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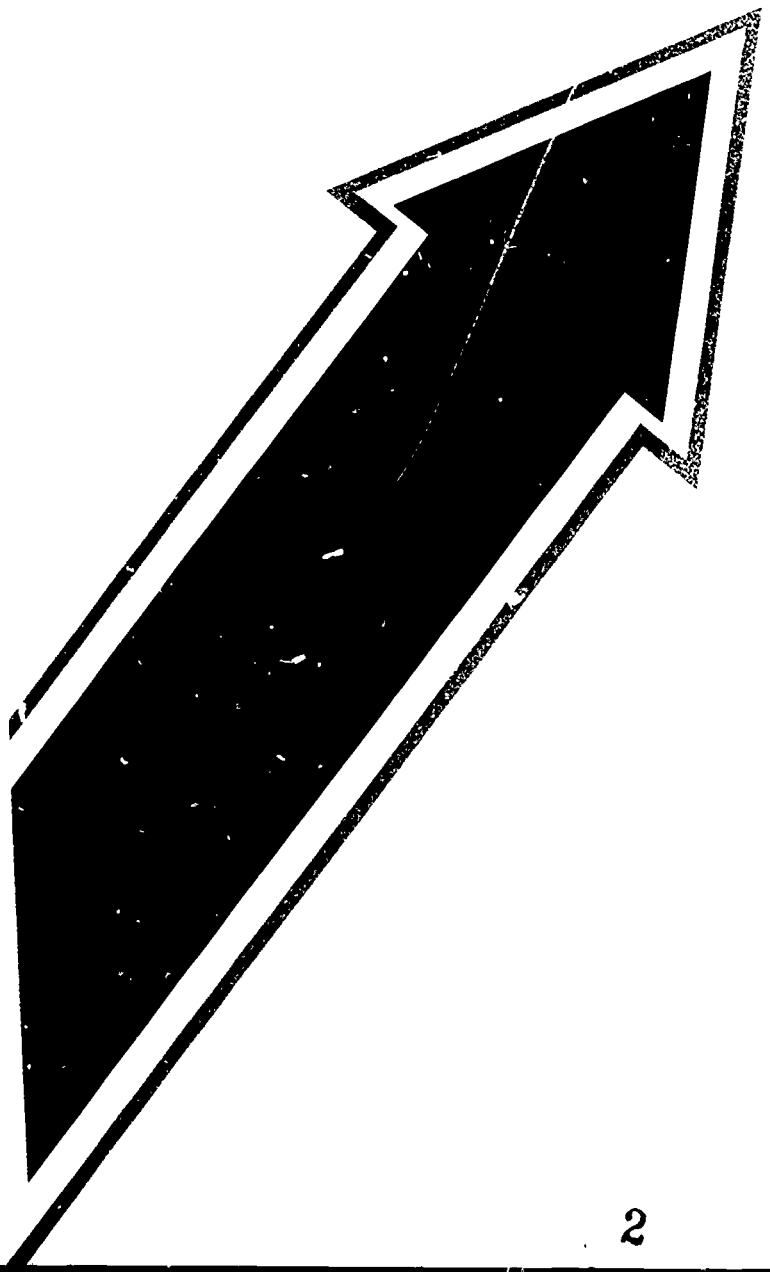
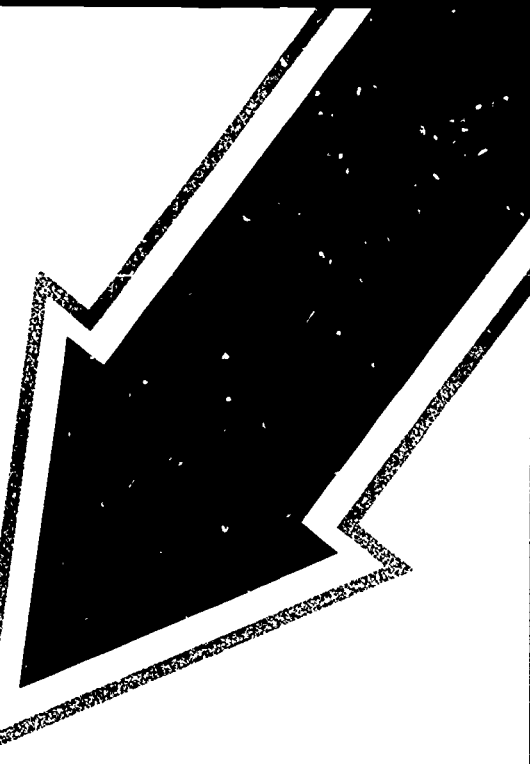
ABSTRACT

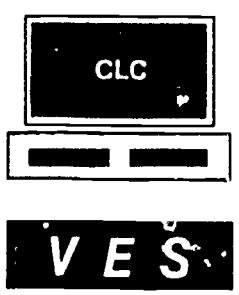
This guide describes the various hardware and software components needed for computer-to-computer communications in nontechnical language and provides guidelines for selecting an appropriate communications package for a microcomputer. Hardware components discussed include both internal and external modems and the advantages and disadvantages of each type; the various features of modems that should be considered by a potential purchaser, including baud rate, auto dial/auto answer, synchronous and asynchronous operation, auditory/visual monitoring, buffer, and intelligence; dumb and smart terminals and their capacities; and the microcomputer as a device for communications activities. Software features to be considered are also identified and explained, including configuration, baud rate, data bits, parity, online telephone directories and dialing, ease of use, downloading, and support for the "host" or auto-answer mode. A glossary of relevant computer terms is provided and 10 journal articles and one book are suggested for further reading. (RP)

Using the Computer as a Telecommunications Device

Sebastian F. Kiteka







USING THE COMPUTER AS A TELECOMMUNICATIONS DEVICE

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What You Will Read About

What is a modem?

How does an internal modem differ from an external one?

What should a potential buyer look for in a modem?

What role does a terminal play in computer telecommunications?

How does the microcomputer fit into the process?

What telecommunications software is required?

What software features should a potential buyer consider?

Key Terms

A glossary is at the end of the article. Following are terms that you will become familiar with:

- ASCII
- auditory/visual monitoring
- auto dial/auto answer
- baud rate
- buffer
- configuration
- data bits
- dip switch
- download
- dumb terminal
- intelligence
- motherboard
- parity
- PC
- smart terminal
- synchronous/asynchronous operation
- telecommunications
- upload

Using the Computer as a Telecommunications Device

Sebastian F. Kiteka

Computer users can "talk" to each other through telecommunications. Telecommunications requires both hardware and software. The hardware includes a modem and either a computer or a "dumb" terminal, a terminal that depends on another computer to function. The software can be under the control of either the "guest" or the "host" computer. Let's look first at the hardware component of a communications package.

Modem

A modem is integral for computer-to-computer communications. Communicating with another computer, like talking to someone on the telephone, requires that the message sender and the message receiver be connected to a modem. "Modem" is an acronym for modulator and demodulator, which are the functions that it performs. Modems accept analog signals (sound) and convert them into digital signals (binary figures using 0's and 1's), or vice versa.

Computers operate on digital signals and the telephone system uses analog signals. Before the modem was invented, digital computer information could not be sent over telephone lines because the signals were incompatible. This problem prompted the invention of the modem.

For computers to "talk," there must be a modem between the computer and the telephone lines at both the sending and receiving

points. The modem conversion process does not alter telephone signals; they remain in analog form. Instead, the modem converts analog signals to digital ones for the computers at each end. In short, a computer does not understand analog signals and telephone wires cannot transmit digital signals. A modem understands both and interprets the signals so that the computer and telephone wires can handle the transmitted information.

Today new software enables computers to respond to voice commands. Nevertheless, a modem must be used at the sending and receiving points because the signals are still converted from digital to analog at the sending point and analog to digital at the receiving point.

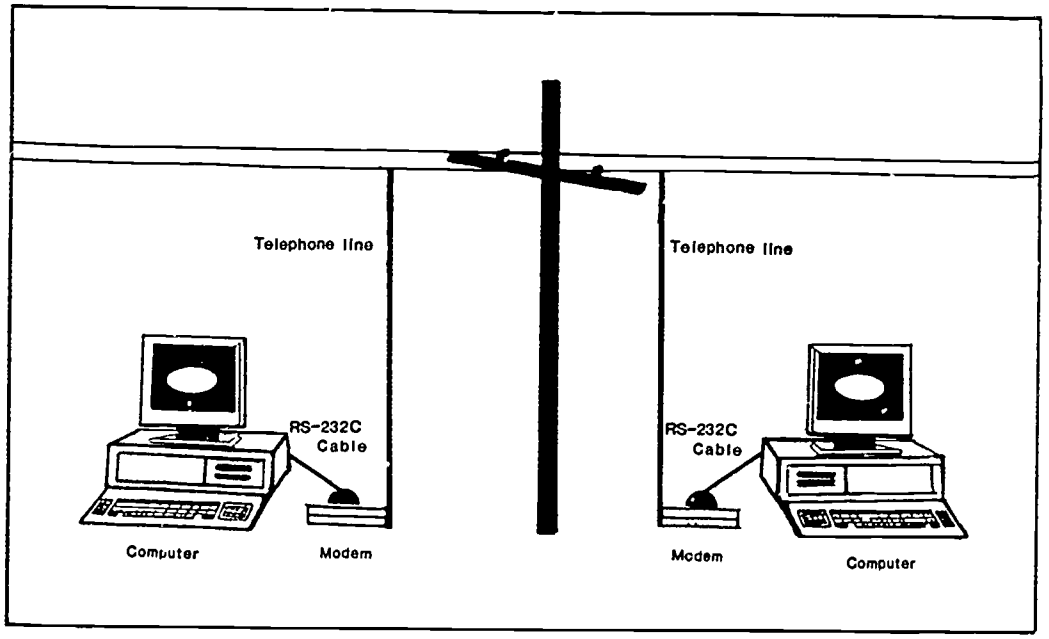

Fig. 1. This illustration identifies the components of the telecommunications process: a microcomputer, a modem, telephone lines, and an RS-232C cable.

In order to communicate, the computer and modem at the receiving point do not have to be of the same make, kind, or quality as those at the sending point. All that the communications process requires at the receiving end is a computer and a modem with the appropriate software configuration to establish dialogue between the two points, or a dumb terminal and a modem.

Types of Modems

There are two types of modems that are differentiated based on where they are used with a computer: external and internal modems. Each type has advantages and disadvantages.

An internal modem is on a card that the user inserts in an open slot (usually slot 2) in a computer. Internal modems are popular because they do not take up desk space or require a serial card, which must be purchased separately and installed in order to use an external modem, a "mouse," a plotter, a printer, or other serial devices. After inserting the internal modem, the user plugs a telephone wire into a jack in the back of the computer. This feature makes an internal modem attractive because the only cord running from it is the telephone wire.

All modems require a power source. The internal modem gets its power from the "motherboard," the guts of the computer system, which is a circuit board that add-on cards are plugged into. If a number of cards are inserted in the computer, the user may be forced to remove some if they generate too much heat in the system.

A user cannot damage a computer by using all the expansion slots. But it is important to be aware of the amount of electrical power that

the whole system, including peripherals, requires to function properly.

As a user adds cards to the motherboard, more power is required from it. There is a possibility that the system may become warm, especially during prolonged use. This situation should be avoided because a cool system functions better than a warm one. One solution is to remove cards that are seldom used and replace them in the computer only when needed.

Unlike external modems, internal modems are not generic. They are crafted to match the size and design of the slot into which they are inserted. For example, an Apple IIe internal modem cannot be used with the Apple IIc, IBM, or any other machine that is not identical to IIe specifications.

Some computers, such as the Apple IIc and the Commodore 64, cannot use internal modems because they do not have expansion slots. Instead, they require specially designed external modems.

There are some drawbacks to internal modems. A primary disadvantage is that an internal modem requires an expansion slot. If all the slots are filled, one of the cards must be removed in order to use the modem. In addition, internal modems do not have light indicators, as external modems do, to show the user the status of the computer-to-computer interaction.

In summary, internal modems are advantageous because they do not take up desk space, but they take up a computer slot and draw power from the motherboard. Their lack of light indicators also may be problematic for the user.

External modems are connected to an existing serial port on the computer, which is used for devices such as a serial printer or mouse. External modems are available in two forms: acoustic-coupler modems and automatic-dialing modems. The older acoustic couplers are disappearing from the market because they are not as flexible as automatic-dialing modems. Their advantage is that they are cheaper than automatic modems. The acoustic-coupler user must dial the telephone number, listen for the connection signal, and then place the telephone receiver over the modem. In addition to the manual effort involved, another drawback is that acoustic-coupler modems are more prone to noise interference than automatic modems, which feature a direct phone-jack connection. These disadvantages make acoustic couplers the dinosaur of external modems. From this point on, our discussion will focus on automatic-dialing modems.

External-modem packages include a modem and a transformer. The transformer, similar to a radio transformer, is needed because these modems operate on external electrical power. Transformers reduce the voltage to the appropriate level for the modem. External modems also require an RS-232C serial cord, which is usually sold separately. The serial cord, transformer, and telephone line take space from the user's work area, but this inconvenience is offset by the advantages an external modem offers.

One of the biggest differences between external and internal modems is that external modems can be used with any computer or terminal as long as an appropriate cord links the computer and the modem. And because external modems rely on a separate power source, they do

not depend on the motherboard for power.

External modems offer more communications flexibility than internal ones, although this is changing. They provide automatic dialing and call answering, and can send and receive files without user intervention. Other features may include the following: a program to keep calling a number until a connection is established and a buffer to receive information automatically and maintain data even when the computer to which they are connected is turned off.

External modems also have light indicators that allow the user to see how the communications process is progressing. The modem front panel usually has eight coded lights: MR (modem ready), TR (terminal ready), SD (send data), RD (receive data), OH (off hook), CD (carrier detect), AA (auto-answer mode), and HS (high speed). When the modem power switch is turned on, the MR light comes on. If the light is off, there are several possibilities: The power switch has not been turned on, the indicator light has burned out, the power supplier has not been plugged into an electrical outlet, or the electrical outlet is faulty.

The TR light indicates that a signal has been given to the modem and the terminal is ready to send or receive data. It also means that the modem is ready to execute communications commands.

The SD light flashes when data is sent from the communications port (RS-232C) to the modem or when data is transmitted to another computer. The RD flashes when the data received from a remote computer is sent from the modem to the communications port.

The CH light shows that the modem is using the telephone line. The CD light comes on when the modem has "detected a carrier" by making contact with a caller. The AA light means the modem has received a call, which it will answer after a set number of rings.

The HS light indicates that the modem is operating in its high-speed mode. For instance, a 1200-baud modem also can operate in lower baud rates (300 baud and lower).

Light indicators may not work if the dip switches are not set properly. To avoid this problem, refer to the instruction manual.

Modem Selection

Comparatively speaking, external modems cost more than their internal counterparts because they offer more features. Internal modems are gaining more capability, however, and this will have an impact on cost.

What should the prospective buyer look for in a modem? It is important to evaluate these factors:

- baud rate, or the number of characters transmitted per second--300, 1200, 2400, 9600. The higher the number, the faster the modem will handle information.
- auto dial/auto answer, or modem ability to dial and answer the telephone automatically
- synchronous and asynchronous operation, or whether the sending and the receiving points must transmit and receive signals in regular, timed intervals (synchronous) or not (asynchronous)

- auditory/visual monitoring, or whether the modem has light indicators or the user must listen for signals
- buffer, or memory that will store information transmitted or received
- intelligence, or built-in modem capabilities such as an internal buffer and automatic log on, log off, and file transmission.

Baud Rate

The baud rate is usually described as the speed at which a modem is capable of transmitting information and is referred to as bits per second, but this is inaccurate. The baud rate is the rate of phase-shifting: the production of electrical impulses to convert characters from readable bits, small units of information that the computer handles, to non-readable bits. "Bits per second" i a convenient phrase because the process is complex. And from the buyer's perspective the end result is the same: A modem with a greater baud rate transmits data more rapidly than one with a lesser baud rate. Common baud rates are 300, 1200, 2400, 4800, and 9600.

The greater the baud rate, the faster a modem transmits information and the more it costs. Prospective buyers can save money by choosing an off-brand modem that is compatible to a name-brand modem. Just as 8088 Personal Computers are compared with the IBM Personal Computer for compatibility, off-brand modems are compared with Hayes modems. Buyers can check the manufacturer's statement on the product's compatibility with Hayes modems, or ask the dealer to run Hayes Smartcom II communications software on the modem. If the modem runs

the software, it will function with IBM and compatible PCs. This test is similar to running MS Flight Simulator software or Lotus 1-2-3 software on an off-brand computer to determine its compatibility with the IBM PC. A word of caution: Testing a single program does not ensure that the product is absolutely compatible to specific standards. It means only that the buyer can assume that the product is virtually compatible.

Terminals

There are two types of terminals: dumb and smart. A dumb terminal is exactly what its name implies. It has

- a screen,
- a keyboard,
- a port or two, which are used to connect devices that send and receive information serially (one bit at a time) or in parallel fashion (eight bits at a time), and
- dip switches, which control the speed of information transmission. Duplex interaction allows both users to transmit information at the same time (full duplex), or just one at a time (half duplex).

Because a dumb terminal does not have much built-in "intelligence," or ability to perform computer functions, it cannot perform automatic activities such as dialing or answering. A smart terminal has all the features of a dumb terminal, plus the intelligence to automatically log on, use macros (chains of commands), and perform other complex functions, such as saving data to a disk.

Microcomputer

A microcomputer is the best device for communications activities, especially when used with an intelligent modem and communications software. A computer can be made "dumb" or "smart." When used with communications software that has few features, a microcomputer becomes a dumb terminal: The software overrides its internal memory and the disk drives and the user cannot access them.

In contrast, when a microcomputer is used with a multifeatured communications package, all of its components are active. The user can download (receive) information, save it onto floppy disks, and print it simultaneously. The computer can be programmed to dial, answer, log on, search for information, download information, and log off without the user's intervention.

To minimize telecommunications costs, a user can take advantage of the automatic information-sending process. First, compose the information to be transmitted and save it as a file. Then, give the computer a command to call the receiver's computer and establish a connection. When connected, the computer will open the file, transmit it, and disconnect immediately. This process takes place in a matter of seconds, depending on the size of the file. In this way, users who cannot type quickly or accurately can save money by preparing their communications session off-line. The alternative is to compose the text and type it while on-line.

Software

The most important element in the communications process is the software. A cheap computer and a modem can do anything that expensive equipment can do if the communications software is good. When choosing software, consider the following:

- Configuration. Can the software easily be made to conform to the setting of the computer the user wants to communicate with?
- Baud rate. Can the software support more than one baud rate (300, 1200, 2400, etc.)?
- Data bits. Does the software support both the seven-data-bit format for transmitting ASCII files and the eight-bit format for transmitting binary files? Information retrieval services use ASCII files, a standard text that does not use features such as underlining or boldfacing. These files require seven bits to transmit each character. Binary files are more complex: They contain nonstandard features and are commonly transmitted using the eight-bit method. The extra bit is used to check the integrity of the data being transmitted.
- Parity. Does the software support the "even, odd, no parity" method to check the integrity of transmitted data? In an "even parity" scheme, the eighth bit (1 or 0) always adds up to an even number. If the receiving system detects an odd number, it requests that the character be retransmitted. When the "no parity" option is used, the transmission of information is accomplished without any parity check. Normally, this means that other methods of checking data integrity are used.

- On-line telephone directories and dialing. Is the software able to access an on-line telephone directory and dial a number from it? Many telecommunications software packages allow the user to create a list of telephone numbers for information-retrieval and bulletin-board services. To access these services, the user gives a command and the system dials the number and makes the connection. This feature shortens the connection process and limits typographical errors.

- Ease of use. Can the user interrupt the session and access peripheral devices, such as a printer? Some programs allow the user to exit to the Disk Operating System (DOS) and to perform functions, such as copying a file. Afterward, the user can return to the communications session.

- Downloading. Can the user download data to disks, a printer, or both? This feature is especially attractive when information-retrieval or bulletin-board services are accessed.

- Does the software support the "host," or auto-answer, mode? The host mode enables a PC user to interact with another PC user. Without this feature, a computer can originate calls only; it cannot answer calls.

There are many good communications packages on the market. But not all of them are "user friendly," or easy to use. A rule of thumb about computer-software packages is that those that claim to do everything are the least user friendly. An exception to this rule may be Microsoft Access, which offers easy-to-use features.

Another alternative to commercial packages is "shareware" software, which allows the prospective buyer to preview the package before paying for it. The process works this way: Shareware users make copies of the software for potential users who try it out and pay for it only if they are pleased with the product. "Shareware" telecommunications programs include Kermit, Pibterm, and Procomm.

Telecommunications software may include a feature that allows a user to download a program on a "window," a smaller work area on the computer screen. This means that while on-line the user can juggle tasks, such as downloading on one window, uploading on another, and accessing the host computer's menu.

There is a variety of software from which to choose. Decide which features are most attractive, compare prices, and preview the package if possible.

Conclusion

As we become more heavily involved with information processing, we cannot overlook the importance of using the computer as a telecommunications device. It is the best mechanism for sharing information quickly and inexpensively. Basic knowledge of telecommunications concepts can turn any computer into a powerful communications tool.

GLOSSARY

ASCII: acronym for American Standard Code for Information Interchange, which was established to allow for compatibility between different data communications equipment.

auditory/visual monitoring: modem users can monitor the telecommunications process either through sound signals (internal modem) or light indicators (external modem).

auto dial/auto answer: this feature means that the modem has the ability to dial telephone numbers and answer calls automatically.

baud rate: the method used to estimate the number of characters a modem is capable of transmitting per second. The higher the baud rate, the faster a modem will process information. Available baud rates are 300, 1200, 2400, and 9600 characters per second.

buffer: memory that allows for storage of transmitted or received information.

configuration: a process that enables a user to set up a computer so that it will interact with other peripheral devices, such as a modem, printer, etc.

data bits: the number of bits required for each byte, or character, to be transmitted. Each byte consists of seven bits for ASCII files and eight bits for non-ASCII files.

dip switch: allows the user to change the configuration from the factory setting (for example, a user can increase printer speed from 1200 to 2400 characters per second by resetting a dip switch). Dip is an acronym for Dual-In-line Package.

download: the ability for a computer to receive information via the telecommunications process.

dumb terminal: a terminal that cannot perform functions other than data input or output to or from a computer.

intelligence: the built-in ability that allows a computer or modem to perform complex functions. For example, an intelligent modem can automatically log on and off.

motherboard: a computer's internal circuit board.

parity: the process of checking for errors in transmitted information (even, odd, or no parity) by sending a bit along with each character transmitted. In an even parity check, the bits (1's and 0's) that make up the character must equal an even number or the receiving modem will request the host system to retransmit the data.

PC: acronym for Personal Computer, that is, a microcomputer.

smart terminal: terminal with the "intelligence" to perform complex functions, such as logging on or using macros (chains of commands).

synchronous/asynchronous operation: modem features that require that the sending and receiving points transmit and receive signals in regular, timed intervals (synchronous) or not (asynchronous).

telecommunications: the process of transmitting data over communications lines.

upload : the ability for a computer to send data to a remote computer via the telecommunications process.

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