Part 3 of the BIOS, the actual system BIOS, consists of various interrupt service routines (ISRs) that provide level control for hardware I/O devices and additional system services. In the PC, external devices do not communicate with the processor directly. **Interrupt** requests are sent to the interrupt controller, and only the interrupt controller sends interrupt requests to the processor. When the processor has acknowledged the request, the interrupt controller sends the interrupt vector number to the processor. The processor then starts a standard interrupt initiation sequence. A particular function is accessed by loading a certain value into one or more processor registers before issuing the actual interrupt request.

The last part of the BIOS is the Setup Utility provided in ROM, in some cases also as a separate program on diskette, as a means to configure the programmable hardware components. Programmable hardware components initialize to default settings. Therefore, configurations must be stored. For this purpose BIOS uses a special type of battery-backed nonvolatile random-access memory called CMOS-RAM. During POST initializations data are fetched from CMOS-RAM to initialize the various hardware components according to the configuration set through the BIOS Setup Utility.

Apart from the system BIOS, a personal computer's motherboard also includes a keyboard ROM BIOS. This BIOS is responsible for the conversion of the keyboard scan codes into the extended ASCII codes, comprising one-byte character codes ranging from 0 to 255, an extended code for special keyboard functions, and functions handled within the keyboard BIOS or through interrupts.

The personal computer may also consist of additional BIOSs through optional ROM chips, residing on adapter cards (video adapter, floppy disk drive, and hard disk drive controllers). These adapters and/or controllers may also be integrated onto the motherboard: therefore, the optional ROM(s) may reside on the motherboard also. At a certain point during POST, after the default interrupt vectors have been initialized, the memory addressing space will be scanned to look for optional ROM.

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—*Alle Metzlar*

Bit and Byte

In the **binary system**, numbers are represented using only the binary digits 0 and 1. The composite term *binary digit* is abbreviated as *bit.* In a **digital computer**, a bit is the minimal amount of information that can be processed.

A group of eight contiguous bits in the computer is called a *byte.* Usually, computers process and transfer several bits simultaneously. The first popular **microprocessors** worked with eight bits at a time; now microprocessors can handle up to 64 bits simultaneously. In the latter case, we would say that the word length of the processor is 64 bits or 8 bytes.

The word *byte* was coined in 1956 by the **IBM** engineer Werner Buchholz (1922–), who wanted a term to represent a subset of a word that could not be confused with *bit.* Afterward, some computer manufacturers used the term *byte* to denote a seven- or even nine-bit unit of information (necessary to store one character), but eventually, only the connotation in which a byte refers to eight bits of information survived. The IBM 360 series of computers, started in 1964, was the first 32-bit architecture with byte addressing.

When referring to large sets of bits and bytes, the abbreviations K (kilo), M (mega), G (giga), and T (tera) are used. They correspond to 1024, 1024^2 (approximately 1 million), 1024^3 (approximately 1 billion) and 1024^4 (approximately 1 million-million) units. The capacity of memory chips is measured in bits (denoted as "b"). A 64-kb (kilobit) memory chip, for example, can store up to 64 × 1024 bits. The capacity of secondary storage media, such as floppies, **hard disks**, or **CD-ROMs**, is measured in bytes (denoted as "B"). Therefore, we speak of 1-MB (megabyte) **floppy disks** and 3-GB (gigabyte) hard disks. The transmission speed of networks is measured in bits per second (b/s). The classic **Ethernet**, for example, is a 10-Mb/s network.

There is another word that programmers sometimes use: a *nibble*, which refers to four bits of information—that is, half a byte. A nibble is a convenient unit of information, since it can be used to pack an hexadecimal digit. In telecommunications, a nibble is sometimes called a *quadbit*.

—*Raúl Rojas*

BITNET

BITNET was one of the transitional academic networks that prepared the way for the **Internet**. The network was founded in 1980 by the directors of computer centers at seven large universities on the east coast of the United States. The group was led by Ira Fuchs, who was then vice-president for information services at the City University of New York (CUNY). They envisioned BITNET as a way to bring the services of computer communications to schools and programs that lacked access to **ARPANET**.

Originally, BITNET stood for "Because It's There Network," a reference to the commercial networking software that came with their **IBM** machines. Most of the first nodes on BITNET were large IBM mainframes at university computer centers. BITNET relied on standard telephone lines and 2400- or 4800-baud modems to implement a store-and-forward network; instead of breaking messages into small packets and routing them through a complex network, the computers of BITNET sent entire messages from one computer to another. The network was originally star shaped, with the center of the star at CUNY.

BITNET operated as an informal cooperative for three years. The network had no central institutions beyond an informal executive committee. The computer center at CUNY maintained and distributed routing tables while other network expenses were paid by the member institutions themselves. Each member had to pay the nominal cost of connecting their computer to the nearest BITNET node. To allow the network to expand, each member was obligated to provide connections for at least two other network members. In 1984, IBM gave BITNET a three-year grant to fund an operations center and an information center to promote the network. When the grant ended in 1986, the network incorporated and relied on user fees to pay the cost of maintenance.

As a store-and-forward network, BITNET initially offered users only two services: file transfer and interactive messaging. Volunteer programmers worked to extend the capabilities of the network and soon developed software for e-mail, chat rooms, and file servers. Among their contributions, the most lasting was the Listserv program, a combination of mailing list and file server. Written in 1986 by Eric Thomas, a student at the École Polytechnique in Paris, Listserv allowed users to manage mailing lists, e-mail discussion groups, electronic libraries, program archives, and electronic periodicals. Flexible, yet relatively simple to operate, Listserv quickly proliferated through BITNET. Among Listserv users in 1989 were the governing board of BITNET, a group of humanities scholars centered at the University of Toronto, and a Chinese student organization in the United States that supported protesters in the 1989 Tiananmen Square uprising.

BITNET flourished from 1987 to 1989, before the general availability of Internet services. At the start of this period, BITNET had about 400 institutional members and about 3000 computer nodes. The network gained hundreds of new users each month, and the number of Listserv mailing lists ballooned from 130 to over 3000. During this period, the network established gateways to similar networks in Canada, Europe, South American, and Japan.

In 1989, BITNET merged with CSNET, a small **Unix**-based network that connected academic computer science departments. The resulting organization was called CREN, the Corporation for Research and Educational Networking. As the new organization grew, its leaders became increasingly aware of the limitations