COMMUNICATIONS CORNER

What is half duplex?

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TWO SURE-FIRE INDICATORS OF THE state of advancing technology are newspaper articles and reader mail. For instance, about a year ago, newspaper articles of any kind that contain the term "modem" always provided a concise explanation of what a modem was (or what it did). Similarly, reader mail almost without exception referred to radio or telephone voice-transmissions.

Today, newspaper and magazine articles use the term modem with no attempt to explain what it is because it is now assumed that everyone knows about the device. And as for reader mail, it now reflects a substantial interest in data communications via a modem.

However, there is a feature of computerized communications through a modem—called *half duplex*—that seems to confuse newcomers to the computer field. One reason for the confusion is because some modem manufacturers (as well as some software authors) use the term out of context. That means that the user suddenly finds himself with three different explanations of what half duplex is—one in computer's documentation, one in the modem's instruction manual, and the other in the software manual.

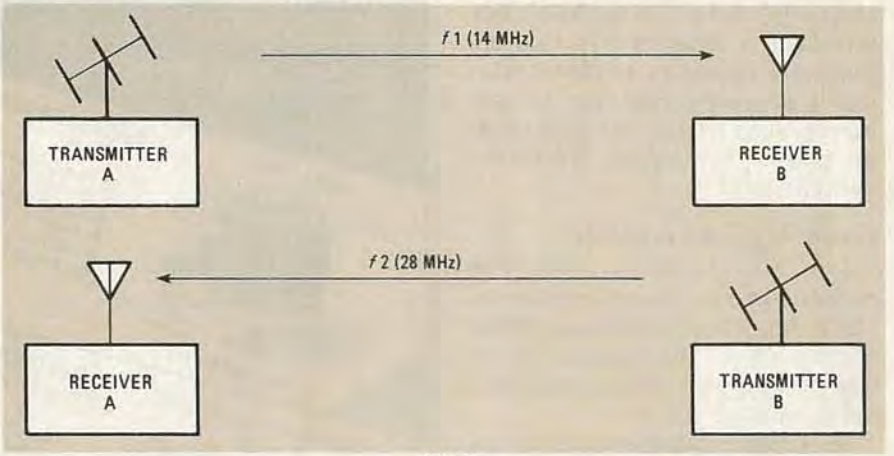

FIG. 1

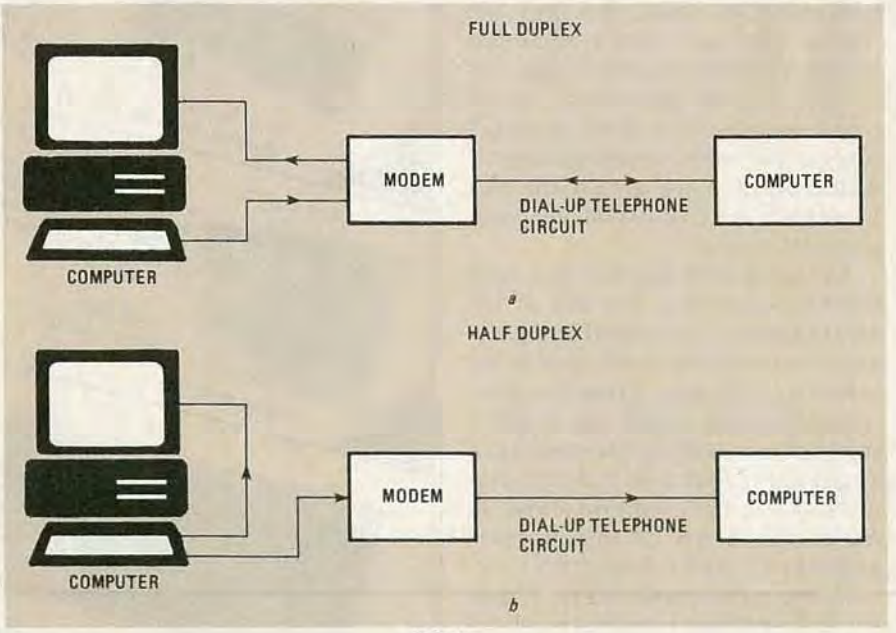

FIG. 2

Full-duplex communications

To understand the term "half duplex" we must first go back to "full duplex." In communications, full duplex means simultaneous transmission and reception. An example of full-duplex communications is the telephone system, where two parties can talk and listen at the same time.

In radio communications, the same thing can be done by using two frequencies, as shown in Fig. 1. Let's assume that two radio amateurs are using full-duplex systems on 20 and 10 meters (even though it is supposedly illegal).

Transmitter A broadcasts to re-

ceiver B on a frequency of 14 MHz. The transmitter at B broadcasts on 28 MHz to receiver A. With that arrangement, the operators can talk and listen at the same time, as if they were using the telephone. Now enter the computer.

Computerized communications

The terminal-to-computer circuit used for the dial-up telephone system is shown in Fig. 2. Notice that one wire (Fig. 2-a) carries the signal in both directions. Bear in mind that a terminal's display and keyboard aren't connected; they are two distinct and separate units.

The terminal is connected to the telephone line through a modem. The modem routes the outgoing signal from the keyboard to the telephone line, and the incoming signal from the line to the display. That arrangement is called "full duplex" because it allows you to transmit as well as receive data.

Imagine for a moment that you're in Boston inputting data to a terminal for transmission via the dial-up telephone system to a computer 3,000 miles away in, say, San Diego. Now, let's suppose that you type in a single letter "Z," for instance. But how do you confirm that your transmission was actually received by the computer at the other end of the telephone circuit?

The computer at the other end confirms that it has received your transmission by echoing back the letter "Z" (which appears on your display)—telling the originating operator the that the computer (at the other end) has received the correct character. (That takes place so fast that it appears as if the letter "Z" pops up on the display as you press the key.)

However, there is one problem that may occur: The computer (at the other end) receives the correct transmission, but the echo gets garbled by line noise. The echo would then appear at originating computer as something other than what was originally transmitted. What happens then depends on your software.

At high transmission rates (4800 to 19,200 baud), several characters would be transmitted before the first echo returned, causing confusion as to what was going out. To

avoid that problem, baud rates for single-wire circuits are generally limited to 1200 baud. For a faster transmission rate, we would use separate send and receive circuits—but that is beyond the scope of this article, so let's stick to the dial-up telephone system and 1200-baud maximum.

If there is a transmission delay when using a terminal, there's nothing you can do as the terminal operator. You must put up with the "gibberish" displayed on your terminal, unless you can send a code to the other computer to shut off its return echo. But if you're using a computer as a "smart terminal" (which is more likely in this day and age), it's possible that your communications software can overcome a transit delay.

To handle moderate delays at normal transmission rates (300 and 1200 baud), some communications software will not transmit a character until it receives an echo for the previous character. That's all it takes to accommodate a transit delay—just wait until the echo is received.

There is, however, another problem—dual echo—a phenomenon that's caused when the computers at each end of the circuit are generating a return echo. Neither would be able to distinguish between the echo and the transmitted signal.

To further explain, let's again assume that the originating computer transmits a letter "Z," which is picked up at the other end by the receiving computer. The receiving unit would then send a conformation (echoing the letter "Z") back to the sending unit. When the sending computer receives the echo, it assumes that that signal is (not an echo but) a transmitted character and echos its confirmation, causing a feedback loop.

The single character "Z" would bounce back and force between the two units filling their screens with "Z's." (In other words, the first operator could press just one

key and watch the screen fill with "Z's.")

Half duplex

To avoid the problem of return-echo delay, or dual-echo bounce back, we can use what is called "half duplex." Figure 2-b shows that the terminal's keyboard is connected to the display, so the display reproduces whatever is input for transmission. There are no connections between the modem and the display: The modem transmits only to the computer on the opposite end of the dial-up circuit. Whether the computer echoes or not makes no difference since the originating computer does not display the return echo.

Normally, it's difficult to muck up half-duplex when only a terminal is involved. It's when we use a computer as a "smart terminal" that things can get sticky (as when the software isn't well thought out). Using "half duplex" should automatically disable reception of the echo; however, that isn't the case with all communications software.

If the computer can operate in half-duplex—showing all characters entered on the keyboard—and still display the echo, everything will be displayed twice on the screen. For instance, the word "ZAP" would be displayed as "ZZAAPP."

When that happens the software author usually avoids lock-up and continuous looping by somehow disabling the return echo, even though the screen is displaying the characters twice. Quite frankly, he either has no understanding of half-duplex, or has simply screwed up (which is more likely).

The general rule for half-duplex is that if you're having problems, such as your screen displaying every character twice, turn off the half duplex because you're receiving an echo. If the screen is in a continuous loop and only one character is repeating, either you or the other end (not both) must turn off the computer echo. Though both computers can operate individually in half-duplex, that's not usually recommended because then there is no check (of any kind) on the status of the computer-to-computer link. **R-E**