, and when you press a key on your home keyboard, your office computer behaves as if you had pressed a key on its keyboard.

Being able to use your main computer remotely allows you, for example, to take advantage of all the applications software on the remote computer. You do not have to have that software on the computer in front of you. You can use the large hard disk on the remote computer and do not have to have such resources on your connecting computer.

Remote control software also may enable you to perform maintenance and configuration changes remotely. Because you have control of the remote computer, your keyboard causes actions on the remote computer, and your monitor displays the correct screen, you can rearrange the hard disk contents and alter configurations at will.

It also can provide remote technical support and training in a way not possible unless you are physically in the same room as the remote computer. As discussed in Chapter 2, "Understanding the Communications World," the telephone removes the sense of sight from a communication. In a way, remote control brings sight back into the situation.

Suppose that you install a spreadsheet on a customer's computer. When that customer needs to know how to enter a formula into a cell, he or she may call you for technical support. With remote control software, you can see the same screen that your customer sees and press keys for him or watch him press keys. If you have ever done technical support via telephone, you will appreciate how remote control software can be a boon to productivity.

One problem with remote control software is that both computers must have the software installed and ready to use, so it typically is employed in situations where you know you are going to need it rather than being a coincidental part of most PC users' software set.

Other problems relate to compatibility and system resources. You need to run applications programs that will allow the remote control software to operate correctly, but not all application programs will support the software, and not all computers have adequate resources to allow both the application and the remote control software to run at once.

However, the advantages of remote control software for technical support and home/office use can be tremendous. Chapter 12, "Special Purpose Communications," explains remote control software in more detail. It also includes information on using your communication software's host mode, which makes your remote computer behave like a bulletin board, allowing you to exchange files or find files on a remote computer without needing to be at that location.

Where to Go from Here

To choose and install your modem and communications software, you need to read Chapter 4, "Selecting Your Equipment," next. Chapter 5, "Understanding Your Modem," which deals with actually making the connection, communicating, and disconnecting, assumes your modem and software are installed correctly.

To choose and install your PC fax modem and its software, you also need to read Chapter 4 next. Chapter 7, "Understanding Your Fax Modem," covers actually sending and receiving your fax document, but it assumes you have a PC fax modem already installed.

Other variations on telecommunications, such as remote control software, international communications, and using modems on the road, are also covered in Chapter 12. This chapter assumes you understand how and when to use your data modem and fax modem in more common situations. This information is found in Chapters 4 through 11.

Summary

Part I introduced the world of telecommunications. It showed what communication is, what you can communicate with, and what you need to communicate.

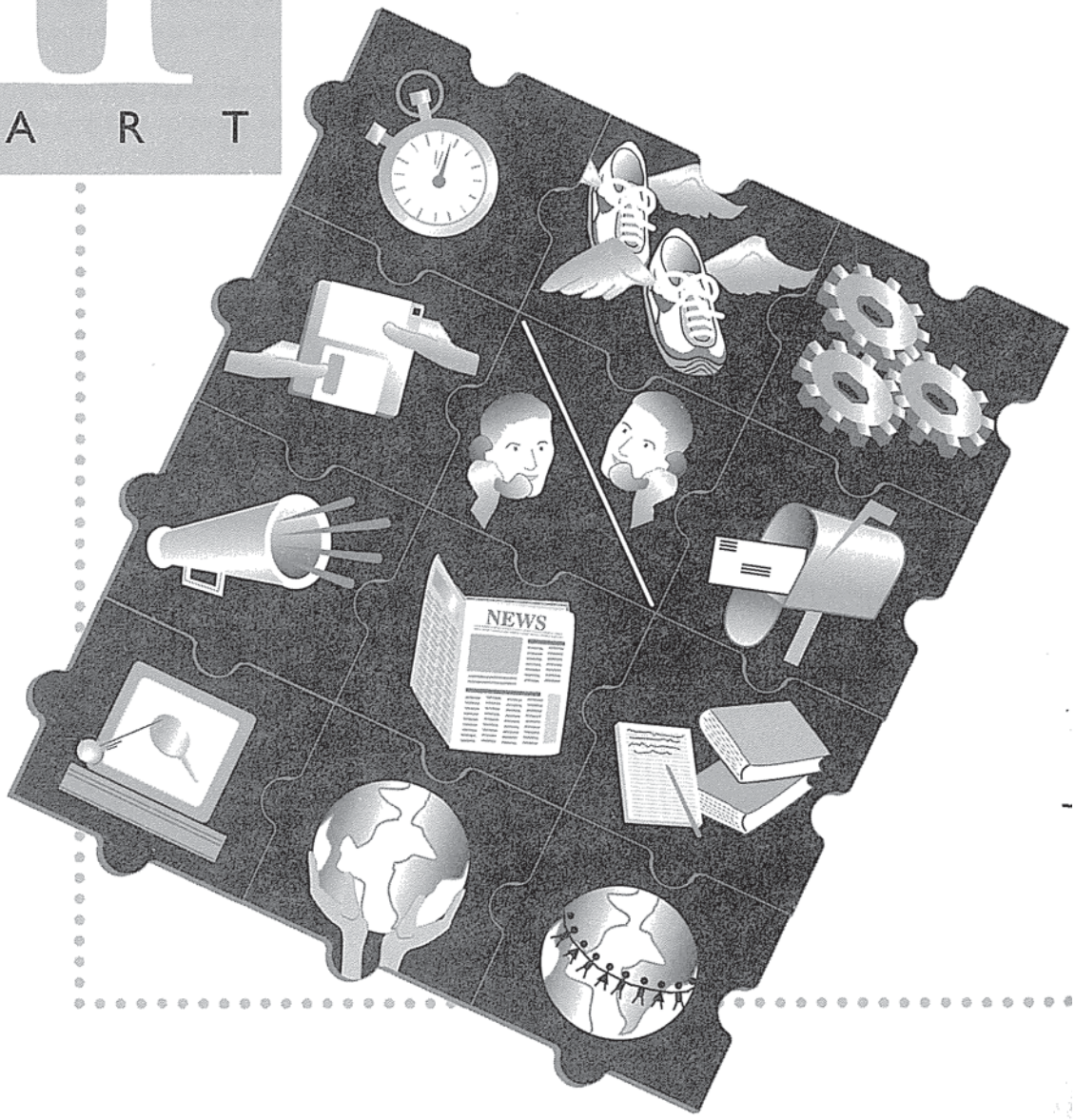
It introduced the major items involved in telecommunications: modems and their software, fax modems and their software, and online services.

Although it avoided detail, Part I also showed the basics of a modem connection and fax modem connection, knowledge that is assumed in subsequent chapters.

Part II, "Communications Basics," details how to choose the equipment, install it, and get it up and running. You can begin to focus more on a particular chapter to identify the specific items you need to make a successful communications link.

When you have your modem or fax modem up and running, you can examine Part III, "Survival and Efficiency Tools," to learn more about making the most of what you have, and Part IV, "The Online World Tour," to discover the limitless opportunities for online data resources.

PART II



Communications Basics

Part II introduces the concepts and practical tools you need to make your data modem or fax modem work. By the end of this part, you will have your equipment up and running and will know enough to make a connection, communicate with another computer, and transfer files and fax documents between the computers. However, you will not necessarily know the most efficient or fastest way to make the transfer or know streamlining and automation techniques. These techniques are covered in Part III.

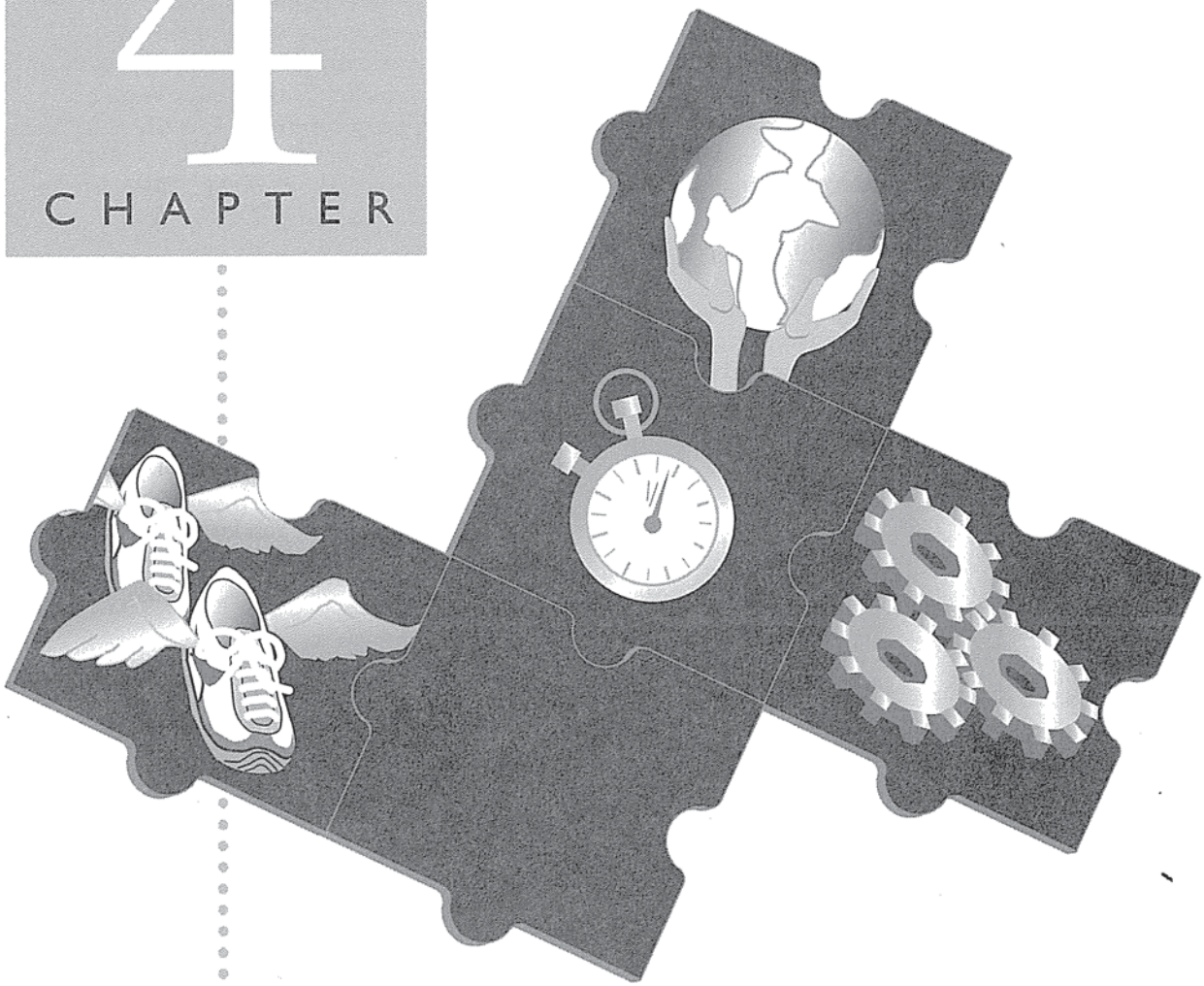
Chapter 4 introduces selecting your equipment and installing it. By the end of this chapter, you know whether you want to use a modem or fax modem and will be ready to make your first connection.

Chapter 5 explains how to make a telephone connection with your modem and how to communicate with another computer via modem. You learn such terms as terminal emulation as well as how and when to use AT commands.

Chapter 6 extends your modem use to include file transfer. You learn how to transfer a file to and from another computer and when to use which file-transfer protocol.

Chapter 7 explains how to make a connection with your fax modem. You learn the pros and cons of PC fax modems as well as fax machines and how to send and receive fax documents.

CHAPTER 4



Selecting Your Equipment

This chapter covers the essentials for selecting and installing your data modem or fax modem. Even if you already own a data modem or fax modem, this chapter shows the important features you should understand to make the first connection. Most new modems include a plethora of features, and you only need the essentials to start with. In particular you will learn about the following concepts:

- Understanding telephone essentials and serial ports
- When to choose a data modem and what to look for
- When to choose a fax modem and what to look for
- Installing your data modem or fax modem and making it work

Serial Ports, RS232, and Telephone Essentials

Installing and operating your data modem or fax modem is the most important part of telecommunications. When you have the data modem working, you can start choosing from all its options. You can think of this process like installing a VCR: Until you can make a tape play on your television, learning about setting the clock and automatic programming isn't worth too much.

Before you learn when to use a fax modem and when to use a data modem, you need to understand a little about the telephone connection and serial ports in your computer. You make a connection between two computers and two modems by connecting the first computer to a modem and the modem to a telephone line; the second computer is connected to its modem, which is in turn connected to the phone line.

Telephone line essentials

Using a phone line is a convenient way of linking the two modems. The whole country, and most of the world, has telephone lines linking businesses and residences. In concept, these telephone lines are cables that connect one place with another. In reality, there are a wide variety of methods for actually making the connection, but you can think of it as a long cable.

The telephone exchanges include switching equipment that route the telephone call in different directions, and the actual route may not include a physical cable. For example, most international and some long-distance calls are transmitted to a satellite in space and sent back down to earth in or near the receiving area. In most connections, different types of cables are used. The phone cable that is actually attached to your phone outlet is probably a four-wire cable; when that cable reaches a junction box, the connection is continued via cables with many more wires or wires that use more advanced technology, such as fiber optics and packet-switch networks, so that many phone calls can be routed along the same cable.

As a modem user, you should understand that the phone companies involved make the connection in many different ways. This variation, as well as other factors, including the weather, can affect the quality of your connection. For example, you may get a very clear connection one time you call your mother but a noisy line the next, even if you hang up the phone and redial immediately. When you use a modem, you do not actually hear the clarity of the connection, although its effect is noticeable when you try to communicate or transfer files.

If your connection and transfer run smoothly, you do not need to think about the telephone connection. However, when you experience intermittent problems, such as losing data or getting random or unexpected characters appearing on-screen, remember that your equipment and settings may be perfect, but the phone line connection may be noisy.

The telephone is designed to transmit the human voice from one location to another via cable. As explained in Chapter 3, the human voice is *analog*, rather than *digital*, and consists of a variety of signal levels. Digital data has only two states, on or off, which are often referred to as zeros and ones.

To transfer information between two computers, the digital data must be converted into a form suitable for transmission along telephone lines that are designed for analog data transmission. The modem *modulates* the data into a form for transmission and also *demodulates* the data for the receiving computer or device. The modem does not change the data — only the form of the data.

Modem technology is reaching the point where increasing the speed of data transmission (shoving more data down the line at once) will require better connection equipment. The fastest modems currently available, when used with all the special data-compression features, are stretching the limits of analog phone connections. To move beyond this speed, replacement connections will be necessary. Although the majority of users do not need to transmit faster, the new technology is available in some geographical areas, and some people have started to use it. However, not every phone connection will ever exceed the current analog telephone standards.

Three types of telephone lines are typically available: voice grade, conditional voice grade, and leased lines. The vast majority of phone lines are voice grade; they are designed to be of a sufficiently high quality for transmitting the human voice well. However, if you have special needs, such as transmitting a lot of data, you can get higher-grade lines. You will pay more for these lines and may need to pay for their installation at your location and at any receiving locations.

The conditional voice grade line provides a better-quality phone line by using more-modern technology, such as packet-switched networks. A leased line, as its name implies, is a phone line that you lease. It is "permanently" connected to a particular phone and is used most frequently for connecting terminals, which may be PCs, to a minicomputer or mainframe. This permanent attachment means that you do not have a dial tone and you do not have the ability to dial a phone number.

Why Not More Data, Faster?

You may wonder why the modem manufacturers do not make faster and faster modems. The problem is not with the modems but with the relatively antiquated analog phone system. Because the phone system is designed for the human voice and consequently analog data, the digital data from your computer is modulated into analog form for transmission down the phone line.

The current modems, such as V.FC and V.FAST, are transmitting data at just below the theoretical limit of the phone lines. They probably could send data just a little bit faster, but not reliably, with every phone connection in the world.

There are two ways of increasing data rate. You either send the data faster or send more data at once. However, it requires power to send the data along the telephone line, there is inherent noise on the telephone line, and there is a limited amount of bandwidth on the telephone line. You are limited by the physical limitations.

This limitation, known as Shannon's Law — after Claude Shannon who proved the limits for an ideal situation — shows it is related to the power of the signal, the power of the noise, and the bandwidth of the channel. In reality, this limit cannot be reached because of other problems found in a practical situation. (For example, Shannon's Law assumes only random noise.)

The amount of power available is limited by the design of the telephone system. The bandwidth of the telephone system, which can be thought of as the amount of room available to send multiple bits of data at once, is limited. You reach a point where you cannot distinguish the difference between two bits of data being sent at the same time, you cannot distinguish between two bits of data being sent one after the other, and the signal is so weak that you cannot distinguish the bits of data from the noise on the phone line.

"Do I need a special telephone line for my modem?"

All home users and most small- to medium-sized businesses will need only a voice-grade phone line. Specialized needs, such as typesetting or printing services that transmit data more or less continually to the printers, are possible exceptions. If you have applications that need these capabilities, you will probably be told by your software or hardware supplier as well as the phone company.

Most telephone companies offer a variety of extra services on the standard voice-grade line. Some of these are beneficial to modem users. Others are hazardous.

One option is pulse or tone dialing. A pulse dial phone sends a series of pulses that sound like clicks when you dial the phone. When you press 6, for example, you hear

six clicks on the line. A tone dial phone sends a different tone for each digit on the keypad. (When I lived in Florida, I regularly called a local engineering company regularly whose number sounded like "Mary had a little lamb!")

Tone dialing is an extra cost item in most areas; in others, it is a standard part of the service. Tone dialing is much faster, and when using a modem, which sends tones or pulses down the phone line faster than you can dial manually, the extra cost is well justified. If you have tone dialing, you can use pulse dialing, but in some cases, if you only have pulse dialing, the telephone exchange equipment that routes your call will not be able to recognize the tones as digits in the dialed number.

Another option increasingly being offered by telephone companies is call waiting. Call waiting adds a signal to the phone line — in some areas, it sounds like a beep, in others a clicking noise — to indicate that someone else is trying to call your phone number.

Although you may not consider it rude or inconvenient to have someone interrupt your phone call, because you can keep talking without interruption, the modem cannot ignore the signal. You may lose some data, or you may lose the connection completely because the two modems lose track of each other.

"How do I disable call waiting?"

You have two alternatives for call waiting besides not subscribing to the service in the first place. You can disable call waiting before making a phone call. This typically involves dialing *70 from a tone phone or 1170 from a rotary phone. You can program your modem to send this dialing sequence before dialing the desired phone number. Chapter 9 explains how to do this with communications software, and Chapter 11 explains how to do this with fax software.

However, there are several problems. Your phone company service may use a different number sequence or may not allow you to disable call waiting. Additionally, if you are receiving the phone call rather than dialing out, call waiting is not disabled.

Another technique, which requires some experience to set up properly, involves setting a parameter in your modem so that the modem ignores interruptions that are only as long as the call-waiting beep. However, this technique requires a balancing act of making the modem ignore the call-waiting signal while recognizing interruptions that prevent corrupted data. If at all possible, disable call waiting before making a phone call.

If you have a single phone line into your home, you should be able to use this to connect a modem. All PC modems that connect directly to the phone line use a modular connector known as an *RJ-11* jack. You plug a phone cable into the modem in the same way that you plug a phone cable into an extension phone.

Most homes now use these modular connections rather than the previous four-terminal system. If not, you can inexpensively purchase adapter kits that convert to the modular jack system, or you can get a telephone installer, such as the phone company, to make the conversion for you.

To give your modem the best line possible, remove as many other phone extensions as possible. The more telephone extensions you have attached to the phone line, the more potential for problems. In particular, be wary of very cheap phones, especially old ones, because they can cause many problems related to noisy phone lines and poor data connection. Cordless telephones are another potential problem.

"Can I use my telephone at the same time as the modem?"

In the same way that call waiting adds beeps to the phone line that interfere with the data connection made between the modems, picking up a telephone receiver while a modem is using the phone line introduces extraneous noise (even if you only listen and do not talk). This noise may cause your computer to receive or send corrupt data or lose the telephone connection between the two modems.

If you use a modem in a house with many phone extensions, create a system so that people do not inadvertently use the phone when the modem is connected. For example, you may decide that a second phone line is justified specifically for the modem.

Although a typical phone wire to your house includes four wires, only two are used to make a connection to a typical phone. The phone cables you attach have a similar modular RJ-11 jack that can accommodate the four wires, but only two of the wires may be connected. These two wires are named *tip* and *ring* and harken back to the early days of telephones when a telephone operator at the local telephone exchange made the connection for you.

"How do I attach a modem to my second phone line?"

In many cases, your home may be already wired for two telephone lines. The second two wires in the four-wire cable, also named *tip* and *ring* but for a second phone number, allow you to have a second phone number. To use this second line with a telephone, you purchase a two-line phone or you buy an adapter.

A two-line phone uses an *RJ-12* jack instead of an RJ-11. These are physically the same size, but all four wires are connected and used with the RJ-12. The phone has a button of some sort that connects with the first or second phone line.

Depending on your modem, you may be able to use the second phone line in an RJ-12 jack (or even other less common phone jack types that are most typically found in businesses). However, this feature, which you may need to enable using software, is not available on all modems.

A more common alternative is purchasing an adapter that makes the second phone line appear like the first phone line to the modem. To connect a modem or single-line phone to the second phone line, you can purchase an adapter that is sold at most electronic stores or your local telephone store. This adapter is a small plug that plugs into your phone outlet and has three sockets in it. One socket is labeled *L1+L2*, another *L1*, and the third *L2*. To plug a modem or phone into line 1, you can use the L1+L2 or L1 socket. To plug a modem or phone into line 2, you use the L2 socket. The L2 socket makes the third and fourth wires in your phone outlet appear in the locations normally used for the first and second wires. (To plug a two-line phone into this adapter, use the L1+L2 connector.)

In a business situation, or in homes with more than one phone line, you may have different types of telephones. If your company uses a private branch exchange (PBX), you may or may not be able to attach a modem so that it goes through the exchange. You may need a separate phone line that bypasses the PBX to connect your modem to the phone line. In particular, if you have a digital PBX, you cannot connect a typical modem. However, you can purchase modems designed to work on digital PBXs.

In some business environments, you can't know whether someone is already using the phone line that is attached to a modem because each extension attached to the same line may be in a physically different location. Additionally, you may not want to supply

all users with their own modems but may want them to share a modem or a few modems. In this situation, consider a more advanced connection arrangement, known as *modem pool*. If your users are connected via a *local area network* (LAN), you can probably add a modem so that multiple people can share a single-user modem. This is comparable to sharing a printer on a LAN. Only one person can use each modem at a time, but the arrangement can be economical if implemented sensibly.

Other more-specialized telephone situations include using a modem in situations where modular telephone jacks are not feasible, such as in a hotel room or at a public telephone. A device known as an *acoustic coupler* may help in these cases. This kludgy-looking device connects a typical phone handset and a modem's RJ-11 jack. Chapter 12 includes examples of unusual situations, especially when using a modem on the road, and explains acoustic couplers in more detail.

Serial port essentials

A modem is the interface between the computer and telephone line. After deciding that you can plug the modem into a telephone line, you need to determine how to plug the modem into the computer. Unfortunately, this is not always as easy as plugging into the phone line.

As explained in Chapter 3, you can consider your PC as a microprocessor with a series of devices attached to it. These devices are attached via a connection known as a *port*. Typical devices are the keyboard and monitor. The PC also includes support for two additional, industry-standard ports, known as a *serial port* and a *parallel port*.

You can attach serial devices to serial ports and parallel devices to parallel ports. Because the PC's ports conform to an industry standard, rather than a PC-specific standard, you can choose from a wide variety of serial and parallel devices rather than having to buy a PC-specific device.

Most PC users know the general definitions of bits and bytes and serial and parallel. However, these bear repeating. Digital data consists of ones and zeros, known as *bits* of data. In a PC, these bits are typically moved around in groups of eight. These groups are known as *bytes* of data.

A typical printer is a *parallel* device that can accept data one byte at a time. A typical mouse, digitizer, or external modem is a *serial* device and can accept data one bit at a time. A typical internal modem is a *serial port* and modem combined into a single expansion board that you plug into your PC.

The parallel port in a PC can take the data given to it and arrange it in a form so that one byte of data is sent out of the port at a time. The parallel port communicates with the device, such as a printer, to coordinate the sending of data at a rate that the device can accept.

The serial port is similar, but its job is more involved. A serial port takes the data presented to it as a byte of data and arranges it so that the data is sent from the port one bit at a time. Similarly, the serial port accepts data one bit at a time and rearranges the data into bytes so that the PC's microprocessor can manipulate the data. This conversion is done by an *integrated circuit* (a chip), known as a *universal asynchronous receiver/transmitter* (UART), and its supporting circuitry.

The following sidebar gives you more detail on this process. For the purposes of making your modem work, you probably do not need to understand more than the preceding paragraph. However, to take full advantage of the faster transmission speeds, you need more-detailed knowledge to understand terms like overrun and to know what type of UART is in your serial port and understand its speed limitations.

"What do RS-232 and RS-232C mean?"

The serial port on a PC is said to conform with the Electronic Industries Association's (EIA) standard number RS-232. (The RS stands for *recommended standard.*) The C is added after the name to refer to the revision level of the standard. Formally, the RS-232 standard specifies the interface between data terminal equipment (DTE) and data communication equipment (DCE) using serial binary data interchange. In other words, the standard gives details on sending serial data from one piece of equipment to another.

The RS-232 standard is a written document that actually specifies only a limited portion of what has come to be known in the PC world as the RS-232 standard. For example, revision C does not specify the shape of the connector. However, it does specify the connector's gender—whether it has pins or holes. IBM, and as a result almost all PC-compatibles, use the wrong gender connector for their serial ports according to the specification.

Revision D of the standard is now released and actually makes some PC-compatibles even less in compliance because it specifies a 25-pin D-type connector. Many PCs, most notably AT-compatibles, use 9-pin connectors for their serial ports.

Understanding a UART

In most situations, such as using a serial mouse, the speed at which data is sent from or received by the serial port is relatively slow, and no problems occur. However, problems can occur when using high-speed modems because the UART and the way in which it interacts with the PC may not be fast enough to avoid data loss.

For example, the UART may signal to the microprocessor that it has data to be transferred, but the microprocessor may be busy doing something else and take too long to respond. If the UART receives more data than it has room to store, data will be lost. This is known as *dropping characters* or *overrun*. In modem communications, this phenomenon manifests itself as lost data or data that appears to be corrupted. Your file transfer may abort because too many errors in the data were detected.

The early PCs used a UART chip from National Semiconductor called an 8250B. Faster PCs, such as AT- and 386-based computers, used a functionally comparable chip called the 16450. The 16450 is typically placed in a socket in your computer, rather than being soldered directly into the circuit board.

These UART chips include a serial port and baud rate generator. In simplistic terms, the *baud rate generator* is the mechanism that controls when, what, and how fast data is sent from the serial port.

The 16550AFN UART is used in IBM PS/2 computers and some newer PCs. This UART is a direct pin-for-pin replacement for the 16450. It includes a serial port and baud rate generator but has the advantage of also including a 16-character FIFO buffer on both the receiver and transmitter portions. A FIFO buffer is a *first-in first-out* storage area. The first character to be placed in this buffer is the first character read from the buffer.

This UART is less likely to experience overrun because a temporary storage area exists for the characters that are waiting for processing. As a minimal cost upgrade, many communications experts recommend replacing the 16450 with the 16550AFN.

If you are not using high-speed communications (say 9600 bps or higher), this upgrade is unnecessary. If you are using high-speed communications, it is an inexpensive alternative where physically possible, but it is not a panacea. Be sure to examine other potential causes of data loss, such as unshielded long wires or noisy phone connections.

Some manufacturers offer alternative solutions, such as replacement serial ports, sometimes known as communications accelerators. These are introduced in Chapter 9.

Now that I've stated that PCs do not conform with the RS-232 standard and have probably confused you, you should realize that the PC conforms with the RS-232 standard well enough so that if you can make your PC talk to the serial port and connect the modem to that port, you probably can make the modem talk to the computer and make the appropriate connections.

Port addresses, interrupts, and names

For most PC operations, you do not need to know the technical details of how the application program uses the operating system and how the operating system controls the microprocessor and hardware. However, this detail becomes important when installing or configuring software that needs to use extra hardware, such as mice and modems. It's a pity that you can't learn about the detailed stuff after you have the program working, but unfortunately, you need the knowledge to make it all work together.

Because you are adding a serial device to your computer when you add a data modem or fax modem—regardless of whether the modem is internal or external—you need to know what serial ports you have, what they are named, and part of how they are configured. The PC can only control one thing at a time, so your addition must appear to the software as a distinct and separate item. If, for example, you have a mouse and a modem both responding to the microprocessor's instructions at once, neither device will work correctly.

This basic understanding is the most confusing part of installing a modem. When it is installed and configured appropriately, you can forget most of the detail until you install new software or replace or rearrange your hardware.

First, the information you probably know. Your application programs, such as word processors or communications software, interface with the operating system, which in turn manipulates the computer hardware. The most prevalent operating system on the PC is DOS.

DOS Version 3.3 or later supports up to four serial ports. Earlier DOS versions support up to two serial ports. These ports are named by DOS as COM1, COM2, COM3, and COM4. In your communications software, you probably need to specify which serial port your modem is attached to.

The microprocessor communicates with the devices by using I/O (input/output) addresses commonly referred to as *port addresses*. The port addresses can be thought of as the "positions" of the devices. Each serial port is assigned a group of eight port addresses. (You specify the first address, and the subsequent seven addresses are assigned as the rest of the group.)

Additionally, each serial port is assigned an *interrupt* number. An interrupt number is often referred to as an interrupt level or interrupt request level. Interrupt level 3, for example, is abbreviated to IRQ3, and interrupt level 5 is abbreviated to IRQ5. An interrupt is a signal line that the serial port uses to indicate to the microprocessor that it needs attention. For example, the serial port may signal that it has some data ready for the microprocessor to collect.

"What are the typical address and interrupt assignments for serial ports, such as COM1?"

You can (theoretically) assign an address and interrupt to a particular serial port, such as COM1 or COM2. In fact, the flexibility of this assigning depends on the sophistication of your software. The typical assignments are shown in Table 4-1.

Table 4-1 Typical Serial Port Assignments

Port name	Address	Interrupt
COM1	3F8	IRQ4
COM2	2F8	IRQ3
COM3	3E8	IRQ4
COM4	2E8	IRQ3
COM3 (PS/2)	3220	IRQ3
COM4 (PS/2)	3228	IRQ3

Notice that COM1 uses the same interrupt as COM3, and COM2 uses the same interrupt as COM4. This is because the PC was actually designed to support only two serial ports, and the addition of COM3 and COM4 are workarounds.

IBM PS/2 computers have a different I/O address map, and you can assign different addresses to your additional serial ports.

You need a unique name, interrupt, and address for each serial port in your computer. For example, if you have a mouse, you place it on one serial port and your modem on another.

The usual approach is to attach your first serial device to COM1 and the next to COM2. Wherever possible, avoid reconfiguring the devices you already have installed. If you change them, you will probably need to change the configuration of each of the software programs that use that particular device.