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Telecommunications in the Office

Many activities are underway to apply technology to the office to achieve improved productivity. This paper discusses advances in telecommunications technology and how they can be applied to the office environment. Trends in technology are discussed but predictions are avoided. Earlier, scientists and engineers have succumbed to the temptation to predict the future with poor results. Thomas Tredgold, in 1835, said, "any general system of conveying passengers—at a velocity exceeding 10 miles per hour or thereabouts—is extremely improbable." This railroad engineer failed to foresee the bullet train traveling from Tokyo to Osaka at over 100 miles per hour.

In 1903 Simon Newcomb said, "quite likely the most effective flying machine would be one carried by a vast number of little birds." Near the beginning of this century, one of the country's most eminent scientists, the secretary of the Smithsonian Institution, said he was certain man would never fly. *The New York Times* agreed with Professor Newcomb in an editorial. Presumably the Wright brothers did not read the *Times*. One week later they succeeded in raising "Flyer 1" from the sands of Kitty Hawk.

Innovators predict the future at their own risk. Even Wilbur Wright predicted slow progress toward flying when, in 1908, he revealed, "I confess that in 1901, I said to my brother Orville that man would not fly for 50 years." Notice that all these predictions tend to be negative. It is typical to underestimate the rate of technological achievement.

It is our knowledge that the pace of technological change is quickening. In the late 1800s, agriculture occupied 50 percent of the work force.

Industrial occupations were high. Service was low and information activities accounted for a mere 5 percent.

Then came the big boom in industrialization in the late 1800s and early 1900s. Agriculture sank to 28 percent of the work force. Industry now consumed over half the work force. Service and information had begun to grow.

In our time less than 3 percent of the work force is engaged in growing food—and we feed half the world. That is real productivity. On the other hand, over half the work force now deals with information in some fashion such as programmers, teachers, clerks, secretaries, accountants, stock brokers, managers, and of course, librarians. The broad perception is that they are not dealing with information very effectively—The Information Explosion.

TABLE 1
DISTRIBUTION OF THE WORK FORCE

	Stage 1 Mid-1800s	*Stage 2 Early 1900s*	*Stage 3 Now*
Agriculture	50%	28%	3%
Industry	36%	53%	27%
Service	9%	10%	14%
Information	5%	10%	56%

In 1979 the single most common occupation in the United States became that of clerk. Clerks now outnumber laborers. In fact, this segment of U.S. history can be characterized by the transition from farmer to laborer to clerk.

As librarians you are undoubtedly aware of the information explosion. Currently information in science and technology is growing at a rate of 13 percent per year—i.e., the information doubles every 5.5 years. About enough time to complete an MS degree. John Naisbitt, author of *Megatrends,* foresees an increase of 40 percent per year. That means information will double in twenty months. Another way to put it is, information will quadruple during the time it takes to get a bachelor's degree. The implications to those of you who are teaching is staggering. This can be even more threatening to the working professional. Technical obsolescence is a very real threat. Hence, I see a growing market for continuing education.

Consider that by the end of 1982 there were more computers than people in the world. There were over 5 billion computers on earth—including the big ones in the accounting departments and research labs, and the little computers in cars, games and calculators. By one estimate there will be over 8 million computer terminals in U.S. homes before the end of this decade.

What is driving this explosion of computers? It is spectacular progress in microelectronics—the first key technology of the "information age." It began with the invention of the transistor at Bell Labs in 1947. The first transistor was a rudimentary device but it worked. That set the stage for a microelectronics explosion. Today we can put the equivalent of hundreds of thousands of transistors into one cornflake-sized chip of silicon. That means that each of these chips has all the intelligence of a room-sized computer of the 1950s. As the size comes down so does the cost. In fact, every year for the past twenty years—on average—the computing power of silicon chips has doubled and their cost has been cut in half.

To give an idea of the magnitude of that progression, one economist (Edward Steinmuller, Stanford University) points out that had air travel progressed as fast, the Concord would carry half a million passengers, fly at a speed of 20 million miles an hour—and the cost of a ticket would be one penny.

Our latest microprocessor at AT&T Information Systems is the Western Electric 32000. The chip is smaller than a man's fingernail, yet contains 150,000 transistors. It has as much computing power as some of today's minicomputers that are the size of file cabinets—but it costs much, much less. So microelectronics is giving us the ability to make computers very small and cheap.

When computers talk to each other, they speak digital—the second key technology of the information age. Digital systems have two main advantages—simplicity and speed. Nothing could be simpler than a single bit of information—a one or a zero—represented as the presence or absence of a pulse in a series of pulses. This simplicity means that, in general, digital systems cost less, and their use results in reliable, high-quality services and systems.

In addition, digital components are what give computers their terrific speed. For instance, in the split-second it takes for a club to strike a golf ball, a Western Electric Digital Signal Processing chip can perform a few hundred thousand complicated arithmetic operations.

So in the first two technologies we've got the microelectronics hardware and the digital systems to process a lot of information very quickly. But how will all this information travel from here to there?

The third key technology is photonics. In electronics, metal wires carry information as pulses of electricity. In photonics, glass fibers carry information as pulses of light. Light pulses are a perfect match for digital systems. In fact photonics is so promising that in 1982 the Bell System installed more than 15,000 miles of glass fiber—twenty-five times more than the year before. Just one of those photonic systems (e.g., in Pennsylvania) contains more glass fiber than the systems of all domestic non-Bell companies combined.

The light comes from tiny light-emitting diodes or lasers smaller than grains of salt. The lasers turn on and off millions of times each second, sending pulses of light through fibers made of ultra-pure glass. These fibers form "superhighways."

Speaking of the speed of lasers, one of Bell Laboratories' latest achievements in laser technology is a laser that emits flashes of light that last thirty femtoseconds—10^{15} seconds. That is the shortest amount of time ever measured. Let me put that into perspective. In one second a beam of light can travel most of the way to the moon. In thirty femtoseconds a beam of light can travel only about one-tenth the thickness of a human hair. Someday a version of this laser might become the light source for lightwave communication systems. A laser so incredibly fast would be able to transmit enormous amounts of pulsed information.

The three technologies I have described—microelectronics, digital systems and photonics—give us the hardware to process and move enormous amounts of information with great speed and efficiency.

The fourth technology—software—is the glue that holds all the hardware together. It is what tells the hardware what to do. Software has a lot in common with phonographic records. In fact, software is to hardware as a record is to a stereo system. Just as which record you pick determines what music you hear, software is what gives products and services their unique features. Software makes it possible to customize services to meet individual needs.

In order to meet the Bell System's enormous appetite for software, today about half the people in Bell Labs develop software. Human designers need the computer's help—some of the solid-state circuits we are designing are so complex that it would take a human being a whole lifetime to design all the electronic connections by hand. Herein may be a clue to dealing with the information explosion. Designers are equipped with computer tools which allow them to deal with vast amounts of detailed information. One major advantage of the computer tool is that it brings any inconsistency to the designer's attention. That makes it very difficult to make an error.

Then there are the key technologies of the information age. Digital systems based on microelectronics are proliferating. Not only are they prevalent in computers and telecommunications but they are becoming common in automobiles, microwave ovens and washing machines. Photonics offers a new form of intercommunication. Software is becoming a buzzword. It made a big splash in arcade games. Now it is featured on the cover of *Time* magazine along with the youthful millionaires who wrote it.

In January 1983, AT&T announced a new system called DIMENSION, System 85. The system basically is a premises-based switching system called a PBX. It can connect a telephone to others in the same complex or switch it to various trunk lines across the country. Since it is a digital system it can conveniently handle data to and from computers.

One capability pioneered by System 85 is simultaneous voice and data. Voice is encoded into digits at the telephone instrument. Thus the voice can share wires with digital data. This allows a terminal user to independently use a telephone while communicating with a computer. But even for voice only, there are some new capabilities.

Combining voice and data also simplifies the wiring of the building. We use a simple outlet as the universal connector for System 85. It allows the user to move a telephone conveniently. Furthermore, the same jack can be used for computer terminals and printers (see fig. 1).

The telephone designed for System 85 converts voice to digits. The data can be used to drive the forty character display. For example, a secretary who answers a phone for several people can see who is being called and who is calling. This allows the secretary to answer the call in a personalized way and she need not push any buttons. A lamp at the bottom of the phone indicates messages are waiting. Thus, whenever a person returns to their office they can tell they have messages. With a telephone like this, messages can be retrieved automatically.

When an executive returns to his office he can use the display to see who has called and can return the calls by a single button push. If he wishes to answer the call, he can simply touch the "return call" button. When the executive is in the office, he or she can also see who is calling and decide whether to answer or not.

Simultaneous voice and data can be extended to the knowledge worker by means of a keyboard—i.e., a CRT Data Terminal. The terminal functions both as a telephone and a computer input device. The bottom line on the screen emulates the forty character display on the digital telephone. Thus, while the terminal is being used, signals about incoming calls and messages can be seen. The terminal is equipped with a touch-tone dial. However, when using the terminal one can dial from the keyboard. The screen indicates the sequence for keyboard dialing. Holding the break key is equivalent to going off-hook. The system responds with the word "dial" instead of dial tone. When one has dialed the digits and hits the return key, the screen indicates the progress of the call—e.g., ringing followed by

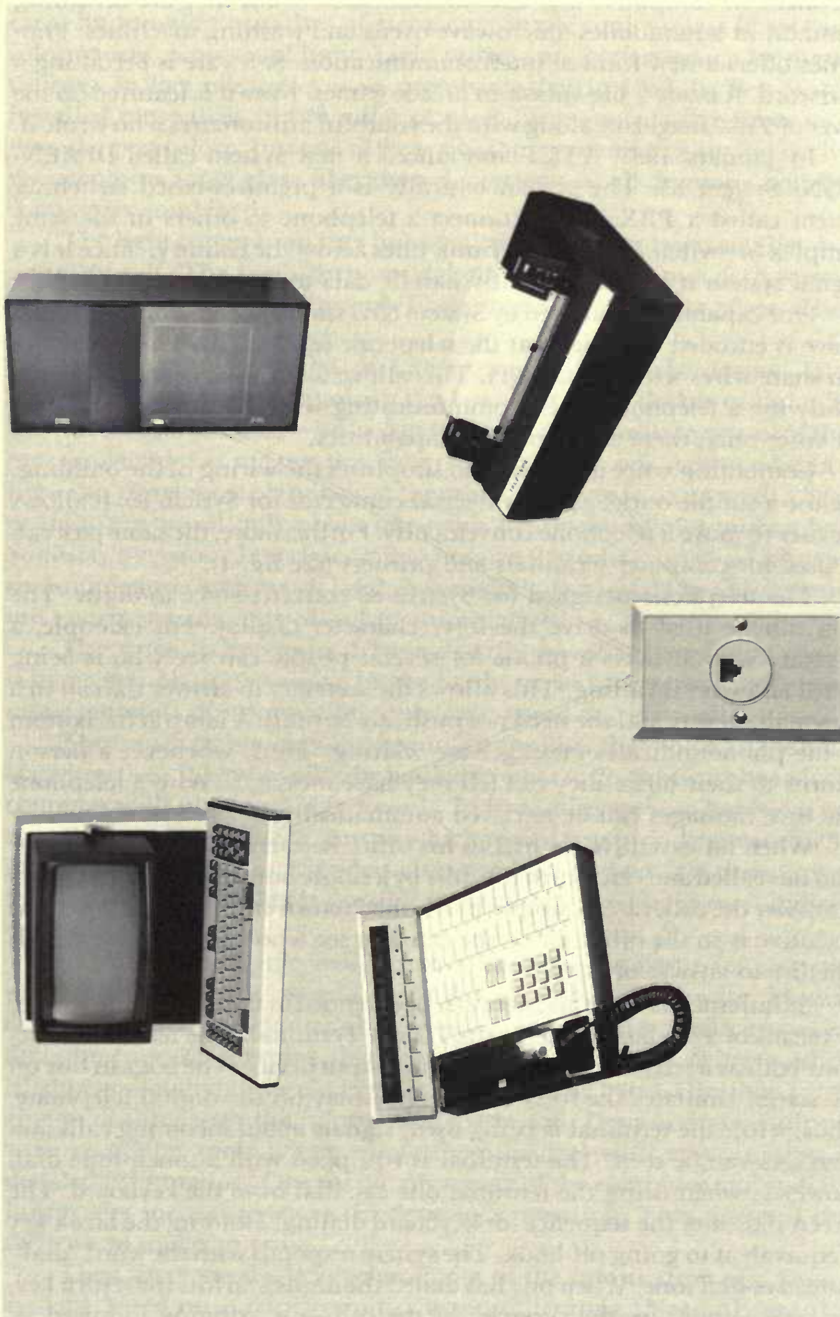

Fig. 1. System 85 Uses a Single Phone Jack to Access Phones, Computers, Printers

answer, or perhaps busy. The terminal coordinates the handshake with the computer. In particular, it sets the data speed to be consistent with the computer port you have reached. This capability is available to any terminal on the system, not just AT&T terminals.

There are several modes in which the data terminal can be used. First, it can directly contact a host computer. Second, it can contact a special host called the "application processor" (AP) for office features such as electronic mail. Or third, it can use the "application processor" as an intermediary to allow communication with various computers. In particular, the AP can make a terminal emulate an IBM 3270 terminal to an IBM host.

The Application Processor can perform a range of functions beyond terminal emulation. Examples are message center, office management and programming. When a phone isn't answered, the call is diverted to a message center attendant. The attendant takes the message and types it on the terminal for storage on the "application processor."

The Office Management System provides a range of functions. It interfaces terminals on one side and communications on the other. For test preparation it has a word processing type of editor. The editor has niceties such as a spelling checker, a punctuation checker and even a sexist language checker. Forms are a mainstay of the office so they have their own editor. A simple programming language, OPL, is provided so work can be customized. Of course, electronic mail is included, as is a calendar/reminder service. A major element is a file system.

There is a menu of alternatives available on the office system. The mail function provides a range of utilities. Creation of mail is eased by provision of text editors. Addressing is simplified by having a directory and an address book. The directory is available for general use. The directory is searched alphabetically, depending on the set of letters you type. All entries that start with those letters are displayed and you select one. It automatically becomes an address for mail. The address book is a personal directory. Names can be created for individuals or groups you frequently address. Mnemonics can be defined as preferred. A mnemonic can refer to a single individual or a group. When a mnemonic is selected, a copy of the mail is addressed to the one or more individuals in the group. Mail can be sent with a range of priorities or mailing can be scheduled. Confirmation of delivery can be requested.

For example, a daily report can be stored in a host computer. At a given time the report can be retrieved and sent to anyone in the department. A simple six-line program can do it.

The computer on the desk is becoming commonplace. It is indeed a valuable tool. However, its true potential won't be achieved until it is networked to other computers. The data needed is always somewhere else. The data is needed in a form in which it can be used without trancsribing it. Thus, computer networking needs to be integrated. Telecommunications is a force toward integration. Surely, no one wants more than one terminal in their office. Not only can't the space be spared, but also no one needs to learn different sets of routines for different applications. Again, telecommunications is the catalyst of integration. System 85 is an example of the facilities that are becoming available. The same fundamentals apply to most needs: single terminal access to a wide array of computers distributed nationwide or worldwide.

New technology is rapidly being converted to applications which affect our daily lives. In particular, telecommunications is rapidly exploiting new technology. The most dramatic impact is being seen in the office place.