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*Creativity
lies in seeing the
extraordinary
in the
familiar...
and making
it work*



Computer Communications, Inc.

“All the literature that has ever been written in the modern English language consists of patterns of only 26 letters.

All the paintings ever made are patterns of only three primary colors.

All the music ever written consists of patterns of no more than twelve notes...

And for the vast computations of digital computers, everything is made up of patterns of only two components, 0 and 1. ”

Donald Fabun, *You and Creativity*

Something new, then, is merely an original pattern of already existing components; the imaginative process in art or in science is the same. What is required to make something new is the ability to see a new relationship between the seemingly unrelated, and the competence to bring it to practical fruition. For a company involved in the complex and exactingly difficult science of computer technology, that takes individuals who value above all else the pleasures of imaginative and productive work. People with abstract insights, to be sure, but skilled in the practical applications of technology; able to look at a problem with fresh and candid eyes, yes, and then deal with it purposefully and successfully. People who find pride and satisfaction in taking their creative ideas from conception to working conclusion.

We have just such people.

Out of the everyday life of a company, of the people who work for it and the things they do, there evolves a sense or an image of what that company is like and what it will become. This brief profile is designed to define and amplify our experience so that, like a prism, it will reflect much meaning to the simple point that Computer Communications has a gifted capacity for bold innovation and creative achievement in systems which, while challenging to design and build, are clean, simple, and economical to use.

WHAT WE ARE

Computer Communications is engaged in research, development, and production of total computer-based systems. As our name implies, we give special attention to that most important trend in the computer business—the linking of central computers to users at remote locations over communications paths which vary from ordinary telephone circuits to special microwave links (as a dramatic indicator of things to come in this area, it is estimated that the traffic between machines will be occupying as much communications capacity in 1975 as all the traffic between people).

The computer-communications explosion, which has opened a vast new area for computer applications, is creating new (and sometimes uncomfortable) relationships between the computer industry and the communications industry. It is also creating new economic and technical challenges to both by greatly enlarging the traditional problem of making the power and potential of digital computers more readily accessible, for more purposes, to a wider audience, through simpler and more convenient input/output techniques and languages.

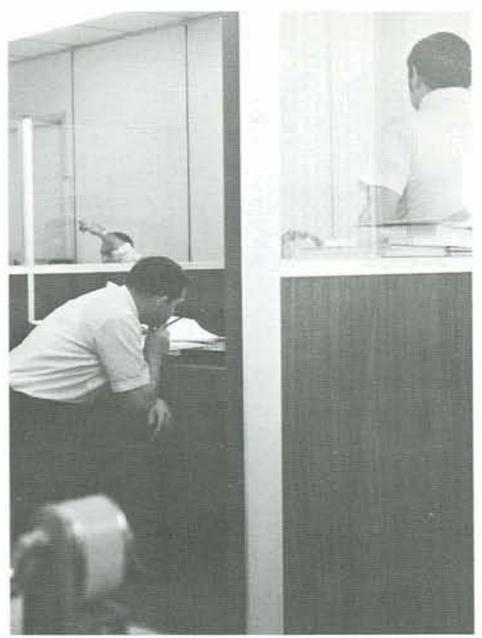
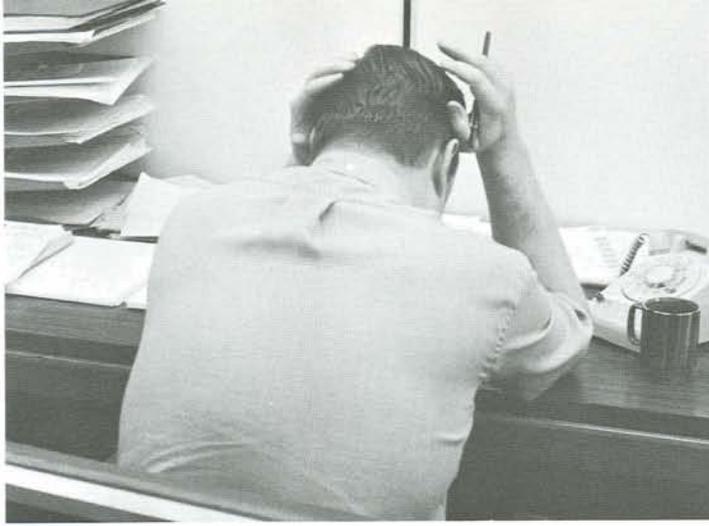
In this vital area of computers and communications, the business of our business is not merely to be productive, we want to advance and refine the very nature of the mix. And we measure our success accordingly.

Computer Communications, Inc. is a publicly held corporation with broad credentials in the complex realm of hardware systems architecture, systems engineering, installation and operation of on-line and time-sharing systems, software development, and the design and manufacture of a family of remote data stations and digital computer communications equipment. In an industry characterized by constant and aggressive competition, the ultimate measure of any company, no matter how technically qualified, is its ability to compete and maintain profitable growth. And we do that very well. But we frame the chronicle of our growth and profitability—our success—in quality performance, and technical excellence in the extensive services and products we offer.

At Computer Communications skill is the common currency. The scientists, engineers, mathematicians, and computer specialists whose complementary skills work in creative resonance have had extensive experience—most in principal roles—in all levels of computer languages, on all kinds and sizes of computers for business, scientific, and communications systems. Their education is not a passive wrapping but an active process. They have a clear view of their own judgements, an eloquence in expressing them, and a strength in urging them. They prefer the kind of action at the interface that only a dedicated, solidly technical company can offer. And they have proven their individual and team effectiveness by a surprising number of technical firsts.

In any company where the freedom to discover and produce exists, that company and its people will find the kind of heady accomplishments that make life, make interest, make importance.

That's the way it is at Computer Communications.



Computer applications are as diverse as they are immense, and in most cases the potential is yet untapped. While the range of available equipment is growing, becoming more powerful, and more economical, a major bottleneck prevents even greater utilization and exploitation of computers. The protracted problems are in the areas of analysis, definition, development, checkout, and installation of a system to meet an operational requirement in a reasonable time scale.

Each element in the application of a computer network to the solution of a specific need or for the provision of a general class of service is vital in its own right, essential to the whole, demanding in terms of skill, and unforgiving in terms of error.

The *planning stage* includes a definition of the service needed. The *design stage* includes the selection of computers, peripheral equipment, communications media, and software specifications. The *development stage* includes the procurement of standard hardware, the production of special digital equipment, the hardware integration of the system for checkout purposes, and the development and checkout of both systems and applications programming packages. Finally, in the *operational stage*, there must be continuing service to users in the maintenance and updating of both hardware and software.

So much knowledge is required—penetrating and practical knowledge of components, configurations, capabilities, cost performance, features, limitations—that the cardinal choices in any integrated effort to solve problems and create systems have to be made by men with a vast assembly of skills who have had first hand experience in what those choices are and what their results may be. This computer knowledge must be accompanied by a profound and emphatic understanding of *information*: its collection, transmission, processing, storage, retrieval, display, dissemination, use. And it goes without saying that each interpretation depends in equal measure on a real insight into the day to day needs of the user.

It is rarely possible that the necessary analytic and development skills outlined above can be supplied by any one

company specializing in only one area, such as the manufacture of central computer equipment, or the supply of peripheral equipment, or communications facilities, or analysis, or software. The mix of problems encountered—the number of new combinations of equipment configuration, the intricacies of reliable digital data communication, and the highly sophisticated software required—make it both difficult and undesirable for the ultimate user to have to rely on a number of narrowly specialized suppliers who are unable to take responsibility for the entire job, especially on new applications and specialized projects.

To sort out facts from opinions, performance from promise, there must be a source of unbiased advice and fresh ideas. There dare not be any unsupported impressions or unrationized articles of faith.

To get the highest return on computer hardware and software investment, maximum operating efficiency, and long term utility, a system must be flexible, open-ended, evolutionary. Comprehensive analysis must parenthetically, but no less importantly, deal with reduced machine time, reduced man-hour requirements, improved hardware-software utilization, reliable operation, more efficient management control, and better integration of the system into the overall fabric of organizational objectives, whether that organization is an industrial concern, business service, or government agency.

To repeat what we said earlier, Computer Communications was established to provide a self-contained total systems capability. Through careful purpose and exacting selection of staff, an immense amount of skill in each stage of the systems development cycle and in each technical area is together in a single, closely knit organization. In the computer industry—as in others—it has been repeatedly demonstrated that a cohesive, highly motivated group of people can create new systems and solve complex problems much more quickly and efficiently than a massive organization lacking technical direction and burdened by a cumbersome linkage of channels and command.

SYSTEMS

Since the interplay between analysis, engineering, logical design, development, and programming has become so critical—especially in the creation of complex total systems—we deem it of paramount importance that all capabilities exist in a single staff. Possession of all skills (in many cases combined in specialists with experience in both hardware design and software development) puts our company in a unique position to define and produce total systems when all capabilities are required.

As a matter of emphasis, what follows is a representative admixture of substantive projects undertaken by Computer Communications in the affirmative pursuit of its skills:

CONTRACTUAL DESIGN

Because of its multiplicity of prominent skills and profound knowledge of the many intricate aspects of computer technology, Computer Communications is frequently called upon to perform design studies for others. Many of these studies, characterized by valuable innovation on our part, have led to notable advances in the industry. Examples include:

- The entire logical design of a central processing unit and I/O modules for a special purpose real-time computer system later built by a large electronic systems corporation.

- Analysis for a major aerospace company which resulted in a unique, forthright method for reliable cost-performance evaluation of airborne computer systems.

- A next-generation systems study for a computer manufacturer defining an integrated hardware/software organization encompassing a family of compatible real-time computer systems.

- The initial conceptual design of a multi-computer real-time data processing complex which resulted in a contract award to our client. The conceptual design was followed by detailed design and implementation of portions of a special purpose operating system for the project.

COMPUTER COMMUNICATIONS PRODUCT LINE

In the complex realm of on-line man/machine interaction—especially where the staggering consideration of distance is involved—nothing can be done at one end without making a difference at the other. The science concedes nothing without making a demand. It is axiomatic that terminals must be relevant to user needs and applications. Equally important, if a terminal is to be universal (and most are not), it must also be compatible with a wide variety of communications facilities and the unique characteristics of each computer.

In meeting these technological imperatives, Computer Communications has designed and built communications stations and related products which are anchored in extraordinary engineering inventiveness and distinguished by superior power and flexibility.

- We were the first to offer, commercially, terminals that use an ordinary television set to display computer-generated data. It was no small feat (at the time it was generally thought to be impossible) but it provided great flexibility and kept the cost of the terminal far below others and it meant that users could select the CRT size which best suited viewing requirements.

- We were the first to include both alphanumeric and graphic capabilities in a single, low-cost unit.

- We were the first to build a portable, modular terminal for use in a normal office atmosphere without sacrificing a single powerful characteristic.

- We were the first to take a building-block, systems approach to creating a universal remote terminal.

The result of these and other firsts was more than a display station...it was a communications station...the CC-30 Communications Station to be exact.

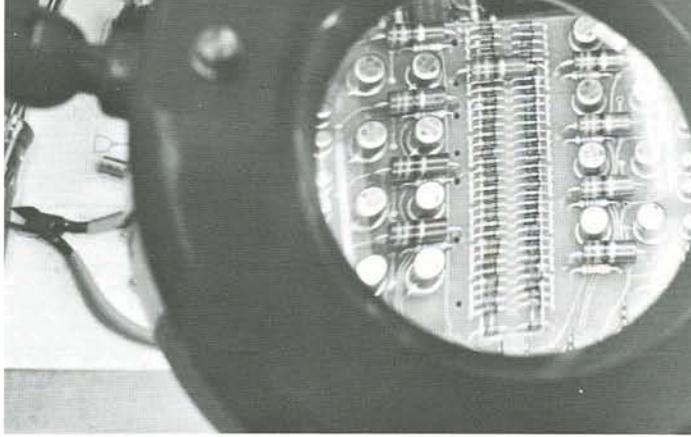
The CC-30 is incomparably flexible and open-ended. We made it that way by marrying in-depth knowledge of the

SOFTWARE



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* CPU100
RJ CPU100
EQ VDA VERIFY IF DATA AVAIL
ZR X6, CPU100
RJ CPU100 ERROR
* CPU100
RJ MSR READ OR WRITE SML I
EQ *+1
RJ CPU100 ERROR
* CPU100
PS
SA6 0
SA6 FDERRFG
SA6 CHFETADR
SA2 CALLERFL
SB3 X2
SA2 CALLERCP
SB4 X2
* CPU100
CPU110 BSS 0
SA6 CP, CPU100
SA7 QDCP
SA6 T, QMTRC+1
SA7 A6-B1
XJ
EQ CPU1
  
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state of the art (as it presently existed and was likely to exist in the future) and consummate engineering skill. We placed great emphasis then as we do today on a product line that would be evolutionary. The station controller, the CC-301, is open-ended in the number of peripherals it will drive at the station site (a light pen, card reader, line printer, magnetic tape and disc drives), open-ended in the number of modems it can be interfaced to (all 100-, 200-, 300-series data sets, serial hardware at speeds up to 50,000 bps, parallel connection at speeds up to 500,000 char/sec), open-ended in the number and types of computers it can communicate with (IBM, CDC, SDS, UNIVAC, GE, DEC, Varian, and others).

But we didn't stop there.

Because of our evolutionary, systems approach, we were able to respond quickly to the growing needs of users of time-sharing systems anxious to upgrade their terminals to the new generation of remote display stations. What was preventing the changeover was the tremendous investment that had been made in operational software geared to the mechanics of Teletype equipment. We solved that problem with the CC-33 Teletype Compatible Display Station. The CC-33 gives users a window on their programs without any change in existing Teletype-oriented software. And that's not all. Again, because of our stress on flexibility, open-endedness, evolution, we saw the CC-33 as a new base from which future time-sharing systems can be developed. And so we added a capability for switchable transmission speeds of 110-, 600-, and 1200-baud.

Then, in continuing response to the needs of the market, we introduced the CC-36 Televideo Conversational/Batch Station, an incomparably inexpensive integrated console system designed for use as a remote batch terminal, as a remote on-line conversational station, or for off-line peripheral operations. The CC-36 is actually a family of stations, functionally and logically identical in method of operation, control, and communication, but varying in the complement of peripheral equipment. A typical version of the CC-36 includes a keyboard for operator control and data entry, a television screen, a card reader, a line printer, control electronics for specified batch operations, and a data set interface for remote communication.

Above all else, we never forgot how important it was to be able to tie our line of stations to cables, to phone lines, and to computers. We developed standard communications inter-

faces, standard multiplexers, concentrators, and polling switches, and standard channel interfaces to all popular computer main frames. As a result, networks using CCI standard building blocks can be installed smoothly and efficiently on almost any computer over almost any transmission network conceivable. And we have a standard product line that helps us apply our total systems capability to satisfy just about any computer-communications network application.

MAJOR SOFTWARE PACKAGES

CCI software capabilities range from conceptual design to comprehensive specification, from efficient and economical implementation to systems acceptance and operation. Substantive software projects have included total responsibility for large scale systems, the extension and modification of existing programs, and the development of proprietary software packages.

Some examples:

- A message switching and communications processing software system—including systems analysis, software development, administration and technical supervision, maintenance, and training—on a global communications network for a prime NASA contractor.
- An extensive and sophisticated FORTRAN IV package for real-time processing on an 8K, 16-bit computer consisting of a compiler, the compiler executive, the run-time package, the subroutine package, the loader, and the run-time monitor.
- EXPAND (EXtensive Processing of AlphaNumeric Data)—a comprehensive business data processing system for the IBM 1130 computer. This proprietary software package handles payroll, labor and material distribution, job cost, accounts payable, and general ledger for most small businesses.
- CAP (Communications Access Package) 360—Developed for the IBM System 360, this proprietary package is designed for simple, fast, and economical implementation of on-line applications that involve networks of CCI communications display stations.
- CAP/1130—A powerful proprietary telecommunications software subsystem for the IBM 1130 which, like CAP/360, permits FORTRAN or Assembly Language pro-

HERDWARD

grams to communicate directly with CC-30 Communications Stations.

INTEGRATED SYSTEMS

Since CCI products are designed with deliberate emphasis on compatible operation in a total systems environment, we have been deeply involved in integrating our communications stations and the related equipment necessary into large and often intricate systems.

Implementation has been swift and exact on important and complex installations for 18 colleges and universities, on a sophisticated, multiple-station block securities reporting system for brokerage houses and institutions which is national in scope, numerous real-time process control and monitoring applications, and on time-sharing and multi-processing systems for government agencies and industrial concerns engaged in research, development, manufacture, and operation of computer directed communications systems.

Some specific examples:

- Thirty CC-30 Communications Stations were installed and made operational on one of the largest and most powerful university computer installations in the world—the Campus Computing Network at UCLA. Stations are spread throughout the entire campus and communicate at 50,000 bps through message concentrators (developed by CCI) and channel adapters (also developed by CCI) connected directly to an IBM System 360/75 with one million bytes of core storage. Additional stations operated by off-campus users communicate over high-speed phone lines.

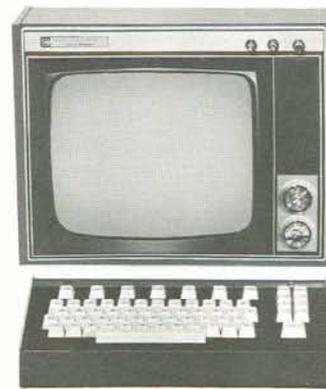
- CCI provided the communications interface, computer interface, multiplexer, and CC-30 Communications Stations for a vast, advanced medical information system. Each medical station at the hospital site includes a light pen in addition to a TV monitor, alphanumeric keyboard, and station controller. High-speed line printers are also used where hard copy output is required. All units are manufactured by CCI and were installed, made operational, and verified by diagnostic software in remarkably short time.

Communications between the computer site and the hospital site (a distance of 3 miles) are at 50,000 bps. Messages at the hospital are concentrated in the CC-72 Multiplexer. The interface to the computer, an IBM System 360/40, is a CC-7012 Channel Adapter.

- Computer Communications has a total systems contract for the design, development, implementation, and operation of a unique and comprehensive multicomputer time-sharing system. The contract calls for CCI to specify standard computers and peripherals—including remote terminals—and provide special intercomputer communications interfaces, special multiplexers, and a special purpose multi-computer real-time operating system.

Too many things have happened and are happening at Computer Communications to paint a complete portrait; we have had to be content with presenting a few frames of a changing picture. But the magnitude of our success in the future, based on the successes of the present, is clearly visible. Tomorrow, as today, we will be helping people perform their work in the most professional way possible by providing the most sophisticated tools and techniques possible in the field of computer-communications.

Aerospace Corp.
American Totalizator Corp.
Ampex Corp.
Andrews Air Force Base
Argonne National Laboratories
Astrodata
AutEx Service Corp.
Bell Laboratories
Boeing Company
Brookhaven National Laboratories
Calif. Institute of Technology/Mt. Palomar
Canadian Dept. of Transportation
Carnegie-Mellon Univ.
Carrier Corporation
Case Institute of Technology
C.B.S. Television
Com-Tel Corp.
Computer Network Corp.
Computing Corporation of America
Data Corporation
Data Network Corp.
Dial Data Inc.
Duke University
Esso Mathematics & Systems, Inc.
General Mills
Holloman Air Force Base
Honeywell, Inc.
Idaho Nuclear Corp.
Intercontinental Systems, Inc.
International Controls Corp.
Interstate Electronics Corp.
ITT Gilfillan
Jet Propulsion Laboratories
Kennecott Copper Corp.
Lawrence Radiation Laboratories
Lockheed Missiles and Space Co.
Logic Sciences
LV Computer Systems
McDonnell-Douglas Corp.
Mobil Pipe Line
NASA
National Accelerator Lab
National Institute of Health
New York University
Scan Data Corp.
Teledyne, Inc.
Texas Technological College
Trans International Airlines
Transamerica Corp.
Union Carbide
United States Government
Univ. of Arizona
U.C.L.A.
Univ. of Calif/Los Alamos
Univ. of Illinois
Univ. of Maryland
Univ. of Michigan
Univ. of Minnesota
Univ. of North Carolina
Univ. of Oregon
Univ. of So. California
Univ. of Texas at Austin
Univ. of Utah
Univ. of Wisconsin
Varian Data Machines
West Point Military Academy
Western Electric Co.
Worley & Rindge Inc.
Young & Rubicam, Inc.



Communications Stations

Ability in
computer
communications
means
Computer
Communications

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