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CARRIER TONE

The transmission of computer data via the telephone network requires the use of a modem or acoustic coupler, as a telephone line can handle only a limited range of frequencies. When a link is established between two machines, a constant signal called the *carrier tone* is transmitted. You can hear the carrier tone just before you push the telephone handset into the acoustic coupler, or by picking up the handset during transmission with a modem (the latter is inadvisable, however, since it is liable to introduce noise into the signal and corrupt the data).

Most modems and acoustic couplers have an LED, labelled 'carrier detect', on the front panel. If this should go out then the tone isn't being received and there has been a break in transmission. The frequency of the carrier tone is designed to fall in the middle of a telephone transmission band, and the data is 'modulated' onto this tone according to a predetermined system. Thus a '1' might be represented by a frequency a little higher than the carrier tone, and a '0' by one a little lower. It is this system of modulation that determines the maximum data transmission rates. Most modems can handle up to 1200 baud, but some devices can deal with rates as high as 9600 baud.



In the film *Wargames*, in which a home computer user accidentally breaks into the North American military computer system, the hero made use of an ingenious program for locating computers that can be 'tapped' via the telephone networks. The program that he devised simply dialled up every number for a given area code in sequence. If it answered with a carrier tone the number was logged on disk, otherwise the computer terminated the call and went on to the next number.

CARRY

All arithmetic relies on the idea of digits being 'carried' from one column to another. Computers use exactly the same technique for performing arithmetic on the binary numbers that they process internally. A half-adder is a simple circuit that can add two binary digits together to produce two outputs — a *sum* and a *carry*. A full-adder circuit can cope with a third input as well — a carry-in from the digit on its right. Eight full-adder circuits can therefore be coupled together to add

two eight-bit numbers together and produce an eight or nine-bit result. A microprocessor or CPU contains a general purpose arithmetic and logic unit (ALU), and one of its functions is to set a special *carry bit* in one of the internal registers whenever such an addition has resulted in nine binary digits.

CCD

Charge-coupled devices are now replacing conventional television camera tubes to give computers visual input or a 'sense of vision'. This is particularly applicable to the field of robotics, in which researchers are attempting to develop software that will enable an industrial robot to identify components.

Compared with a conventional television camera, a CCD system is smaller, lighter and cheaper to manufacture in large quantities. It consists of an array of tiny electronic circuits packed onto a conventional silicon chip. Each circuit is charged to a known potential, and then the image is focused onto the array by means of a conventional lens. Light falling onto a cell will cause the potential to drain away, allowing the image to be read electronically. The result will be an array of bits, perhaps 256 by 256 at maximum. Dark areas will be represented by a '1' and light areas by '0'. The *threshold level* — the level of light that determines whether a bit will be a 1 or 0 — is determined by the time for which the image is exposed to the array.

It has been discovered that some dynamic RAM chips can behave like CCD arrays if the metal protective covering on the top of the chip is carefully removed. These chips form the basis of the low-cost computer vision systems that are now starting to come onto the market.

CELL

As well as referring to a battery used in a portable computer, *cell* can mean the intersection of a row and column on a spreadsheet. The interesting thing about this type of cell is that it can be used for storing either 'raw' data, such as a figure or the label for a column, or a relationship such as $B4+B2$, where the contents of the cell are expressed in terms of the values of two other cells.

CENTRONICS

Centronics is the trade name of a computer printer manufacturer whose name has become synonymous with a type of interface that is developed for its machines. A *Centronics* interface is a 'parallel' interface (meaning that data is carried simultaneously along eight separate lines). It consists of a plug or socket with 36 pins on it, although smaller plugs can be used. A piece of equipment with a Centronics interface can be relied on to work with other devices with the same interface. However, because Centronics interfaces send data in one direction only, they are not used on devices such as modems, which need to send and receive data.