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Computer Communications: Industry Interdependence

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COMPUTER COMMUNICATIONS: INDUSTRY INTERDEPENDENCE

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The computer and communications industries, drawing upon a common base of technology and competing for the same markets, are growing increasingly interdependent. Convergence of the technology used by these industries is evinced by the development in the telecommunications industry of an electronic switching system controlled by a stored program very similar to the system software utilized by computers. The convergence is further demonstrated by the amount of computer capacity—beginning with the IBM System 360—presently devoted to communications functions. Another manifestation of this interdependence is the increasing utilization of micro processors in both industries: processors are now widely used in computer systems and terminals and will be installed in all telephones in the near future. Both industries are also drawing upon the new magnetic bubble storage technology.[1] More importantly, since about 1960, the telecommunications industry has become increasingly digital in form. Some illustrations should clarify this point.

The natural form of the spoken word is analogue. Illustration 1(a) (see p. 472) characterizes this natural form, and typifies how the telecommunication transmission systems have evolved over the past 100 years. Illustration (b) depicts the concept of instantaneously "sampling" several thousand times a second the amplitude or height or energy level of the signal, and transforming those sample slices into dots and dashes or "bits", as shown through steps 1(c) and 1(d). In this way the voice signal becomes digitized. Thus the digital form deals with long strings of "on" and "off" signals, or ones and zeros. This is the same form in which a computer processes data.

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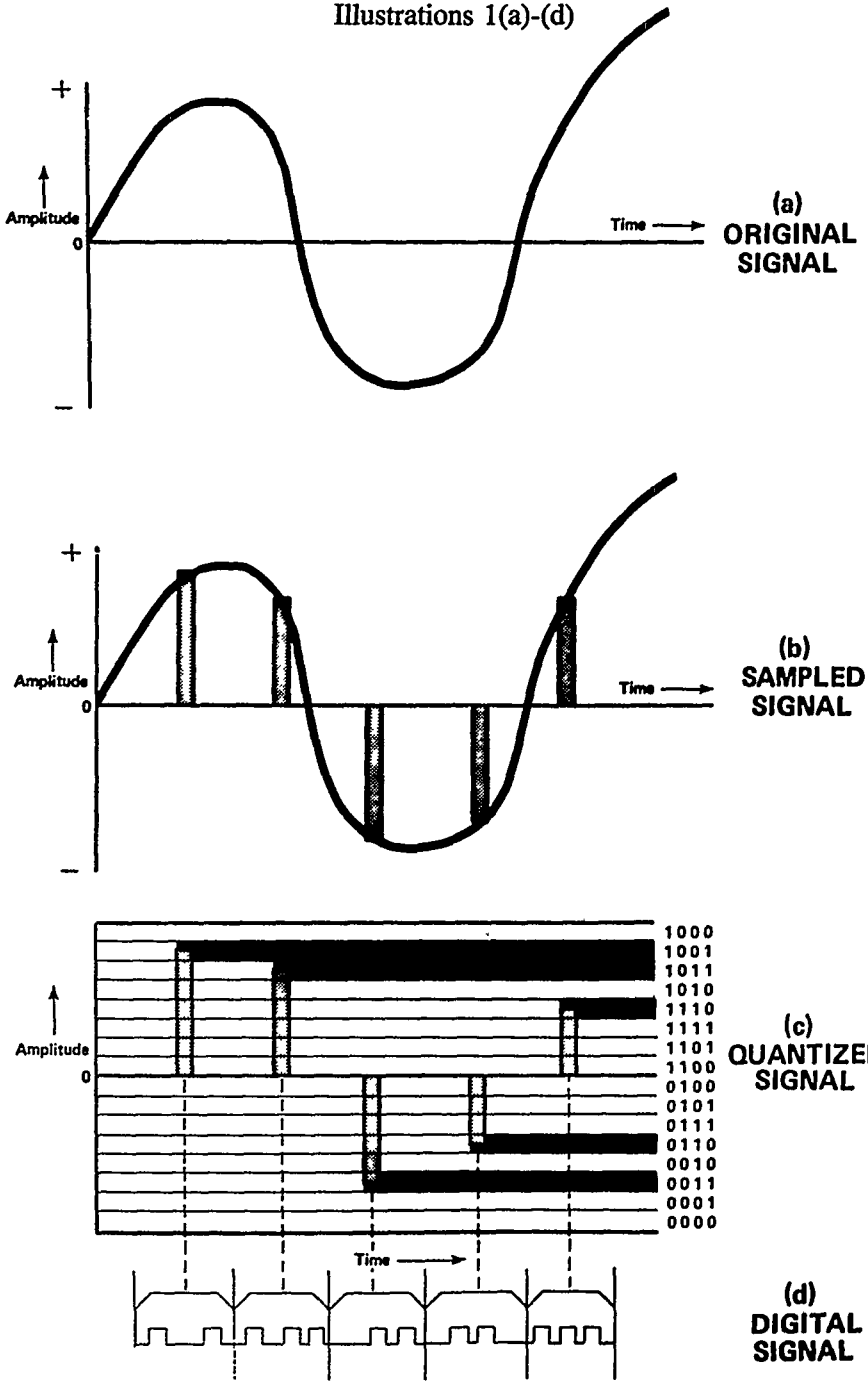
1. A technique that utilizes the magnetic properties of material to store information.

Illustrations 1(a)-(d)



A similar movement toward digital operation has occurred in telephone switching. When a telephone is dialed, the telephone line is connected automatically, in the central office building where the telephone is terminated, to another telephone line or to a trunk to another central office, by a switching system. A switching system can be thought of as a matrix, which has incoming telephone lines on its vertical side, and outgoing lines on its horizontal side. When a telephone is dialed, the switching system connects the incoming customer lines with the outgoing trunks. When the telephone system is an analogue, the function of the switching is to connect—electrically and physically—the lines and trunks together. But with a digital system, handling signals encoded as bits, which may be interspersed on the line as the digitized speech of a number of users, the switching problem is different. Instead of connecting physical lines together, the digital switching system must precisely sort and route the bits, so that those representing the encoded speech of one user are sent over one line, and those of another user are sent over another line. Since about 1972, the newest telephone switching systems, whether of the central office or private branch exchange type (PBX),[2] have been time division, digital switching machines. Thus digitized transmission systems and time division switching systems are very similar to the natural operating mode of the computer; in this way the technology of the two industries is converging.

As noted above, the two industries are increasingly competing for the data communications market, which is substantial. A comparison of the estimated annual expenditures for data communications in the United States for the twenty year period between 1965 and 1985, and the annual expenditures for voice communications in the same period suggests the growing significance of these markets. Data communications expenditures were at about a billion dollars in 1965, and grew to some five and one-half billion dollars by 1975. The Bell System projects that by 1985 data communications expenditures will be approximately $22.5 billion. Total voice expenditures were about $17 billion in 1965, and will be slightly less than $40 billion in 1985. Thus the proportion between expenditures for data communications and for voice is in-

2. The internal (to the user organization) telephone switching system commonly used in offices and businesses having more than 10 to 20 telephones.

creasing and, within 10 years, Bell expects that data communications expenditures will be more than half of voice expenditures. Additionally, Bell projects that by 1985, expenditures for data communications terminals will exceed those for voice communication terminals.

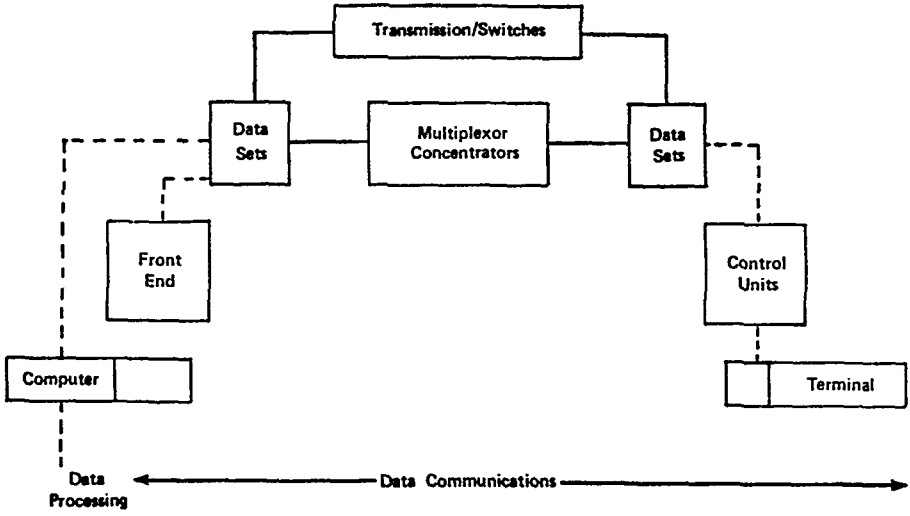
"Data communications" refers to the movement, by electrical means, of coded information between two or more points, which can be displaced either in distance or in time. The process of data communications is comprised of three functional categories. The first is the "Transmission" category, the actual transport of the encoded information. In order to achieve the transporting of the information, it is necessary to convert it from its original form suitable for humans to one suitable for electrical transmission. This is the "Media Conversion" category. The third, "Communications Processing," refers to any "handling" of the information in a manner that makes its communication more certain, reliable, error free, or economical. A simple example of Communications Processing is dialing the telephone; the functions activated by dialing make the communications more economical and reliable.

The composition of the marketplace regarding these functional categories has been changing. Ten years ago the portion of data communications expenditures accounted for by the Transmission function was approximately one-half of the total. Ten years from now it will be less than one-quarter, while the whole will be four times larger than it now is, and 20 times greater than it was ten years ago. The Media Conversion function has increased from 30 percent ten years ago to 40 percent today, and will be about 45 percent ten years hence. Finally, the Communications Processing function has grown from approximately 15 percent ten years ago to 30 percent today, and is expected to remain at this level for the next ten years. The technological developments discussed above are responsible for this transformation of the marketplace. The dollar value of each of these functional categories is obviously great given the rate at which the market as a whole is growing.

The competition between the communications and computer industries for these common markets can be visualized by an illustration. This illustration depicts a typical data communications system, beginning with the terminal, shown at the extreme right. The terminal might be a teletypewriter, a keyboard-cathode ray tube (CRT) display,

Illustration 2

Data Communications System Components



or any of a number of other media conversion devices. The terminal will be controlled by a control unit connected to a data set (or modem). The data set will be linked to a transmission channel which will then be connected to the computer shown at the extreme left.

The communications industry says that any portion of such a system, except the computer, is an appropriate market for it to compete in. The computer industry, on the other hand, seeks to compete for all the elements of such a system except the transmission channel. The "overlap" or competition between the two industries is clearly considerable. Although the communications industry has not yet evidenced a particular interest in the computer itself, and the computer industry has expressed no desire to become involved in the transmission, switching element, both industries are competing for the terminals, data sets, mutiplexer concentrators, and terminal controllers.

Because the two industries have moved toward a common technological base, the systems and subsystems marketed by one industry are increasingly adaptable to applications and uses by the other. The most litigious manifestation of this phenomenon to date concerns the marketing of data communications terminals; one example of this is the CRT.

The computer industry contends that the Dataspeed 40's,[3] marketed by the Bell System, are functionally equivalent to the units supplied by vendors of computer systems and are thus, in reality, data processing devices. The communications industry, on the other hand, contends that these terminals are simply a more technologically advanced form of the terminals it has supplied for years. They are simply "modern teletypewriters," with a visual display capability that replaces the printed copy.

The adaptability of products and services supplied by one of these industries to major markets served by the other is not confined to data communications terminals. Indeed, the most sophisticated PBX offerings today have stored programs[4] and a processor.[5] Although they are designed to "control" telephone sets, PBXs can be adapted for other applications. The two industries have already begun to compete in this area. The latest PBX systems marketed by the Bell System, called the "Dimension," are stored program—time division, *i.e.*, digital—switching devices. For the past several years IBM has been marketing a functionally similar PBX in Europe, called the "3750." Both have processors within them, are controlled by stored programs, and have the capability of controlling not only telephone sets, but data communications terminals, such as the Dataspeed 40's, and other media conversion devices. Conversely, the sophisticated mini-computers currently on the market are capable of serving as multiplexers,[6] controllers for data communications terminals, or as PBXs themselves. Thus, because of the technological convergence discussed above, there is an emerging and converging competition between the two industries for the same markets.

Why is the communications industry, and particularly the common carriers, interested in this? First, under the system that has evolved in the United States, the communications common carriers are obliged, by

3. A keyboard-CRT data communications terminal.

4. Electronically encoded logical instructions which governs the functioning of the PBX. The stored program can properly be thought of as "software" in computer terms.

5. That portion of the PBX in other stored program controlled devices that interprets the logical instructions encoded in the stored program and causes the device to perform the desired functions.

6. A device that divides communications channels into several subchannels or smaller communications capacity or bandwidth.

the terms of their franchises, to serve all users in their franchised territories who want their services. By their presence, therefore, the communications common carriers offer users a supply source they otherwise might not have. Some users prefer to select the best mix (for them) of elements from a variety of supply sources in developing their systems. Other users place a premium on having a single supplier for their entire communications system. The presence of the communications common carriers in the competitive marketplace provides the user with an additional alternative of the latter sort. The ubiquity and the geographical proximity which the communications common carriers offer is an important consideration for users in some locations, and is not always matched by suppliers from the computer industry. Secondly, the Bell System and communications common carriers are interested in offering the sophisticated communications capability outlined above to small users and small outlying branches of large users.

There is an additional straight forward reason why the communications common carriers are interested in these highly competitive markets: they will realize substantial revenue dollars. In addition, the convergence of all communications toward the digital form is part of an evolving world-wide trend. Increasingly, telecommunications carriers throughout the world are moving into network services that draw on "intelligence," *i.e.*, stored programs embedded in the networks. Bell System recognizes that to remain a leader of the communications industry it must be part of that continuing world-wide trend—Bell has to be a part of that action. Because communications and computer technology are converging, Bell must participate in the new markets if it is to remain a significant supplier of future communications services, whether voice, image, visual, or data communications.