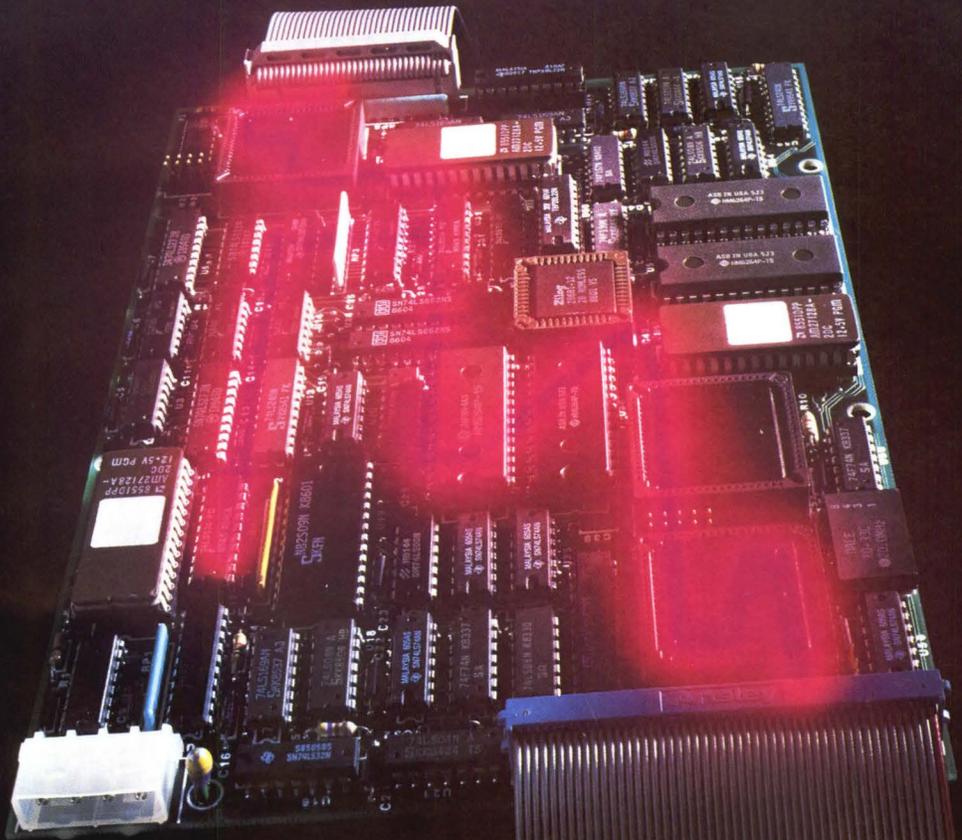


# Mini-MicroSystems

THE MAGAZINE FOR COMPUTER SYSTEMS INTEGRATION

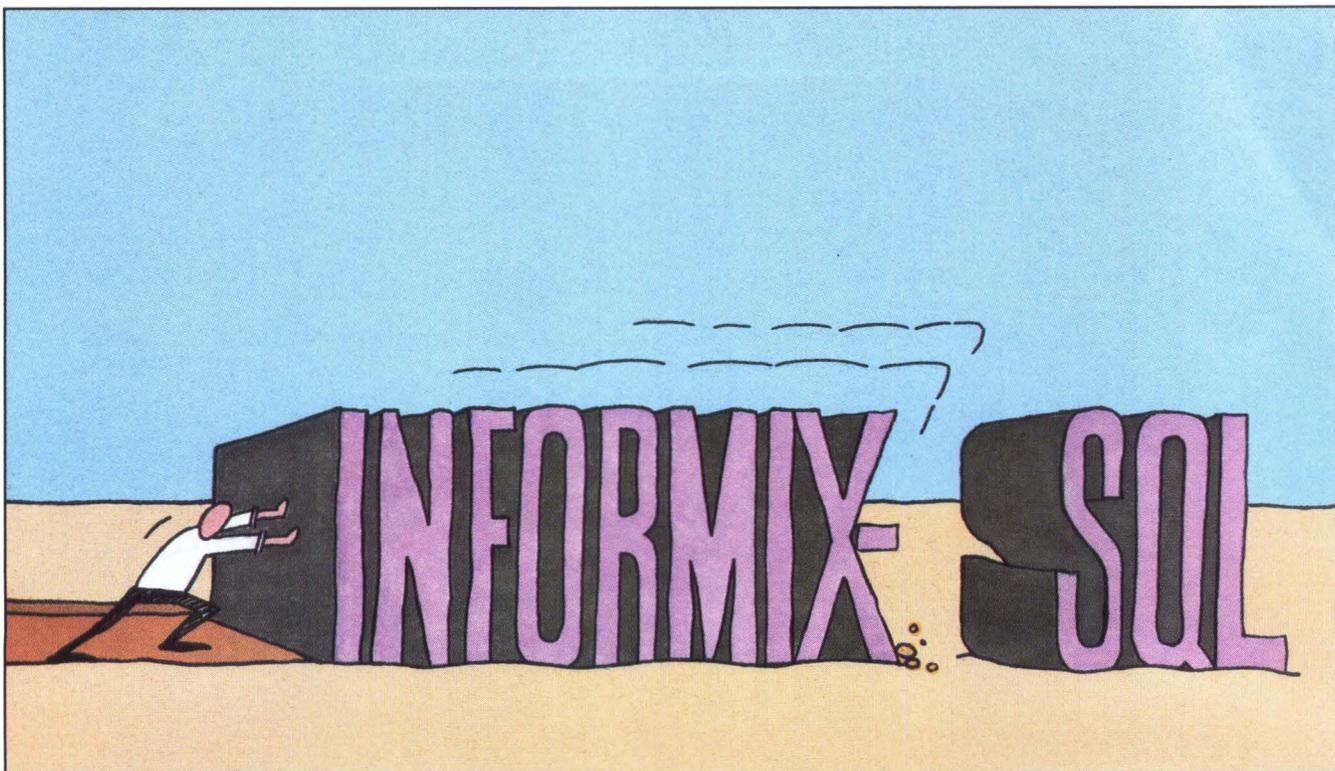
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## Optotech adds SCSI controller to 5 1/4-inch optical disk drive

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- Micro-to-mini options multiply
- Multiprocessors use radical architectures
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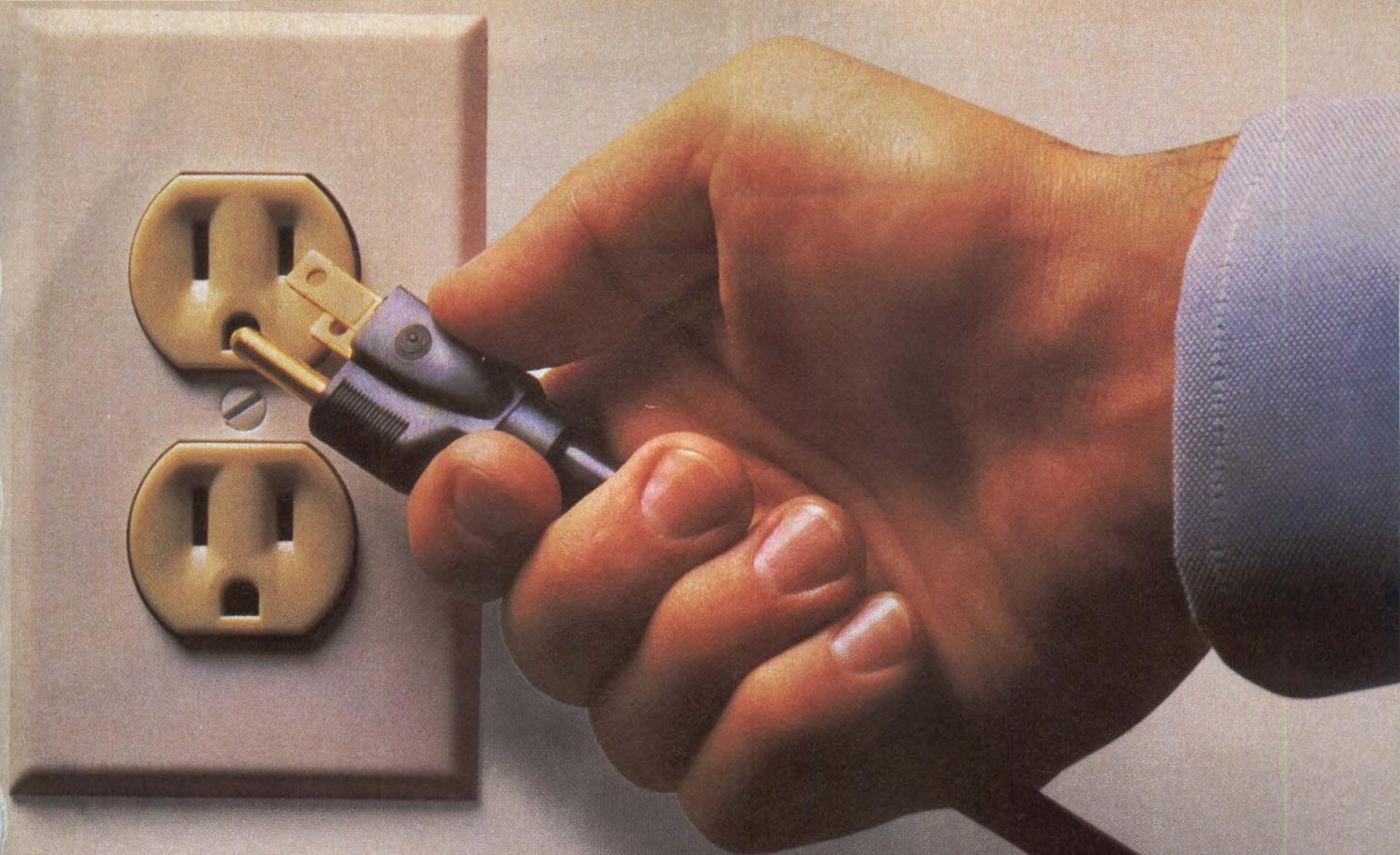
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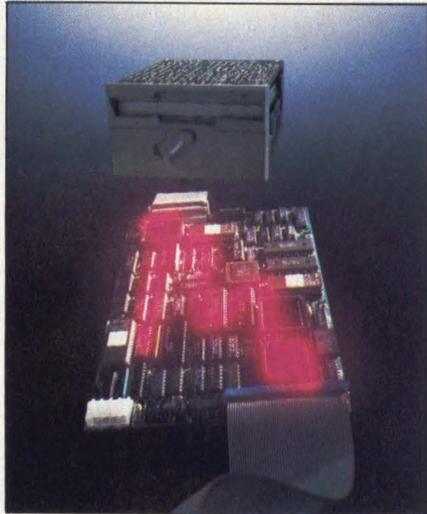
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p. 31 . . . Art direction and design by Daddino-Morgan. Photography by John Bagley. Courtesy of Optotech Inc.

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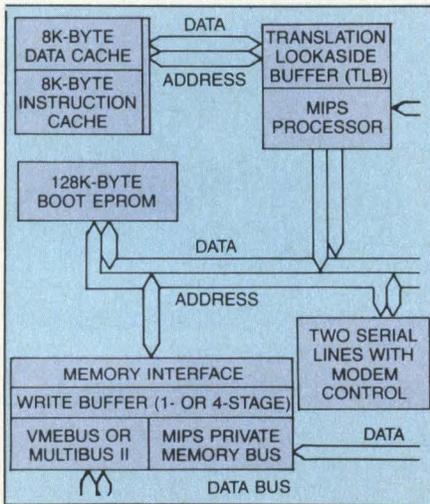
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 MINI-MICRO SYSTEMS (ISSN 0364-9342) is published monthly with additional issues in February, April, June and November by Cahners Publishing, A Division of Reed Publishing USA, 275 Washington St., Newton, MA 02158. William M. Platt, President; Terrence M. McDermott, Executive Vice President; Jerry D. Neth, Vice President of Publishing Operations; J. J. Walsh, Financial Vice President/Magazine Division; Thomas J. Dellamaria, Vice President Production and Manufacturing; Terrence M. McDermott, Group Vice President. Copyright 1986 by Reed Publishing USA, a division of Reed Holdings Inc., Saul Goldweitz, Chairman; Ronald G. Segel, President and Chief Executive Officer. Circulation records are maintained at Cahners Publishing Co.,

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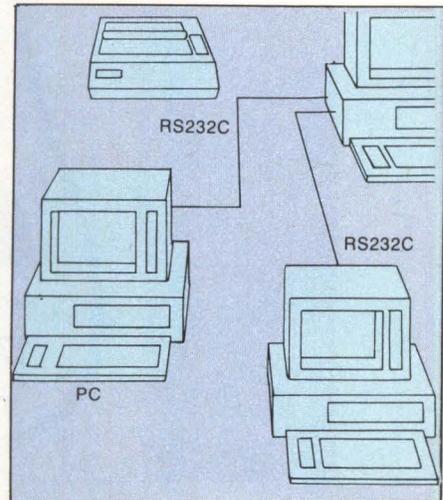
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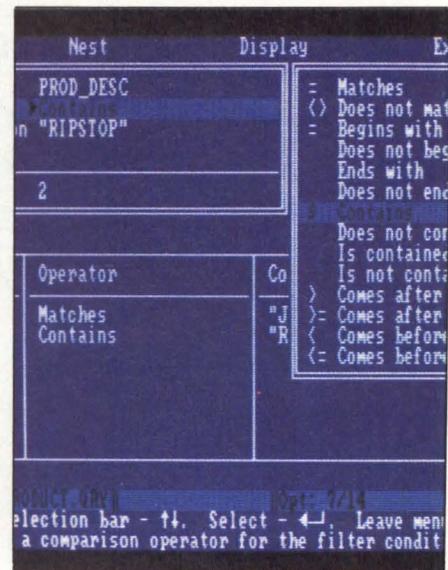
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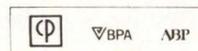
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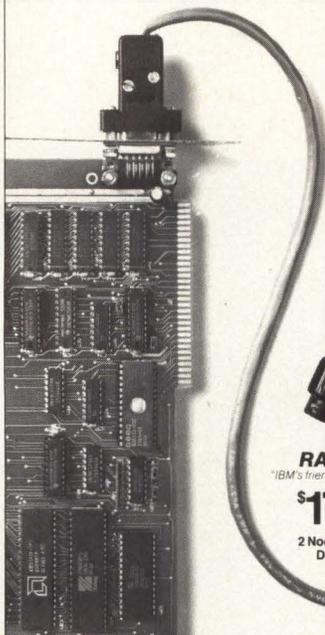
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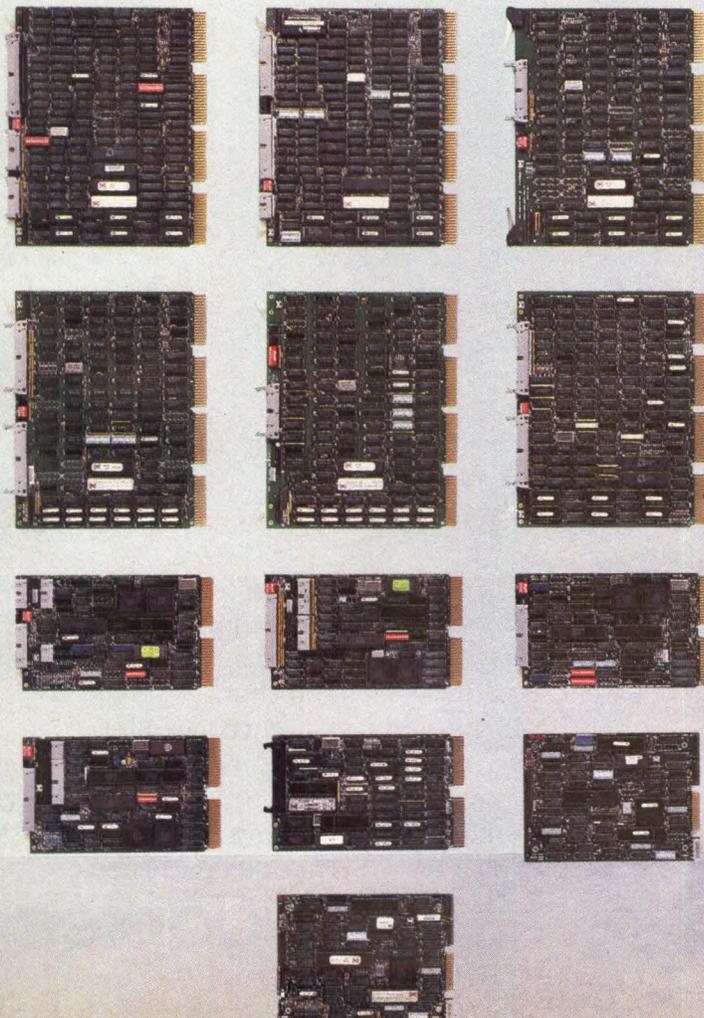
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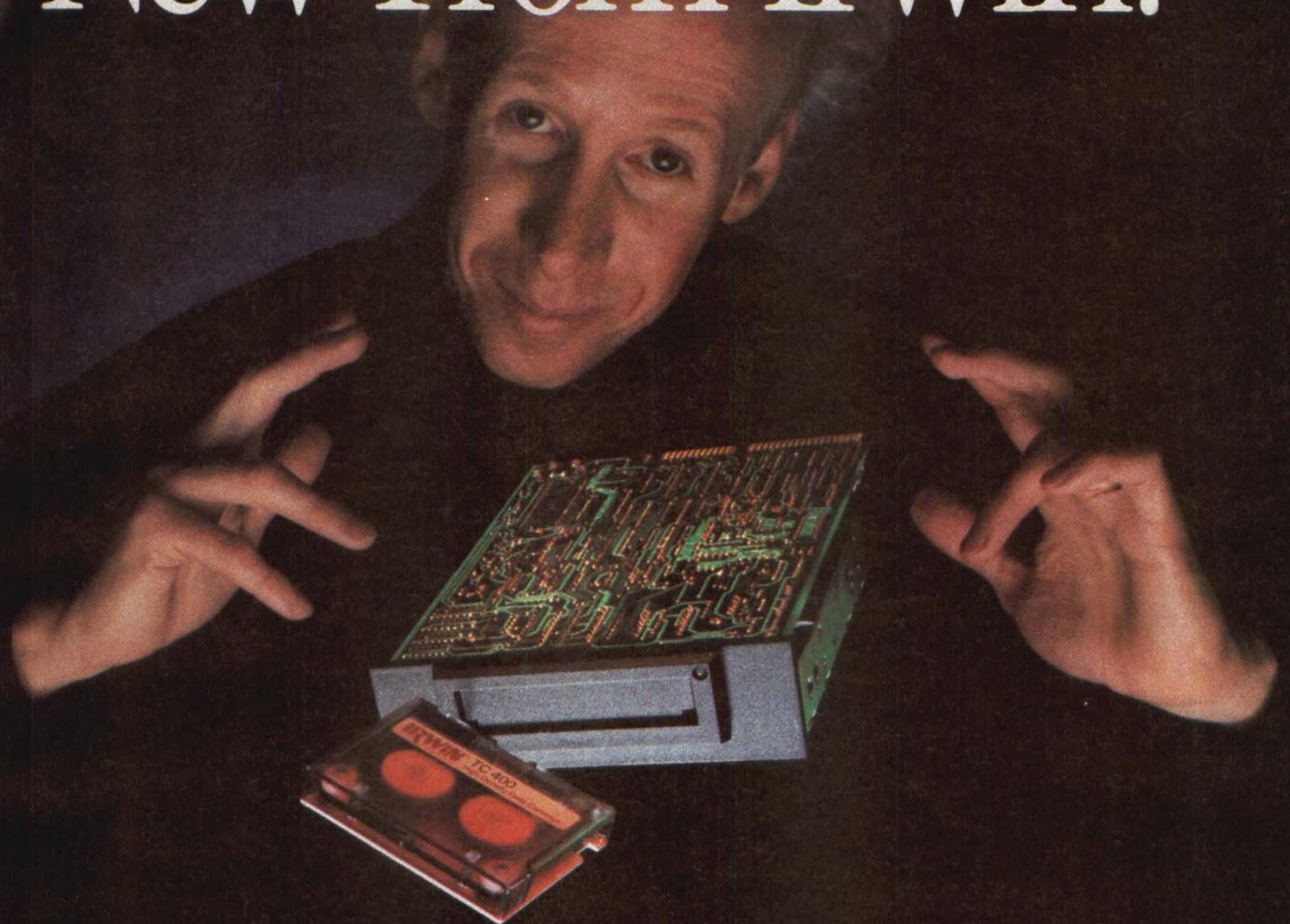
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# NORMAN L. CAHNERS

1914-1986

Norman L. Cahners, founder and honorary chairman of the Cahners Publishing Co., died on March 14 in Boston. He had been ill with cancer for several months.

Mr. Cahners was born in Bangor, Maine, in 1914. He was educated at Phillips Academy, Andover, Mass., and at Harvard College, where he was on the football and track teams. He served in the Navy in World War II.

Mr. Cahners began the Cahners Publishing Co. in 1946 as a result of his wartime experiences. His first magazine, *Modern Materials Handling*, was based on the knowledge he had gained in the Navy as a specialist in cargo-handling operations.

At the time of his death, his company had grown to be one of the largest business publishing companies in the United States, with 35 specialized business magazines and numerous newsletters, directories and buyers' guides. Another division, the Cahners Exposition Group, produces and manages trade shows and conferences worldwide. The company became a part of Reed International Plc., London, in 1977.

Mr. Cahners pioneered many new concepts in the field of business magazine publishing. He was an early proponent of controlled, or qualified, circulation and worked to upgrade circulation audit and verification throughout the magazine industry. He was among the earliest publishers in his field to utilize full-color printing processes in the editorial pages.

Perhaps Mr. Cahners' most notable contribution to magazine publishing was his development of the "niche" concept. He believed that each of his magazines had to reach and serve well-defined groups of readers to be of the most value to the advertisers. Mr. Cahners made this concept an integral part of his business operation—controlling circulation, editorial content and marketing.

He played a key role in merging the former National Business Publications and American Business Publications associations into the American Business Press. He was a founding member and first chairman of the International



Business Press Associates and served as chairman of the Business Press Advisory Committee on Civil Rights.

He was twice voted "Outstanding Business Paper Executive" in polls conducted by the Gallagher Report, was selected "Magazine Man of the Year" by the Magazine Industry Newsletter, "Man of the Year" by the Advertising Club of New York and "Top Business Publication Executive" by the Boston Advertising Club. The American Business Press conferred upon him its highest award, the ABP Scroll, in 1984.

Mr. Cahners had received honorary degrees from Northeastern University, Husson College, Suf-

folk University, Franklin Pierce College and Colby College. In 1977, Harvard Business School bestowed on him its Business Statesman Award for his achievements in both the business world and in the community. He had recently been elected to the Harvard Varsity Club Hall of Fame and, posthumously, has been awarded the National Conference of Christians and Jews Annual Award.

He had served as chairman of the board of the Boston Museum of Science, as a fellow of the American Academy of Arts and Sciences, a vice chairman of Northeastern University, a fellow of Brandeis University, a trustee of Colby College and on the Harvard University Overseers Committee on University Resources.

He also had served as: overseer for the Children's Hospital and Medical Center, Boston; trustee, New England Medical Center; trustee-for-life, Beth Israel Hospital; and member of the corporation for both the Massachusetts General Hospital and the Affiliated Hospitals Center, Boston.

Further, Mr. Cahners was a trustee-for-life of the Combined Jewish Philanthropies; a former vice president of the Greater Boston Chamber of Commerce; a trustee of the U.S.S. Coast Guard Academy Foundation; a member of the executive committee, Massachusetts Bay Federated Council of the Boy Scouts of America; and a director of the Boys and Girls clubs of Boston.

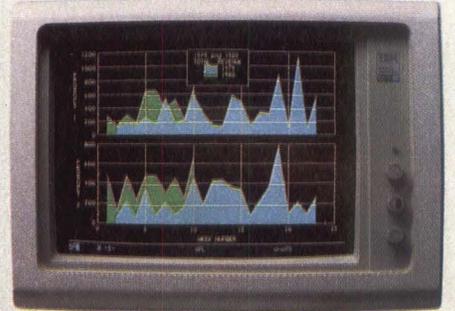
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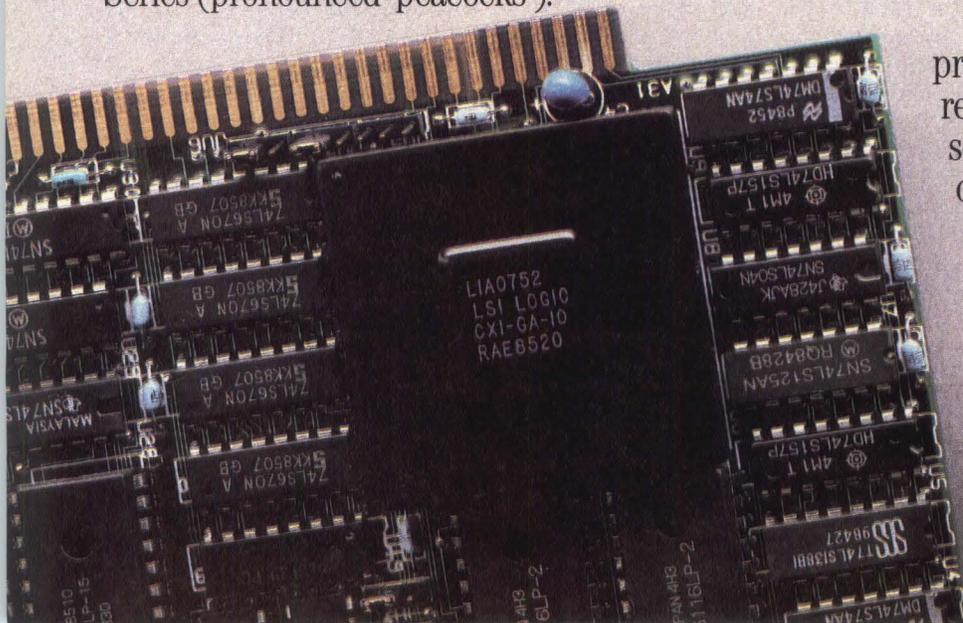
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To start with, there's our PCOX/STANDARD and PLUS emulator boards. They link your PCs to the mainframe. And provide file transfers to and from the host.

Our PCOX/3270 PC upgrades your PC to multiple host sessions for a fraction of the price of an IBM 3270 PC. While PCOX/GRAPHICS lets you do true S3G graphics terminal emulation right on a PC.

Looking for micro-to-mainframe connections for your LAN?

Our PCOX/GATEWAY products come in coaxial and remote versions and serve host sessions to your IBM PC Network or NETBIOS-compatible LAN.



*We designed this proprietary gate array chip (on your left) to let us fit a lot more capability in a lot less space. With more reliability. It was also the first chip designed exclusively for 3270 terminal emulation.*

# have all the more of them.

Or snap on one of our smart accessories. Like **KEYBOARD MATE**. A compact addition to your PC keyboard that gives you single keystroke access to 3278/79 and 3270 PC functions.

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All PCOX products work with IBM® PCs, XTs, ATs and compatibles. They're easy to install. And easy to upgrade. It's as simple as changing a diskette.

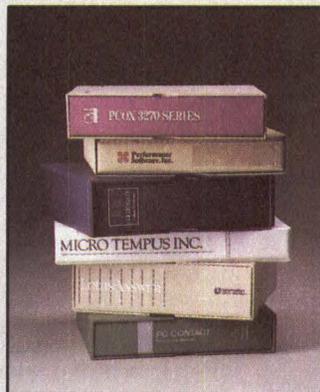
But more important, since we design and manufacture everything we sell, we can track and respond to changes in the industry.

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With training, technical assistance, and even a toll-free customer hotline.

Of course, when you go with

CXI, you'll be in the company of other good companies like General Motors, Citicorp, TWA, British Petroleum and more.



## PCOX works with all major micro-to-mainframe software.

Whether it's Cincom, Cullinet, Informatics, MSA, Micro Tempus or Performance Software, PCOX runs it. This is due in part to the three application program interfaces we provide. Namely, IBM's, IRMA's and our own PCOX API.

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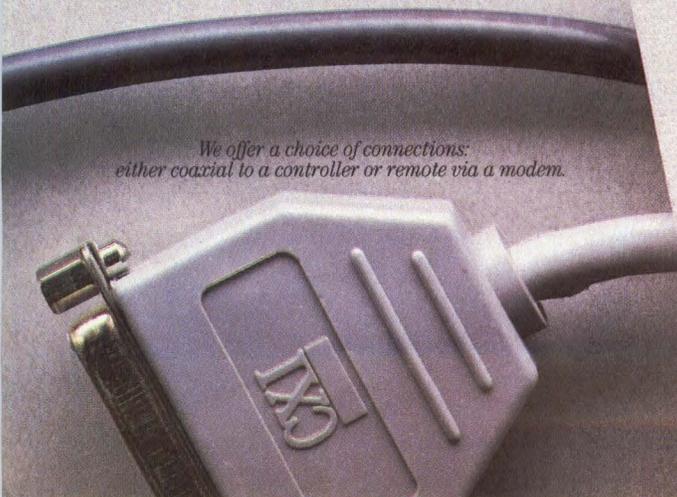
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CIRCLE NO. 9 ON INQUIRY CARD

*We offer a choice of connections:  
either coaxial to a controller or remote via a modem.*



# Does A True ESDI Controller Really Exist?

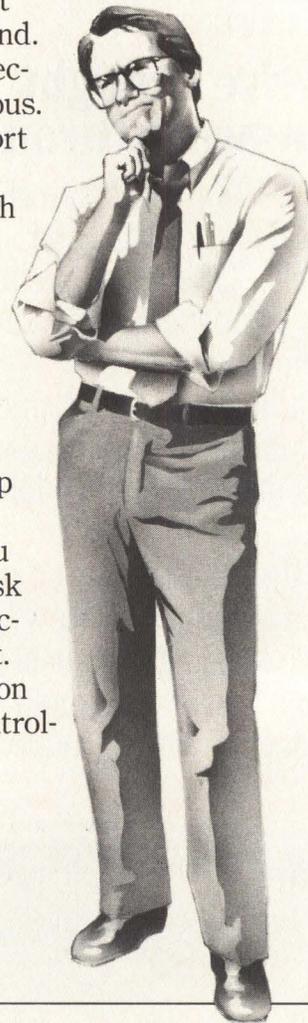
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If today's claims and counterclaims leave you unsure of just what constitutes a true ESDI controller, you are not alone. Still, from all the confusion one fact is clearly emerging: simply put—*"a fully effective ESDI controller has to be one that allows your system to take maximum advantage of the SCSI bus."*

To achieve this, the controller must offer these performance features: A 64-Kbyte continuous circular buffer. Burst rates of 1.5 to 1.85 megabytes per second. Full through-parity, connector to connector. Capability to format while off the bus. Programmable sector sizes. Full support of write/verify commands. 48-bit ECC. And the ability to format the drive with redundant ID fields to increase error recoverability.

Any ESDI controller that does not offer at least these features will compromise your system. The ADSI D200 ESDI controller most assuredly provides all these features plus others, thereby enabling your system to live up to its fullest potential.

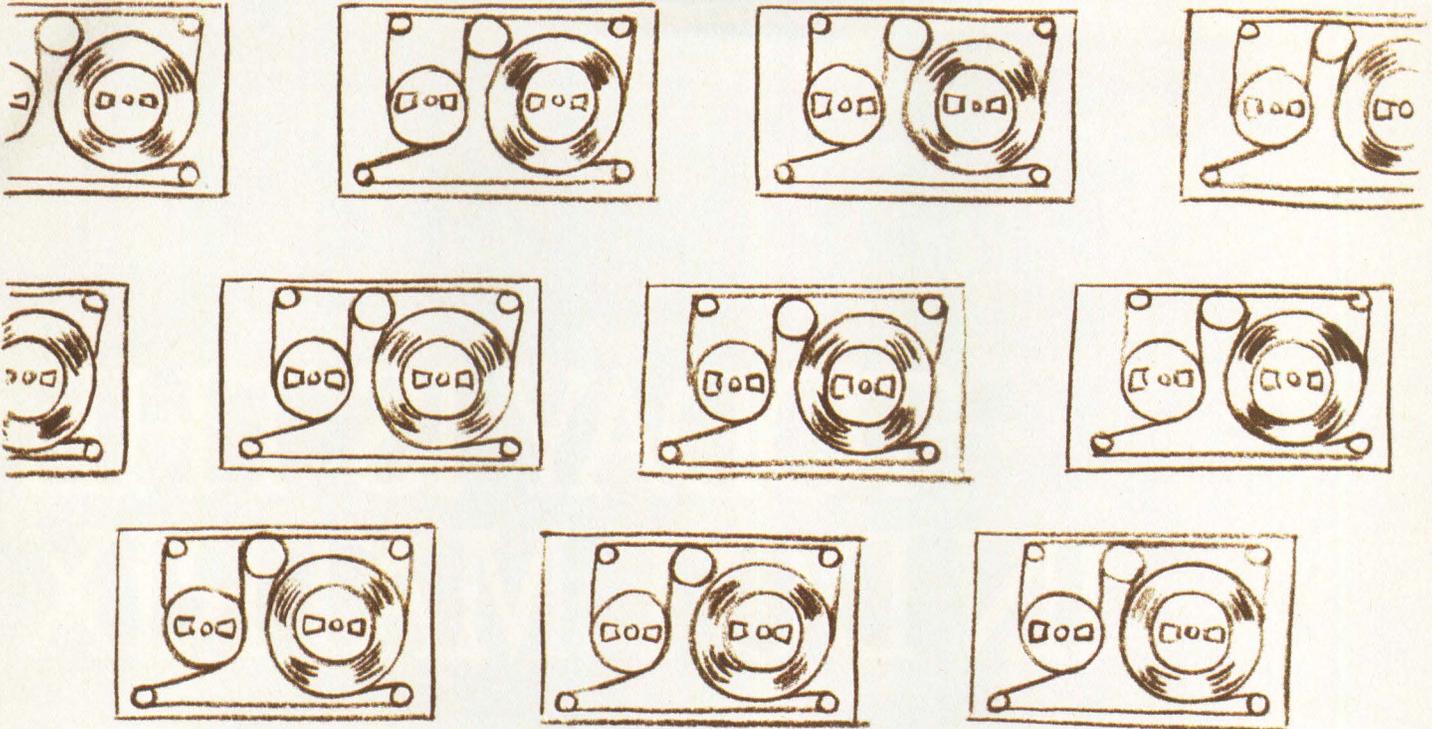
So next time someone talks to you about an ESDI controller, be sure to ask about its speed, data integrity and functionality. Or better still, ask ADSI first. Call 714-594-5858 for full information on the D200 and all our disk and tape controllers and VLSI custom chip sets.



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CIRCLE NO. 10 ON INQUIRY CARD

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The fastest, most powerful tape backup systems for your IBM PC, XT, AT or compatible are available from Hall-Mark with Tecmar's Qic-60 product line.

Qic-60 is peace of mind for IBM or compatible users. Never again worry about computer crashing, theft or burning with this two-minute\* tape backup that fits in a pocket. The Qic-60 takes up no desk space — the external model sits right beside the CRT

and is available with or without an optional hard disk. Or if you prefer, the internal model fits right inside the computer!

And Hall-Mark offers you peace of mind, too. We take the worry out of availability, technical support and on-time delivery. Call today and learn how you can put nationwide inventory and a commitment to service on your team. We're the people who care.

\*Time for mirror image backup

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CIRCLE NO. 11 ON INQUIRY CARD

A COMMITMENT TO EXCELLENCE

# TODAY IS THE IN DOT MATRIX

It would pay you to mark it on your calendar.

Because today is the day we introduce our new Pinwriter™ P5XL dot matrix printer. The only dot matrix printer available capable of producing the crisp, black printing you associate with a letter-quality printer. Because it's the only one designed to use not just a fabric ribbon, but a letter-quality multistrike film ribbon—the same ribbon used in typewriters and letter-quality printers.

## A LITTLE BLACK MAGIC.

Actual line printed with the  
Pinwriter P5XL printer.

It's only natural that the first dot matrix printer with true letter-quality printing should be an NEC. After all we make Spinwriter® letter-quality printers, the most popular line today, as well as the Pinwriter P5 series dot matrix printers, the most advanced and extensive family of 24-pin printers available.

Black letter-quality printing is not the only thing our Pinwriter P5XL can do. It can also use an optional ribbon to print seven other colors. And it has the finest graphics resolution of any impact printer available. So charts and drawings are much more vivid. Plus it's very fast, extremely quiet and can use an array of type faces. And it's designed and built to have the reliability that has made NEC printers legendary.

# BLACKEST DAY PRINTER HISTORY.

Now for all the exclusive features we managed to pack into the Pinwriter P5XL, you'll find it only costs about the same as other top 24-pin dot matrix printers.

The Pinwriter P5XL printer is the newest addition to the only 24-pin printer line that has a model designed to fit every need and budget. See them at your dealer or for more information call 1-800-343-4418 (in MA 617-264-8635). Or write: NEC Information Systems, Dept. 1610, 1414 Massachusetts Ave., Boxborough, MA 01719.



**NEC PRINTERS. THEY ONLY STOP  
WHEN YOU WANT THEM TO.**

**NEC**  
NEC Information Systems, Inc.

CIRCLE NO. 12 ON INQUIRY CARD



## There is value added in having one product do the work of two.

How unlikely it would seem for something as unattractive as the oyster to be able to produce something as exquisite as the pearl. Indeed, it is exceedingly rare that something designed for one specific task should perform another so well.

That juxtaposition, however, merely reinforces the philosophy behind the CIT 50+ terminal.

For this one terminal emulates both the DEC VT100 (ANSI) and the Wyse WY-50 (ASCII) and allows you to add great versatility to your systems.

It is also crafted to replace the VT52 and VT102. And the Wyse WY-75, with even more complete VT100 emulations. Further, it is compatible with

other ASCII terminals, such as the Lear Siegler ADM 31, Hazeltine 1500, ADDS Viewpoint, and TeleVideo 910, 920, and 925.



For many manufacturers, such capabilities would have been enough. But stopping so few steps from the beginning is not the CIE Terminals way.

That is why we have priced the CIT 50+ lower than the DEC VT100. Now you can get both ASCII and ANSI capabilities for less than you would have had to pay for either in the past.

In both modes, you get 24 x 80/132 format with a 25th status line, 26th label line, variable speed smooth scroll, and variable time CRT saver.

Call us to find out more about the CIT 50+. As with many things in life, one should look past mere external beauty to discover the beauty within.

### **CIE TERMINALS**

Where craftsmanship is still a tradition.

CIE Terminals, Inc., 2505 McCabe Way, Irvine, CA 92714-6297. 1-800-624-2516.

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ADM 31 is a trademark of Lear Siegler.

**CIRCLE NO. 13 ON INQUIRY CARD**

# BREAKPOINTS

## **COMING FROM CULLER: THE 'PERSONAL SUPERCOMPUTER'**

Look for a new entry-level minisupercomputer from Culler Scientific Systems Corp., with a peak performance of 18 million instructions per second (MIPS), for less than \$100,000. The Santa Barbara, Calif., company will introduce the system, dubbed the Culler psc (personal supercomputer), at the National Computer Graphics Association show, May 11-15, in Anaheim, Calif. The psc replaces low-end models W and 5 in the Culler 7 line, which were introduced last fall and cost about \$200,000 apiece. Culler's 64-bit machines can act as servers in Sun Microsystems Inc.'s workstation networks and are aimed at computationally intensive engineering applications.—*Mike Seither*

## **SINGLE CHIP SUPPORTS SEVERAL GRAPHICS STANDARDS**

Paradise Systems Inc. of South San Francisco, Calif., has a present for system integrators who want to offer variety in their video display controllers while supporting as many graphics programs as possible. The circuitry in the company's PEGA-1 chip supports most major display standards for personal computers. These include Paradise color simulation on monochrome; the IBM Corp. monochrome, color and enhanced graphics adapters; Hercules Computer Technology monochrome graphics; and Plantronics/PC+ Products Inc. ColorPlus. Paradise says the PEGA-1 chip will allow OEMS to market systems that give users a continuous migration path to higher level graphics without making their software obsolete. Development boards with the chip cost \$900.—*Mike Seither*

## **IT'S OFFICIAL: GM OPTS FOR UNIX SYSTEM V**

As a result of an extensive study by a joint General Motors Corp.-Electronic Data Systems transportability task force, GM has informed its computer-equipment suppliers that, as of February, GM has adopted UNIX System V from AT&T Co., or a certified equivalent, as the standard operating environment for manufacturing-based systems. The certified equivalent is likely to be determined by conformance to the newly approved IEEE P1003.1 UNIX standard, which GM has said it would adopt. GM's goal in adopting UNIX is to promote software transportability to reduce software costs. The same GM-EDS task force also recommended Manufacturers Automation Protocol (MAP) as the communications standard for manufacturing plants. A MAP task force has been formed to specify the protocols and take other steps to ensure MAP's success with vendors and users.—*Wendy Rauch-Hindin*

## **ADAPSO RELEASES SOFTWARE-PROTECTION STANDARD**

The Association of Data Processing Service Organizations (ADAPSO) has released its proposed hardware-based software-authorization standards and is soliciting comments on them. They recommend a standard physical connection for a "key ring" interface device to attach to a serial port and a "key" consisting of a unique ROM code that is connected to the ring. All comments

on the proposals must be received by June 30 to be considered. For a copy of the standards, contact ADAPSO, Suite 300, 1300 N. 17th St., Arlington, Va., 22209, (703) 522-5055.—*Stephen Shaw*

### **FOR BBN LABS, 'PARALLEL' MEANS 8,192 PROCESSORS**

Computationally intensive applications such as seismic analysis and image processing may no longer require massive, expensive supercomputers once the next generation of parallel-processing machines goes into production. BBN Laboratories Inc., Cambridge, Mass., recently reported that it is in the advanced stages of research on its parallel-processing Monarch, which will boast 8,192 processors in a desk-sized enclosure, run 8 billion instructions per second and furnish 4G bytes of memory and 1.7G-bytes-per-second I/O. If you can't wait for the Monarch, BBN is currently shipping a Motorola Inc. MC68020-based version of the unit's predecessor, the Butterfly, which incorporates 256 processors.—*Jesse Victor*

### **HOUSE COMMITTEE APPROVES TELECOMMUNICATIONS TRADE BILL**

By a vote of 33 to 2, the Ways and Means Committee of the U.S. House of Representatives has approved a trade bill designed to open overseas markets to U.S. telecommunications companies. The bill, sponsored by Robert Matsui, D-Calif., would require the administration to identify countries with trade barriers to U.S. imports and negotiate to end them. If a satisfactory resolution is not reached with a country within 12 months, the administration would be required to restrict that country's access to U.S. telecommunications markets and to impose retaliatory tariffs and import quotas. Similar legislation, introduced by Reps. James Florio, D-N.J., and Tim Wirth, D-Colo., was approved by the trade subcommittee of the House Ways and Means Committee. Should the Florio-Wirth measure be approved by the full committee, the House Rules Committee will decide which bill to submit to the House.—*Stephen Shaw*

### **OKIDATA STRATEGY INCLUDES NEW PRINTERS, MODEMS, RIGID DISK DRIVES**

Okidata, Mt. Laurel, N.J., is seeking to strengthen its position in the dot-matrix printer market with two new high-performance units, the \$699 Microline 292 and the \$899 wide-carriage 293. Both print 200 characters per second in utility mode and 100 cps in near-letter-quality mode. Single-pass printing for fast output is provided by a dual-nine-pin printhead, and separate "personality modules" provide either parallel or serial RS232C or RS422A interfaces. The company is expanding into data communications as well, with a CLX96 series of 9,600-bit-per-second modems. And look later this year for new laser printers, and rigid disk drives.—*Bruce MacDonald*

### **ITT ENTERS THE MULTIUSER-SYSTEM BUSINESS**

Until recently, ITT Information Systems has concentrated on building its XTRA personal computers, which are compatible with IBM Corp.'s PC line. Now the San Jose, Calif., company has introduced the XTRA XL, which is built around Intel Corp.'s 8-MHz 80286 processor. The XTRA XL can be configured either as a file server running MS-DOS for local area networks or as a XENIX-based multiuser system that can handle up to 16 terminals. As a file server, the XTRA XL costs about \$5,300. A typical multiuser system for eight users, configured with a rigid disk drive and tape backup, is priced at about \$12,000.—*Mike Seither*



## We demo our Data PBX on-site. (They just send brochures.)

Since we introduced our first Data PBX two years ago we've been doing things that other vendors would like to do . . . but can't. Things like on-site demos, 30 day free trials and packing more data switching features into less space for less money than anyone else. Today over 100,000 terminals and computer ports are connected to over 500 Equinox Data PBX's.

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ports at \$120 per line. It can be expanded to 1320 lines and is completely compatible with its bigger brother, the DS-15.

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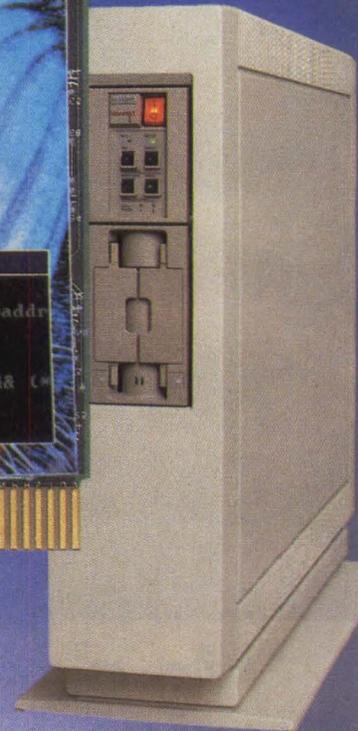
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- 1 million pixels/second image load
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Matrox now offers two new intelligent color graphics boards for the Q-Bus. The QG-1280 and QG-640 provide the speed and resolution necessary to upgrade DEC's MicroVAX and PDP computers into Professional Graphics workstations.

The QG-1280 has a resolution of 1280 x 1024. The board's drawing speed of 35,000 vectors/second means complex pictures are displayed in under a second. For solid modelling applications, an optional 3D accelerator module complete with Z buffer provides fast hidden surface elimination and shading.

The QG-640 is the perfect solution for OEM's requiring the same performance but with less resolution; 640 x 480, at 50% less cost.

Unlike conventional graphics terminals the QG-1280 and QG-640 are directly accessible from the Q-Bus. There are no slow serial communication links. **You "see" results immediately.**

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**E-MAIL AN EARLY AREA FOR OSI ADOPTION**

Expect adoption soon by the National Bureau of Standards of a set of electronic-mail standards based on Comité Consultatif International Télégraphique et Téléphonique's X.400 recommendations. Joseph St. Amand of Wang Laboratories Inc., chairman of the NBS X.400 Special Interest Group, expects the Corporation for Open Systems (COS) to adopt the NBS X.400 standards within the next few months. COS promotes Open Systems Interconnection (OSI) standards in the United States, and OSI embraces X.400. St. Amand says the NBS standards have been harmonized with those now being ratified in Europe by two closely related standards organizations, Centre Européen de Normalisation, and Centre Européen de Normalisation Electrotechnique, both of Brussels.—*Keith Jones*

**NEW FROM IBM: A LITTLE LAPTOP AND A LOT MORE**

As IBM Corp. begins shipment of its new laptop computer—the PC Convertible—this month, industry observers continue to wonder about the potential market for such machines. But IBM, which lost out to Zenith Data Systems in a bid to supply the Internal Revenue Service with laptops, has positioned the Convertible as more than a laptop. The 13-pound machine lists for \$1,995 and features dual 3½-inch flexible disk drives, AC or battery power and a removable liquid crystal display (desktop CRTs are optional). IBM's recent deluge of 40 new products also included 20M-byte and 30M-byte versions of its PC/XT and AT, an enhanced version of the TopView operating environment and aggressive price cuts for older model PCs.—*Mike Seither*

**CIPHER FOCUSES ON ARCHIVE, WANGTEK IN PATENT DISPUTE**

Stopping short of legal action for now, Cipher Data Products Inc., San Diego, is holding out a carrot—non-exclusive manufacturing licenses—to companies whose quarter-inch streaming tape drives Cipher claims may infringe on a patent it recently received. Cipher offered the licenses to prime competitors based in California: Wangtek of Simi Valley and Archive Corp. of San Diego. At issue are the design of end-loading tape cartridges for drives with a 5¼-inch form factor and the movement of the read/write head. Wangtek and Archive may bring a group challenge against the patent.—*Mike Seither*

**TRADE GROUP PUTS A YARDSTICK ON THE SLOWDOWN**

Just how much of a downturn occurred in the U.S. electronics industry last year? According to the American Electronics Association, Palo Alto, Calif., domestic employment in the industry declined 2.3 percent in 1985. That was a loss of 60,000 jobs from 1984—from 2.59 million to 2.53 million. The software and programming fields were big gainers, up 31,000 new jobs, and communications equipment makers added more than 27,000 new people, but the components sector laid off 63,000, and computer and office-machinery manufacturers cut 45,000. According to the AEA, whose figures come from the U.S. Bureau of Labor Statistics, electronics is the largest employer in the manufacturing segment of the U.S. economy.—*Bruce MacDonald*

**TECH FILES: A QUICK LOOK AT NEW PRODUCTS AND TECHNOLOGY**

**Versatec**, Santa Clara, Calif., will use the May 11-15 National Computer Graphics Association show in Anaheim, Calif., to demonstrate its new Series CE 3400 electrostatic color plotters that print 400 dots per inch. The CE 3424 is priced in the mid-\$50,000 range and prints on 24-inch-wide paper. The CE 3436 produces 36-inch-wide plots and costs about \$70,000. Both machines will be available for shipment this summer. Versatec's current CE3000 line, which prints 200 dpi in 24- and 36-inch widths, can be upgraded to 400 dpi using the new plotting head in the CE 3400 machines.—*Mike Seither*

The **Persyst Division** of Emulex Corp., Costa Mesa, Calif., will begin shipping this month a front-end communications processor for IBM Corp. PC/ATs and compatibles that will offload the communications functions of up to eight terminals. The single-board DCP/MUX uses an Intel Corp. 80286 microprocessor to manage four or eight synchronous/asynchronous, full-duplex RS232C serial ports, and can be configured with either 128K or 512K bytes of dual-ported, parity-checked RAM. Suggested list prices for the four- and eight-line units are \$1,250 and \$1,495 respectively.—*Bruce MacDonald*

**Control Data Corp.**, Minneapolis, last month became the first manufacturer to announce a half-inch tape cartridge (HI/TC)-compatible drive. Conforming to the HI/TC committee's standard, the 240M-byte Patriot has a transfer rate of 250K bytes per second, an enhanced small device/small computer systems interface (ESDI/SCSI) and features two-track, serial, serpentine recording on 18 tracks. Possibly distinguishing it from expected competition, the unit comes in a 5¼-inch form factor and has a tape-path design that allows the oxide side of the tape to touch only the read/write head and cleaning mechanism. Production shipments are scheduled for the first quarter of next year.—*Dave Simpson*

**Digital Equipment Corp.** has expanded its VAX minicomputer family with the 32-bit 8500, designed for both technical and commercial applications. According to DEC, the VAX 8500 offers twice the performance of the VAX-11/785 for the same price and in about one-third of the floor space. It is intended to replace the 11/785. The 8500 begins in price at \$260,000, and a preconfigured system—including disk and tape drive—is available for \$299,000. DEC has also added the VAX LISP/ULTRIX language for DEC's native UNIX operating systems, ULTRIX-32 and ULTRIX-32m. Prices range from \$4,800 to \$24,000, depending on the host.—*Lynn Haber*

**NOTES FROM OVERSEAS:**

Do you fancy owning a portion of **Inmos Ltd.** of Bristol, England, the makers of the innovative Transputer microprocessor? Parent company **Thorn EMI Plc.**, London, wants to sell a large minority share of its subsidiary for the capital injection Inmos needs to fund development programs. Inmos, with a U.S. subsidiary in Colorado Springs, Colo., is beginning to achieve some success with its Transputer. Floating Point Systems Inc. of Beaverton, Ore., for one, uses it to control communications among its numerous high-speed, 64-bit arithmetic processors in its T Series parallel vector processor. Floating Point says the Transputer was "absolutely key" to the T Series' design.—*Keith Jones*

Look what a pioneer in miniaturized data communications can pack into a modem. Our short range models feature data rates of up to 19,200 bps, distributing data locally over unconditioned 4-wire telephone lines. What's more, they're transformer-isolated from the telephone line for uninterrupted transmission and protection of your equipment. Operating without AC power, these mini modems are the ideal



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MINI-MICRO SYSTEMS/May 1986

# SPEC

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## FALCO 500

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# The case in black and white.

### Introducing a somewhat more colorful member of the family.

Meet the IBM 3164 ASCII Color Display Station.

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### Emulation.

#### Another side of the family.

Our ASCII terminals are designed to fit into existing systems. Even if the systems aren't ours.

Emulation Capability	
3161	IBM 3101 Model 881 ADDs Viewpoint* Hazeltine 1500* Lear Siegler ADM-3A* Lear Siegler ADM-5* TeleVideo 910*
3163	IBM 3101 Model 881 DEC VT 52* DEC VT 100* TeleVideo 950*
3164	IBM 3101 Model 881

For example, our basic ASCII Display Station, the IBM 3161, emulates up to six

Features	3161	3163	3164
Screen size	12"	12"	14"
Lines x characters	25x80	25x80	25x80
Character matrix	8x16	8x16	8x16
Double-sized characters	No	Yes	Yes
Line drawing characters	24	24	24
Vertical scroll	Jump	Jump/ Smooth	Jump/ Smooth
Definable function keys	24	24	24
Windowing	No	Yes	Yes
Partitioning	Horiz.	Vert./ Horiz.	Vert./ Horiz.
Characters in buffer	1920	7680	7680

terminals. And the advanced-function 3163 emulates a number of higher level ASCII data streams.

What's more, every one of our ASCII terminals can operate in its own function-rich native mode.

### Our family is flexible.

Our unique plug-in cartridges allow for considerable flexibility in your operation. For example, simply by switching cartridges you can shift a terminal from one data stream to another.

And, in many countries cartridges are also available that go beyond emulation to let you operate your ASCII terminals in several foreign languages. Appropriate foreign language keyboards are also offered.

### Enhanced ergonomics. Another family trait.

All our ASCII terminal keyboards have 102 keys. But that's not all they have in common. Every keyboard also has a low profile, gentle contour and typewriter touch.

And our keyboards have

programmable function and editing keys so they can be custom-tailored to fit your application needs. The 3163 and 3164 models also have redefinable and recappable keys.

Superior ergonomic design isn't confined to the key-

board, however. All three displays tilt and swivel for maximum user satisfaction. And, of course, by making the display easy to read, we made it easier on the eyes. In addition to the 8 x 16 character matrix, we gave it an advanced non-glare etched screen, cursors, and character and field attributes like blink, reverse video, under-scoring and dual intensity.

### High standards.

#### Competitive prices.

Quantity discounts are offered, too. And financing is available through the IBM Credit Corporation. Best of all, each terminal comes with the quality, service and support you'd expect from IBM.

Contact your IBM marketing representative, or call 1 800 IBM-2468, Ext. KC/96, for the IBM Authorized Distributor nearest you. And we'll present more evidence in the case for IBM's ASCII terminals.

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# The case in color.



### 3164 TERMINAL

- Smooth Scrolling
- Double Width & Height Characters
- Definable Function Keys
- Paging
- Host Loadable Characters (up to 96)
- Character and Field Attributes
- 1920 (80 X 24) Character Display
- Attachment to IBM/non-IBM Systems
- CRT Saver
- Emulation
- Line Drawing Characters
- Wide Range of Communication Speeds (50 BPS through 19200 BPS)
- Selectable Interface (EIA RS-232C or RS-422A)
- Longitudinal Redundancy Checking
- Displays up to Eight Colors

### 3164 DISPLAY

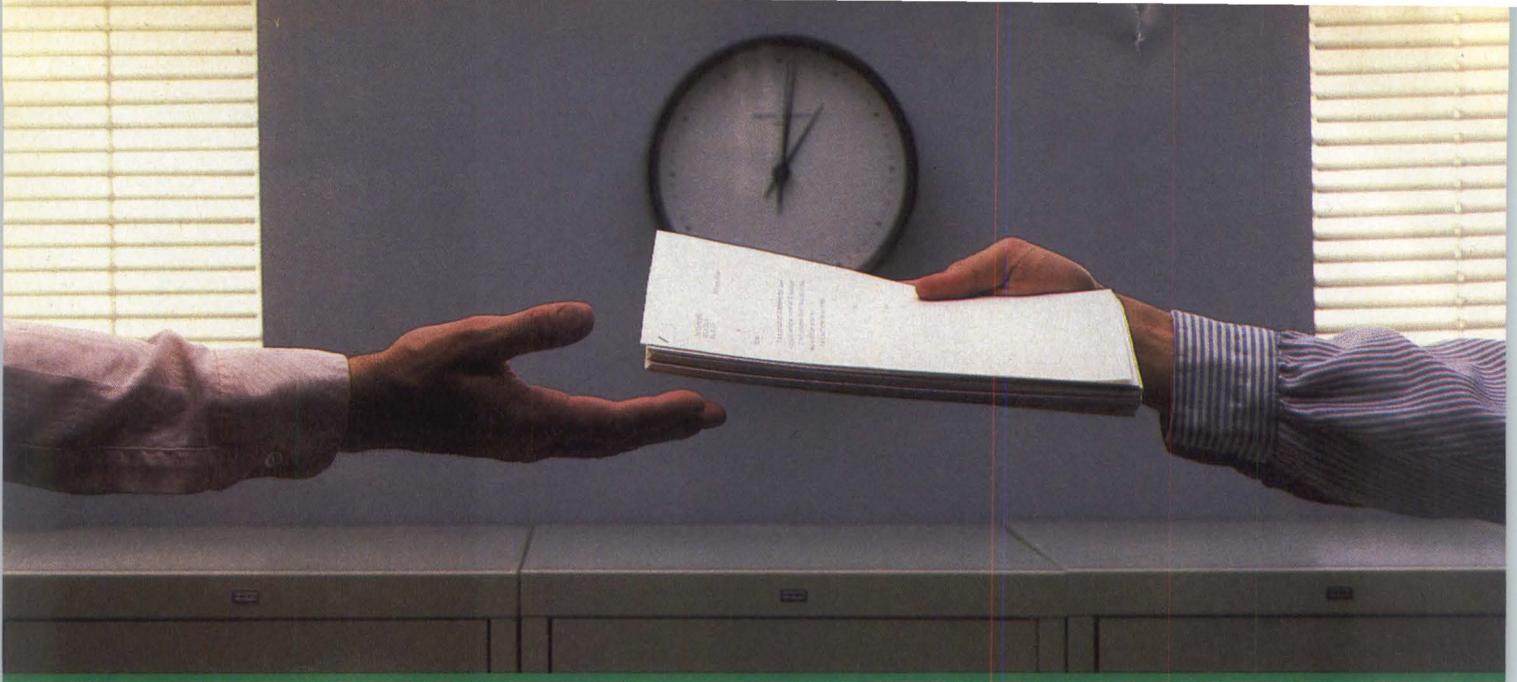
- Tilt/Swivel
- Direct Etched/Anti-Glare
- Adjustable Brightness
- 1920 (80 X 24) Characters
- Reverse Video, Blinking, Underline, Non-Display

### 3164 KEYBOARD

- Low Profile
- Tactile Feedback
- 12 PF Keys
- Re-Definable Keyboard
- Numeric Keypad
- 3 PA Keys



CIRCLE NO. 19 ON INQUIRY CARD



## 2400 bps modems: Do you Really need another speed?

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- 2400 bps modems can improve throughput, thereby getting tasks done quicker and more economically. However, 1200 bps has become the virtual standard for professional dial-up communications, and most users are satisfied with it. So why consider a 2400 bps modem at all?
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- The MultiModem224 is available in both desktop and IBM PC™ internal card versions. (There is also a rack-mounted version for central sites.) And as a bonus, we provide free offers from ten of the most popular on-line information services, including CompuServe™, Dow Jones™ and The Source™.
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## Optotech adds SCSI controller to 5 1/4-inch optical disk drive

**Mike Seither**  
Associate Western Editor

Optotech Inc., doing some quick foot work to become a leader in 5 1/4-inch optical storage devices, has introduced a small computer systems interface (SCSI) controller for its 400M-byte model 5984 disk drive.

The 5984 is the first 5 1/4-inch write once, read many (WORM) optical disk drive available in the United States with a SCSI controller, according to industry analysts. Toshiba America Inc., Santa Clara, Calif., has a 500M-byte SCSI drive—the DF-050—in the 5 1/4-inch form factor, but it is available only in Japan. Information Storage Inc., Colorado Springs, Colo., also is shipping a 5 1/4-inch optical drive, but the 100M-byte device supports only the enhanced small device interface (ESDI).

The SCSI controller marks the second version of the 5984 since Optotech first showed the drive—its only prod-

uct so far—to system integrators and OEMs last July at the National Computer Conference in Chicago. The drive shown at NCC works with the IBM Corp. PC and uses a proprietary drive interface and controller that plugs into a PC expansion slot. The 5-by-8-inch SCSI controller, on the other hand, is attached underneath or on top of the drive.

The newer SCSI controller, like the one for the PC, will be priced at \$310, says Optotech's marketing director, Jeff Delude. The optical drive itself sells for \$1,100 apiece in quantities of 1,000, or about the same price as a 5 1/4-inch, 40M-byte Winchester disk drive. At the beginning of this year Optotech had built slightly more than 100 of the WORM drives.

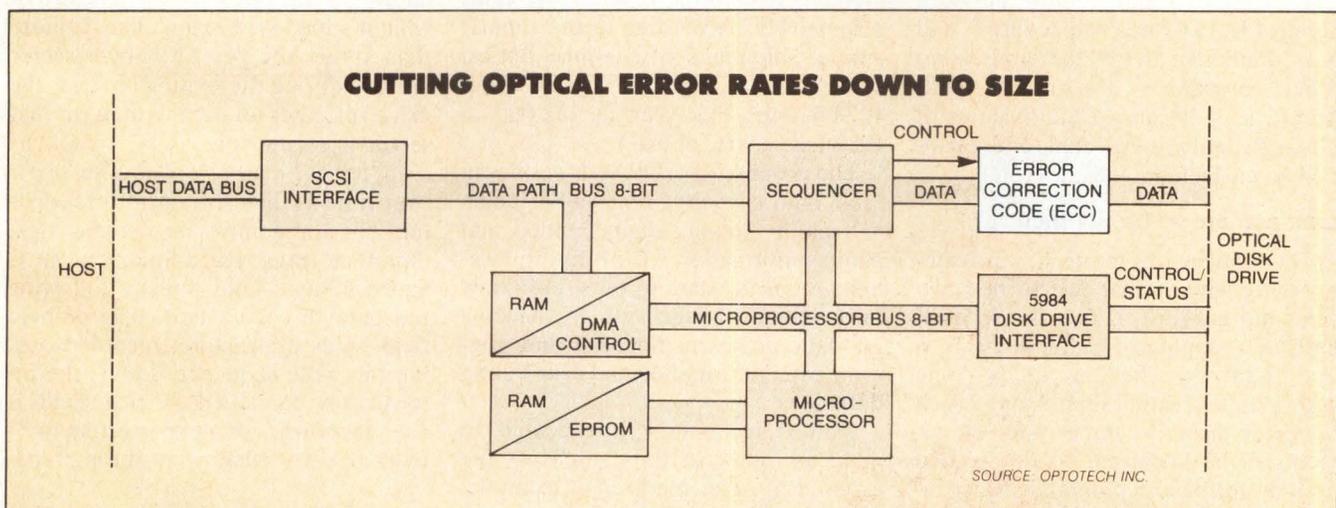
### Subsystems and servers

Delude says the company began a pilot production run in March at its plant in Colorado Springs, Colo. Initial production will take place in Colorado,

but later this year Optotech plans to move manufacturing overseas to reduce production costs. The company expects to ship about 10,000 drives during 1986.

Optotech has already signed OEM agreements to supply a number of companies with the 5984. Tallgrass Technologies Corp., Overland, Kan., is combining the 5984 with an 80M-byte Winchester to create a mass-storage subsystem for the IBM PC and compatibles. Lancore Technologies Inc., Westlake Village, Calif., plans to buy more than 1,000 of the optical disk drives, which it will incorporate into a variety of server products for local area networks. Optotech has also signed a \$3 million contract with Miltope Corp., Melville, N.Y., which plans to customize the drives for military applications.

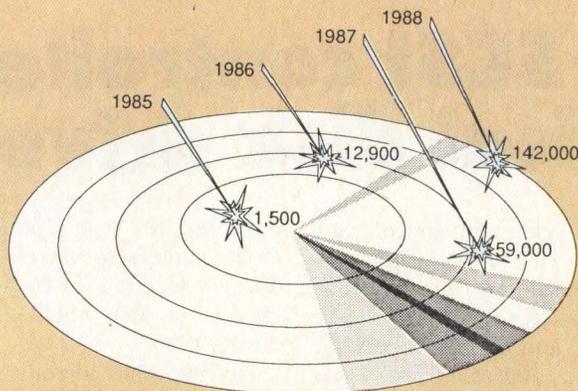
"As a percentage of installed base, the shipments of [5984s with] SCSI drives will be larger than without," says Delude. "Not all PCs require



**Optotech's SCSI controller** uses an ECC to reduce raw bit-error rates to one in a billion over the 10-year life of an optical disk drive cartridge.

## HOW THE MARKET WILL GROW FOR 5 1/4-INCH READ/WRITE OPTICAL DRIVES

(Unit shipments by year)



SOURCE: DISK/TREND INC.

200M bytes of on-line storage." The 5984 uses a removable cartridge with 200M bytes of capacity on each side. Although the cartridges are available from Optotech for \$150 each, the company encourages OEMs and system integrators interested in large volumes to deal directly with media suppliers.

Some industry observers have noted problems of inadequate supplies of media for WORM drives, but Delude says, "That is no longer an issue for us. We have a lot of media in-house." He says Optotech has qualified two cartridge suppliers: Diacel Chemical Industries of Japan and Optical Storage International, a joint venture between Control Data Corp., Minneapolis, and N.V. Philips of the Netherlands. Two other companies, 3M of St. Paul, Minn., and Plasmon Data Systems of Great Britain are expected to be qualified soon, Delude adds.

### Lion's share to be 5 1/4-inch

The strategy of Optotech, a privately held company that just turned two years old in April, is to position itself early as a supplier of high-end 5 1/4-inch optical drives. The reason for going with 5 1/4-inch, rather than 8- or 12-inch diameter disks, as some other manufacturers have chosen to do, is tied directly to market potential. Most industry analysts agree that the biggest growth for WORM drives—and erasable devices, once media is available—

will lie in the 5 1/4-inch form factor.

Edward S. Rothchild of Rothchild Consultants in San Francisco predicts that 90 percent of all the optical drives on the market by 1990 will be 5 1/4-inch. Another mass-storage consulting firm, Disk/Trend Inc. of Los Altos, Calif., also says 5 1/4-inch drives will claim the lion's share of optical drive shipments for the near term. In a 1985 report, Disk/Trend breaks down share of market by disk diameter for optical drives with capacities of less than 1G byte. Those include 8-, 5 1/4- and 3 1/2-inch diameter disks. For 1986, 1987 and 1988, the report gives 5 1/4-inch a commanding lead by 63, 72 and 73 percent, respectively. According to the report, annual shipments of 5 1/4-inch optical drives are expected to grow from 12,900 units this year to 142,000 in 1988 (see chart, above).

The promise of WORM drives lies in their high capacity, removable media and ability to mix digital, video and audio information. Current applications requiring data to be written only once include image storage, backing up data, archiving financial and governmental information and distributing databases.

Optical technology is expected to make its mark in those areas at the expense of other media. For example, data stored by random access on optical drives can be retrieved "in fractions of a second, vs. minutes for tape," says

Disk/Trend vice president Robert Katzive. Because optical devices have the capacity to store the dense digital data that makes up images, they also offer an alternative to microfilm.

Optotech seeks to differentiate itself from other optical-drive manufacturers in several areas. The company cites for its drive a powerful error-correction code (ECC), interchangeability of cartridges among PCs and minicomputers, implementation of the SCSI common command set, the capability for users to format their own cartridges and a method that allows information to be updated. Optotech also offers extensive software-development tools for both the PC and SCSI version of the 5984 drive.

Optotech developed its SCSI controller in conjunction with Scientific Micro Systems Inc., a Mountain View, Calif., controller house. The goal was to "achieve an error-correction scheme that eliminates raw bit-error rate from consideration," says John Hay, Optotech's controller product manager. The result, Optotech claims, is one bit error in a billion over the estimated 10-year life of the cartridge, or approximately the error-rate tolerance of magnetic storage devices. This is accomplished by the way the laser beam burns the pit on the disk's surface, and by the way the bit is read.

Optotech uses a technique called direct read during write (DRDW) to immediately compare the actual "signature" of the burned pit to a record of what it's supposed to look like. If more than three bits per 512K-byte sector are bad during the writing process, the drive relocates all data written on that sector to a new one.

In optical media, errors also occur over time as the media oxidizes, creating bits randomly. To handle this, Optotech uses Reed-Solomon ECC and a 48-byte field directly following the data in each sector. The 48-byte field holds information recorded during the write sequence. Later, the information contained in that field is used for comparison to correct up to 24 bytes of errors that occur during reading.

Optotech has taken several other steps to broaden the appeal of the 5984. For instance, the company claims

it is the only manufacturer that allows users to format the disk themselves. Marketing director Delude says this will ultimately give users more choice in where they purchase their optical cartridges. Other 5¼-inch optical disk drive vendors such as Toshiba and Information Storage perform the disk formatting themselves.

Optotech also claims that disks written with either its PC controller or SCSI controller are interchangeable when created with the company's file-management system. What that means, Delude says, is that a minicomputer using the SCSI version could be used to create disks for database distribution to PCs. Those same PCs in turn could use the drives to collect data in the field then send it in for central analysis.

#### Write once, write again

The data on a write-once disk is not necessarily static. Written information may not be erased or changed, but it can be updated. Optotech has incorporated this feature into its drive through the use of 5-byte "post fields" at the end of each sector that can be used to create pointers that link groups of data. Two special commands are used to write and read these post fields. Mailing addresses in a database, for instance, could be updated as they change.

To speed up development for system integrators, Optotech says it has incorporated the 12 required commands in the so-called "SCSI common set," as well as 15 of 21 optional commands. The common commands constitute a workable subset of the unwieldy, complete SCSI command set that a group of vendors has agreed to adhere to. By adopting the common command set, Optotech hopes to help system integrators reduce the time it takes to do tasks such as write device drivers.

A key part of Optotech's marketing strategy is its package of software tools that allows integrators to develop end-user applications. Already available for the PC version of the drive is a bundled tool kit of low-level I/O routines, a file-management system and PC-DOS utilities and device drivers. Optotech plans to make the same tools available for the SCSI version. □

## MIPS puts RISC processor on VMEbus, Multibus II

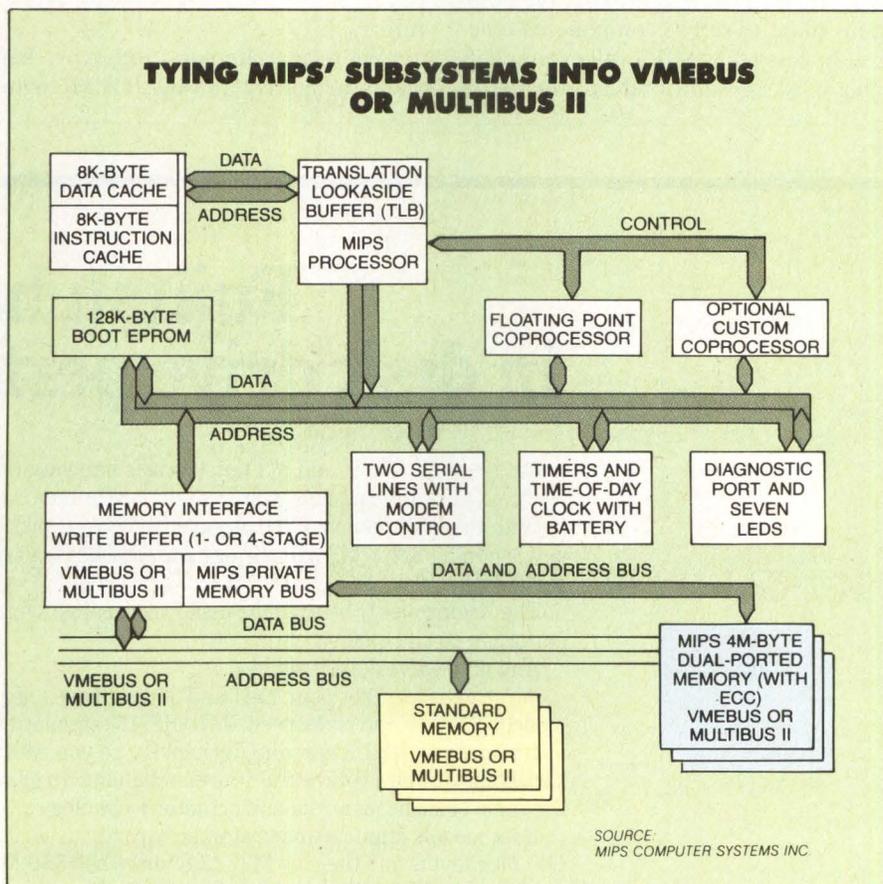
**Mike Seither**  
Associate Western Editor

Reduced instruction set computers (RISC) have shrunk to the subsystem level. MIPS Computer Systems Inc., a start-up from Sunnyvale, Calif., has introduced a family of board-level products for the VMEbus and Intel Corp.'s Multibus II that are based on MIPS' proprietary 32-bit processor. In so doing, MIPS has become the first subsystem supplier to offer RISC technology to OEMs.

The subsystems can deliver from 3 to 8 million instructions per second

(MIPS) for prices ranging from about \$3,000 to \$6,000, the company says, and are aimed at computer manufacturers and system integrators for use in existing and future product lines, particularly high-performance UNIX-based supermicrocomputers, minicomputers and technical workstations.

MIPS delivers this largely untested computer architecture to the market at an especially propitious time. Just months ago, industry heavyweights IBM Corp. and Hewlett-Packard Co. conferred status on the technology by introducing RISC machines—IBM in January with its RT PC technical work-

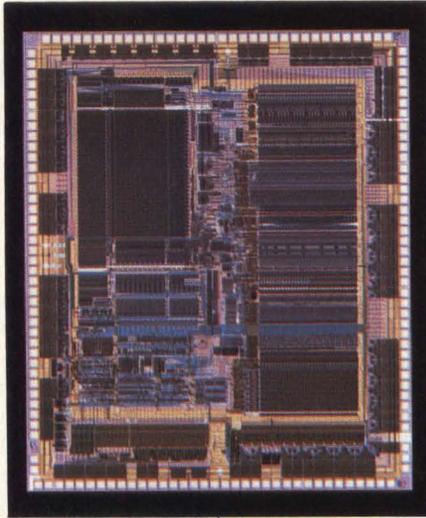


The R2100 CPU board from MIPS Computer Systems can operate at 3 million instructions per second using off-the-shelf VMEbus or Multibus II memory boards (yellow). The faster R2300 and R2600 CPU boards, running at 4.81 and 8 MIPS, respectively, require the company's proprietary R2350 4M-byte memory boards (blue).

station, and HP a month later with its Spectrum line. Admits Albert Sisto, MIPS' vice president of marketing, "IBM and HP have already done a lot of free advertising for us."

Even with the big boys running interference to popularize RISC, MIPS still has long yardage ahead of it. Cautions industry consultant Andrew Allison of Los Altos Hill, Calif., "Having a RISC product may make it interesting, but OEMs are becoming hard-nosed about technology for the sake of technology. Cost performance and utility are what count. The question is, can MIPS bring that to the party?"

MIPS officials believe the answer to that question won't be long in coming. Part of the company's strategy is to get products out the door in packages that OEMs are already familiar with. Hence, the initial move to market board-level products for the VMEbus and Multibus II. Eventually, the company plans to sell its components separately. Sisto says MIPS will even sell its chip masks to semiconductor manufac-



**The backbone** of MIPS Computer Systems' R2000 family of subsystems is this fully customized CMOS 32-bit processor chip with 4G bytes of virtual address space.

turers.

"We're a technology company that wants to market through OEM chan-

nels," Sisto says. "Restraining access to our technology will do us no good."

The backbone of that technology relies on a custom VLSI CMOS central processor packed with more than 100,000 transistors. This CPU in MIPS' R2000 Series of processor subsystems features a five-stage pipeline and uses 32-bit data, addresses and instructions. Therefore, it is capable of addressing 4G bytes of virtual address space.

The CPU gets its power from a set of 102 fixed-format instructions which execute in a single 8-MHz clock cycle (16 MHz for the high-end CPU board). The architecture includes 32 general-purpose, 32-bit registers. Its instruction set supports three external processors, each with 32 registers. The processor has a cache control unit with 8K bytes for data and instructions, in addition to a translation lookaside buffer that allows fast access to the 4G-byte virtual address space (see diagram, Page 33).

The processor is now available with

## Fujitsu has done it again in disk drive performance, with a

Put these new 10½" and 8" Fujitsu drives into your existing design, and with only minor changes, you'll significantly increase your system's performance and capacity.

With the introduction of the original 10½" Eagle disk drive five years ago, Fujitsu established a new modified SMD (MSMD) performance standard, achieving a data transfer rate of 1.8 Megabytes per second.

The Eagle quickly became the disk drive against which others were measured. For both performance and quality.

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It's done using RLL encoding technology, so you get this new level of performance without sacrificing one bit of our world-proven reliability. To minimize your technology risks, these drives use the same basic head, media and actuator technology as our previous products.

Both models offer expanded storage capacity as well. The new M2361 Eagle provides 689 Megabytes and the new M2333 8" drive has 336 Megabytes. And you can stack four of the 8" units in a standard 19" rack, providing 1.3 Gigabytes of storage in the space of one 14" drive.

These drives can also use the same controllers. And most major controller houses provide off-the-shelf products to integrate them on virtually all system buses.

The Eagle and 8" drives both provide fast access (18 and 20 milliseconds respectively), and the same track capacity. And both offer Fujitsu's field-proven quality, backed by a 20,000 hour MTBF specification.

32-bit instruction sets for Pascal, FORTRAN 77 and C, each of which are optimized with MIPS' compiler. MIPS says the processor will support Ada, COBOL and LISP by the end of next year.

The MIPS processor also accommodates a tightly coupled floating point accelerator that executes 3 million double-precision operations per second. MIPS claims that the floating-point chip conforms to IEEE 32-bit single-precision and 64-bit double-precision formats and supports recommended exceptions such as invalid operation, division by zero and inexact result.

Using the CPU and floating point accelerator as building blocks, MIPS offers a variety of products. They include the three processor subsystems: the R2100, R2300 and R2600. All come with bus-interface circuitry and connectors, a time-of-day clock with battery backup, two serial communications and eight I/O ports, electrically programmable ROM for boot and seven light emitting diode status indi-

cators. MIPS is also introducing a 4M-byte memory board, a development system and a software component kit. All prices are for OEM quantities and are the same for VMEbus and Multibus II implementations. With one exception, (the R2600, ready for shipment in the fourth quarter of 1986) MIPS says all products will be available within 90 days of order.

MIPS' subsystems include the following:

- **Model R2100.** The low-end of the MIPS CPU subsystems, the R2100, is rated at 3.15 MIPS under the LINPACK benchmark (the same used for the company's other two processor subsystems). The R2100 has a clock cycle of 8 MHz, a one-stage transistor-to-transistor write buffer and is priced at \$3,170. According to the company, it can sustain a performance of 3 MIPS when used in conjunction with off-the-shelf VMEbus or Multibus II memory boards from other vendors.

- **Model R2300.** As the mid-range CPU board, the R2300 can be pushed

to 4.81 MIPS at a clock rate of 8 MHz. But, unlike the R2100, this subsystem requires the use of MIPS' proprietary memory board. It also has a deeper four-stage gate array write buffer. The price is \$4,775.

- **Model R2600.** Priced at \$6,420, this is the company's top-of-the-line CPU board, capable of delivering 8 MIPS. To reach that performance it also must be used with MIPS' memory board. It operates at 12 MHz.

- **Model R2350.** This is MIPS' 4M-byte memory board that is necessary for optimum performance of its two top CPU subsystems. Priced at \$3,300, it is designed as two independently addressable 2M-byte memory banks. The board supports 8-, 16-, and 32-bit transfers.

- **Component kit.** This collection of MIPS software is priced at \$1,370. The price includes Pascal, FORTRAN 77, C and the binary license to its UMIPS, the company's version of the UNIX operating system. UMIPS is offered either as a version of AT&T Co.'s

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System V.2, or of Berkeley UNIX Version 4.2.

• **Development system.** For \$59,000, MIPS offers a complete development system with a chassis for either Multi-bus II or VMEbus. The system comes with MIPS' R2300 CPU and R2350 memory board (capable of 16M bytes), a 337M-byte Winchester disk drive, a 60M-byte quarter-inch streaming tape drive, Ethernet controller, six expansion slots and the UMIPS operating system.

Opening with what it considers a full line of products, MIPS expects to do about \$8 million in business this year, and reach \$20 million in 1987. According to marketing vice president Sisto, by March the company had \$1.5 million in orders for boards. Although MIPS won't comment on current contracts, one major deal may be with Prime Computer Inc. of Natick, Mass. It was with Prime that MIPS originally contracted to deliver a workable silicon version of its first RISC processor.

The company identifies four basic markets on which it intends to concentrate its sales, and the percentage of revenues each should provide, as: high-end computer aided design, manufacturing and engineering workstation manufacturers, 40; multiuser UNIX system vendors, 25; military systems suppliers, 15; and makers of high-performance communications switches, 20.

Some industry analysts believe that MIPS, as an early entrant into the RISC game, is well-positioned to exploit the architecture's power. Jeff Canin of Hambrecht & Quist, San Francisco, notes that MIPS' low-end product outperforms Motorola Inc.'s MC68020 by a speed factor of 3-to-1, and Digital Equipment Corp.'s VAX 11/780 by 4-to-1.

MIPS officials say they can milk the architecture for even more power. John Moussouris, a MIPS co-founder and now vice president of VLSI development, says the company's RISC design allows performance to be doubled every 18 months for the next 15 years. In the near term that will come about through the use of faster clock rates and wider data paths. Later, MIPS plans to use multi-processing techniques to boost power. □

## Sun's NFS, ATTIS' RFS to compete for recognition

Lynn Haber, Associate Editor

NFS, which is already here, and RFS, which is coming, are network services that are likely to battle it out to become the de facto standard among major manufacturers of engineering and scientific workstations.

NFS is Sun Microsystems Inc.'s Network File System, a network service that permits users to transparently access files on systems from a variety of vendors. It seems to have the lead in the standards sweepstakes over RFS (Remote File Sharing), which will be AT&T Information Systems' entry. ATTIS intends to offer RFS as a feature to UNIX System V Release 3.0, expected this year. RFS will permit users to share files between different UNIX operating systems—but only UNIX systems.

According to Bill Keating, NFS product manager at Sun, Mountain View, Calif., 28 computer companies provide implementations of NFS for their systems and 30 more are evaluating it—including European and Japanese manufacturers.

Sun published the NFS specifications in early 1985 when it introduced the protocols, thereby making them available to everyone, and it licensed its own implementation. Sun workstation customers get NFS bundled free with the operating system.

Key support for NFS came when Digital Equipment Corp. (DEC) announced this past January that it will implement NFS protocols for the company's computers running the ULTRIX operating system (ULTRIX is DEC's version of UNIX.) "We saw NFS as being the accepted file system within the industry," says Rich Lewan, DEC workstation marketing manager. "We believe it's a good and solid networking service." DEC, a leading vendor of scientific and engineering computers, would not say if it will implement NFS on VMS, the company's proprietary operating system.

Other NFS supporters include Alliant Computer Systems Corp.,

Acton, Mass.; Convex Computer Corp., Richardson, Texas; Data General Corp., Westboro, Mass.; Gould Inc., Computer System Division, Fort Lauderdale, Fla.; and Texas Instruments Inc., Dallas.

The most often cited benefits of NFS, aside from its open nature and transparency, are savings in disk space and file consistency. Prior to NFS, file transfer across a local area network required file duplication, which eats up disk space and creates the potential for inconsistent files. Sun's network file-sharing service architecture allows workstations to share access to the single file.

### Promotes open systems

The beauty of NFS, says supporters, is that it operates independently of machine type or operating system.

At the January UniForum trade show in Anaheim, Calif., Sun hosted a demonstration of NFS on systems from over 12 vendors running four operating systems: Berkeley UNIX Version 4.2, ATTIS's UNIX System V 2.0, DEC's VMS and MS-DOS. Machine types ranged from personal computers to minisupercomputers.

Transparent file access, while available on proprietary distributed systems such as Apollo Computers Inc.'s DOMAIN and DEC's DECnet LAN, are not found on heterogeneous systems. Transparent file access means that a user can access files anywhere on the network and use them as though they were resident on that individual's system—without having to know the location and address of the file.

Not software, NFS is a set of protocols that reside in the kernel of the local operating system and, according to Sun's Keating, is compliant with layers 5, 6 and 7 (Session, Presentation and Application) of the International Standards Organization's seven-layer model for open systems interconnection (ISO/OSI). But Keating cautions that NFS is not an OSI product because the exact specifications for the upper layers of the reference model

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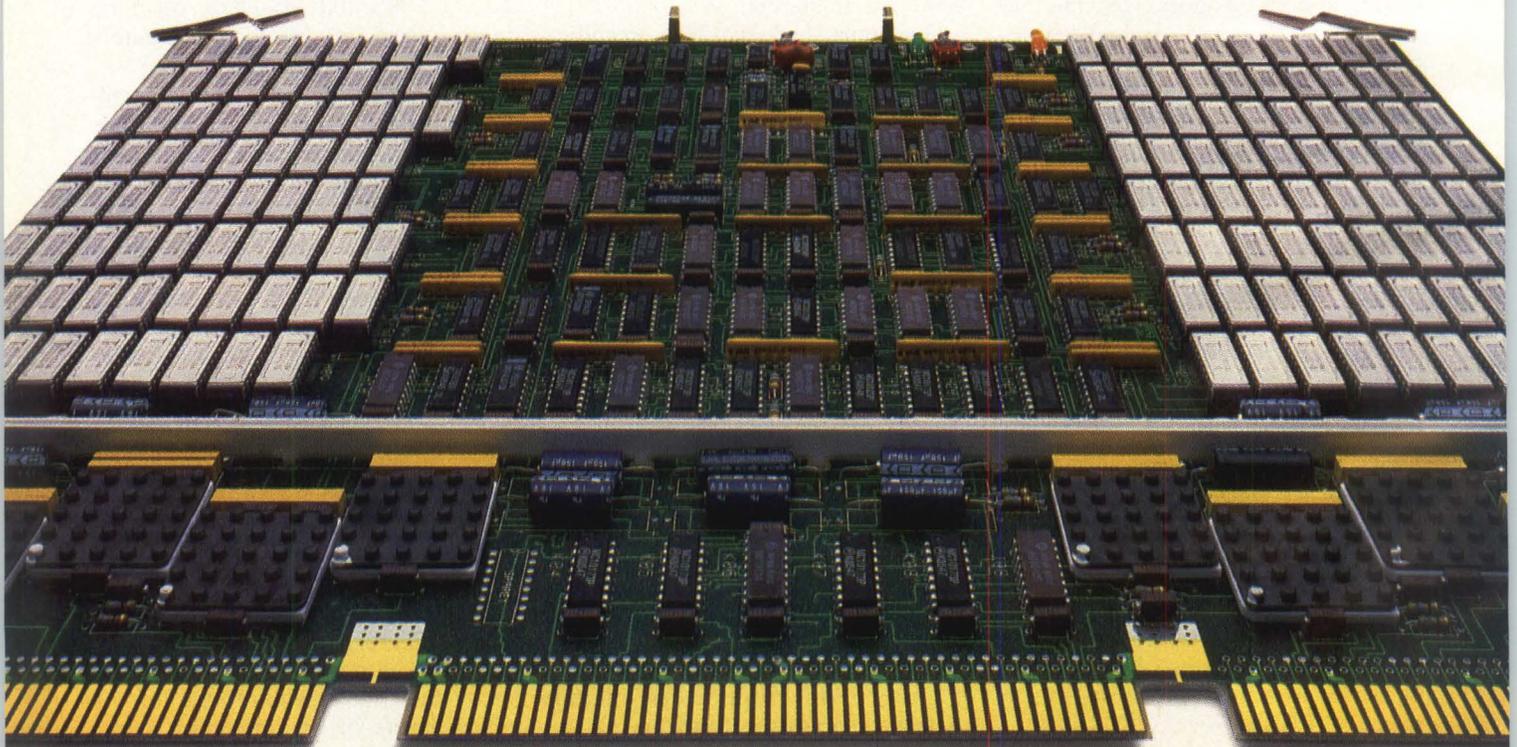
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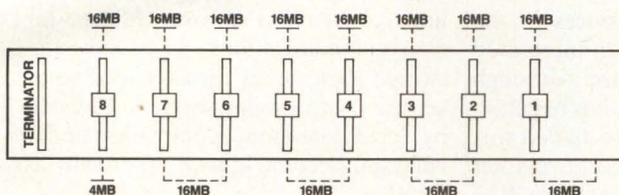
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have not been established. When they are, Keating contends, NFS will comply with the open systems standard.

Despite the groundswell of support for Sun's NFS, ATTIS has not dropped plans to offer RFS to the UNIX world when UNIX System V Release 3.0 is born.

According to Dave Sandel, division manager at AT&T Computer Systems, Summit, N.J., ATTIS will eventually offer source versions of RFS—so that value added resellers and OEMs can utilize the technology for their own purposes—in addition to an initial offering of RFS on the company's 3B2 minicomputers. Sandel says ATTIS will eventually implement RFS across the company's entire product line.

RFS is a kernel architecture and is protocol-independent, according to Sandel. It runs under the Transport Layer interface—level 4 on the ISO/OSI model. Unlike NFS, which is a network service that deals with files, RFS reportedly allows users to transparently access devices as well as files.

Sun's Keating says NFS takes a cafeteria approach to network services in that it allows users to choose among services. NFS is the first in a series of network services that will be available from Sun, says Keating, and will coexist with additional network services and provide complementary and compatible functions.

Vicki J. Brown, senior analyst at International Data Corp., Framingham, Mass., believes that RFS will be a strong contender because it has the support of ATTIS and because the UNIX operating system pervades the scientific and engineering fields. "I think, though, that Sun's NFS is a grander and broader scheme for open systems," she contends.

Despite ATTIS' push for RFS, Brown sees DEC's backing of NFS as significantly influencing the industry's awareness of Sun's proposed standard.

The battle will rage for awhile, however, as manufacturers take sides. For example, Apollo, a rival of Sun's, has announced support for ATTIS' RFS. According to Mark J. Hatch, the company's communications and operating systems marketing manager, RFS is a superior solution to NFS from both a marketing and technical perspective.

"Basically, Apollo wants to support the file system that it feels will be the industry standard," he says.

Meanwhile, while squared off on the file-service issue, Sun and ATTIS have agreed to look for ways to converge their conflicting versions of UNIX.

In addition, Hatch contends that ATTIS can support RFS better than Sun can support NFS. Hatch says NFS is technically weak in concurrency control in file security; and in the maintenance of UNIX file system semantics. □

## Capacity, economy hinder PBXes for datacom

**Stephen J. Shaw**  
Washington Editor

In the early 1980s, private branch exchanges lined up against local area networks and telephone-company-provided leased-voice services in the race to wire offices with integrated voice/data communications. Although far from over, the contest has begun to resemble that between the fabled tortoise and hare. Two recent market studies indicate the tortoise-like PBXes stand little chance of recovering lost ground.

Analysts report that PBXes—telephone switching systems usually owned and operated by the user rather than by the telephone company—have simply failed to live up to their promise because of various technical, marketing and economic reasons. As a result, market researcher International Data Corp. (IDC), Framingham, Mass., expects the installed base of PBXes to grow only 2.75 percent a year between now and 1990. Instrumental in that slow growth is the sheer cost of using a PBX as a data switch. The studies say the price will preclude truly integrated voice/data office systems for the foreseeable future.

Just a few years ago, PBXes were being touted as the potential kingpin of the automated office. They were capable of handling both voice- and data-switching tasks and of providing sophisticated value-added features for telephony and for data-communications applications. The technology was alluring: pumping one digital stream through a central piece of hardware that handled telephone management (call transfers, conferences, billing in-

formation, etc.), and also enabled computer-based workstations to switch among internal host systems, other workstations and external databases.

But true voice/data integration remains an unfulfilled promise. Users have chosen LANS over PBXes for data communications. They have answered their needs for advanced voice services with similar services provided by local telephone companies under what has become known generically as Centrex.

According to a recent study by market researcher Venture Development Corp. (VDC), Natick, Mass., the integration of data connectivity into PBXes was not based on user requirements. It gathered momentum by the sheer excitement of its technology and was pushed by PBX vendors so they wouldn't be frozen out of the more lucrative data communications market. "Users simply don't have the applications for switched data yet," comments VDC analyst Bill Garrett. "It's not like they're demanding something that's not there yet."

IDC's market study pegs the growth of the installed base of PBXes, in terms of telephone lines, at a modest 3.5 percent between 1984 and 1985. In 1984, the number of lines shipped was an estimated 3.64 million, for a value of \$2.79 billion. In 1985 those numbers grew to 3.86 million lines shipped, totalling \$2.98 billion. IDC says shipments are expected to grow at an annual compound rate of 5.83 percent until 1990. Replacement or upgrading of existing lines will account for more than half of the growth. IDC expects the installed base of new systems to grow at a compound rate of only 2.75

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percent a year.

IDC pins the slow growth of the PBX market on a combination of four factors:

- The failure of manufacturers to deliver promised new technology to the market, specifically, "truly" integrated voice/data PBXes;

- Suppliers' inability to differentiate their products, caused partly by a glut of new vendors entering the market in 1984 with similar products. Products were differentiated only by descriptions of their capabilities rather than by their underlying technology;

- User confusion and frustration over both the technology and the long-term viability of newer vendors;

- The repositioning of Centrex services once provided by the former Bell telephone operating companies. Those companies were able to capture much

of the demand for advanced voice services by leasing tailored packages rather than by selling all-inclusive, and expensive, hardware.

According to VDC's Garrett, no more than 15 percent of PBX lines are currently being used to carry data traffic.

A VDC survey of users, revealed that, while larger PBX users "almost without exception" specify data capabilities in their PBX requests for proposals, 75 percent of the survey respondents are using their PBX only for voice applications.

PBXes have yet to fulfill their role in data communications because of customers' patterns of use, economics and, to a lesser extent, the dearth of true voice/data PBXes: the "fourth-generation PBX" that could handle both voice and data tasks with equal

facility.

According to an AT&T Co. spokesman, data transfer in an office environment has evolved in a manner inimical to PBX switching. "The normal pattern of usage for a data workstation user is to come into the office in the morning, sign on to the terminal and connect with a host for the rest of the day. With a lot of heavy data users, you begin to tie up the capacity of the PBX, because it has to dedicate separate lines for all those terminal-host connections," the spokesman says.

IDC anticipates that this equation will dictate separate voice and data office systems, at least in the near future. Data PBXes—switching systems that carry data traffic exclusively—can provide interconnection and network-management functions for approximately \$300 to \$600 per port. Traditional voice-oriented PBXes, the IDC report estimates, cannot perform data-communications functions for less than \$1,000 per line.

LANs, with their variety of switching approaches, have provided a less expensive pipeline for data communications.

The data throughput rate of PBXes is also slower than that of LANs. One of the fastest PBXes currently offered, the Meridian system from Northern Telecom Inc., Nashville, Tenn., can transmit data at 2.5M bits per second (bps) over twisted-pair wire. By contrast, IBM Corp.'s Token-Ring Network handles data at 4M bps, and some LANs carry data at throughput rates up to 80M bps.

Lastly, market acceptance of the integrated voice/data PBX has been hamstrung by the delay of the so-called "fourth-generation switch," one that can switch both data packets and the digital voice/data circuits found in the current "third-generation" PBXes. Additionally, the fourth-generation switch will allow for a distributed processing architecture to take full advantage of "smart" microcomputer-based telephone handsets. Some vendors claim that theirs is such a fourth-generation PBX, but the IDC study asserts, "The PBX market has been characterized by a great deal of hype concerning the increased capabilities of a new generation of PBXes." □

### WHO CONTROLS WHAT IN THE PBX MARKET (PBX vendor market share in percentage—based on 1984 line shipments)

Company	Very low end	Low end	Mid range	High end	Very high end	Super high end	Total percent	Installed base x 1000
AT&T	9	9.0	22.0	19.0	22.0	32	17.0	620
American Telecom	10	6.0					2.8	103
Anderson Jacobson		1.0	2.0				0.9	34
Ericsson			1.0	3.0	8.0	9	1.7	61
GTE	3	3.0	5.5	3.0			3.6	131
Harris	5	3.5	1.0	1.0			2.1	75
Hitachi			1.0				0.4	13
ITT	15	3.0	3.0	1.0			4.1	151
Intecom				12.0	14.0	15	3.6	130
Mitel	27	24	6.0	2.0			11.0	430
NEC	2		5.0	9.0	8.0	8	4.5	163
Northern Telecom		18.0	23.0	23.0	26.0	36	19.1	696
Oki	2	5.0	2.0				2.1	76
Roim	5	16.0	21.0	21.0	20.0		16.6	605
Siemens	9	5.0	3.5	2.5			4.1	151
Solid State		0.5	1.5	1.5	0.5		0.9	34
Stromberg-Carlson		1.0	1.0				0.6	21
Telenova	5	2.5					1.3	47
Teleresources	5	1.0					1.0	35
United Technologies	3	1.5	1.5	2.0	1.5		1.8	64

#### Key:

Very low end = up to 50 lines

Low end = 50 to 199 lines

Mid range = 200 to 799 lines

High end = 800 to 2,999 lines

Very high end = 3,000 to 10,000 lines

Super high end = over 10,000 lines

Source: International Data Corp.

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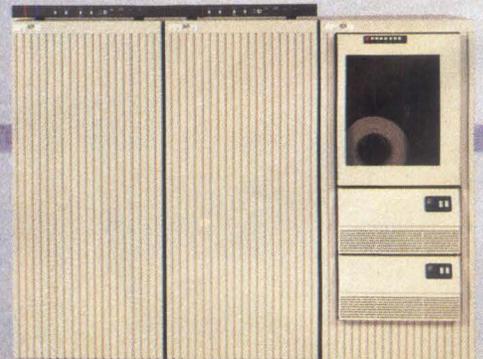
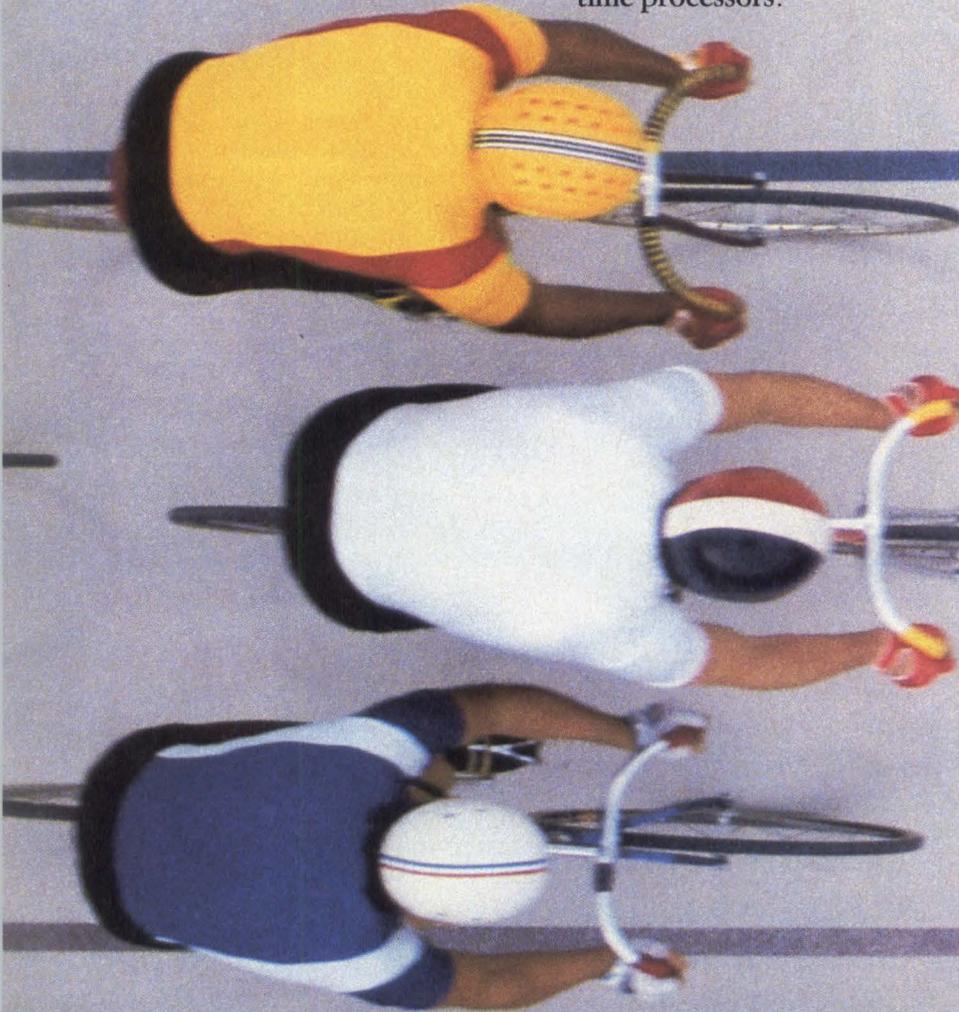
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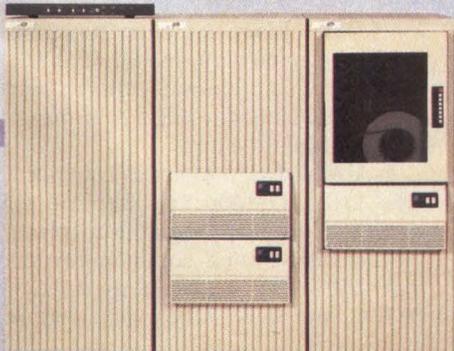
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# British Telecom advances on America through Mitel

Keith Jones, European Editor

Mitel Corp., a leading North American vendor of small private automatic branch exchanges, has had a tough couple of years. When the Kanata, Ontario, company sought to introduce its SX-2000 to the market for large digital PABXes (up to 10,000 lines), shipments were delayed from 1982 to 1984, due to production problems. The company lost \$22.7 million in fiscal 1984, and another \$22.7 million in fiscal 1985. Things could have looked better.

Today they do. The company may be on the way up again thanks to the recent acquisition of a 51 percent controlling interest by British Telecommunications Plc., London. British Telecom, the dominant common carrier in Great Britain, boasts annual revenues well over \$10 billion and profits of around \$1.5 billion. "Mitel now has a sugar daddy from Britain and should do well in the market for PABXes with more than 100 lines," says Doane Perry, a telecommunications consultant with International Data Corp., Framingham, Mass. That task has been made smoother by the \$228.6 million that British Telecom paid for its share of the company.

Of greater importance to the U.S. telecommunications market overall, however, is the trans-Atlantic foothold British Telecom has gained with the purchase. "Prospective customers who were planning to buy SX-2000 from Mitel now know that the company's future is assured," says a British Telecom spokesman. But he freely admits that the Mitel takeover is simply part of British Telecom's strategy to transform itself into an international information-technology company. Most European common carriers' business activities are limited to their home country, but British Telecom was denationalized in 1984 and thus was freed to seek global opportunities.

Mitel's new financial support may be sturdy, but enlarging the company's—and thus British Telecom's—U.S. mar-

ket share won't be an easy task, assert some analysts. "Mitel will have an uphill battle in the bigger PABX market," says William Garrett, an analyst with market researchers Venture Development Corp., Natick, Mass. Major vendors, such as AT&T Information Systems, Northern Telecom Ltd.—another Canadian company—and Rolm Corp., all enjoy a big lead over Mitel in PABX sales. Telecommunications analyst Alan Fross of Eastern Management Group, Parsippany, N.J., adds that Mitel can also expect greater competition in the under-100-line PABX market from more vendors, as well as competition from products that offer the more advanced digital switching. All Mitel's PABXes are currently analog except for the top-of-the-line SX-2000.

## Keeping up with the Rolms

Mitel's assistant vice president of marketing for North America, Charles Urquhart, based in Boca Raton, Fla., acknowledges that limitation in its PABXes, but says that the full Mitel line will be digital by this fall. The Mitel family includes the SX-10, SX-20, SX-100 and SX-200, which range in line capacities from 32 to 150; the Generic 1000, which handles up to 350 lines; and the SX-2000, which accommodates from 100 to 10,000 lines.

Despite the obstacles, Garrett contends, "A lot of users of Mitel's small PABXes are potential customers for bigger Mitel systems." He adds, "Mitel also has a lot of small PABXes at satellite sites of big companies, which are potential purchasers of bigger Mitel PABXes."

In answer to Fross and Garrett assertions that PABXes will increasingly need local area network interfaces, Urquhart maintains that Mitel has planned for that too. The SX-2000 will incorporate interfaces for Ethernet, IBM Corp.'s Token-Ring Network and the Manufacturing Automation Protocol, he says, adding, "Mitel has already demonstrated an Ethernet interface on the SX-2000, and we could

supply it to a customer, if it's needed."

Fross and Garrett also say that Mitel needs to restructure its distribution network, particularly for its SX-2000, to become more competitive. Traditionally, Mitel has shipped all its products to wholesalers (Mitel calls them "supply houses"), who in turn sell to dealers ("interconnects"). But those 2,000-odd dealers sell a wide variety of telecommunications equipment, including simple telephones. Garrett insists that, with the SX-2000, Mitel needs to be much more selective, bypassing wholesalers altogether in some cases and shipping directly to large dealers. Only they are capable of handling such a sophisticated product, he maintains. Urquhart says that, within the last 18 months, the company has acquired 35 large dealers with regional or national coverage to handle the SX-2000.

In Fross' opinion, Mitel also needs to reopen a key sales channel through the Regional Bell Operating Companies (RBOC). Because of the two-year delay in SX-2000, Mitel lost out in the first round of accords that the RBOCs struck with PABX manufacturers after the RBOCs became independent of AT&T Co. Fross thinks that Mitel now has a chance of making deals with some of them, because they are currently re-evaluating their suppliers. Mitel's Urquhart says the company is talking to all of the RBOCs and hopes to reach agreements by the end of next year to supply three or four of them with the SX-2000.

Mitel is also divesting certain outlets in a consolidation to improve its penetration of three major markets. It is moving out of Latin America and other Third World areas in favor of North America, Europe and the People's Republic of China. The company has a plant in Portskewett, Wales, and for several years has been supplying British Telecom with smaller PABXes, which British Telecom sells to end users. In China, the SX-200 is manufactured under license.

Analyst Edward Meier of Dataquest UK Ltd., London, is skeptical of Mitel's European expansion plans. Government-owned common carriers that sell PABXes to end users favor PABX suppliers who manufacture

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within the country, he points out. Urquhart is more optimistic. Mitel has already obtained technical approval in West Germany and Italy for its PABXes to be connected to the public telephone network.

The signs are that Britain itself won't necessarily be an easy sell. The British government has obtained agreements from British Telecom—the country's largest supplier to end users of PABXes—that it will not buy PABXes either wholly or predominantly from Mitel. The government's goal is to prevent damage to traditional British PABX suppliers such as The Plessey Co. Plc. and General Electric Co. Plc. One of the agreements restricts British Telecom until 1988 from buying more Mitel equipment by value per year than it did in 1985. British Telecom has also promised to continue putting PABX orders out to open tender.

#### A new face at the top

To oversee Mitel's operations worldwide, British Telecom has made its own deputy chairman, Deryk Van der Weyer, Mitel's new chairman. He is replacing Terence Matthews, who himself took over as chairman last year from Dr. Michael Cowpland. Matthews and Cowpland founded Mitel, and both remain on Mitel's board of directors. Anthony Griffiths will continue as Mitel's president and chief executive officer.

Van der Weyer faces a healthy challenge, as Mitel is not out of the financial woods yet. On top of its successive annual losses of \$22.7 million in 1984 and 1985, it lost another \$31.9 million in the first nine months of fiscal 1986. Several factors have contributed to the losing streak, says a spokeswoman for the company. These include development costs of the SX-2000; a write-down of nearly \$8.5 million on inventories of older analog PABXes; and a loss of more than \$7 million at Mitel Semiconductor, the company's integrated circuit manufacturing division. Mitel Semiconductor accounts for approximately 10 percent of Mitel's overall revenues, which totalled \$209.1 million in the first nine months of fiscal 1986. Urquhart also cites the increased competition in the small PABX market as a contributing factor to the losses.

British Telecom has gained more than a foothold in the U.S. telecommunications market with the Mitel purchase. British Telecom is now looking to further extend its operations with the purchase of ITT Dialcom, a subsidiary of ITT Corp., New York. ITT Dialcom leads the market in selling the use of its packet-switched network to organizations setting up their

own electronic mail services.

A British Telecom spokesman says there is no link between the Dialcom and Mitel acquisitions except that they are both part of British Telecom's expansion strategy. Observes Venture Development Corp. analyst Leone Pease: "British Telecom is clearly building an empire for itself in the United States." □

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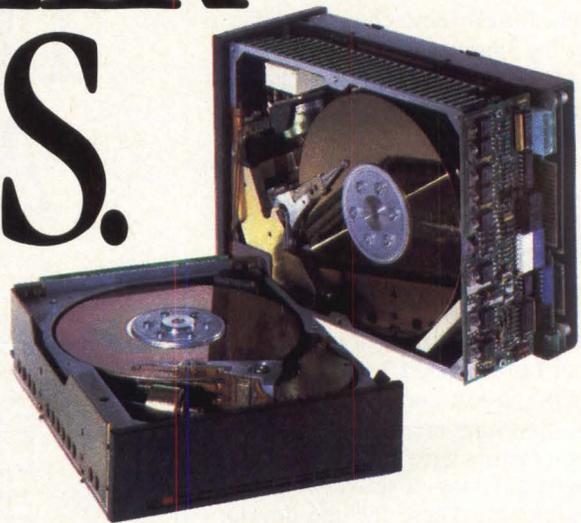
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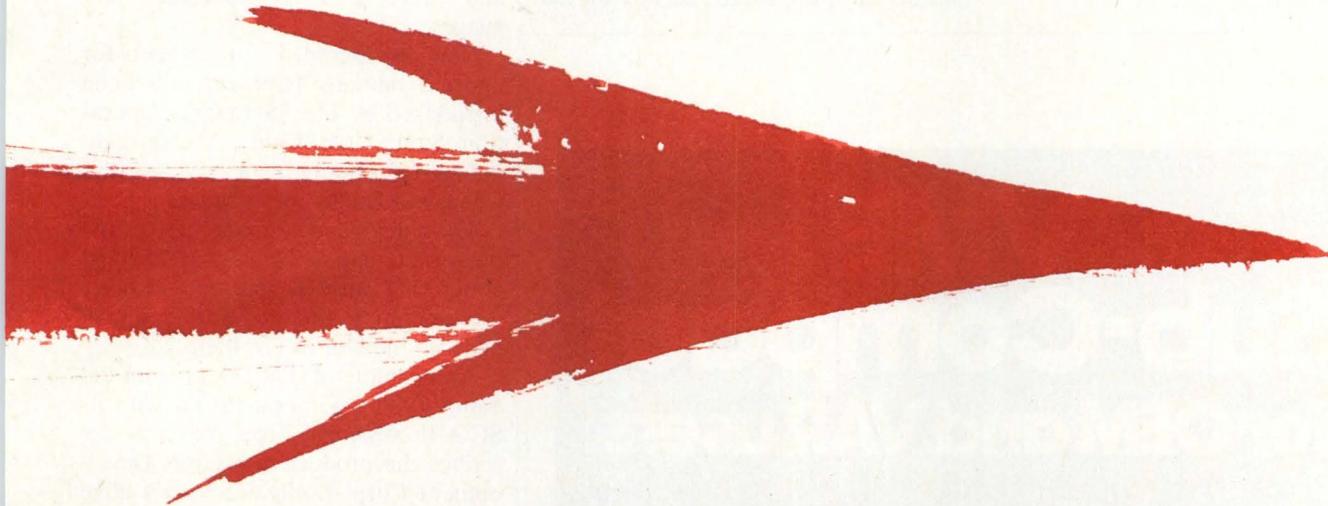
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CIRCLE NO. 27 ON INQUIRY CARD

# Spreadsheets move out to more powerful machines

Michael Tucker, Associate Editor

Spreadsheets have left home in search of new adventures.

Long regarded as personal computer products restricted to the MS-DOS and CP/M operating systems, spreadsheets have appeared recently on ma-

chines once believed to be too big and powerful for such software. These include machines based on the UNIX and XENIX operating systems, multi-user microcomputers and minicomputers and the so-called dedicated LISP engines—computers designed for LISP and other artificial-intelligence languages.

New, or upgraded, spreadsheets for unusual markets have recently been introduced by The Santa Cruz Operation, Santa Cruz, Calif.; Access Technology Inc., South Natick, Mass.; and Chaparral Dallas Inc., Dallas.

The causes and consequences of the invasion remain unclear. A good guess about the cause is that spreadsheets are migrating to new worlds simply because the worlds are there.

An example of that comes from the Santa Cruz Operation (SCO) with its SCO Professional. The company describes the product as a Lotus Development Corp. Lotus 1-2-3 work-alike for the smaller UNIX- and XENIX-based multiuser systems, such as IBM Corp.'s PC/AT and AT&T Information Systems' PC 6300 Plus. This means SCO Professional does everything MS-DOS-based Lotus 1-2-3 does, but does it in the more spacious XENIX arena. It can, for instance, use XENIX utilities, be multitasking and read existing Lotus 1-2-3 files.

However, the true importance of SCO Professional to spreadsheet development lies in its multiuser capabilities. The software includes facilities for file- and record-locking, something UNIX/XENIX products have traditionally lacked. It is also closely linked to XENIX-NET, SCO's XENIX implementation of Microsoft Corp.'s MS-NET network. Clearly, SCO envisions XENIX-based microcomputers functioning as servers in small networks of MS-DOS machines. It would have local MS-DOS applications—specifically Lotus 1-2-3—feeding into central, but compatible, XENIX products: i.e., SCO Professional.

There is nothing particularly revolutionary about the vision itself. UNIX and XENIX have traditionally been the operating systems for departmental machines. Even the link between

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MS-DOS spreadsheets and UNIX spreadsheets was predictable; there has been for some years an entire industry devoted to linking UNIX to MS-DOS (MMS, January, Page 83).

What's important is the size of the machines. The PC/AT and the PC 6300 Plus are among the cheapest and smallest UNIX engines around. It has been suggested that spreadsheets are appearing on UNIX machines simply because those machines are finally inexpensive enough to enjoy widespread use on the desktops of business.

### Spreadsheets gain Access

On the other hand, spreadsheets are also gaining acceptance on expensive multiuser machines. Access Technology has been selling spreadsheets for multiuser systems since 1980. The product, 20/20, now runs on UNIX systems, Digital Equipment Corp. VAX and MicroVAX machines, IBM computers and several other multiuser microcomputers and minicomputers. Access' 20/20 offers extensive graphics capabilities, macros, on-line tutors, windowing and the ability to run other programs from within itself. It also provides a data import/export facility that allows communication with word processors and database management systems.

Calling it a "hi-fi spreadsheet," Access says the major sales of 20/20 have been to software developers who integrate the spreadsheet into their own products. As of now, 20/20 has over 15 remarketers. Among them are Wang Laboratories Inc., Lowell, Mass., which incorporates the product in its Wang Office, office-automation, package; Motorola/Four-Phase Systems, Cupertino, Calif., which uses it in its Business Assistant package; and Charles River Data Systems, Framingham, Mass., which integrates it into its Work Center, factory-automation decision-support, software.

More than being well suited for value-added resellers, 20/20 also provides significant evidence of how pervasive a concept the spreadsheet has become. Even highly sophisticated users are increasingly demanding that their multiuser machines behave as though they were personal computers. To survive, hardware and software vendors are

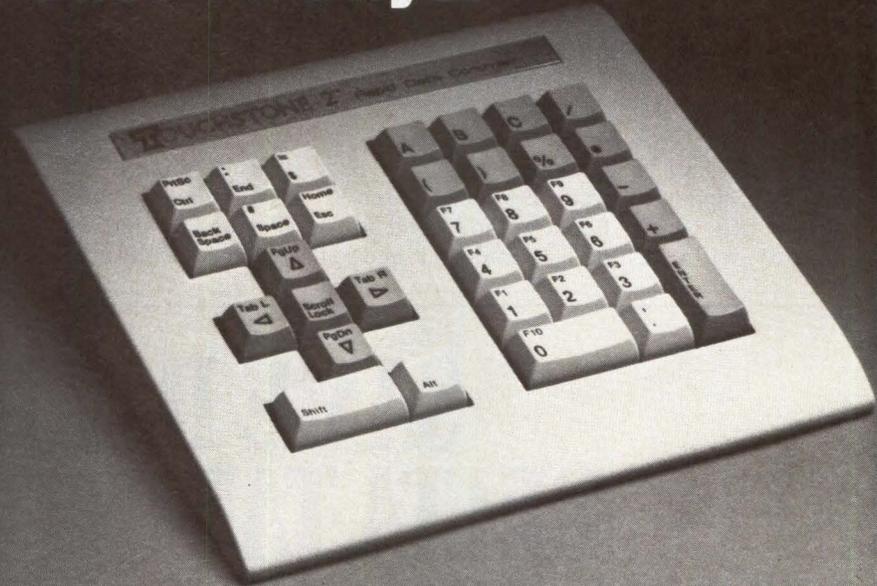
turning to products like 20/20—if only to give their offerings the kind of user interface that the marriage of Lotus 1-2-3 with the PCs seems to have made a de facto standard.

The most exotic spreadsheet on the market may be HyperCalc, from Chaparral. HyperCalc is a spreadsheet with no less a target than the Explorer artificial-intelligence workstation from

Texas Instruments Inc., Dallas. Explorer is a dedicated LISP engine designed for advanced computing applications.

HyperCalc and the Explorer appear to make a comfortable match. HyperCalc is designed not only for LISP programmers who want to run simple spreadsheets on their esoteric symbolic-processing computers, but also for

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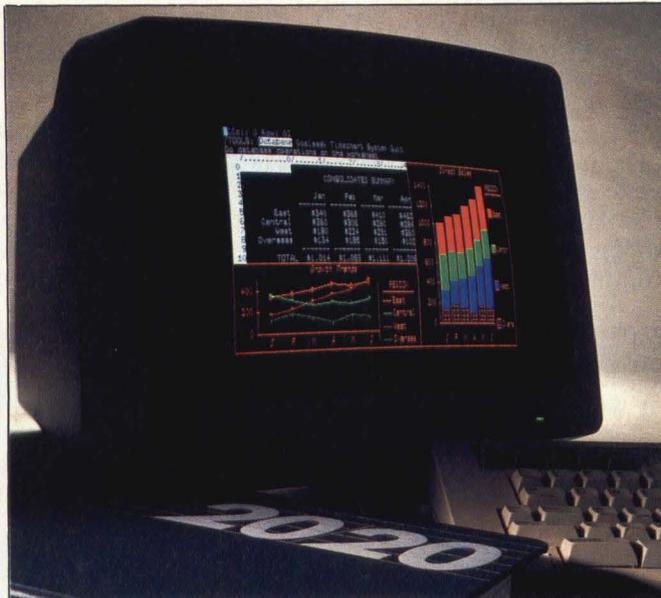
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VARs and developers who need a user-friendly front end. Programmers can put together high-powered expert systems running on the Explorer and then use HyperCalc as the user inter-

face.

HyperCalc isn't cheap—its suggested list price is \$3,000—but it may still be a bargain for TI and its VARs, if it makes the Explorer easily accessible

to commercial users. Indeed, HyperCalc could have an exciting future if TI continues its efforts to get LISP engines onto the desk. As part of a contract with the Defense Advanced Research Projects Agency, TI recently developed a single-chip LISP processor. If TI, or an imitator, chooses to market such a chip, hardware vendors could produce a generation of inexpensive, desktop workstations with AI capacities even greater than those of today's highly advanced AI machines. And all of those computers would be looking for software.

So, it may be that the spreadsheet's sudden turn for the exotic is a product of both users' demands and the increased availability of new technology. LISP machines, UNIX-based processors and the like have finally become inexpensive enough for the desktop arena, but users have firmly set the price of admission: They want their spreadsheets to behave like Lotus 1-2-3 running on a PC. □

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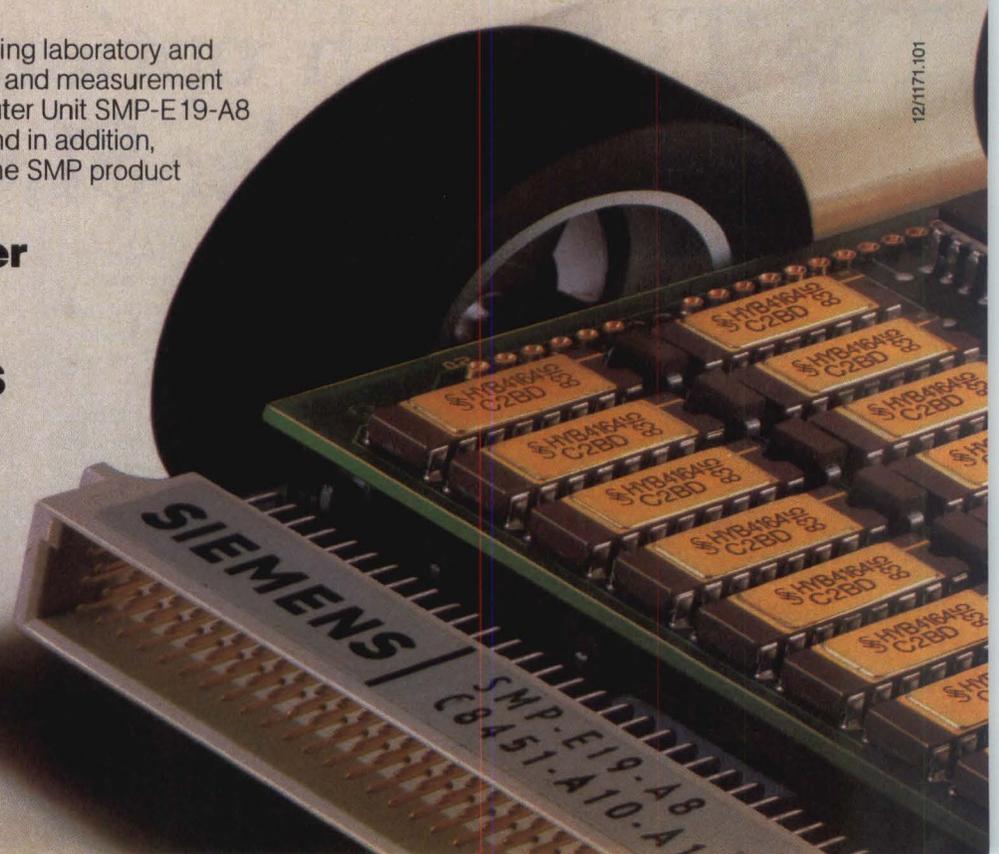
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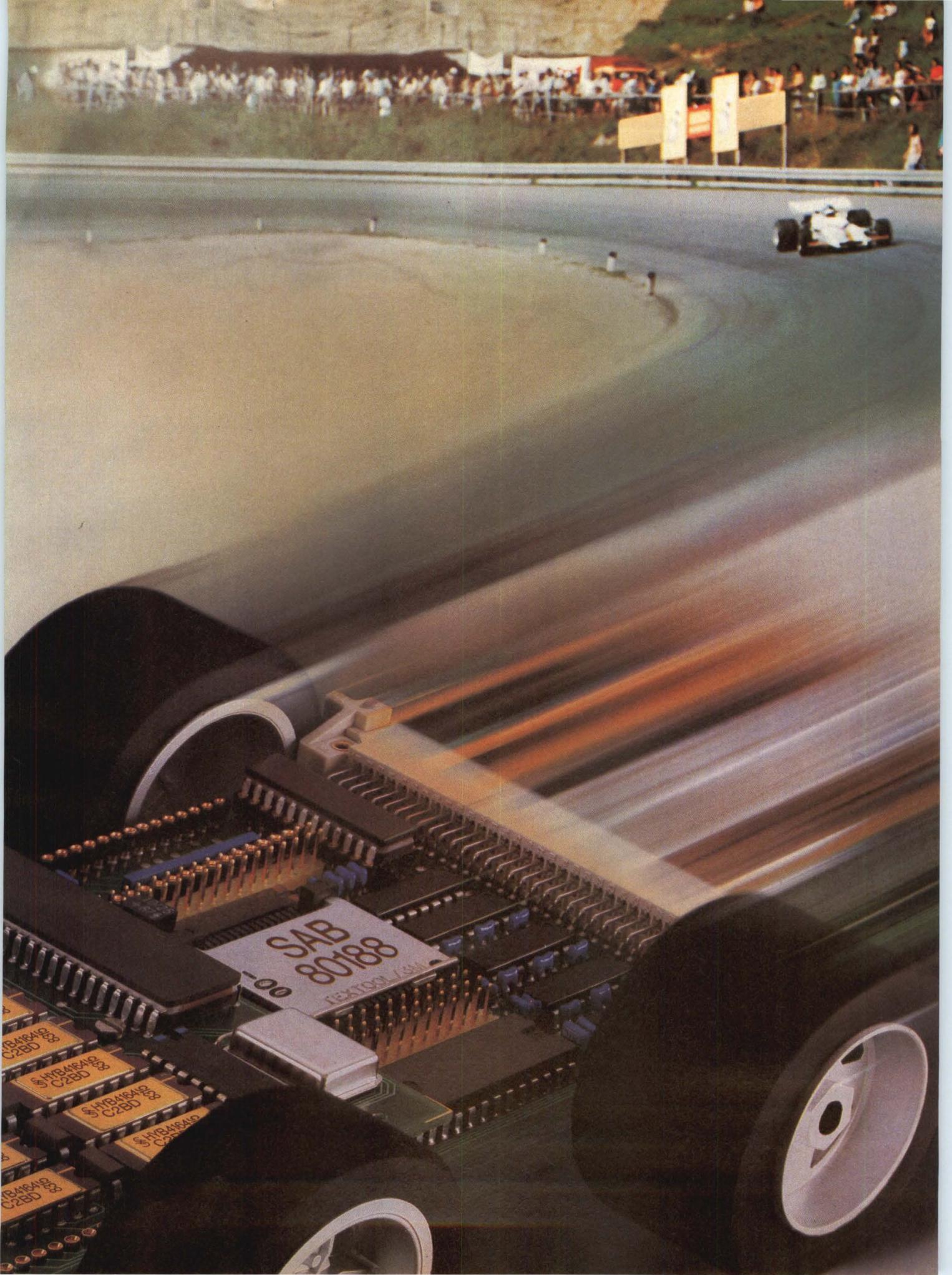
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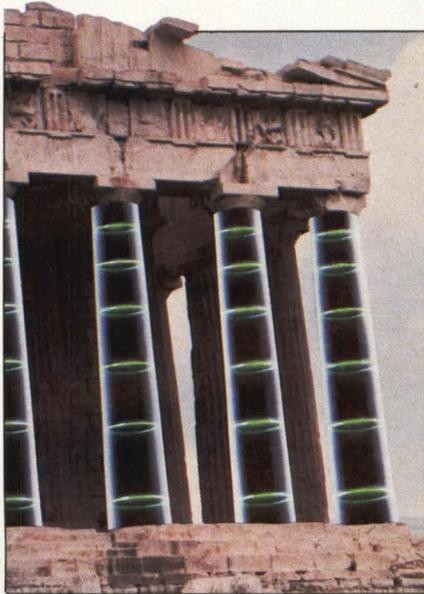
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# FEATURE HIGHLIGHTS



p. 77 . . . . . *New architectures*

## **MICRO-TO-MINI OPTIONS MULTIPLY . . . . .63**

Linking PCs to departmental minicomputers and corporate mainframes in the IBM environment is getting easier and easier. A variety of products can do the job, including local and remote emulator boards, file-transfer and cluster software, application-specific links and local area networks. And looming on the horizon are the Logical Unit 6.2 packages of IBM's Systems Network Architecture, which could alter the nature of micro-to-mini and micro-to-mainframe links.

## **MULTIPROCESSORS USE RADICAL ARCHITECTURES . . . . .77**

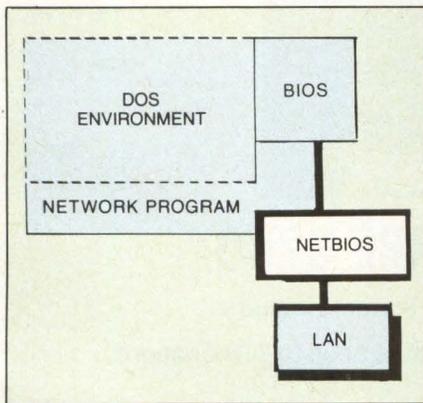
Broadly positioned between supermicrocomputers and supercomputers, multiprocessors offer significantly greater speeds compared to traditional uniprocessors. Low-end multiprocessors, which are well within the price range of most system integrators and OEMs, can run existing UNIX applications. High-end parallel processing machines are attacking the IBM- and DEC-controlled scientific/engineering market. How fast are these new machines, and is it worth rewriting uniprocessor-based code to take full advantage of multiprocessing?

## **DATABASES MANAGE NETWORK ENVIRONMENTS . . . . .95**

One problem facing database users is how to manipulate and protect files and records in a multiuser or local area network environment. A variety of solutions come from vendors of database management systems, multiuser computer manufacturers, LAN equipment vendors, software houses and even disk drive manufacturers. Fortunately, standards such as IBM's NETBIOS lend order to the chaos of distributed databases in heterogeneous environments.

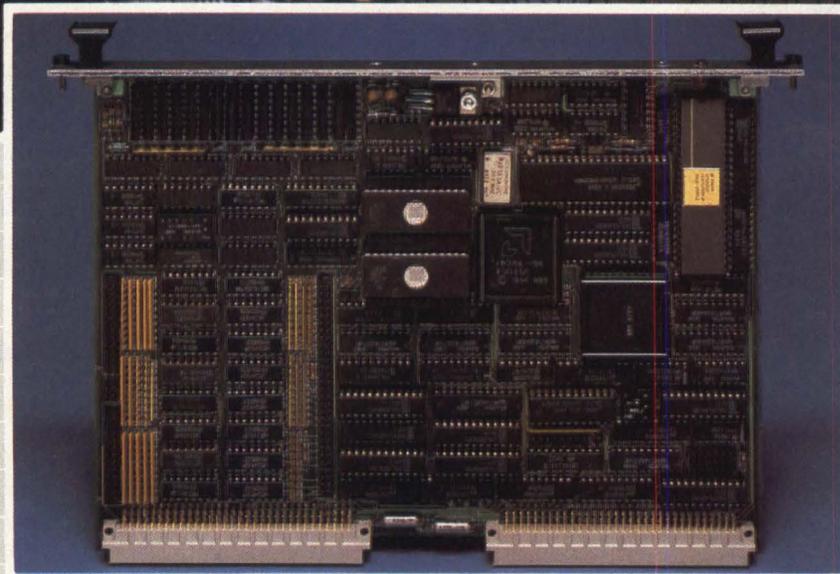
## **TCP/IP PROTOCOL ADDRESSES LAN NEEDS . . . . .111**

While network integrators wait for commercial products based on the ISO/OSI standard to arrive, many vendors and users turn to the TCP/IP protocols as a viable interim solution to the problem of connecting diverse machines. A major vendor of TCP/IP equipment explains the layers of TCP/IP, examines UNIX-TCP/IP-Ethernet products and reviews the alternatives to TCP/IP, including ISO/OSI and XNS.



p. 95 . . . . . *Adding functionality*

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# MICRO-TO-MINI OPTIONS MULTIPLY

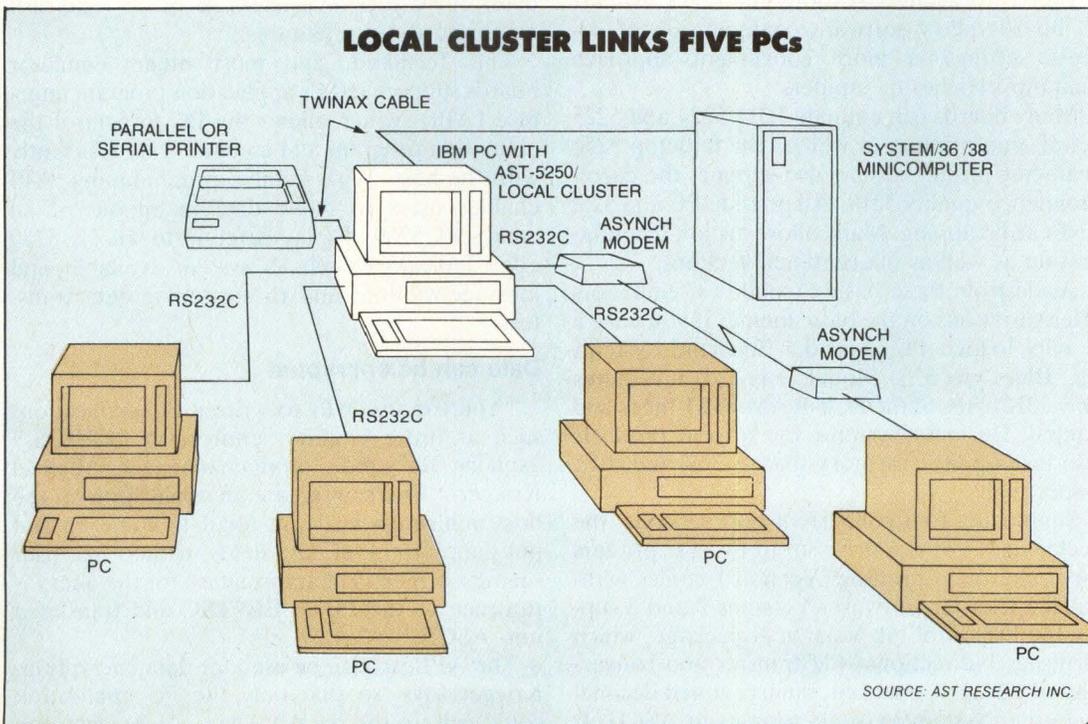
Local and remote emulator boards, intelligent links, cluster products and LU 6.2 interfaces speed access to corporate data

**Jesse Victor**, Associate Editor

As departmental minicomputers become a key part of many organizations' office-automation strategies, system integrators have more choices than ever in linking these machines and disparate microcomputers. Local 5250 emulator boards and file-transfer software give IBM Corp. PCs, PC/XTs and PC/ATs access to departmental files stored in IBM System/36 or System/38 minicomputers. Remote boards provide similar

access through integral or separate modems and telephone lines to geographically dispersed microcomputers.

Intelligent microcomputer-to-minicomputer products furnish more flexible and selective access to corporate data. Cluster software, application-specific links and local area network servers offer cost-effective solutions for many linkage problems. And looming on the horizon are the Logical Unit (LU) 6.2 packages of IBM's Systems Network Architecture that could radically



**Cluster software and hardware, such as the AST-5250/Local Cluster from AST Research, allow five IBM PCs to exchange files with a host minicomputer via the cluster product installed in one of the PCs.**

**All 5250 boards allow for multiple LU sessions with the host, permitting a printer to operate concurrently with a workstation session.**

alter the nature of microcomputer-to-minicomputer and microcomputer-to-mainframe links.

Vendors of 3270 emulator boards for micro-to-mainframe connections have turned to 5250 emulation to offer a growing number of products linking IBM PCs to System/36 or /38 minicomputers (see table, Page 68). All vendors include both twinaxial (twinax) cable for the connection to the minicomputer and terminal-emulation software. The software makes the System/36 or /38 think it is talking to the IBM 5251 Model 11 or Model 12 (remote), or to the 5291 or 5292 (color) display station normally attached to the minicomputer.

The emulation software transforms the PC into a dumb terminal. It allows users to view files but not to download them for processing by the PC. Approximately half of the 5250 emulation-board vendors listed bundle software with their add-in boards to provide basic whole-file-transfer capabilities and enable the PC to manipulate the transferred data. Other vendors offer popular file-transfer packages, such as DecisionLink 5251/11 from the DecisionLink division of Laguna Laboratories Inc. or Software Systems Inc.'s (SSI) emulator transfer utility (ETU).

**Variations on the basic theme**

All 5250 boards allow for multiple LU sessions with the host, permitting, for example, a printer to operate concurrently with a workstation session. Hotkey capability (usually a two-key sequence) enables users to toggle back and forth between workstation sessions and DOS. Almost all boards allow software configuration of address settings—a more convenient approach than dip switches or jumpers.

Many boards can emulate IBM 5224 and 5225 mainframe printers as well as the tabletop 5256 character printer. Some also support the correspondence-quality 5219. All provide PC and 5251 keyboard mapping. Many allow custom reconfiguration as well as international versions.

Aside from these basic capabilities, emulators offer variations on the basic theme. If you have a heavily loaded PC, consider Techland Systems Inc. BlueLynx 5251/Model 11 board. It requires only 23K bytes of the PC's RAM. CXI Inc.'s and Ampak Business Systems Inc.'s local products also take up little memory space—36K and 40K, respectively.

Supporting four concurrent host sessions, the Techland board can drive up to two PC printers for background printing. Version 1 comes without file-transfer software. Versions 2 and 3 supply the DecisionLink Version A package, which furnishes bidirectional file transfer and conversion of EBCDIC, packed, binary, zoned decimal and other System/36 or /38 formats to ASCII. It

**MICRO-TO-HOST PRODUCTS EVOLVE**

Characteristic	1985	1990	1995
Open vs. closed architecture	mixed	separate	separate
Security	poor/fair	good	good
Application front-ends	few	many	ubiquitous
Modular architecture	none	common	common
Bulk data handling	little	common	integrated
Distributed data bases	none	few	some?
Microcomputer interface	program	operating system	operating system
Program-to-program interfaces	few	some	common

*Source: International Resource Development Inc.*

also supports conversion of PC formats such as BASIC sequential, WKS, WRK, data interchange format (DIF) and binary image. BASIC Sequential is used by MicroPro International Corp.'s WordStar, WKS by Lotus Development Corp.'s Lotus 1-2-3 and WRK by Lotus' Symphony.

A \$1,295 upgrade furnishes DecisionLink Version B, supporting additional capabilities: record selection, file-chaining, storage of up to 520M bytes of PC files on System/36 or /38 rigid disk and basic security features.

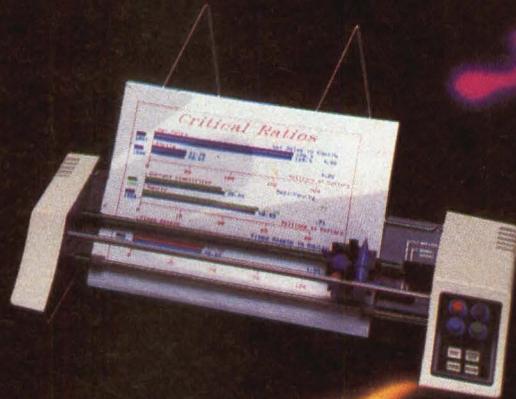
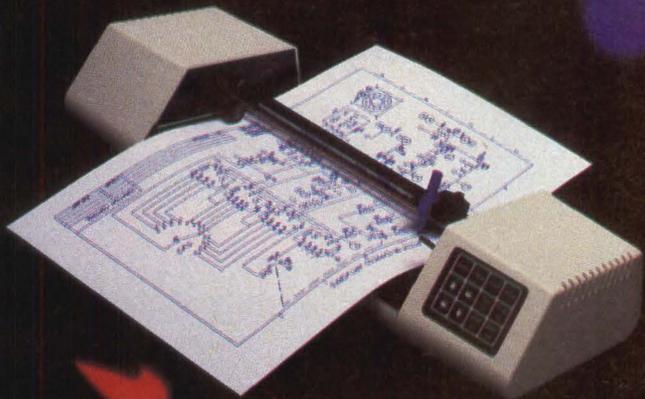
The Techland, and most other emulator boards support IBM's application program interface (API), which allows the PC to control the emulation program and communicate efficiently with the host. With suitable programming, API enables users to move data in and out of an emulated 5250 display screen; to check 5250 edge indicators such as system available and message-waiting; and to customize data transfers.

**Data can be encrypted**

"You can use API to write a PC application, such as order enquiry, entirely in PC-DOS," explains Techland's product manager, Michael Krieger. "You can initiate an application on the host minicomputer, wait for it to come up and put data into input data fields, without the user seeing a screen. The information for the query is returned to the PC in EBCDIC and translated into ASCII."

The API can also be used for data encryption, Krieger says, so that only the PC application could call up the data. "A casual user who ran

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\*U.S. suggested retail price for PC595 model plotter. Pricing subject to change. DM/PL is a trademark of Houston Instrument.

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CIRCLE NO. 37 ON INQUIRY CARD

that job would get garbage." Techland and some other emulator vendors supply a board-level interface as an alternative to IBM's API that talks directly to host hardware.

The Techland board supports IBM's file support utility (FSU), which permits PC users to create virtual disks on System/36 or /38 and other IBM packages such as PC Support 36/38, IBM's "main line" of access from its PCs to its mini-computers.

Digital Communication Associates Inc.'s Smart Alec 5250 emulator can run with the company's Irma board for simultaneous micro-computer-to-minicomputer (5250) and micro-to-mainframe (3270) communication. If you have many devices on one twinax run, Smart Alec's address-bidding feature allows a PC to share one of the seven System/36 or /38 addresses with another PC.

Pathway Design Inc.'s pcPATH 5250 remote board goes beyond IBM's API. Its programmatic interface facility (PIF) allows direct access to SNA data streams via the SNA Transport Layer. "It gives you complete functionality to build applications," explains Mark Mackaman, product manager at Pathway. "You can write applications to make the emulator completely transparent to the user."

The AST 5251/11 Plus board from AST Research Inc. sports a screen-snapshot feature that allows users to save a screen in memory for future retrieval. An optional card enables a PC to emulate all 32 5250 display attributes—normally limited to approximately 20 with most boards.

IDEAssociates Inc.'s IDEAcomm 5251 has a similar capability. The D card option replaces IBM's monochrome display adapter (including a parallel port). The board can configure IBM's Wheelprinter, Hewlett Packard Co.'s Laserjet, NEC America Inc.'s 3550 and other PC printers for 5219 emulation. The enhanced emulator supports a wide variety of file-transfer packages including DecisionLink, ETU, Marcam Data Systems Corp.'s INTELINK, Software International Corp.'s Smart Link and On-Line Software International's OMNILINK.

Finally, Ampak's PC-Mini Extra, the AST board, CXI's PCOX 5251 Twinax, Quadram Corp.'s MiniLink and Software Systems' PC 5251 Twin all support all seven 5250 sessions. The Ampak board allows concurrent flexible disk and rigid disk operation on the PC.

Basic file-transfer packages may not supply the flexibility, selective data extraction, logic-and math-processing and security procedures that system integrators and end users require for more demanding applications. Intelligent products from On-Line, Marcam, Fusion Products

International Inc. and Software Research Corp. (SRC) fill the gap.

On-Line's OMNILINK for System/36 or /38 machines, for example, combines selective-data-retrieval, reformatting and math and conditional-processing capabilities. With the package, users can select fields and records from as many as 16 System/36 or /38 files, do mathematical and logical operations on the data before it is transferred and automatically download the data into PC application programs. A part of OMNILINK attached to the PC, ExecuTrieve/PC, accepts English commands to manipulate the data or to do additional ad hoc queries with it.

Explains On-Line System/36 and /38 products sales manager, Steve Camp: "If you move data from the system database into Lotus 1-2-3 and find one of the columns was incorrectly selected, you can move to ExecuTrieve/PC, do additional selecting, sorting, conditional or math processing and put that back out through the file-reformat utility into Lotus."

Access to data through the data dictionary is controlled by a 10-level file, field and function security system, which, for example, can restrict the ability of a user to print out or transfer data.

### Download into PC applications

Marcam's INTELINK also offers selective, record-level data transfer and automatic downloading into popular PC applications such as Lotus 1-2-3, Microsoft Corp's MULTIPLAN, Ashton-Tate's dBase II or III and MicroPro's WordStar. It can transfer as many as nine files with 99 fields in one operation, loading data directly into individual spreadsheet cells or through horizontal or vertical data strings.

"Simple file-transfer packages translate from EBCDIC to ASCII, but from there, there may be a lot of work to do in order to use the data in your spreadsheet or other PC application," contends Carole Bowers, manager of telemarketing at Marcam. "We deal with users who have purchased the basic emulation package and found it didn't meet their needs."

File-transfer products from Fusion and Software Research suit sophisticated applications and/or extensive networks of connected machines. The ASTlink option functions with the FUSION/36 information-retrieval system on the System/36, with the FUSION/4 on the System/38 and with the AST Research 5251/11 emulator board. Automatically converting data into ASCII, DIF or Lotus 1-2-3 format for the PC, /XT or /AT, ASTlink pulls data from as many as 10 files on the System/38 and up to eight files on the System/36. Users can specify sorting and selection criteria, a full range of mathematical functions and can arrange data on the screen to

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**Most emulator boards support IBM's application program interface (API), which allows the PC to control the emulation program and communicate efficiently with the host computer.**

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**Cluster products and boards with integral modems offer cost savings for remote links.**

match the PC application.

The ASTlink option for the Fusion/36 package supports its menu-based retrieval processor, personal-database, file-maintenance, data-dictionary and color-graphics functions as well as specialized functions such as the link-access method (which follows pointer chains) and the alternate index capabilities of the System/36. Each logical record can be assigned a password, and an audit trail keeps track of user accesses and data modifications.

**Connects diverse machines**

Consider SRC's strategic network environment/file transfer facility (SNE/FTF), if you want to exchange information among microcomputers, minicomputers and mainframes from several different vendors. The network software links IBM or IBM-compatible microcomputers running PC/MS-DOS Version 2.1, Digital Equipment Corp. (DEC) VAX computers running VMS Version 4.1 or Wang Laboratories Inc. virtual storage (VS) machines running version 06.30.07 and IBM mainframes using Multiple Virtual Storage (MVS) or virtual machine (VM) operating systems.

Combining file-transfer, message, directory, operation and administration services, the product provides such functions as electronic messaging, MVS batch interfacing, checkpoint-restart capability, priority control and asynchronous delivery of information with store-and-forward services. Extensive data-security procedures are included.

SRC has a joint marketing agreement with Banyan Systems Inc. and plans to enhance its SNE products to support Banyan's virtual network system (VINES). Based on UNIX System V and Banyan's file server, the system is an alternative to 5250 emulation for connecting multiple microcomputers.

Front-end services—file transfer and terminal emulation—connect the file server to up to five LANs from six different vendors. Back-end services provide transparent access to host processors and wide-area networks. Network resources appear as local services to PC users. The StreetTalk global directory system allows users to find and access files regardless of where they reside on the network.

"If you want a group of files called 'Sales volumes for 1985,' the system will find where the sales volumes are kept and access the data," contends Anand Jagannathan, vice president for systems at Banyan. "Once you have the volume, you use DOS names to find the file. To DOS it looks like another drive, say, Drive E."

Jagannathan claims there are cost savings with the VINES system when compared to 5250 emu-

lation. "Our approach can be an order of magnitude cheaper than that of the System/36," he asserts.

VINES Release 1.25 supports MS-DOS 3.1 with enhanced security, SNA file-capture and record-locking calls for multiuser application programs such as Cosmos Inc.'s Network Revelations and Microrim Inc.'s RBASE 5000. Also supporting MS-DOS 3.1, as well as PC Networking programs, BABY/36 release 2.0 from California Software Products Inc. allows users to run and develop System/36 RPG II-based applications on IBM PCs and compatibles. Modules include an RPG II compiler, an operation-control-language (OCL) processor, screen-format generator and source-entry utility.

Cluster products from AST Research, DecisionLink and Techland and boards with integral modems from SSI offer cost savings for

REPRESENTATIVE				
Manufacturer/ Model	Local	Remote	File-transfer software included	Concurrent host sess.
<b>Ampak</b> PC Mini Xtra	✓		✓	7
<b>AST</b> 5251/11 Plus	✓		✓	7
5251/12		✓		2
<b>CXI</b> PCOX/5251 Twinax	✓		✓	7
<b>DCA</b> Smart Alec	✓		✓	3
<b>IBM</b> Enhanced 5250 Emulator	✓			2
<b>IDEAssociates</b> Enhanced IDEAcomm/5251	✓			4
IDEAcomm 5250/Remote		✓		9
<b>Pathway</b> pcPATH 5250		✓	✓	4
<b>Quadram</b> MiniLink		✓	✓	7
<b>Techland</b> 5251/Model 11, Version 3	✓		✓	4
Advanced 5251/Model 12		✓	✓	5
<b>Tecmar</b> 5251/11	✓			2
<b>Software Systems</b> PC/5251 Twin	✓			7
PC/5251 Plus		✓		2

# MICRO-TO-MINI LINKS

remote links. For example, AST's AST-5250/Local Cluster two-board, hardware/software package allows four PCs or compatibles connected to a PC acting as a controller to emulate IBM 5251 Model 11, 5251 or 5292 Model I terminals without the cost of additional hardware or software for the attached PCs. Local PCs connect via RS232C cable; remote PCs, via asynchronous modems. Full bidirectional file transfer is provided.

DecisionLink's 5251 Cluster software furnishes 5250 emulation via RS232C cable for up to six PCs and compatibles connected to the controller PC (with emulator board in place) for \$395 per PC. Techland's clustering solution allows two other PCs to connect to its emulator card via asynchronous ports. The company's new LAN gateway will provide APIs to PCs connected on a LAN to the gateway PC, allowing

them to run DecisionLink or other file-transfer programs.

SSI's PC/5251 Mate remote board replaces two components: an SDLC adapter and a modem. It combines 5251 Model 12 remote-workstation emulation, auto-dial features, menu-selected configuration and unattended operation with a 2,400-bit-per-second (bps) Bell-compatible 201C synchronous modem or 4,800-bps 208A/B modem.

Access/36, Access/38 and Automated Data Transfer (ADT) utility from Access Telecommunications Corp. permit two-way data transfer as well as voice reponse between host computers and asynchronous devices (such as hand-held computers). The Access Box control unit performs ASCII to EBCDIC translation and multiplexes up to eight ASCII devices over one bisynchronous line to the host. Supported languages

## 5250 EMULATOR PRODUCTS

PC memory (K bytes) ASCII	Download-to-PC formats				Printers emulated				Keyboards emulated			Application interface	Software support					Price (\$)		
	DIF	Lotus 1-2-3	Other		5256	5224	5225	5219	5251	Custom	International	IBM	Own	PC support/36/38	FTF (File Transfer Facility)	FSU (File Support Utility)	ETU (Emulator Transfer Utility)		DecisionLink	OMNILINK
40	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓		895
190	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓		895
128	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓		790
36	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓		895
64	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓	✓	✓		✓		895
45					✓			✓	✓		✓			✓	✓	✓	✓			845
50					✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	895
					✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	✓	795
256	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓							750
128	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓		✓	✓	✓		✓		995
23	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	1,045
120	✓	✓	✓	✓	✓	✓			✓	✓		✓		✓	✓	✓	✓	✓	✓	695
60					✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	795
64					✓	✓	✓	✓	✓	✓			✓		✓	✓	✓			895
64													✓		✓	✓	✓			750

include RPG II and III (on the host) and BASIC (on the PC).

Other specialized micro-to-host links offer performance advantages in dedicated applications. Connecting a PC to Software International's host-computer-based General Ledger and Financial Reporting System, SMART LINK software permits the selective downloading of data directly into DIF-compatible PC spreadsheets as well as uploading back to the host.

Automatically reformatting data for popular PC application programs, menu-driven INGRES/PCLINK from Relational Technology Inc. furnishes access to the company's INGRES relational database management system running on UNIX or DEC VAX/VMS host computers. PC and host components link via dial-up or direct asynchronous communications or through an Ethernet LAN.

Mini-to-mainframe links are also beginning to

appear for AI-based machines. For instance, Symbolics Inc.'s new SNA Facility connects the manufacturer's symbolic processing, LISP-based, 3600 Series of computers to IBM 4300, 3030, 3080 or 370 mainframes running applications under MVS. A high-level application interface governs access to customer information control system (CICS) applications. Symbolics' DECnet product allows several computers to be intermixed with DEC VAXes.

LU 6.2 interface/advanced program-to-program communication (APPC) products such as Rabbit Software Corp.'s Peer-to-Peer PLUS, Communications Solutions Inc. Access/SNA APPC and the Orion Group Inc. SNA6.2 Peer Communications Facility portend the revolution such products may cause in microcomputer-to-minicomputer and micro-to-mini-to-mainframe communications.

The LU 6.2 protocol—a completion of the

## Companies mentioned in this article

### Access

#### Telecommunications Corp.

3010 Woodcreek Drive  
Downers Grove, Ill. 60516  
(312) 960-4455

Circle 357

#### Ampak Business Systems Inc.

2640 Walnut Ave.  
Tustin, Calif. 92680  
(714) 731-4217

Circle 358

#### AST Research Inc.

2121 Alton Ave.  
Irvine, Calif. 92714  
(714) 863-1333

Circle 359

#### Banyan Systems Inc.

135 Flanders Road  
Westboro, Mass. 01581  
(617) 366-6681

Circle 360

#### California Software Products Inc.

525 N. Cabrillo Park Drive  
Santa Ana, Calif. 92701  
(714) 973-0440

Circle 356

#### Communications Solutions Inc.

922 S. Saratoga-Sunnyvale Road  
San Jose, Calif. 95129  
(408) 725-1568

Circle 361

### CXI Inc.

3606 W. Bayshore Road  
Palo Alto, Calif. 94303  
(800) 225-PCOX

Circle 362

### Digital Communications Associates Inc.

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Alpharetta, Ga. 30201  
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Circle 364

### IBM Corp.

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Circle 365

### IDEAssociates Inc.

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Billerica, Mass. 01821  
(617) 663-6878

Circle 366

### Fusion Products

International Inc.  
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Larkspur, Calif. 94939

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### Laguna Laboratories Inc.

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### Marcam Data Systems Corp.

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### On-Line Software International

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### Orion Group Inc.

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### Pathway Design Inc.

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### Quadram Corp.

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### Rabbit Software Corp.

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Malvern, Pa. 19355

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Circle 373

### Relational Technology Inc.

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Circle 376

### Software Systems Inc.

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### Symbolics Inc.

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Circle 378

### Techland Systems Inc.

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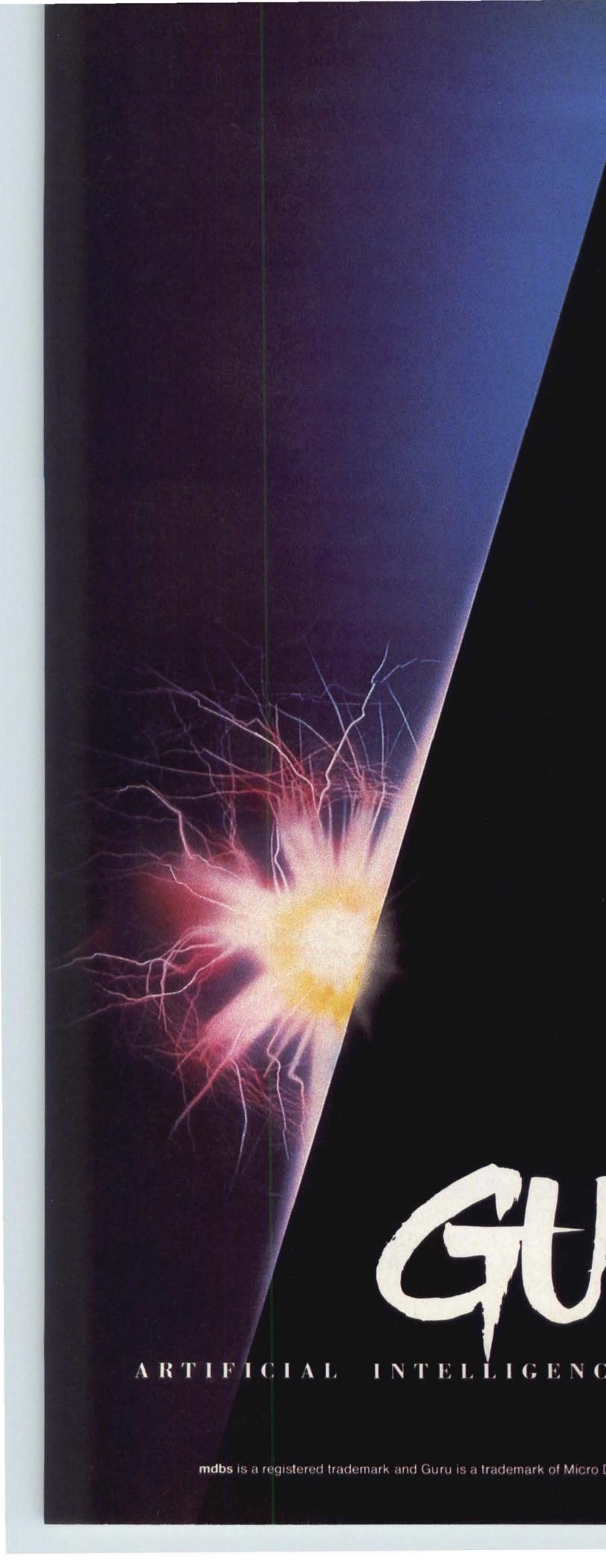
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sixth, Presentation Services, layer of IBM's SNA architecture—will allow system integrators to implement true peer-to-peer and program-to-program communications between microcomputers, minicomputers and mainframes by eliminating the master-slave relationship inherent in 3270 or 5250 emulation. Each device in an LU 6.2 network would have equal status to send or receive data without the overhead involved in having a host master control the transaction.

### Modules supply flexibility

Rabbit Software's Peer-to-Peer PLUS UNIX-based implementation of LU 6.2 and Physical Unit (PU) 2.1 for microcomputers is one of four software modules that together provide application services, a device handler/LU manager, protocol handler and data-link control. When implemented on a network, the LU 6.2 package gives PCs access to mainframe applications as well as to devices on a token-ring LAN via a gateway PC. One LU can engage in multiple, simultaneous conversations with another LU or in single sessions with different LUs.

The modular structure provides flexibility for distributed applications contends Eliot Kane, director of marketing. "Each module has enough intelligence to handle data streams and arbitration. Lower levels of synchronous data link control (SDLC) can be exchanged for X.25. I can talk through Ethernet between modules, through data streams, shared memory or pipes."

Most manufacturers of 5250 emulation boards indicate they will eventually support LU 6.2 on their products. Many minicomputer vendors have also announced support for the protocol. Over the short term, however, LU 6.2 is unlikely to supplant emulation for microcomputer-to-minicomputer or micro-to-mainframe communications. Implementations will have to work their way down from heavy-transaction-processing-oriented applications on large mainframe networks. The International Standards Organization rejection of LU 6.2 as the basis of an open systems interconnection (OSI) transaction-processing protocol may slow down the LU 6.2 bandwagon and spur alternative, OSI-based means of accomplishing the same functions.

"To say that the System/36 supports LU 6.2 is one of IBM's positioning statements," comments International Resource Development Inc. senior consultant, Naomi Kalmus. "They are saying, if you stick with us, we will solve all the problems." The heavy mainframe overhead associated with LU 6.2 may also deter system integrators. "LU 6.2 is clearly a mainframe strategy. I see no reason to think IBM has abandoned its goals for the mainframe market or its belief that everything should rely on the

mainframe."

LU 6.2, however, is only one possible direction for the evolution of microcomputer-to-host computer (minicomputer or mainframe) links. The Norwalk, Conn. market-research company expects link products to change from closed or mixed architectures to more clearly defined open, or proprietary, implementations. They would provide greatly enhanced security, a more modular architecture, a greater number of application front ends and a microcomputer interface more integrated into the operating system.

"Users are now confined to 5250 emulation," notes Kalmus. "They will need a different type of operating system to break out of the emulation mold."

For the time being, at least, the emulator market is expanding. Input Inc., a Mountain View, Calif., market-research company, expects the number of business microcomputers linked to host computer via emulator boards to grow from 200,000 in 1984 to 2 million in 1990—with competition from modem links and LANs—according to Bonnie Digrius, program manager at Input.

However, long-term growth of the 5250 emulator market is directly linked to sales of IBM System/36 and /38 minicomputers. Although IBM has identified the System/36 as the keystone of its departmental-computing strategy, analysts indicate that end users are concerned about the lack of a clear upgrade path and what they see as limited interconnect capabilities on the System/36. Some IBM representatives tout the System/38 as the upgrade to the System/36. However, its different (relational) architecture, operating system (control program facility) and primary program language (RPG III) may make migration difficult. Large-scale defections from System/36 or /38 to other computer manufacturers' solutions will hurt 5250 emulator sales.

"IBM's moves in this area are a little unclear," comments Kalmus. "They are inclined to route all communications through a mini. That could be misleading. When they reveal another piece of the puzzle, it may look very different." The "missing link" in terms of connectivity, could be support of Token-Ring Network by System/36 or /38 and mainframe machines, enabling NETBIOS and APPC to coexist on the token ring as alternative methods of peer-to-peer communications.

How end users and system integrators react to these imponderables will determine the future of microcomputer-to-minicomputer and mini-to-mainframe links. □

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Interest Quotient (Circle One)  
High 451 Medium 452 Low 453

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**The LU 6.2 protocol eliminates the master-slave relationship inherent in 3270 or 5250 emulation.**

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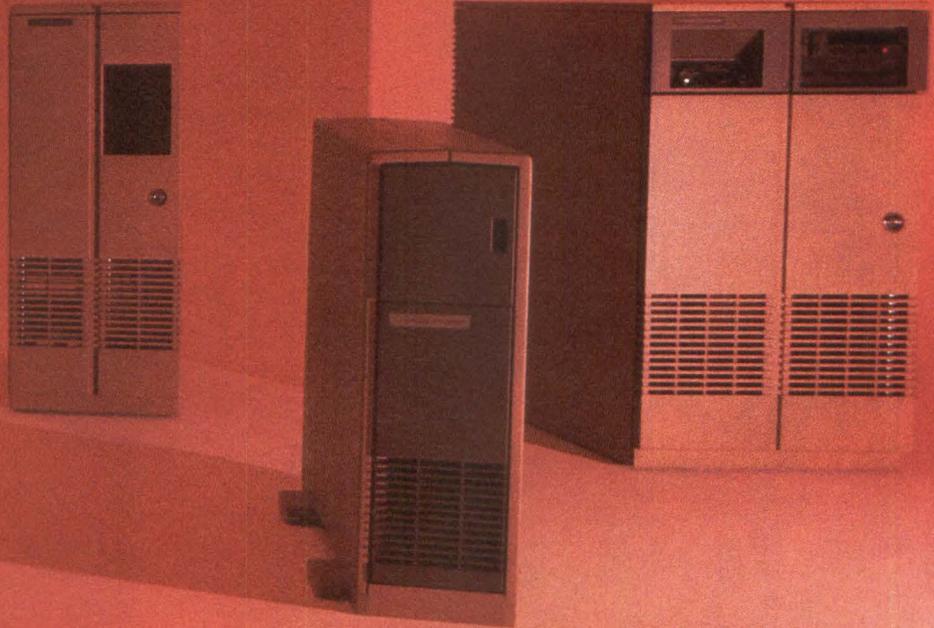
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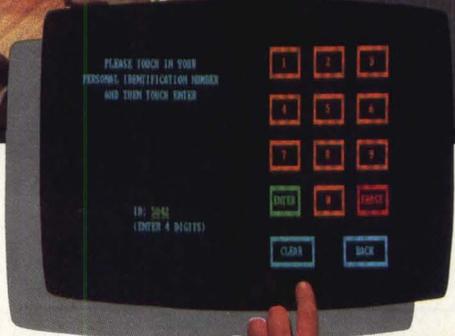
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# MULTIPROCESSORS USE RADICAL ARCHITECTURES

Inexpensive 32-bit processors—and, in some cases, proprietary 64-bit gate arrays—arm multiprocessors with revolutionary architectures fit for existing software

**David Simpson**, Senior Editor

The emergence of low-cost, off-the-shelf, 32-bit microprocessors has catalyzed a revolution of sorts in the medium-scale processing market. Compared to traditional uniprocessor computers, machines incorporating several CPUs can significantly speed up processing in both single- and multiple-program applications.

Bold start-ups, brandishing sharp benchmark ratings, are assaulting the mid-range scientific/engineering market, long the domain of IBM Corp. and Digital Equipment Corp. (DEC). And a few start-ups are taking multiprocessing technology into the commercial transaction-processing arena, a territory ruled by traditional minicomputer and fault-tolerant systems.

Broadly positioned between supermicrocomputers and supercomputers, multiprocessors boast high speed at low cost as well as compatibility with existing software, including UNIX

applications. However, many questions remain. For example, are these companies really competing with IBM and DEC, or are they all scrambling for the rest of the pie? And, how hard is it to rewrite uniprocessor application code to take full advantage of the parallel-processing capabilities of multiprocessors? Furthermore, is any one approach to multiprocessing inherently better than the others, or is it more a matter of matching the application to the architecture? But perhaps the most important question to buyers is, "Who'll survive?"

To get answers to these questions, system integrators and OEMs must understand the various approaches to multiprocessing, which entails knowledge of hardware architectures and the ways in which the various processors communicate and share memory. It also involves untangling a torturous lexicon (see "Multiprocessing engenders multidefinitions," Page 78).

Generally, multiprocessors break down into

two categories: those optimized to run several jobs—or programs—in parallel on separate processors, and those designed to run single jobs across multiple processors. The second technique is often referred to as “true” parallel processing. The former speeds up the aggregate throughput of many jobs, while the latter speeds up single-program processing.

Most multiprocessors incorporate 32-bit processors linked via relatively high-speed buses. The systems share memory, and the processors run concurrently. They are serviced by a single operating system, which maintains a queue of ready-to-run jobs, handing them out as processors successively become available. In these systems, no single job runs faster than it would on a uniprocessor machine incorporating the same chip, but there are more processors to share the common workload, which significantly speeds the aggregate throughput.

#### 64-bit machines claim high end

Alliant Computer Systems Corp. stands out from the multiprocessor crowd, both in architecture and in applications. Alliant's FX/8 can perform simultaneous multiapplication processing, but differs from other multiprocessors in that it incorporates a vector instruction set, parallel-processing instructions embedded in hardware, and a FORTRAN compiler that automatically converts existing FORTRAN code into code that executes in parallel.

### Multiprocessing engenders multidefinitions

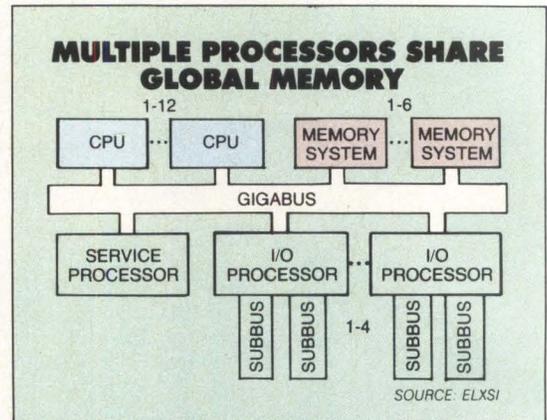
**Multicomputer**—a collection of computers that can share global memory and that also have their own local memory and I/O. Multicomputers can process single programs or multiple programs and make use of closely coupled data transmission and concurrent programming.

**Multiprocessing**—the simultaneous execution of two or more programs or sequences of instructions by two or more processors.

**Multiprogramming**—a feature of an operating system, such as UNIX, that allows it to execute unrelated programs simultaneously by overlapping or interleaving their execution.

**Multitasking**—a feature of an operating system that allows a single job to be partitioned into several cooperating tasks running concurrently. On a multiprocessor, the tasks can be executed simultaneously.

**Parallel processing**—the simultaneous execution of two or more sequences of instructions, or one sequence of instructions operating on two or more sets of data, by a computer having multiple arithmetic and/or logic units.



**A tightly coupled, shared-memory configuration, such as Elxsi's 6400, is typical of many bus-oriented multiprocessors. Machines from Concurrent, Encore and Sequent use similar hardware architectures.**

As many as 12 interactive processors (IPs) run on a one-program-per-processor basis, while up to eight computational elements (CEs) work together on a single program. The IPs are Motorola Inc. MC68012 microprocessors, and the CEs are proprietary, 64-bit CMOS gate arrays. The spine of the FX/8 is a bus that can theoretically transfer data at a blazing 376M bytes per second.

All processors share a global memory system via a common cache system and the main bus. The caches coordinate themselves, providing “cache coherency” (e.g., they make sure that all memory contents are correct, or current).

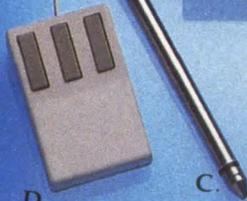
Parts of most application programs have to run serially, while other parts can run in parallel. The FX/8 can go from serial to parallel processing with a single instruction, according to Dave Rome, director of marketing.

The FX/8 executes in parallel that part of the program code that cannot run in vector mode. The keys to this are finding the program's inherent parallelism, which is done by the compiler, and controlling parallel execution without excessive overhead.

The FX/8 can run 36 million instructions per second (MIPS), measured at 4.5 MIPS per CE, with a maximum of eight CEs. The FX/8 can also run 94 million floating point instructions per second (megaflops). A more relevant rating, however, is the LINPACK benchmark, in which a single-CPU FX/8, running 1.75 megaflops, is 1.5 times faster than a VAX 8600, and an 8-CPU system running at 8.4 megaflops is 8.5 times faster than an 8600.

The LINPACK benchmark was developed at Argonne National Laboratories and is used to

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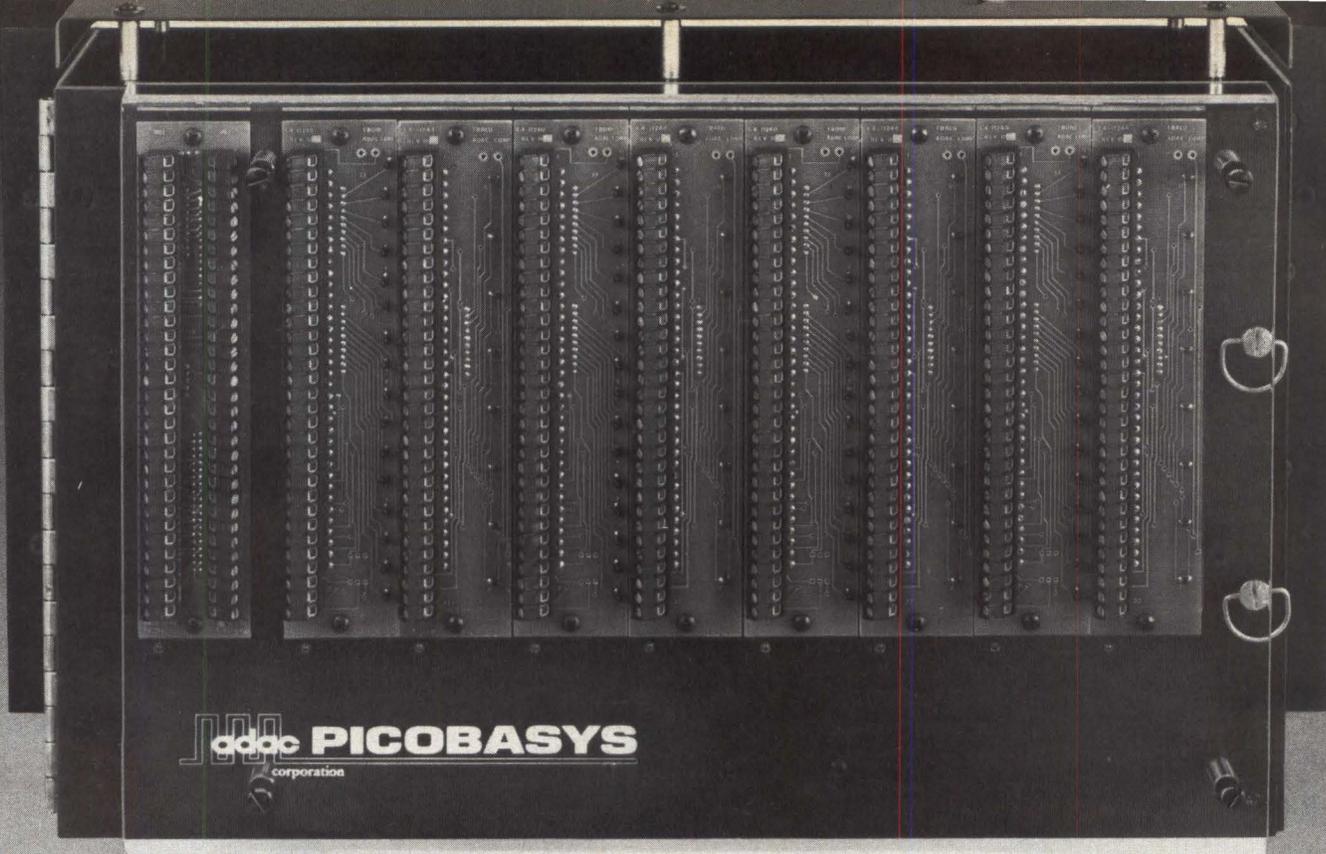
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compare the performance of computers designed for scientific and engineering applications. It determines the speed, measured in megaflops, at which a computer can solve specific linear equations using FORTRAN. In the case of Alliant's FX/8, when the LINPACK is compiled, the FORTRAN compiler identifies the potential for parallel processing and asks the programmer to insert a directive if a subroutine can be executed in parallel.

The FX/8 runs DEC VAX/VMS FORTRAN programs with little or, usually, no modification. All the user has to do is recompile. Although programmers can program the machine in FORTRAN, C or Pascal, FORTRAN is the only language that the machine's compiler can automatically convert into code that can run in parallel. In the case of C, programmers have to insert calls to a library (not the operating system) to take advantage of the machine's parallel-processing capabilities.

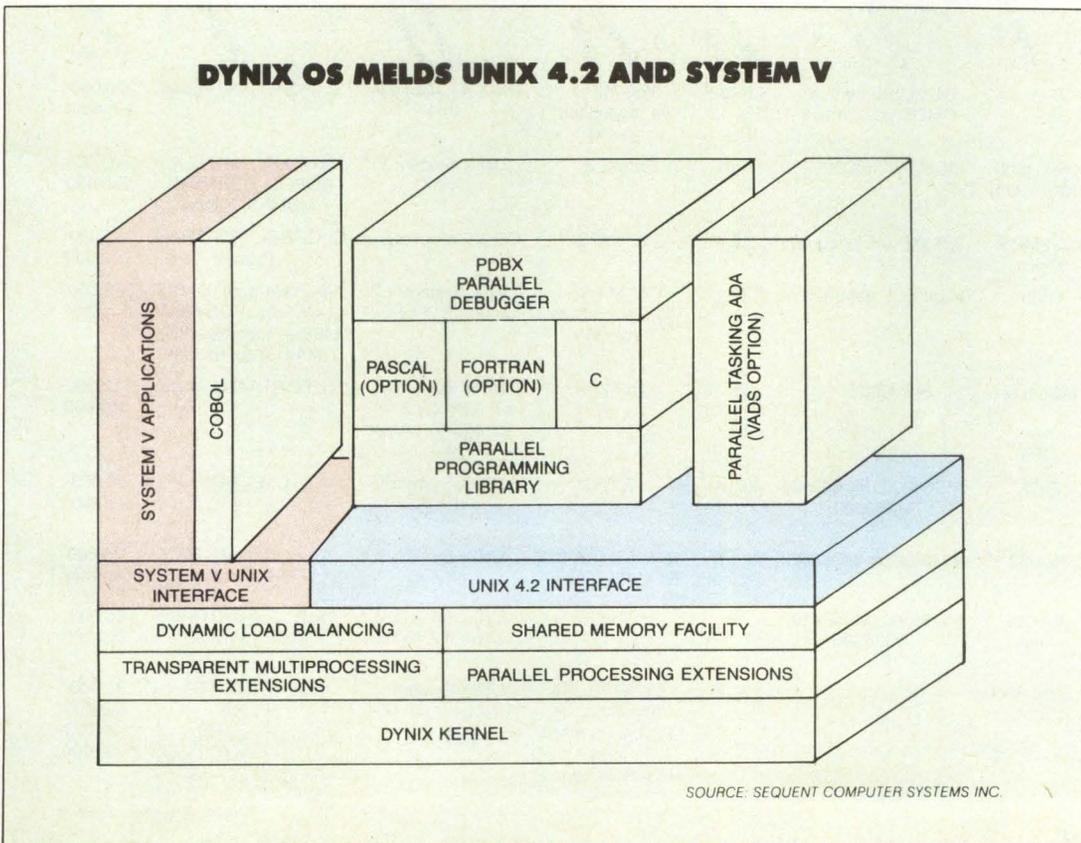
Late last year, Alliant signed a major OEM agreement with Apollo Computer Inc., which sells the Alliant machines under its own name. The DSP9000 "server" fits into Apollo's Domain network.

Although Alliant's major competitor is DEC, the company also bumps heads with vector processors such as those from Convex Computer

Corp. (MMS, December 1985, Page 107) and with Elxsi's multiprocessors, which also incorporate 64-bit processors, implemented in emitter-coupled logic gate arrays. Elxsi also competes primarily with DEC, but cites a variety of benchmarks that put them in the supercomputer ballpark, such as 72 MIPS and 79.2 megaflops (with a maximum of 12 CPUs). As do most multiprocessor manufacturers, Elxsi claims linear performance improvement as CPUs are added. Key to the company's model 6400 multiprocessor is the 320M-byte-per-second Gigabus.

Pushing further into the supercomputing ballpark, Elxsi plans to introduce a new processor next month that will double the power of its current processors. The company will also expand main-memory capacities from a current range of 8M to 192M bytes, using 64K chips, to a range of 32M to 768M bytes, using 256K chips. Large main memories significantly reduce the need for time-consuming disk paging.

To adapt the UNIX operating system to a multiprocessor environment, the company rewrote the UNIX kernel at the base (e.g., below system-call) level. "We've turned UNIX into a multithreaded UNIX," says Bob Hedges, director of market planning, "In addition," he explains, "the three operating systems [UNIX 4.3, UNIX System V.2 and EMBOS] have been



**An enhanced UNIX 4.2,** *Sequent's Dynix operating system also supports UNIX System V. Under Dynix, programmers can use the 4.2 and System V environments separately, or environments can be mixed within an application.*

**Loosely coupled systems are best suited for processing unrelated, independent tasks.**

parallelized. It's a message-based system; when the UNIX kernel talks to what it thinks is hardware, it's in fact talking to microcode messages."

Each CPU includes messenger and scheduler functions in firmware. In addition, the instruction set includes a set of message-handling primitives, implemented primarily in microcode. This architecture supports a global view of independent, sequential processes which communicate with each other by sending and receiving messages. Elxsi's message-based system is in contrast to most other multiprocessors, which use techniques such as semaphores for interprocessor communication.

Last year, Trilogy Ltd. acquired Elxsi, bringing about \$40 million in cash reserves to the alliance. Elxsi claims to have installed approximately 100 systems, with an average of 2.5 CPUs per system.

**32-bit machines save money**

In part due to the 64-bit chips, the Alliant and Elxsi machines are more expensive than multiprocessors that incorporate 32-bit chips. Whereas the 64-bit machines cost anywhere from

\$270,000 to \$3 million, 32-bit machines are more in line with the financial capabilities of most OEMs and system integrators, generally falling in the \$75,000-to-\$500,000 range.

Architecturally, Flexible Computer Corp.'s Flex/32 stands apart from other multiprocessors (MMS, October 1985, Page 153). The machine, which the company calls a "multicomputer," is both a loosely coupled and a tightly coupled multiprocessor.

In a tightly coupled system, shared memory serves as a message center through which a number of processors communicate at a faster rate than with loosely coupled systems. In loosely coupled systems, the intercomputer bus is faster than the connection in a local area network but slower than the shorter buses used in tightly coupled systems. Loosely coupled systems are best suited for processing unrelated, independent tasks. In contrast, tightly coupled multiprocessors are best suited for interrelated tasks.

"Other architectures," explains Nicholas Matelan, Flexible's president, "have the instructions coming out of a single memory. Most multiprocessors have one bus with processors

**REPRESENTATIVE MULTIPROCESSOR VENDORS**

Company	Model	Processor type	Maximum CPUs	Maximum speed	Operating systems	Languages	Price range (\$)
Alliant Computer Systems Corp.	FX/8	64-bit, proprietary, CMOS gate arrays	20 (8 CEs, 12 IPs)	35.6 MIPS, 94 megaflops (peak)	UNIX 4.2 (Concentrix)	C, FORTRAN, Pascal	270,000-1 million
Areté Systems Corp.	Series 1000 (1100, 1200)	MC68000, MC68020	2, 4	5 MIPS	UNIX System V (ARIX)	Ada, APL, BASIC, C, COBOL, FORTRAN, MUMPS, Pascal	50,000-250,000
Concurrent Computer Corp.	3200 MPS Series	3250XP (proprietary)	10	22 MIPS	OS/32 (proprietary)	C, COBOL, FORTRAN, Pascal	140,000-700,000
Elxsi	6400	64-bit ECL gate arrays	12	72 MIPS; 79.2 megaflops (peak)	UNIX System V.2, UNIX 4.3, EMBOS	Ada (year-end), BASIC, C, COBOL, FORTRAN, LISP (6 months ARO), MAINSAIL, Pascal	369,000-3 million
Encore Computer Corp.	Multimax	NS32032	20	15 MIPS	UNIX System V, UNIX 4.2 (UMAX V, UMAX 4.2)	C, FORTRAN, Pascal	112,000-340,000
EnMasse Computer Corp.	E/CS	MC68000, MC68010, MC68020	28 (4 FPs, 24 APs)	7 TPS	UNIX System V (E/OS)	C, COBOL	60,000-2 million
Flexible Computer Corp.	Flex/32	NS32032 or MC68020	20 per cabinet	15 MIPS (32032), 50 MIPS (68020)	UNIX System V, MMOS	C, FORTRAN, RATFOR, SNOBOL	75,000 and up
Massachusetts Computer Corp.	MC5000 series	MC68000, MC68010, MC68020	4	N/A	UNIX System V, UNIX 4.2 (RTU)	Ada, C, FORTRAN, LISP, Pascal	35,000-250,000
Sequent Computer Systems Inc.	Balance 8000, 21000	NS32032	12, 30	8.4 MIPS, .94 megaflops; 21 MIPS, 2.25 megaflops (LINPACK benchmark)	UNIX System V, UNIX 4.2 (DYNIX)	Ada, C, FORTRAN, Pascal	60,000-250,000; 139,000-500,000

Source: Mini-Micro Systems

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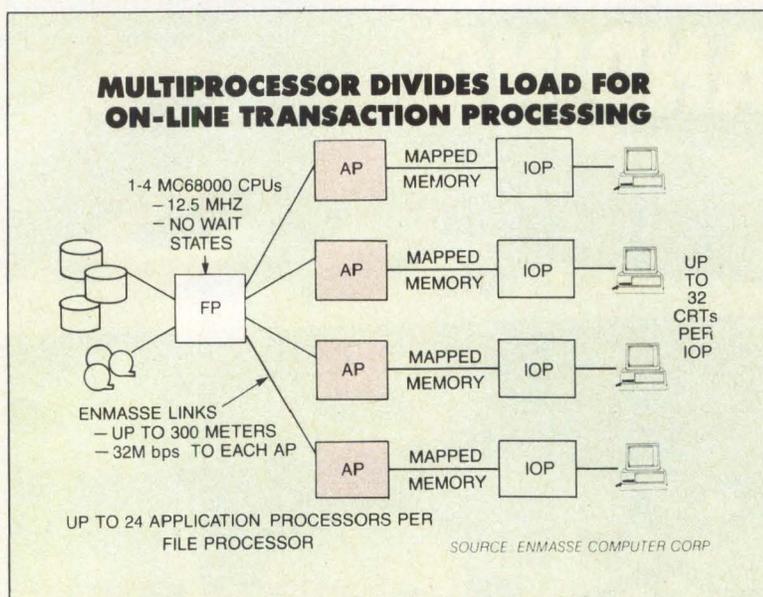
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**Targeting on-line transaction processing applications,** *EnMasse's multiprocessor system includes a file processor (FP) with up to four tightly coupled CPUs, which are in turn loosely coupled to as many as 24 application processors (APs).*

hanging off of it. The processors go to the shared memory, not only to do interprocessor communication, but also to get their instructions from that memory." The Flex/32 can do that, too, but also has a local-memory strategy. "In general, our machine is intended to run code from its processors' local memory and use the common memory and buses for interprocessor communication," says Matelan.

Matelan acknowledges that machines like Aliant's are intended for different applications than are Flexible's; specifically, running existing programs much faster, without rewriting code. Flexible believes that programming a multiprocessor as a parallel-processing machine delivers faster performance. "There's no gain without pain," he says. Thus, Flexible offers an array of programming tools, such as UNIX System V for software development, a concurrency simulator to test parallel applications, Concurrent C and FORTRAN and various debuggers.

The Flex/32 cabinet can contain as many as 20 processors, each with its own local memory and I/O, connected via a synchronous bus; cabinets can be connected via a VMEbus. Last month, the company started shipping MC68020 versions of the Flex/32. Users can upgrade from a National Semiconductor Corp. NS32032 system to a 68020 system without modifying their software because the code goes through the same front

end of the compiler. The company has different back ends to accommodate the 68020s. A 68020 system is approximately two to three times faster than a 32032 system for separate-task processing.

Sequent Computer Systems Inc. tackles both single-program and multiprogram environments. The company's Balance 8000 and 21000 multiprocessors can run existing UNIX applications, which requires only recompilation, or they can break programs up and run them across all the processors. In the latter case, rewriting the code can take anywhere from two days to two years, according to Rick Gimbel, Sequent's product manager. Last December, the company introduced a debugger specifically for parallel programs, and a variety of other support tools for parallel processing—including a parallel implementation of Ada.

Because UNIX was not written to be re-entrant, Sequent—like most other multiprocessor manufacturers—had to rewrite the kernel. The Balance systems are UNIX 4.2 or System V kernel-compatible and incorporate up to 12 32032s (Balance 8000) or 30 32032s (Balance 21000).

Gimbel identifies his company's main competitor as DEC. This March, Sequent signed an agreement involving the sale of more than \$50 million worth of Sequent systems to Siemens AG, West Germany.

Encore Computer Corp.'s Multimax multiprocessor can be classified as a two-bus system, as opposed to, say, Elxsi's 6400, which is a one-bus system. In Encore's Multimax, a 100M-byte-per-second, bipolar Nanobus connects as many as 10 dual-processor cards—for a maximum of 20 32032s—and shared memory cards, each with 4M bytes of memory. The other bus is on the processor cards, and connects the two processors, which share a 32K-byte cache memory.

The tightly coupled architecture of the Multimax allows all processors and programs to access all of the main memory and I/O interfaces. Shared main memory is allocated to processes, not to processors. The operating system in the Multimax is multithreaded, which means that it can handle requests in parallel by supporting multiple, simultaneous streams of control. The Multimax UMAX operating system is compatible with UNIX System V and Berkeley UNIX Version 4.2. The system can run "most" existing UNIX applications with little or no modification.

In a sense, one of the oldest and wealthiest "start-up" multiprocessor manufacturers is Concurrent Computer Corp., formerly the Data Systems Group of Perkin-Elmer Corp., a long-time player in the mid-range scientific/engineering market. Perkin-Elmer spun off Concurrent



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last November, maintaining an 80 percent equity position.

Concurrent's 3200MPS line of multiprocessors employs an older approach to parallel processing: a master-slave scheme. (Although the company hastens to add that it's not a master-slave processor relationship in the old sense, in which the slave cannot act without direction from the CPU.)

The mid-range 3260MPS incorporates a proprietary 3250XP CPU, which acts as the master, connected via a global memory bus to as many as nine proprietary auxiliary processing units. The 3200MPS series runs on the proprietary OS/32 operating system.

Concurrent partitions the operating system among the auxiliary processors, but the main CPU has a complete copy of the operating system. The CPU's primary job is to make sure that run queues are prioritized properly, to maintain system integrity and to pick up workflow overload from the auxiliary processing units. These APUs can schedule tasks, remove them from the queue and dispatch them for I/O handling. As such, the 3200MPS lies somewhere between a true master-slave architecture and a peer-processing architecture.

Fully configured, the system can run 22 MIPS, but it can push 60 million Whetstone instructions per second with an optimizing FORTRAN compiler (not to be confused with an automatic paralleling compiler, as is Alliant's).

At the lower end of the multiprocessor spectrum is Massachusetts Computer Corp. (Mass-comp). The company's MC5000 family goes from a dual-processor version to a quad-processor 5700. Incorporating 68020s connected by a synchronous, 26M-byte-per-second bus, the systems run UNIX 4.2 or UNIX System V. Mass-

comp modified the UNIX kernel to accommodate multiprocessing, handling interprocessor communications via semaphores, pipes and shared memory. The company has shipped over 100 systems, most of which are dual-processor versions, and has a major OEM agreement with Sperry Corp.

Another interesting entry at the lower end of the multiprocessor market is Icon Systems and Software Inc.'s MPS line of supermicrocomputers. For example, the MPS020-2 incorporates two 68020s and an optional 82086 and can concurrently run UNIX 4.2, UNIX System V, MS-DOS, IBM System 370 and Pick operating systems.

Icon plans to introduce at next month's National Computer Conference in Las Vegas, Nev., the 256-user MPS020-3, which can perform true parallel processing with multiple 68020s, according to Andrew Olson, director of corporate development. Icon's machines are manufactured by Sanyo Electric in Japan.

### Multiprocessors go commercial

Not all multiprocessor manufacturers have their sights aimed at the scientific/engineering community. Companies such as Areté Systems Corp. and EnMasse Computer Corp. target the commercial transaction-processing market, thus locking horns with fault-tolerant companies such as Stratus Computer Inc., market leader Tandem Computers Inc. and newcomer Tolerant Systems Inc. (MMS, February, Page 33), which also exploit various versions of multiprocessing. Other competition comes, of course, from traditional minicomputer manufacturers.

Classifying its series 1000 machines as "fault-resistant," Areté's multiprocessors exploit a variation on the master-slave theme, in which a

## Companies mentioned in this article

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**IDC expects the scientific/engineering market to be worth \$2.6 billion this year.**

---

master processor (68000 or 68020) initiates tasks and puts them on an event—or run—queue. After that, any processor can access the queue via hardware semaphores. The master executes some system calls and handles I/O interrupts; slave processors run application processes and also execute some system calls. Like Concurrent, the series 1000 falls somewhere between a master-slave and a pure peer-to-peer architecture.

“The master-slave approach offers an environment that is very similar to a single-processor environment, whereas a peer-processing environment provides a lot more obstacles to implementing parallel processing,” explains Areté product manager Dave Thomsen. The series 1000 runs the ARIX operating system, a version of UNIX System V. “If the application comes from a system that supports common-object-file format and utilizes a 68020 or 68000, chances are we can just load the thing on the system and fire it up,” claims Thomsen.

Whereas most multiprocessor manufacturers modify the UNIX kernel to accommodate real-time multiprocessing and parallel processing, Areté takes a different approach, Thomsen claims. “Our approach,” he explains, “is to answer the issue architecturally by having a computation subsystem that runs a pure UNIX System V.2 and an I/O subsystem that has its own kernel of real-time code downloaded into intelligent I/O controllers.” The system employs up to four application processors and as many as 12 I/O processors.

EnMasse is another new multiprocessor start-up hoping to get a slice of the \$4 billion on-line transaction-processing market. The company employs a unique architecture in which a file processor—containing up to four CPUs—acts as a database engine and is in turn connected to as many as 24 application processors. The FP multiprocessor is loosely coupled to the APs via a 32M-bit-per-second bus. The 68010- or 68020-based APs run applications software, and the 68000-based FPs manage the disks and run file system software.

#### **Who'll survive the shakeout?**

The medium-scale computer market, into which the multiprocessors fit, was worth \$8.4 billion in 1985, of which scientific/engineering machines accounted for \$2.3 billion, or 28 percent, according to International Data Corp., Framingham, Mass. IDC expects the scientific/engineering market to be worth \$2.6 billion this year.

Those figures seem to represent a pie from which multitudes of multiprocessor manufacturers could cut significant slices. However, IBM owns about 27 percent of the scientific/engineer-

ing market (predominantly with its 4381 machines) and DEC owns about 20 percent (with its VAX line). And most analysts agree that the multiprocessor upstarts aren't about to dislodge the two giants.

“Multiprocessors are competing, not so much with IBM and DEC,” explains IDC senior analyst Rich Mikita, “as with other UNIX-machine vendors. Multiprocessors may have better price/performance, but when you're competing with IBM and DEC, it's not just price that counts, it's the vendor environment.” That includes software bases, interconnectivity and networking capabilities.

Mikita contends that, for the near future, the big opportunity for multiprocessor start-ups is in single-purpose, or application-specific, environments. Although most multiprocessors are inherently general-purpose machines, the start-ups are going after relatively specific application areas, such as computer aided electrical design, simulation and real-time process control.

Because of the expected fierce competition among themselves and the overwhelming presence of traditional uniprocessor machines, multiprocessor manufacturers may face a shakeout before they actually establish a foothold. As with any class of start-ups, points to consider when investigating the viability of the new companies include the ability to survive with moderate-volume sales, viability in specific niches, strength of the management team, strength of financing and the significance of OEM contracts.

Few would dispute that parallel processing is the wave of the future, and multiprocessor architectures are the only way to achieve parallel processing. The advantages are obvious: cost-effectiveness, modularity and speed.

But don't expect “Soul of a New Supermini” to show up in the bookstores in the near future: None of the start-up multiprocessor companies—with the exception of Concurrent—has as much as one percent of the scientific/engineering market. And, in fact, some purists would argue that, rather than being a revolutionary new technology, multiprocessing is as old as the Burroughs B5000, a dual symmetrical processor introduced in 1961. □

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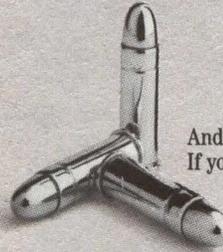
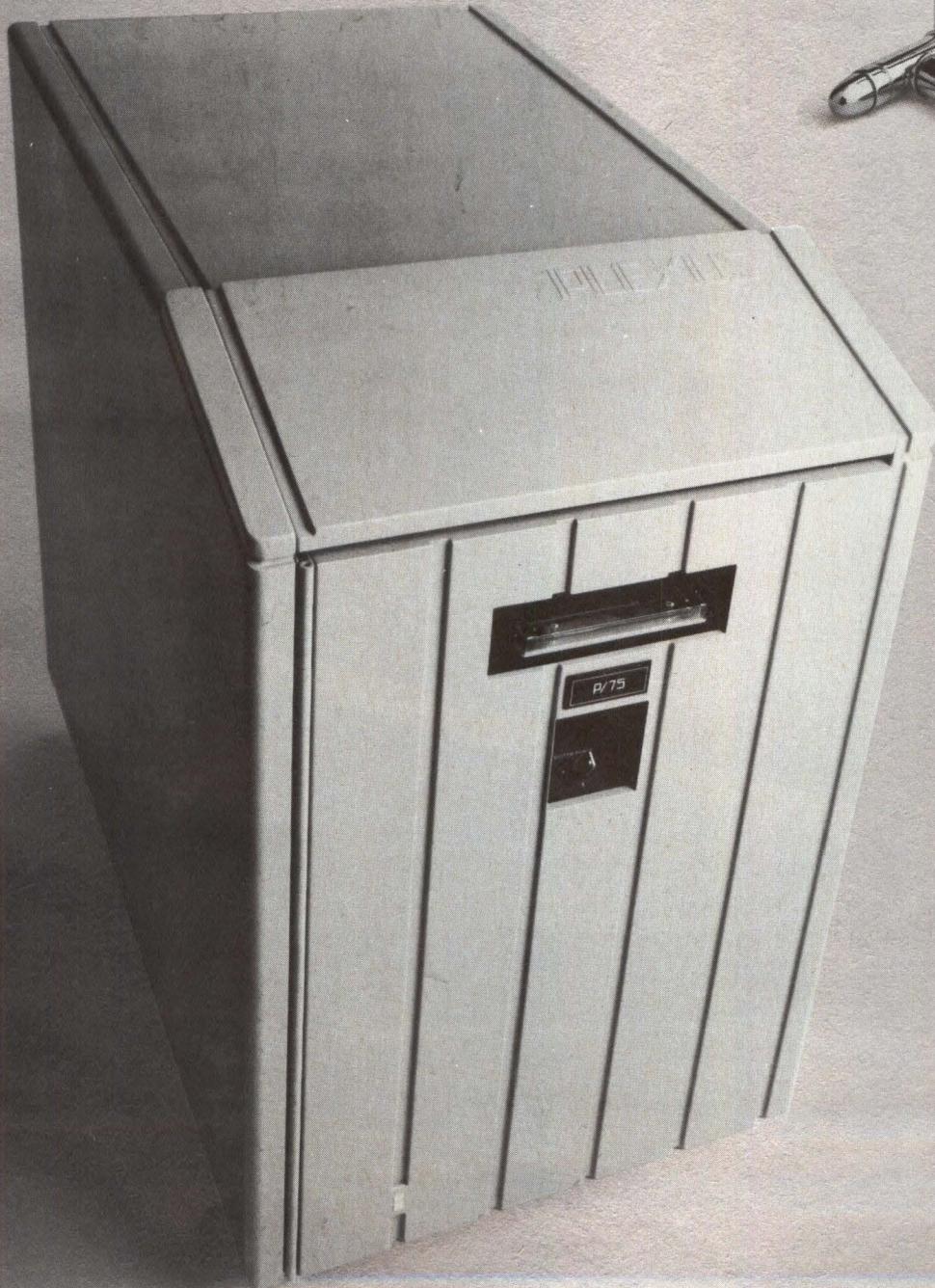
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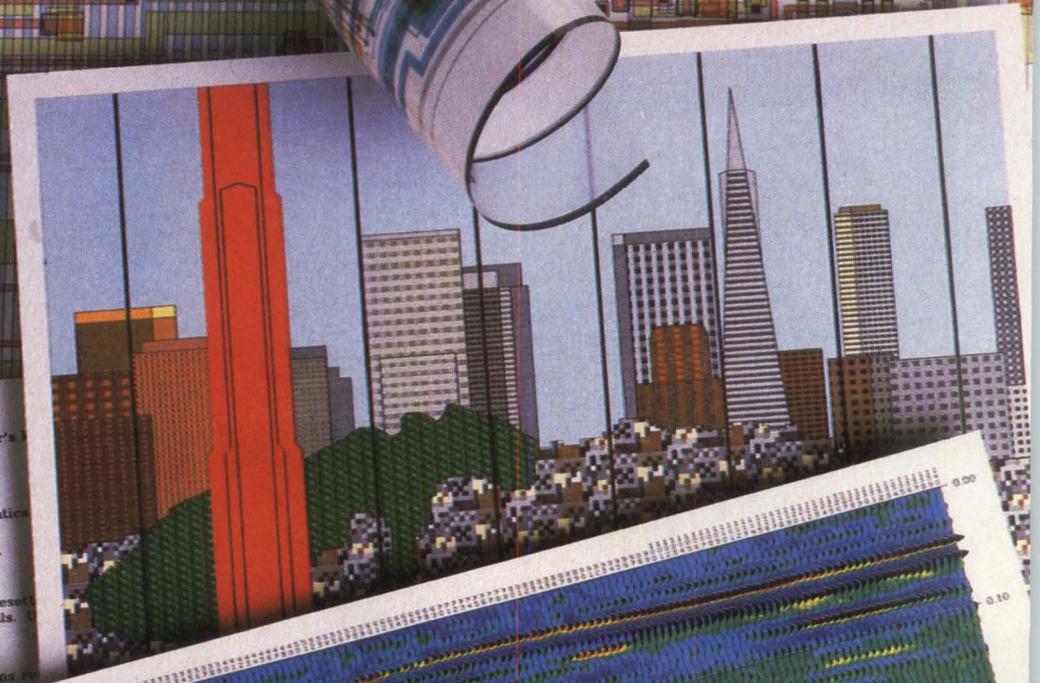
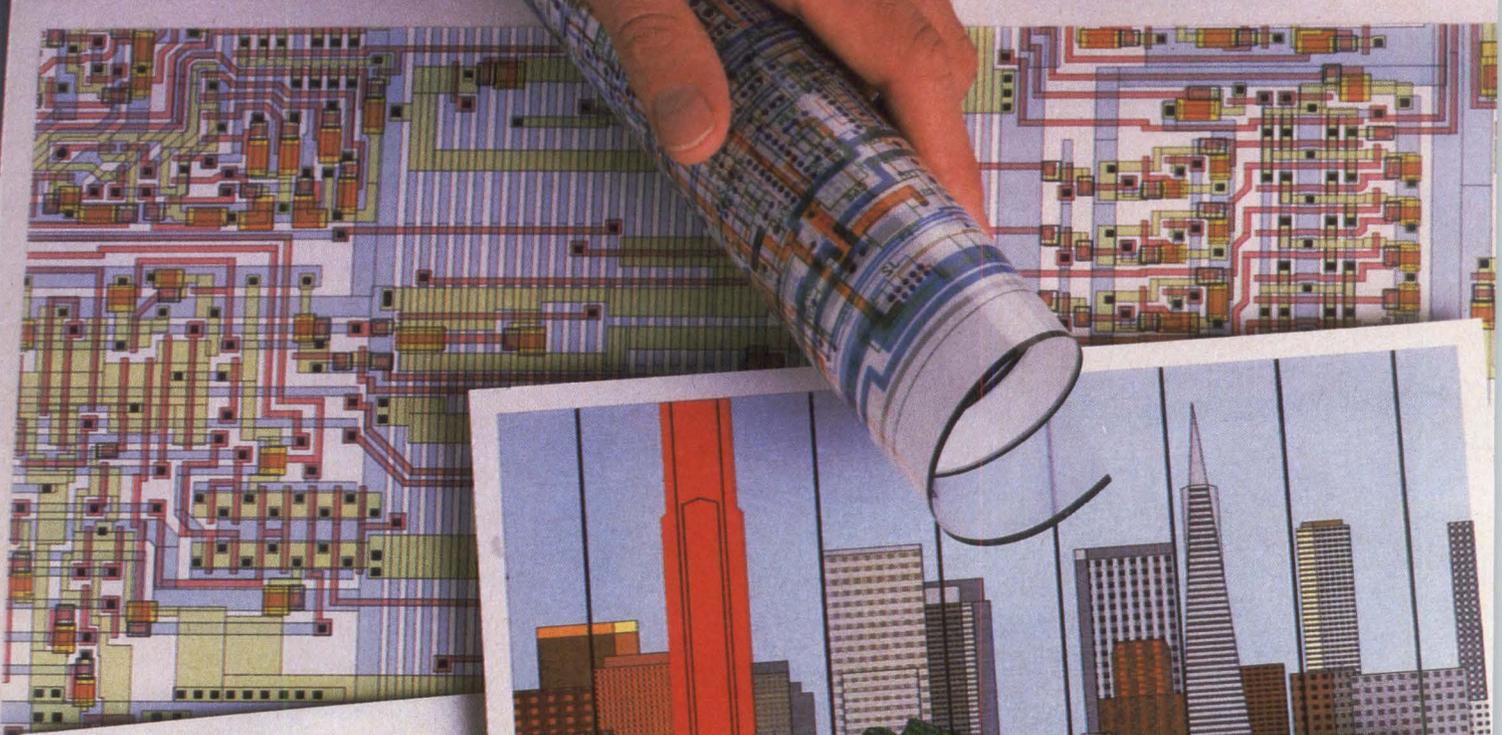
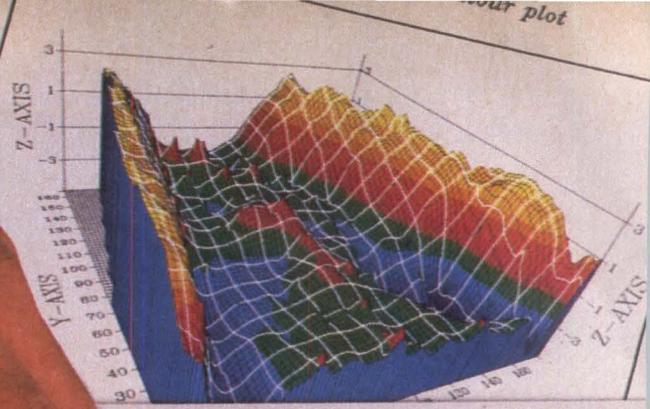
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EQN(1) UNIX Programmer's

**NAME**  
eqn, neqn, checkeq - typeset mathematics

**SYNOPSIS**  
eqn [-dxy] [-pn] [-sn] [-fn] [file] ...  
checkeq [file] ...

**DESCRIPTION**  
Egn is a troff(1) preprocessor for typeset-  
tens phototypesetter, neqn on terminals.

eqn file ... | troff  
neqn file ... | nroff

If no files are specified, these programs read  
beginning with 'EQ' marks the start of a  
marked by a line beginning with 'EQ'.  
may be defined in macro packages. It is  
possible to set two character sets. The  
iters is also treated as eqn input.  
with the command-line argument  
between .EQ and .EN. The left and right  
are turned off by 'delim off'.  
between .EQ and .EN is passed to  
The program checkeq reports errors in  
pairs.

Tokens within eqn are separated by  
quotes, tildes or circumflexes. By  
ing, anywhere a single character  
tion enclosed in braces may be used  
the output, circumflex ~ half as many  
Subscripts and superscripts are pro-  
x sub i makes  $x_i$ , a sub i sup 2 pro-  
 $e^{2x}$ .

Fractions are made with over: a over b  
sqrt makes square roots: 1 over sqrt 2

The keywords from and to introduce  
 $\lim_{n \rightarrow \infty} \sum_{i=0}^n x_i$  is made with lim from {n -> in}  
Left and right brackets, braces, etc., of  
right: left [ x sup 2 + y sup 2 over a ]  
The right clause is optional. Legal charac-  
brackets, bars, c and f for ceiling and floor  
right-side-only bracket).

Vertical piles of things are made with pile,  
above c] produces  $\begin{matrix} b \\ c \end{matrix}$ . There can be an arbi-



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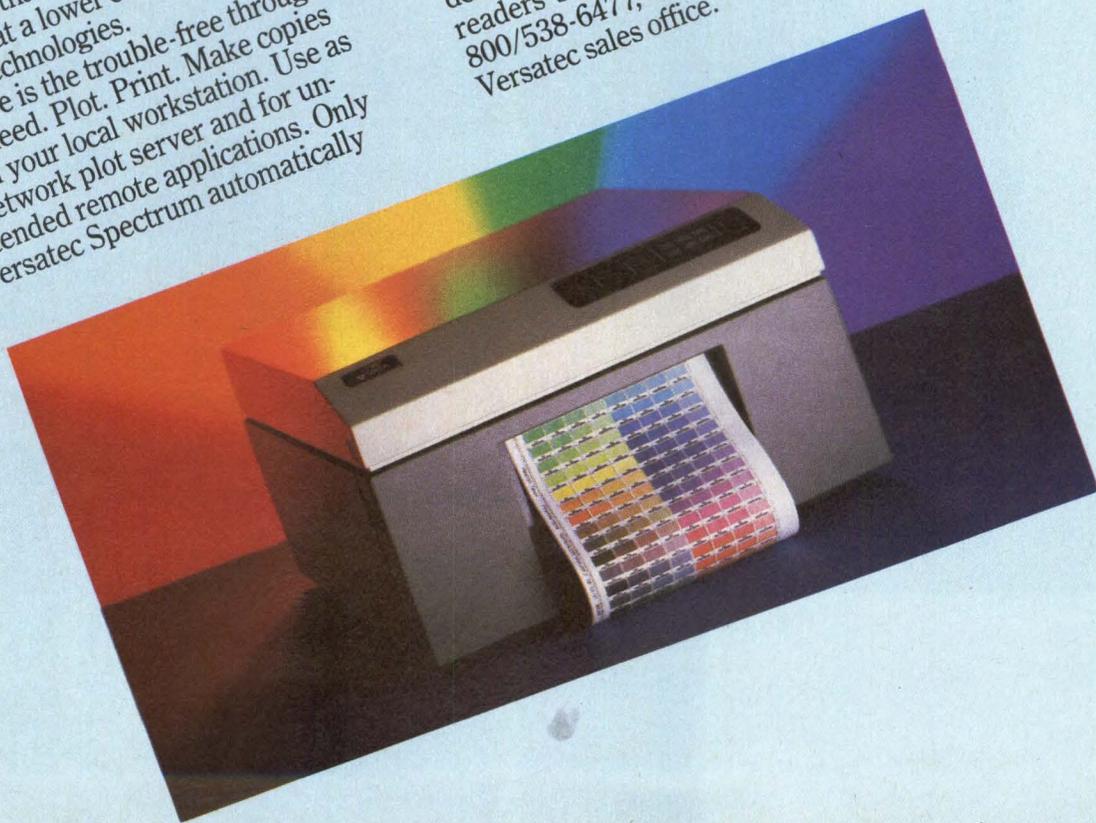
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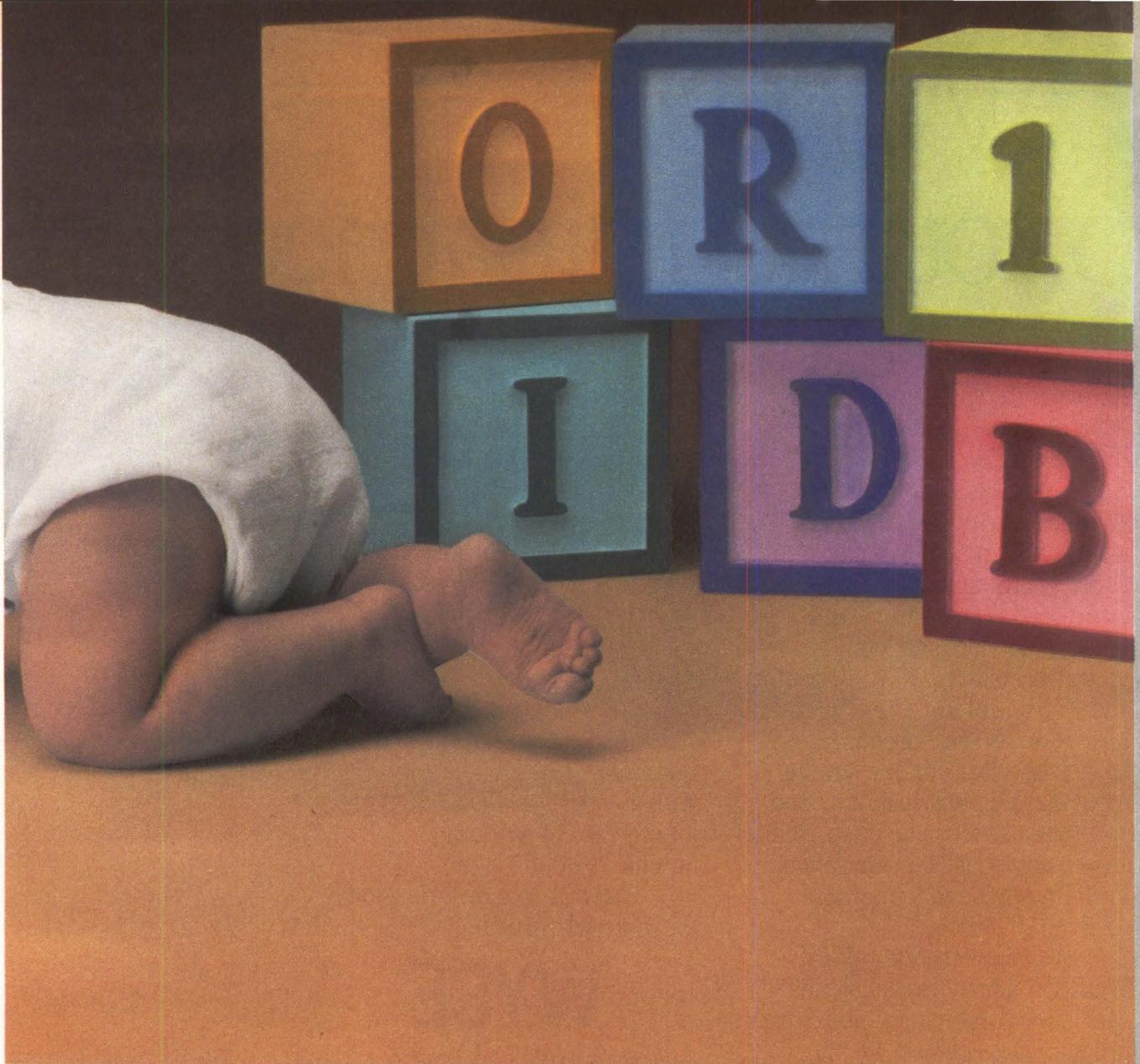
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# DATABASES MANAGE NETWORK ENVIRONMENTS

Providing file- and record-locking capability and interactive network control, personal computer database managers add functionality to LANs and multiuser systems

**Carl Warren**, Western Editor

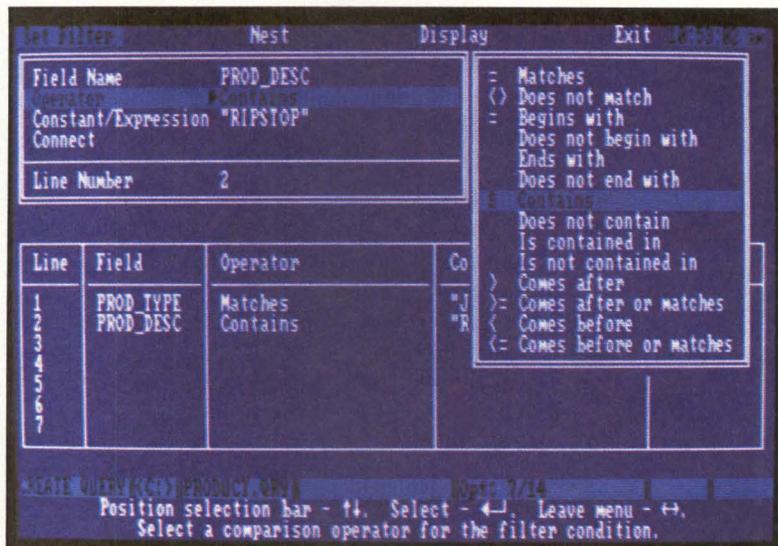
Despite the growing acceptance of local area networks and multiuser microcomputer systems in the office environment, their use hasn't been as great as expected. Part of the problem has been a lack of multifunction software—particularly distributed database management systems.

Specifically, users have been dumbfounded by a single puzzle: how to manipulate and protect files and records in a multiuser environment. Even though LAN and multiuser system vendors offer products that can lock records and files, the techniques are so complex that until recently very little application software took advantage of this capability.

As a result, many personal computer-based installations use single-user software or "pseudo-multifunction applications"—standard single-user software that's had some multiuser functions forced into it. Either way, the results haven't been spectacular.

For example, consider Ethernet, a network protocol that, at first blush, seems to answer most vendors' problems. It's well-defined and widely accepted, and it forms the basis of many personal computer networks. Yet, it's a hardware-oriented protocol network that provides compatibility only at the lowest levels of the seven-layered open systems interconnection (OSI) model. Although Ethernet allows hardware products to coexist on a single cable, the incompatibility at the higher layers of the OSI model—Network, Transport, Session, Presentation and Application—makes it difficult for diverse products to communicate. More important, Ethernet makes it almost impossible to create multiuser software without specialized software-device and system interfaces.

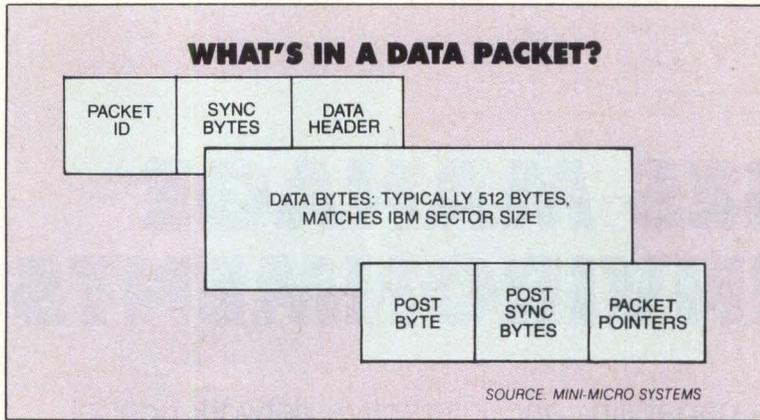
Other network implementations aren't any



**Ashton-Tate's dBase III Plus transparently locks and unlocks files.**

more hospitable to distributed databases. LAN developers—typically enamored of their networks' ability to move bits down a wire—regard as relatively unimportant what happens on the other end of that wire. This situation appears to be true whether the wire represents a LAN or an internal structure in a multiuser system. Hence, would-be distributed-DBMS makers must work with systems in which a request for a record may indeed zoom that data down the desired data path but in a way that ignores such issues as data integrity, contention and backup. Inevitably, problems occur the minute more than one user asks for the same data at the same time.

Most systems handle simultaneous requests for the same data in one of three ways. First, they simply ignore the problem: Everyone gets



**A data packet comprises three distinct subpackets:** a header that tells the network what the packet is and what to do with it; the data, which is usually 512 bytes long to match the IBM PC sector size; and the post bytes and pointers.

the data, but the original file is garbled beyond use. Second, they set a flag that gives only one user at a time access to the file or record. Third—and most ideal—they give all qualified users access but allow none to update a file without signaling all others that an update is in progress. Then he can proceed. The third technique, used in mainframe environments, employs a mirror image of the base record. Therefore, no one can corrupt the original data even after the transaction is finished.

An airline reservation system exemplifies a typical distributed multiuser DBMS with multiupdate capability. A reservation record, which consists of many fields, resides in a reservation file, consisting of many associated records. Anyone with proper identification can request a record from the file. In the example, the file has multiple layers of accessibility. Even with several requesters, only the one who gets the record first can update. There are no ties; the system operates on a first-come-first-served basis.

**Vendors face choices**

However, this isn't how personal computer environments operate. Typically, even the best managed personal computer-based systems allow only one user at a time to simply view a record. In some cases, requesting that record locks other users out of the file, thus inhibiting the multifunctionality of the network or multiuser system. Vendors have taken these approaches partly because the tools to do more sophisticated data management simply haven't been available—as in the case of Ethernet—and partly because of a lack of motivation. Given the

inherently single-user nature of personal computers, vendors haven't had the need—or, in some cases, the skill—to include multiuser functionality in personal computer DBMSes.

The ability to find and manipulate a record, or record-level capability, is only a small part of database use. Before accessing an individual record, users must first access and navigate the database itself. Also critical to distributed DBMS operation is whether the application will run on a LAN or on the central processor of a multiuser system.

For example, a LAN user must first request a given database server. In complex large-scale installations, more than one file server can exist on the network, thus requiring the user to specify in some implicit manner the location of the desired file, record or application software.

In some implementations, depending on the operating system, the request can be as simple as specifying a device modifier that signifies the network; a path; and the name of the file, record or application or all three. It might take the form:

Z:\ASERVER\PAYABLES\MAY

Otherwise, users must dig their way through many levels of protocol and of syntax placements to achieve the same result.

Some multiuser systems easily solve the problem by giving a processor to each user. In this case, a DBMS developer's biggest concern is how to handle the database. The easiest method is simply to transport the database to the local system and perform the work. On a LAN, though, even one that supposedly operates at 10M bits per second, this operation can be time-consuming. On a multiuser system using dedicated-user processors, the capability doesn't exist because the file server looks and acts like a dedicated disk server to the single processor. But, theoretically, many users of a multiuser system can access the same drive and records, so these systems include provisions to lock other users out.

One company, Kimtron Corp., uses a hardware-software combination to give users multiuser functionality. The Kimtron intelligent terminal fits into a personal computer network to provide file and record locking. However, Kimtron relies on software vendors to supply file control.

In systems in which the application runs globally in the environment, the developer must implement special arrangements, such as memory, CPU management and high-level control, in the operating system. For instance, other users must share or ignore the application, which means that other applications can run concurrently. Some operating systems, such as UNIX

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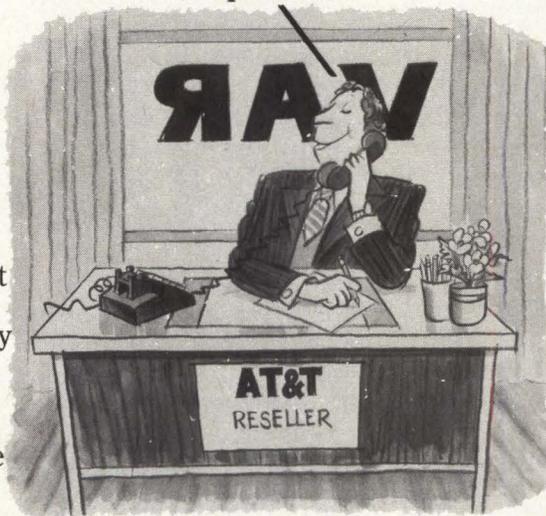
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and Digital Research Inc.'s Concurrent PC-DOS version 4.1, not only permit concurrent operations but also handle record and file functions.

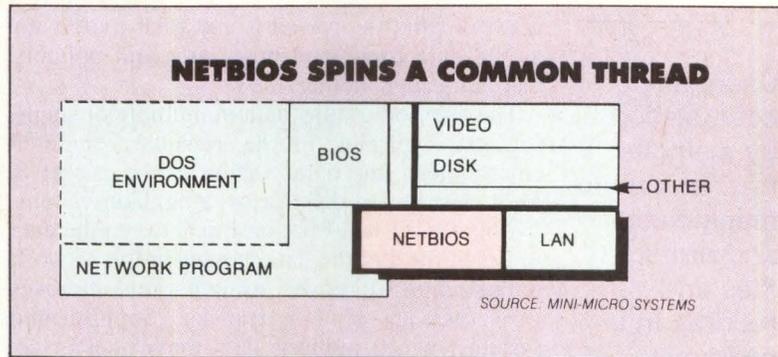
Similarly, Microsoft Corp.'s MS-DOS 3.1 allows users to share files. Although analysts are touting MS-DOS 3.1 as the file-sharing standard, it still has major shortcomings in how data is handled by many users. Specifically, developers must write DBMS application software in such a way that it assumes the presence of DOS file-locking attributes as an underlying premise of the software's operation. Unfortunately, because MS-DOS 3.1 is relatively unknown, many DBMS application developers try to invent their own file- and record-locking schemes, thereby causing serious implementation difficulties.

**Sorting through methods**

However, some developers, including System Automation Software Inc., Fox Research Inc. and Peregrine Systems Inc., have worked successfully in the MS-DOS 3.1 environment. For example, System Automation sells the ReQuest distributed DBMS, which provides the ability to share and manage information over a network, according to the company. Similarly, Fox markets the 10-Base DBMS, which has recently been made compatible with MS-DOS 3.1. This capability gives 10-Base extended record and file locking, conforming to Microsoft's design. The 10-Base DBMS, which operates on Fox's 10-Net LAN, previously operated under DOS 2.1 and provided its own file- and record-handling attributes. Peregrine Systems takes the tack of working at both the personal computer and mainframe ends of data sharing. Peregrine's PNMS III application software uses fourth-generation language techniques to handle data control and access.

Another microcomputer database company, Ashton-Tate, has taken several stabs at handling data in a multiuser environment. The company's latest product, dBase III Plus, ties into the parts of MS-DOS 3.1 that are directly concerned with networking. This method lets users share data within the application environment, meaning that they can share not only a single data source but also the application. Employing pull-down menus and a bit-mapped graphics front-end, dBase III Plus handles the network tasks of locking and unlocking files and records in a way that is user-transparent.

In an ideal DBMS environment, a user can access data via the lowest common denominator—the query language—often made transparent via an application envelope. For example, a fill-in format for a billing statement is merely the visible front-end of a powerful query system that serves as the underpinnings of the entire applica-



**NETBIOS** acts as an interface between MS-DOS 3.1 and a LAN. It allows the network, computers, peripherals and applications to use standard naming and command conventions.

tion. This environment not only allows for a consistent approach to accessing the data in pre-existing heterogeneous distributed applications but also achieves that consistency without changing the database structure, or schema, or the application program. This technique gives the user the illusion of working with a single non-distributed database.

**New definitions shape DBMS futures**

Developers of sophisticated microcomputer DBMS products, such as Data Language Corp.'s Progress, Relational Database Systems Inc.'s Informix, Relational Technology Inc.'s Ingres and Unify Corp.'s Unify, all created for the UNIX environment, still have difficulty in managing databases in a mainframe-like manner.

Still, multiuser DBMS products provide users with better distributed data management than was possible even a few months ago. This improvement stems from better system-level definitions of how networking should be done. These definitions provide standard approaches to file- and record-locking, enabling developers to include a distributed capability in their products.

For example, Microsoft, in concert with IBM Corp., is further redefining how networks operate on a software level. IBM's token-passing Token-Ring Network makes use of IBM's intrinsic understanding of how to manipulate and pass data over a wire to improve efficiency and multiuser functionality, including the functionality of multiuser DBMSes.

This approach allows data to be handled as discrete components, or "packets," in a network. Each packet has its own specific architecture that stipulates how the data will be bundled on transmission and unbundled on receipt. A data packet usually has a header that tells the

**Users have been stalled by a single puzzle: how to manipulate and protect files and records in a multiuser environment.**

network what the packet is and what to do with it, the data itself, and post bytes and pointers that enhance handling.

This method groups data in multiple or single packets. Typically, in the personal computer environment, the data portion of the packet is 512 bytes, or one disk sector, long. Consequently, there is a 1-to-1 relationship between the data in a disk file and the data moving in the network data stream. Moreover, using packets improves the efficiency of data transfer. Sophisticated systems, which monitor data movement in accordance with network activity, allow multiple requests to be interleaved, grouping packets to improve data throughput.

Moreover, products coming to market make it easier to control the flow of data inside personal computer-based networks. For example, although not a network manager, Communication Machinery Corp.'s LanScan Ethernet monitor tracks packet transmission and pinpoints problems. It provides the network manager with the necessary data to plug loopholes and improve overall performance.

**A standard emerges**

Perhaps most important, distributed-DBMS developers are finally getting the standards they

need for their products to operate on networks of heterogeneous machines. For example, the network basic input/output system (NETBIOS), defined by IBM and Microsoft, is emerging as the definitive standard to assist developers in creating both network-control and application software. NETBIOS, a framework for integrating diverse application software, hardware and communications networks, acts as an interface between a LAN adapter and the operating system. Therefore, the network and the applications can use standard naming and command conventions. Also by convention, NETBIOS assumes that everyone using the proposed standard has agreed on system usage and device naming.

To ensure the proper handling of a network and the way data and applications run on the network, a network-control block—essentially, a command-processing table—manages system resource allocation. To provide suitable operation, an application program should ideally make calls directly to NETBIOS rather than to the personal computer hardware BIOS. Thus, proper handling, directing and dispatching occur without interfering with system operation.

By having their products interface with the NETBIOS, which forms a layer of software

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**Circle 410**

**Relational Database Systems Inc.**  
4100 Bohannon Drive  
Menlo Park, Calif. 94025  
(415) 322-4100  
**Circle 411**

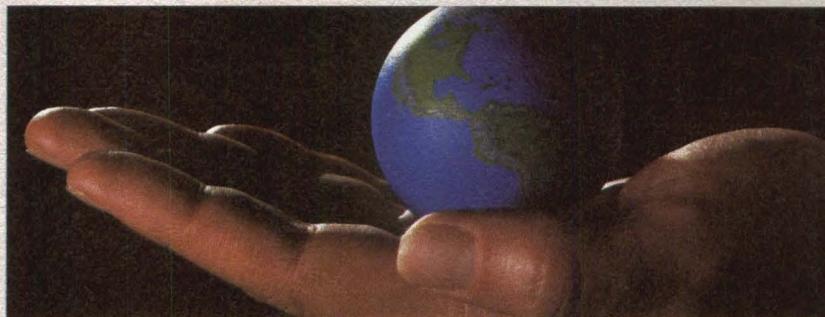
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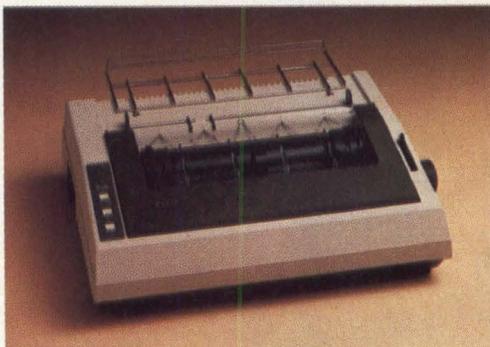
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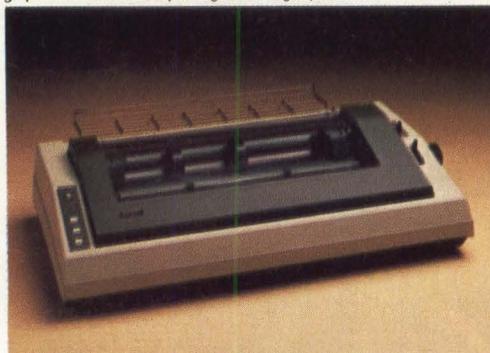
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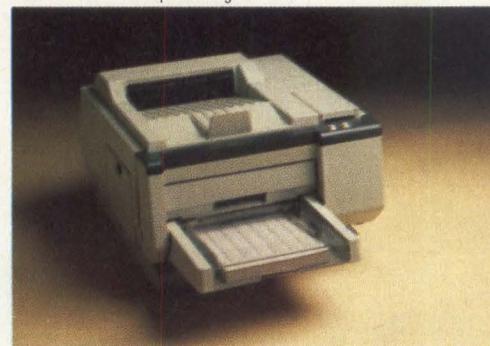
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common to all the machines of an MS-DOS 3.1-based network, DBMS developers can give users the illusion that they are dealing with a single non-distributed system rather than a distributed database on a network. For example, AST Research Corp., a major proponent of NETBIOS, uses its capabilities in PC-Net and resource-sharing systems.

### **Bus structures solve conflicts**

Developers can minimize or even eliminate many of the difficulties associated with running a DBMS on a LAN by using bus-oriented, tightly coupled multiuser systems—systems in which terminals or workstations connect to the bus of a single multiuser machine. Because multiuser systems are in many ways just personal computers that deal with the problems of one user at a time in rapid succession, they can save the developer from worrying about dispatching data to various devices and handling packets over a wire.

Intercontinental Micro Systems Corp.'s LANPC Micronet, for example, provides both bus-structured, tightly coupled capability and loosely coupled, coaxial network extendability. LANPC Micronet comprises a series of hubs, in which a single unit serves several systems and the hubs connect to each other via coaxial cable. This hub-to-hub network uses the cluster technique that IBM has employed with the PC/AT and provides the resource and information sharing of a number of units via the hubs. However, this sharing isn't limited just to users on a hub or within a hub network. A hub-to-hub network also provides gateways to other networks for users of the Micronet or the PC/AT and the token-passing network.

IBM's strategy, meanwhile, provides an open doorway to its Systems Network Architecture and X.25 networks. DBMS developers employing this approach must include sophisticated clustering systems that handle protocol conversion as part of the system architecture. SNA offers developers a convenient, centralized location in which to install file- and record-locking—the multiuser machine at the hub where both hardware and software cooperate for data integrity.

For instance, North Star Computers Inc. has extended the hub-to-hub and multiuser system in its NS1200 and NS300 series of business systems. Rather than rely solely on software or hardware to manage data security and flow, NorthStar has carefully matched the hardware functions with the software, Novell Inc.'s NetWare. Although NetWare handles most system- and application-level tasks of opening and closing files, setting file and record attributes and checking user status, North Star's hardware, Intel Corp.'s

80186 microprocessor operating at 8 MHz, acts as a communications server local to the system, handling the dispatch of information.

### **Security shapes the network**

As a network expands from single-user to cluster to hub to SNA, DBMS developers must address the problem of access levels. As more resources—specifically, data files—become available, some will require usage restrictions. Such restrictions concern locking files and records based on whether they are in use. Password identification is one way to restrict access. However, most personal computer-based networking software applies passwords to open access to a network node rather than to an actual data file. Thus, users can easily bridge these passwords via alternative routes.

Unfortunately, most application software handles data security via "code-patch" techniques that are either cumbersome or simply ineffective when challenged. As a result, vendors are currently developing lock and unlock schemes founded on NETBIOS.

One distributed DBMS technique that has stirred interest puts the burden of file management on the file server. Disk drive manufacturers Priam Corp. and Seagate Technology take this approach. Seagate provides an OEM LAN in a box with a disk drive. The Seagate file server allows users to share data, while the network treats the box as a separate disk drive for each user.

Priam, on the other hand, prefers the hub approach. The company's ClusterTower handles as many as eight users, each with a special card that interfaces the personal computer to the disk subsystem. Priam provides the necessary management and access software, so the user need only log onto or off the Tower without worrying about file- or record-locking. Because the ClusterTower never interferes with the operation of the personal computer, it can serve as a hub within a hub and as a resource on a wire network.

Putting "super smarts" into a peripheral box appears to be a major industry trend. Specialized interfaces such as the small computer systems interface (SCSI) provide for linking hosts to hosts and to virtually any peripheral. Moreover, by combining real-time operating systems on silicon with large-word microprocessors, such as the Intel 80386, peripherals will be able to handle most file-management issues on their own. □

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**NETBIOS, a framework for integrating diverse application software, hardware and communications networks, acts as an interface between a LAN adapter and the operating system.**

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Interest Quotient (Circle One)  
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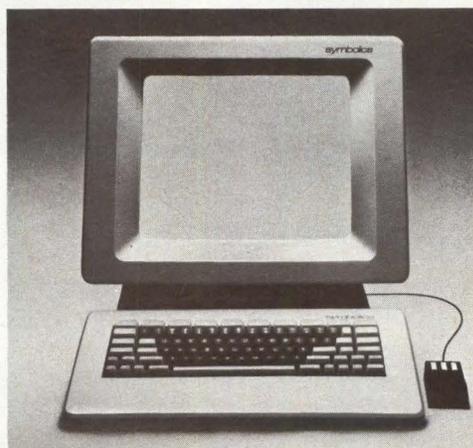
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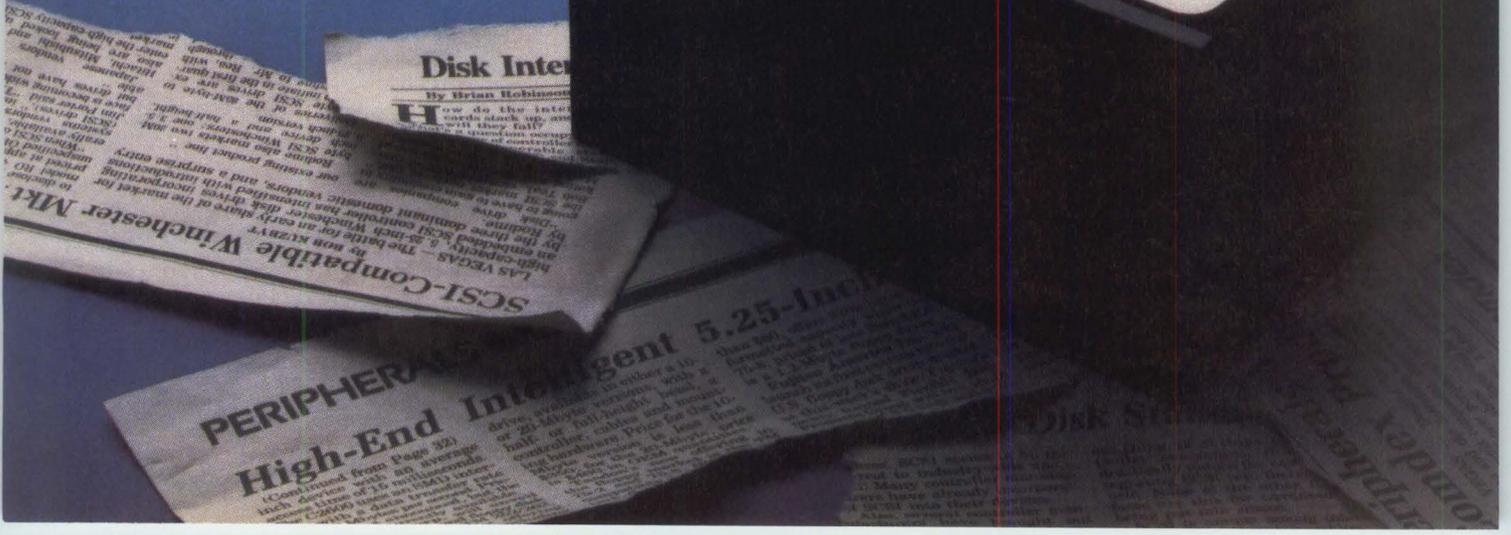
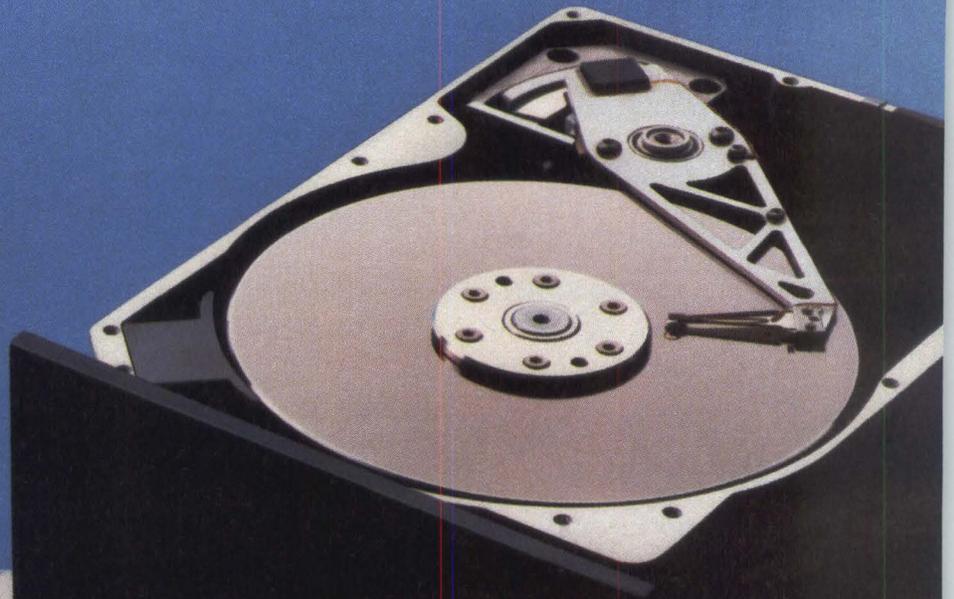
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# TCP/IP PROTOCOLS ADDRESS LAN NEEDS

With ISO-standard products not widely available, manufacturers are implementing the TCP/IP standard for connecting multivendor machines

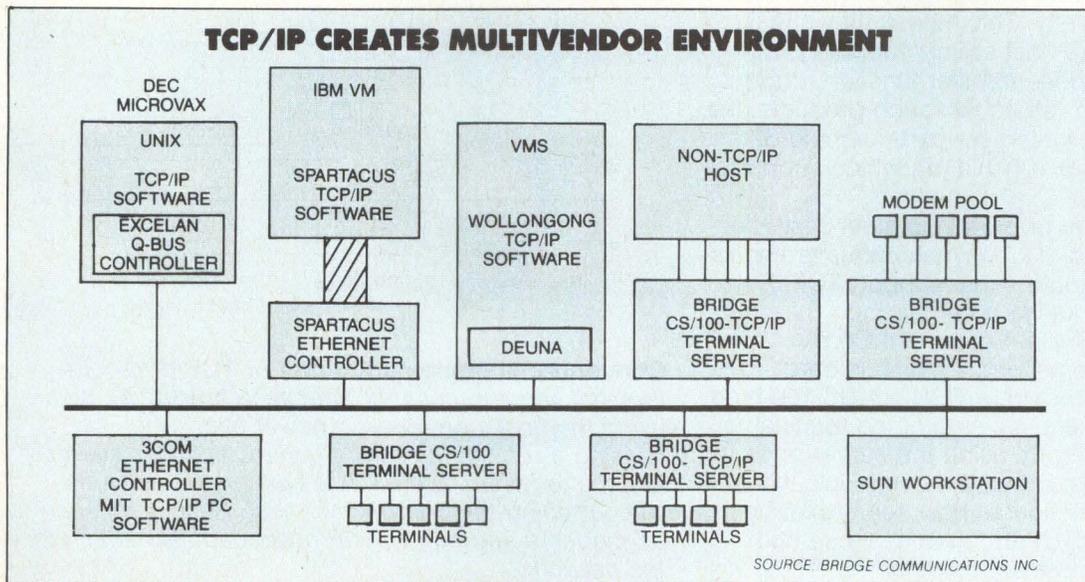
**Judith Estrin and William Carrico**  
Bridge Communications Inc.

The recent groundswell of support for the Transmission Control Protocol/Internet Protocol (TCP/IP) should come as no surprise to industry observers. The primary reason is a lack of commercially available products for the International Standards Organization's open systems interconnection (OSI) standard. That being the case, many vendors and users have chosen the TCP/IP as an interim solution to the problem of connecting diverse machines.

In contrast to OSI, TCP/IP is the only standard local area network protocol for which several products are available, thus permitting full interoperability among multivendor hosts and devices.

Another reason for its popularity is that TCP/IP has been publicly available for a decade. Its development began in the early 1970s when the Department of Defense Advanced Research Projects Agency (DARPA) decided to provide for testing of communications protocols over its ARPAnet packet-switched wide area network. Under DARPA grants, several organizations, including Stanford University, Stanford, Calif.; the University of California at Berkeley; and BBN Communications Corp., Cambridge, Mass., used TCP/IP for developing UNIX-based systems. As a result of this research, the Defense Department adopted TCP/IP as its standard communication protocol, mandatory in many federal government and defense-related networks. By 1982, 75 percent of ARPAnet nodes in the United States—chiefly in major universities

**Many third-party vendors offer TCP/IP equipment that allows users to build a true multivendor environment. For example, a user at a terminal, personal computer or workstation has access to all network resources. The host computers also interchange files.**



and military installations—used TCP/IP over a variety of physical media.

Finally, TCP/IP is an integral part of the Berkeley UNIX Version 4.2 operating system. By placing the TCP/IP protocols—including source code—in the public domain, DARPA laid the groundwork for widespread implementation of this protocol set. But the University of California at Berkeley's development of the UNIX 4.2 operating system boosted TCP/IP into the LAN arena. UNIX 4.2 developers integrated TCP/IP into the UNIX kernel, giving UNIX users a "free" high-level protocol implementation. They also incorporated an Address Resolution Protocol (ARP) that maps TCP/IP addresses to Ethernet IEEE 802.3 addresses, providing a convenient LAN interface. The subsequent adoption and widespread use of UNIX 4.2 in computer aided design, manufacturing and engineering environments brought TCP/IP and

Ethernet along on its coattails.

**Vendors hop aboard**

As a result, the UNIX-TCP/IP-Ethernet combination has become the automatic choice for most computer and workstation suppliers needing a powerful operating system and LAN capability while maintaining an open architecture.

Among the first of these vendors to board the TCP/IP bandwagon was workstation manufacturer Sun Microsystems Inc. This move was not surprising, considering that Sun co-founder William Joy headed the UNIX 4.2 development effort. He also helped develop TCP/IP-based protocols that extend TCP/IP's functionality to layer seven, or the Application Layer, of the OSI reference model.

Other workstation suppliers, such as Massachusetts Computer Corp. (Masscomp) and Symbolics Inc., began to use the UNIX-TCP/IP

**Alternative approaches exist**

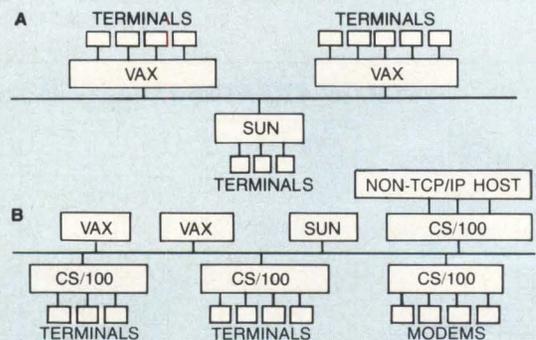
Conventional approaches to implementing the Transmission Control Protocol/Internet Protocol (TCP/IP) treat the protocol set primarily as a mechanism for efficient file transfer between machines. It allows, for example, terminal A to log onto machine B over the network and use machine B's resources. But it allows file sharing only if terminal A connects directly to a network-attached host rather than to the network itself.

Another approach uses terminal servers implementing the TCP/IP protocols. Because terminal-to-host switches constitute a significant percentage of general-purpose local area network applications, TCP/IP products should be able to communicate with terminals efficiently. This means they should offer a full terminal-to-host switch capability rather than a TCP/IP-based file-transfer function. Bridge Communications Inc. offers two such products, the CS/1-TCP/IP server, which supports eight to 32 terminals, and the CS/100-TCP/IP, which supports four to 14 terminals.

The terminal-server approach is most cost-effective when servers connect asynchronous terminals directly to host computers that support TCP/IP and that attach to Ethernet via an embedded Ethernet controller such as Digital Equipment Corp.'s VAX DEUNA card or 3Com Corp.'s Multibus card. These applications require a CS/1- or CS/100-type device only on the terminal side of the terminal-to-host switch. However, by using the server on both the terminal and host sides, the communications servers can also function as host servers for hosts that do not support TCP/IP, such as those from Honeywell Inc. and Prime Computer Inc. Thus, vir-

tually all types of network-attached devices can share resources such as printers and modems.

The limitations inherent in single-LAN systems can be overcome by going one step further and interconnecting TCP/IP networks via gateways to other similar or dissimilar networks. In the past, a means often used to interconnect multiple TCP/IP-based Ethernets was to string telephone lines between VAXes running UNIX and TCP/IP. The disadvantage of this method was that it consumed VAX bandwidth that could be better devoted to applica-



**Conventional implementations of TCP/IP** require terminal users to connect directly to a host (A), thus using the host's processing power even when accessing a remote host. With communications servers (B), the terminals access any host on the network without going through another host. Resources such as modems and non-TCP/IP hosts can also attach to the network.

combination. Also among these users were universities and software-development companies with installations of Digital Equipment Corp. VAX minicomputers.

As UNIX 4.2 continued to gain popularity, manufacturers of larger computers, superminicomputers and supermicrocomputers, including Amdahl Corp., Gould/SEL, Harris Corp., Pyramid Technology Corp. and Sperry Corp., began using TCP/IP in computers designed for the engineering and scientific markets.

**Compatibility is key**

The layers of the TCP/IP protocol set are IP, TCP, User Datagram Protocol (UDP), Telnet Protocol and File Transfer Protocol (FTP). Most implementations of TCP/IP also include ARP and the Internet Control Message Protocol (ICMP).

IP, which corresponds to layer three, or the

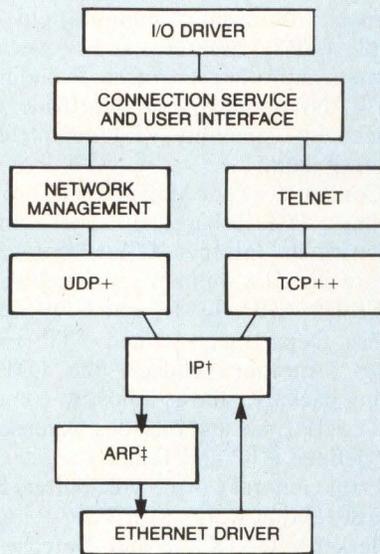
connectionless-mode network layer, of the OSI model, provides datagram service across a network or internetwork. Layer three addresses messages and routes them across a network, provides functions and procedures to exchange data between two systems independent of routing and switching considerations, and furnishes service independent of the transfer technology.

TCP corresponds to OSI layer four, the connection-oriented transport protocol. Layer four sequences messages into a transaction, controls data transfer with an end-to-end service and optimizes the use of available network service. UDP, another OSI layer-four protocol, is used for remote network-management and name-service-access applications. Name-service-access allows users to assign a name, such as "VAX," to a physical, or numeric, address.

The Telnet Protocol corresponds roughly to OSI layers five and six—the Session and Present-

**for TCP/IP implementation**

tions. One solution to this problem is Bridge's GS/3-IP internetwork router, which is dedicated exclusively to interconnecting several physically iso-



**KEY:**  
 + = USER DATAGRAM PROTOCOL  
 ++ = TRANSMISSION CONTROL PROTOCOL  
 † = INTERNET PROTOCOL  
 ‡ = ADDRESS RESOLUTION PROTOCOL

SOURCE: BRIDGE COMMUNICATIONS INC.

**The software architecture** of Bridge's communications servers provide Telnet for terminal-to-host communication as well as network-management software.

lated TCP/IP-based Ethernets over point-to-point connection media, such as leased lines, dial-up lines, fiber-optic links or microwave links. This approach not only costs less than the VAX-to-VAX approach but also offloads the hosts of bandwidth-hungry protocol-processing tasks.

Gateways can extend the TCP/IP environment in other ways. For example, Bridge's GS/6-IP gateway server permits communication among as many as 255 TCP/IP-based Ethernets over a single channel of a broadband LAN. This facilitates the creation of extended, potentially very large, TCP/IP networks in which Ethernet "ribs" communicate with each other over a broadband "backbone." Users gain the combined advantages of Ethernet's higher speed and lower cost and of broadband's longer distance. Both Bridge gateways support the TCP/IP concept that allows users to subdivide their networks into logical "subnetworks."

TCP/IP has also made its way into IBM Corp.'s Systems Network Architecture environment. Bridge's CS/1-SNA-TCP/IP combines full LAN connectivity and services with protocol conversion to SNA hosts, allowing "foreign" terminals or PCs to "look like" IBM 3278 terminals on demand. Thus, a TCP/IP-based device on the LAN—an engineering workstation, for example—can access an SNA host, open a teletypewriter (TTY) window on its screen and receive a 3278 screen emulation. If terminal servers running TCP/IP are also on the network, the same workstation can simultaneously display another TTY window emulating the screen of an ASCII host, such as a Prime computer, that does not support TCP/IP.

tation layers—of the OSI model. Layer five establishes communications, or sessions, that manage and synchronize data exchange between entities and provide mechanisms to structure the communication. These mechanisms also map user-oriented session addresses to network-oriented transport addresses. The TCP/IP application protocol for interfacing to terminals, Telnet supports virtual circuits between terminals and host computers.

FTP, which corresponds roughly to OSI layers six and seven—Presentation and Application, allows file transfer between dissimilar machines or operating systems. Layer six determines data forms and data representation, and layer seven performs applications and provides semantics specific to application programs and functions. Such applications include electronic mail and filing.

ARP, which is required for use with Ethernet, maps IP addresses to Ethernet addresses, and ICMP includes a set of functions for network-layer management and control.

Users in the UNIX environment have adopted two other simple protocols that are not Defense Department standards: RLogin and RCopy. Users sometimes employ RLogin as an alternative to Telnet for remotely logging into one UNIX system from a terminal attached to another UNIX system. However, RLogin does not

include all Telnet features, such as parameter negotiation. The other non-standard protocol, RCopy, is used to move files between UNIX hosts.

These layers are fully compatible across all TCP/IP implementations. This means that Ethernet/IEEE 802.3-compatible devices running TCP/IP not only can coexist on the same cable, sharing the physical medium, but also can communicate with each other across that medium. Outside the LAN arena, users can find a comparable level of compatibility only in such mainframe protocols as IBM Corp.'s Systems Network Architecture.

**TCP/IP market emerges**

A number of third-party vendors of TCP/IP equipment have emerged to serve the growing user market. In the last several years, a variety of products has become available, developed by companies as well as by universities. A partial list of these include:

- Bridge Communications Inc., which offers a family of terminal servers and internetwork gateways implementing the TPC/IP protocols (see "Alternative approaches exist to TCP/IP implementation," Page 112). These products attach terminals and other devices to TCP/IP-based Ethernets; establish communications between multiple TCP/IP Ethernets and between TCP/IP Ethernets and other networks, including broadband LANs and SNA; and provide network-management capability with complete session audit-trail data.

- Communication Machinery Corp., which provides a TCP/IP-based Ethernet controller to work with its Internet TCP/IP software. This software includes military-specification versions of TCP/IP, ARP, ICMP and UDP, as well as Defense Department-defined FTP and Telnet utilities. Another product, the QM100 networking package, allows a host to communicate on a TCP/IP LAN and includes Defense Department-defined FTP and Telnet.

- Data General Corp., which offers Ethernet/IEEE 802.3 that works with TCP/IP implementing Berkeley UNIX 4.2 and Defense Department specifications.

- Excelan Inc., which offers the EXOS 201, 202, 203, 204 and 205 family of Ethernet boards that runs the EXOS 8010, 8011, 8012 and 8040 TCP/IP software. These products allow PC/ATs; DEC VAXes and MicroVAXes; and UNIX-based Multibus, VMEbus and Q-bus workstations to communicate over an Ethernet and implement TCP/IP, Telnet and FTP.

- Internet Systems Corp., which offers a family of hardware and software solutions, including an IBM channel interface, to connect various

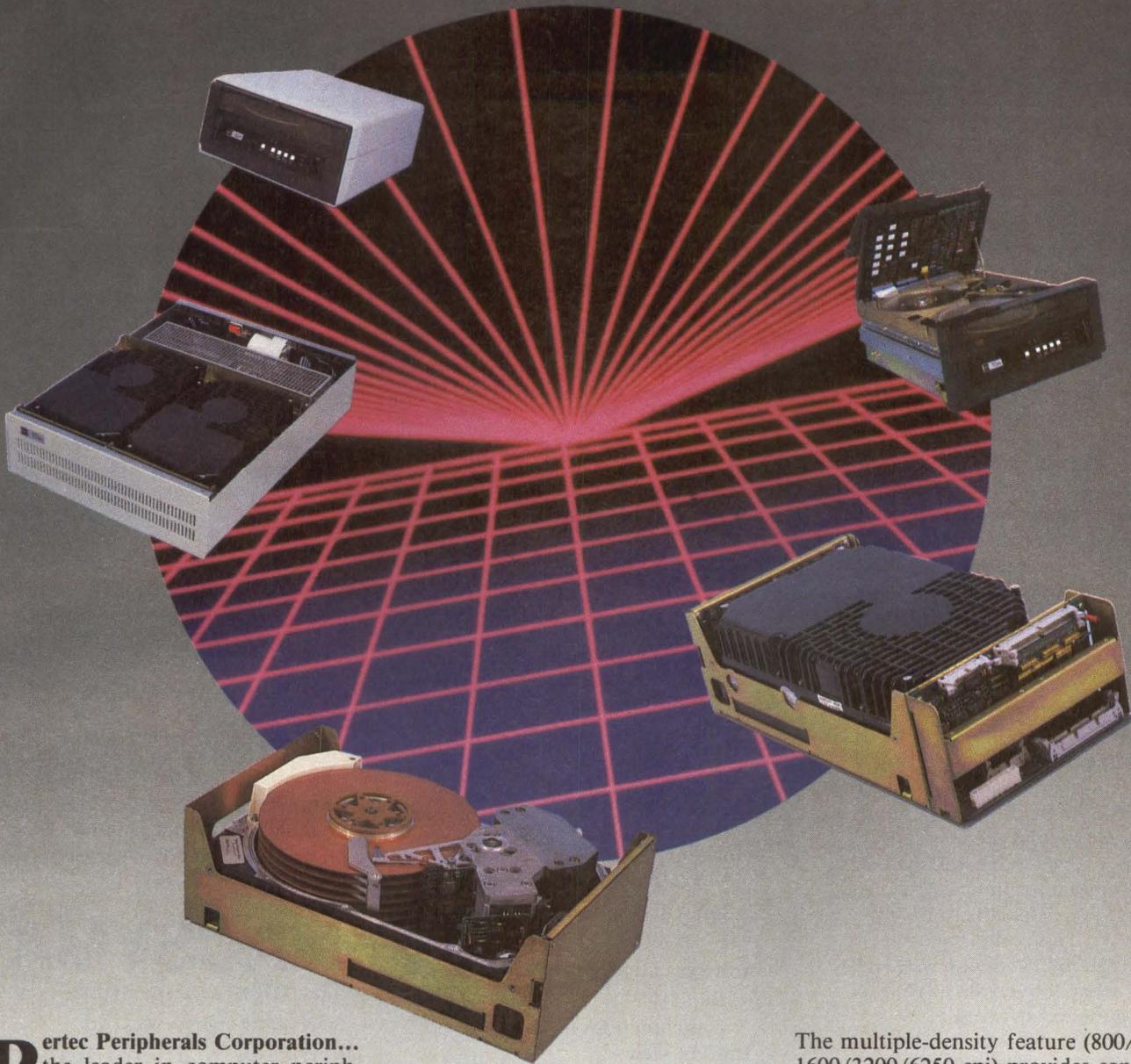
**HOW ISO CORRESPONDS TO XNS, TCP/IP**

ISO OSI model	XNS	TCP/IP	ISO STANDARDS
7 APPLICATION			ISO VTP.* FTAM**
6 PRESENTATION		TELNET/FTP+	ISO PRESENTATION
5 SESSION	COURIER		ISO SESSION
4 TRANSPORT	SPP++	TCP†	ISO TRANSPORT
3 NETWORK	IDP‡	IP#	ISO NETWORK
2 DATA LINK	ETHERNET	ETHERNET	IEEE 802.2
1 PHYSICAL	ETHERNET	ETHERNET	IEEE 802.3, 4, 5

- KEY:**  
 \*VTP = VIRTUAL TERMINAL PROTOCOL  
 \*\*FTAM = FILE TRANSFER, ACCESS AND MANAGEMENT  
 +FTP = FILE TRANSFER PROTOCOL  
 ++SPP = SEQUENCE PACKET PROTOCOL  
 †TCP = TRANSMISSION CONTROL PROTOCOL  
 ‡IDP = INTERNETWORK DATAGRAM PROTOCOL  
 #IP = INTERNETWORK PROTOCOL

*Although the XNS and TCP/IP architectures do not match exactly, the protocol layers correspond roughly to the OSI model.*

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minicomputers to a TCP/IP-based Ethernet.

- Proteon Inc., which provides ProNet-10 and ProNet-80 LANs with MS-DOS TCP/IP software. These products provide terminal emulation to a ProNet network interface unit and file transfers between PCs on other TCP/IP hosts. Using Proteon's VM/CMS TCP/IP, the LANs provide TCP/IP for the VM/CMS environment and remote login and file transfer with other TCP/IP hosts on the the ProNet ring. The VAX/VMS TCP/IP provides UNIX 4.2 facilities on a DEC VAX/VMS system and compatibility with all TCP/IP implementations.

- Spartacus Inc., which offers the K200 front-end processor that works with KNET networking software to allow an IBM mainframe to communicate over an Ethernet with IBM and non-IBM workstations and computers. KNET implements both TCP/IP and Xerox Network System (XNS) protocols from Xerox Corp.'s Systems Group. KNET also supports FTP and Telnet. The front-end processor interfaces via an IBM channel, and the TCP/IP protocols run on the mainframe. It allows devices on the TCP/IP network, such as engineering workstations or terminals on TCP/IP communications servers, to access IBM mainframes via a high-speed channel.

- The Wollongong Group, which provides a TCP/IP software implementation running under DEC's VMS operating system. Using the Wollongong approach, the protocols run on the main CPU with a non-intelligent Ethernet controller.

On the academic front, several universities have developed TCP/IP products. Among them are:

- Dartmouth College, which developed a TCP/IP port to the Apple Computer Inc. Macintosh personal computer. Mark Sherman, a Dartmouth computer scientist, developed the Macintosh port while he was working at Carnegie-Mellon University.

- The Massachusetts Institute of Technology, which developed TCP/IP for the IBM PC and compatibles. The package runs on a PC's MS-DOS operating system using an EtherLink Ethernet controller board from 3Com Corp. This software provides both Telnet and FTP support from the PC.

- The University of Wisconsin, which developed Wiscnet, a VM interface program marketed by IBM that provides TCP/IP to several LANs via the IBM Device Attachment Control Unit.

### Alternatives are available

Alternatives to TCP/IP consist chiefly of two other LAN protocol sets: the ISO-standard OSI reference model and XNS. OSI, although not yet available in many commercial products, is emerging as the standard for packet-switching local and wide area networks.

Many companies supplying or planning to supply network products have committed themselves to offering OSI-compatible equipment. The OSI protocol set received a major push

## Companies mentioned in this article

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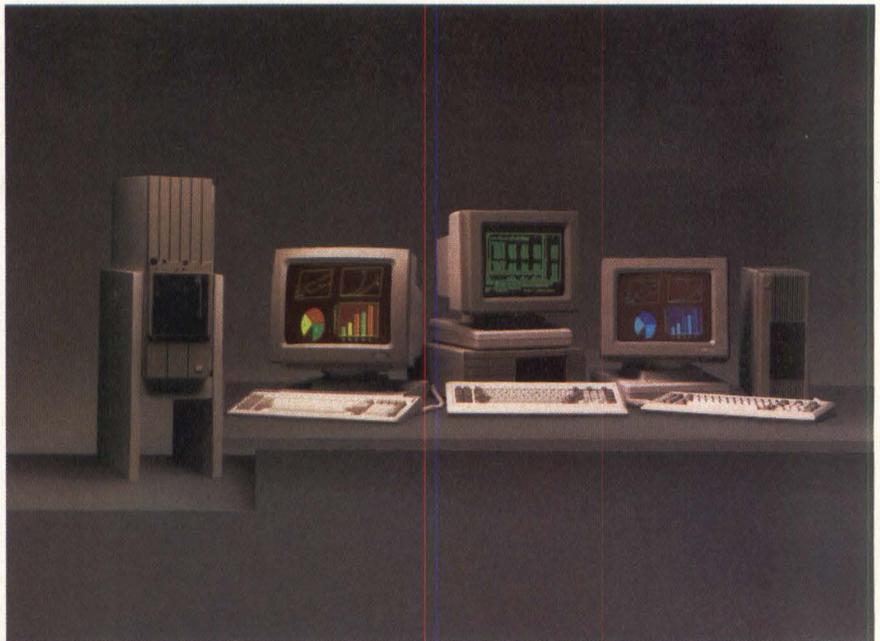
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when numerous vendors exhibited partial implementations as part of the Manufacturing Automation Protocol (MAP) demonstration by General Motors Corp. at the 1984 National Computer Conference.

But users are still waiting for MAP or any other full commercial implementation of the ISO protocols. Part of the reason is that the initial OSI standard, which was the reference model, addresses network architecture, but only over the last two years has it addressed the implementation of any network. Thus, any two network vendors using only the OSI standard as a reference would most likely build two incompatible networks. However, now that published drafts are becoming available, products will be available by year-end.

**XNS, TCP/IP share roots**

The other major alternative to TCP/IP is Xerox's XNS, which became publicly available in 1981. An evolution of TCP/IP, XNS was the first de facto standard protocol set and is in widespread use, mainly in the office-automation and product-development environments.

XNS is commonly run over Ethernet, which conforms with the OSI model at layers one and two—the Physical and Data-Link layers. Layer one, the connection to the cable that physically links the systems, transmits bits on a communications path, which is independent of the technology. The path can include coaxial cable, optical links or microwave transmissions. Layer two organizes bits into messages and provides the functions and procedures to establish, maintain and release data-link connections.

XNS shares roots with TCP/IP: Both were developed as a result of DARPA-funded research at Stanford University and share the layer-three datagram concepts on which higher level protocols are based. Because TCP/IP was developed for public networks, it has a more cumbersome architecture than does XNS, which is a second-generation protocol designed specifically for LANs. Xerox published some protocols at layers five, six and seven of XNS in 1984 and has released two applications: the Raster Encoding Standard for bit graphics and the Printer Integration Service for page-formatting software. However, unlike TCP/IP, XNS offers no virtual-terminal protocol standard.

XNS implementations typically offer approximately twice the performance of equivalent TCP/IP implementations. Two key factors contribute to this performance. First, XNS is packet-oriented, which allows more efficient processing than with byte-oriented TCP/IP. The packet-oriented XNS allows the implementor to allocate

buffers more efficiently than is possible with TCP/IP.

Second, TCP/IP, unlike XNS, has mandatory checksums—a summation of digits or bits according to an arbitrary set of rules—slowing transmission.

XNS also offers strong internetworking capability, especially as it relates to dynamic routing, the ability to route data along the shortest path when load or error conditions change.

One major drawback of XNS, however, is that it has not been standardized above its Sequence Packet Protocol—the fourth, or Transport, layer in the OSI model. TCP/IP has been able to make significant inroads because its highest layers, Telnet and FTP, are standard across all implementations of the protocol set. □

**Judith Estrin** is executive vice president, research and development, and **William Carrico** is president of Bridge Communications Inc., Mountain View, Calif.

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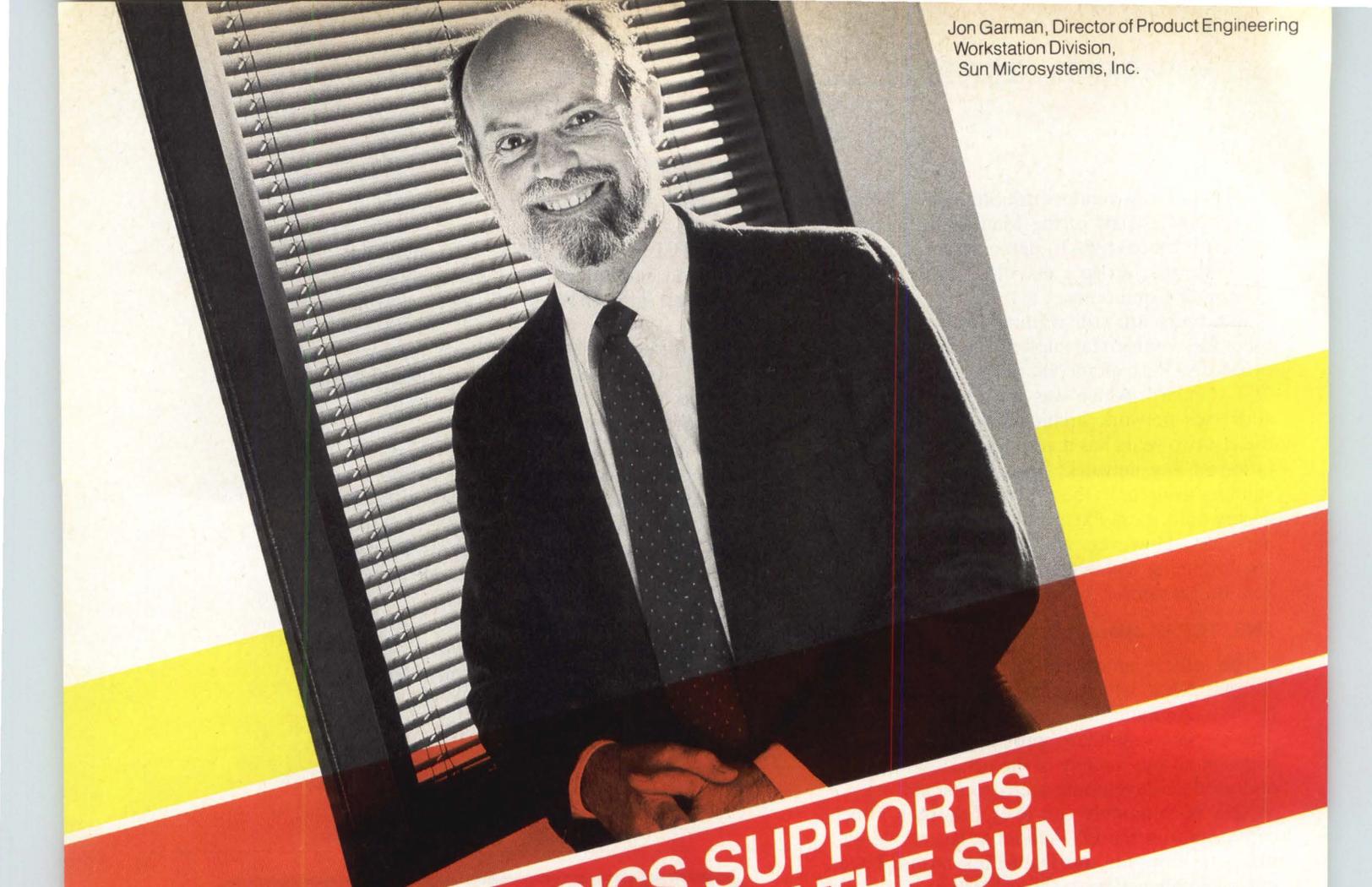


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*"We needed a fast Multibus SMD disk controller, one that could read fast drives, like the Fujitsu Eagle, at full speed,"* says Sun Director Jon Garman. *"The boards we were evaluating simply couldn't measure up."*

That's when Sun discovered Xylogics.

*"Getting Xylogics' 440 controllers operational with Sun's workstations was a positive experience,"* Garman remembers. *"What the manual said, the Xylogics boards did, and the software interface was simple to use."*

*"We had our first Xylogics board up and running with UNIX in just four hours. It was quite phenomenal,"* he says.

Next, Sun integrated the Xylogics 450 in its second-generation family of workstations because it was the fastest, most reliable Multibus board they could find.

*"From the start, our number one concern has been performance,"* says Garman. *"But just*

*as important is the support Xylogics gives us. They've always been very responsive.*

*They listen. And take us seriously. We have a close working relationship: engineering to engineering and management to management. They've always delivered on their promises."*

Xylogics' newest product, the 751 VME controller, is now being integrated into Sun's third generation of workstations, The Sun-3 Series.

Little wonder that Xylogics is the secret behind virtually every supermicro and workstation company. Or that nearly half of all high performance Multibus disk and tape controllers in use today are Xylogics.

Find out how Xylogics performance, reliability and support can be part of *your* success story. Call or write for information about our complete line of Multibus and VME bus products.

**THE SECRET'S OUT.**



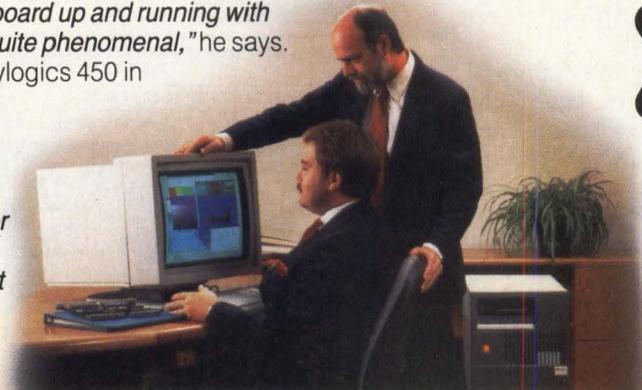
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(617) 272-8140

Kevin Gonor, Xylogics and Jon Garman,  
Sun Microsystems, with Sun-3/160 C  
Color Workstation

CIRCLE NO. 61 ON INQUIRY CARD



# NEW PRODUCTS

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## SYSTEMS

Megan Nields, Assistant Editor

### Portable offers IBM compatibility

- 512K-byte RAM
- 80-by-25 LCD
- 3½-inch disk drive

An IBM-compatible, nine-pound, portable personal computer, the T1100 provides 512K bytes of RAM and a 720K-byte, 3½-inch, flexible disk drive. The system offers a 640-by-200-pixel, 80-character-by-25-line LCD and an 83-character keyboard. Peripheral interfaces for an RGB graphics monitor and parallel printer are standard. Options include a 300-bps modem, a printer and a multi-function card with an asynchronous communications port. \$1,999. **Toshiba America Inc.**, Information Systems Division, 2441 Michelle Drive, Tustin, Calif. 92680, (714) 730-5000.

Circle 294

### PC employs 80286 microprocessor

- IBM PC/AT compatible
- 512K-byte RAM
- MS-DOS 3.1

Based on an Intel 80286 microprocessor, the Tandy 3000 personal computer operates 33.3 percent faster than the IBM PC/AT. The IBM-compatible system is available with a 1.2M-byte flexible disk drive or an additional 20M-byte rigid disk drive. Both configurations include 512K bytes of RAM; the MS-DOS 3.1 and XENIX 5.0 operating systems are offered. \$2,599, flexible disk system; \$3,599, 20M-byte rigid disk system. **Tandy Corp./Radio Shack**, 1800 One Tandy Center, Fort Worth, Texas 76102, (817) 390-2129.

Circle 295

### Image scanner suits IBM PC

- 300 dpi
- 2,552 by 3,508 pixels
- Interface board

Targeting OEMs and system integra-

tors, the 730 Word Image Processing System interfaces to the IBM PC, PC/XT, PC/AT and compatibles. The scanner provides image resolutions of 2,552 by 3,508 pixels or 1,725 by 2,233 pixels at 300 or 200 dpi, respectively, over an 8½-inch-by-11-inch document. It consists of the model 230 Image Scanner, an interface board for the PC, interconnecting cable and proprietary Word Image Processing System (WIPS) software. Windows can be created in either mode to scan a portion of the full area. \$4,950. **Datacopy Corp.**, 1215 Terra Bella Ave., Mountain View, Calif. 94043, (415) 965-7900.

Circle 296

### Workstation combines text and graphics

- 1,024 by 768 pixels
- 68000 microprocessor
- 16-page memory

The GraphText I, a graphics/text station, combines bit-map and raster-scan technology with a Motorola MC68000 microprocessor. As many as 16 pages of memory or graphics characters can be downloaded, stored and edited locally without accessing a host computer. Resolution is 1,024 by 768 pixels displayed on a 15-inch monochrome monitor. Operating with UNIX and VMS systems, the workstation is compatible with DEC VT52, VT100 and Tektronix 4010 and 4014 protocols. Intelligent host communication is performed via a Z80A microprocessor and a rapid host interface up to 1M byte per second. \$2,950. **Forward Technology Inc.**, 227 Devcon Drive, San Jose, Calif. 95112, (408) 971-6700.

Circle 297

### Single-user computer comes in two models

- 68000 CPU
- 512K-byte RAM
- 640 by 500 dots

A single-user 16/32-bit computer, the M68MX comes in two hardware configurations. Both models offer a Motorola

68000 CPU running at 10 MHz, 512K bytes of RAM and 16K bytes of ROM. Memory is expandable to 2.5M bytes on the Mark 20 and 3.5M bytes on the Mark 41. Both configurations display a resolution of 640 by 500 dots on a 12- or 14-inch screen. It operates under CP/M-68K Version 1.2; BASIC, SVS-FORTRAN, RM-COBOL. Pascal and C Compiler software are supported. \$2,990, Mark 41; \$4,790, Mark 21. **Sord Computer of America Inc.**, Olympic Tower 6F, 645 Fifth Ave., New York, N.Y. 10022, (212) 759-0140.

Circle 298

### 3-D workstations stress I/O performance

- 68020 CPU
- 14 microprocessors
- Up to 32 bit planes

Based on the 8-MHz 68020 CPU, the IRIS Series 3000 real-time 3-D workstations offer improved I/O performance. The series comprises three products: IRIS 3010 terminal with a 20M-byte disk drive; IRIS 3020 workstation with a 72M-byte disk drive; and IRIS 3030 workstation with a 170M-byte disk drive. All units include 14 proprietary VLSI microprocessors, 2M bytes of memory expandable to 16M bytes, 8 bit planes expandable to 32 bit planes with a Z-buffer and a 20-slot chassis. A 19-inch RGB monitor is supplied. \$39,900, 3010; \$44,900, 3020; \$54,900, 3030. **Silicon Graphics Inc.**, 2011 Sterlin Road, Mountain View, Calif. 94043, (415) 960-1980.

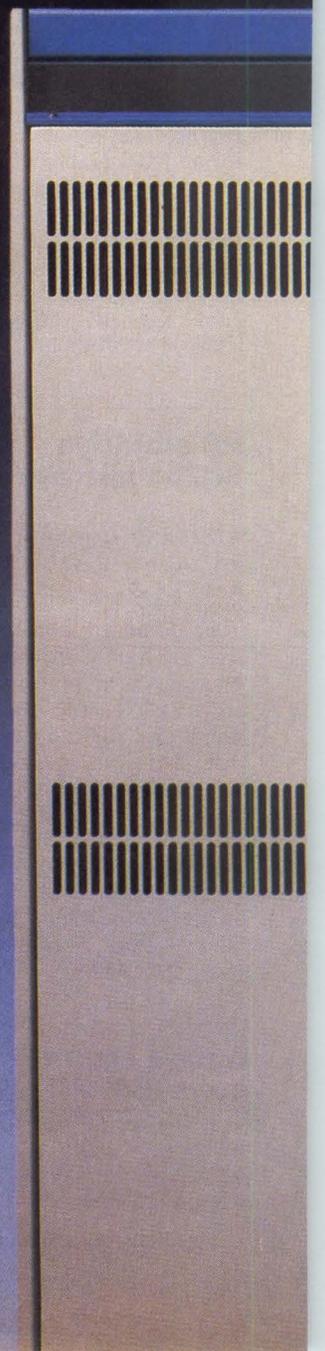
Circle 299

### UNIX systems support multiusers

- Three models
- Eight to 48 serial ports
- Dual 68010 processors

Consisting of three models, the Ensign II computers handle multiuser, multitasking UNIX applications. Model S-6810 supports eight serial ports, 1M byte of memory, three 5¼-inch rigid disk

**OUR 310 AP HAS RATHER  
ORDINARY PERFORMANCE  
COMPARED TO  
MOST MINICOMPUTERS.**



Its CPU performance is only marginally faster than the VAX\*-11/780 shown on the right, for example.

And even with a couple additional high-performance application boards slugged in, it can't quite keep up with a Wang VS300.

But this parity changes to a powerful competitive edge when another

number is considered.

Cost.

Our new 310 AP gives you over 1 MIP of CPU performance for under \$20,000. (A fifth the price of a mini.) And you can add up to three additional CPU boards to provide up to 5 MIPS of performance, for under \$50,000.

Which makes this either one of the most ordinary minis around, or the most extraordinary supermicro.

But what's in a name? Performance is performance, whatever name it goes by. And with this expandable system you can cost-effectively deliver the performance your customers need.

An expandable open system like this allows you to avoid obsolescence by making future upgrades of performance and/or functionality without having to buy a new system.

But there are open systems and there are open systems.

The starting point for any open system that really is an open system is, of course, standards.

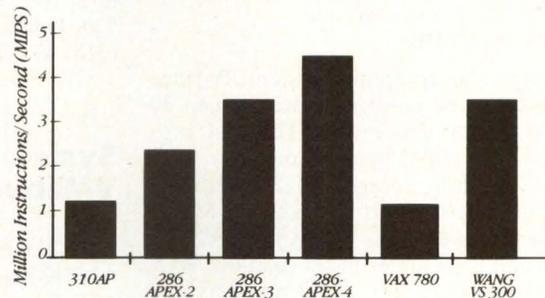
We support more standards than anybody. So we can offer a *complete*

open system, and a complete open product line — from operating systems to applications software to networking — all based on standards.

And because the 310 is a truly open system, you can have more than 50 independent software packages. More memory if you want it. Or additional Winchester drives.

And all our systems are supported fully by our

Composite MIPS Rating



worldwide customer service organization.

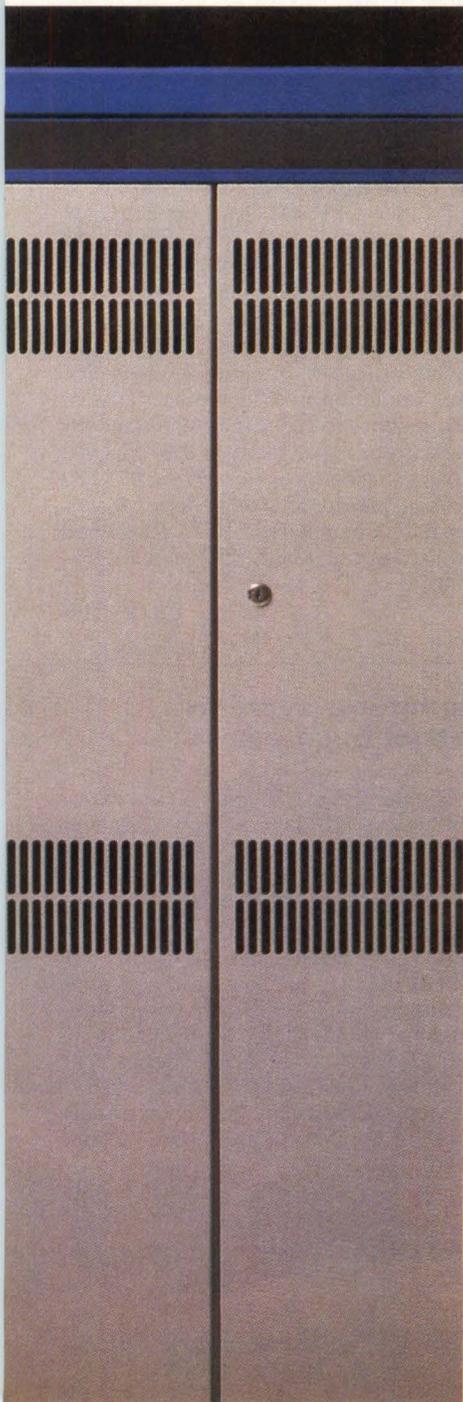
When new technology comes along our systems don't get obsolete and replaced, they get upgraded.

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## SYSTEMS

drives and an optional 6881 floating-point processor. Model D-6810 provides 16 serial ports upgradable to 32 ports, dual 68010 processors, 3M bytes of memory and a 1M-byte disk buffer. Model T-6820 is a 32-bit, 68020-based system that accommodates up to 48 serial ports and 8M bytes of memory. Starts at \$5,995. **Integrated Business Computers**, 21621 Nordhoff St., Chatsworth, Calif. 91311, (818) 882-9007.

Circle 300

### Parallel system handles 30 processors

- 48M bytes of memory
- Up to 256 terminal lines
- 2.8 to 21 MIPS

A parallel computing system, Balance 21000 can be configured with up to 30 32032 32-bit processors. The unit provides up to 48M bytes of memory, 10G bytes of disk storage and 256 terminal lines. It delivers from 2.8 to 21 MIPS, performing twice as fast as the VAX-11/780 and three times faster than the VAX 8650. Network ports, I/O adapters and memory capacity are expandable. \$139,000 to \$500,000. **Sequent Computer Systems Inc.**, 15450 S.W. Koll Parkway, Beaverton, Ore. 97006-6063, (503) 626-5700.

Circle 301

### Computer offers PC compatibility

- Three configurations
- 8088 microprocessor
- 256K bytes of RAM

An IBM PC-compatible, 16-bit desktop computer, the Equity I comes in three configurations. The basic unit contains an 8088 microprocessor, 256K bytes of RAM expandable to 640K bytes, a 5¼-inch flexible disk drive, an IBM AT-style detachable keyboard and a Centronics parallel printer port. The other configurations come with dual flexible disks or a single flexible disk with a 20M-byte internal rigid disk. \$995, basic; \$1,295, dual flexible; \$2,195, flexible/rigid. **Epson America Inc.**, Computer Products Division, 2780 Lomita Blvd., Torrance, Calif. 90505, (213) 539-9140.

Circle 302

### Computers support four to 20 users

- Nine models
- 8 MHz to 16.67 MHz
- SCSI interface

The QT family of multitasking computers supports four to 20 users. Nine models are offered that use the 68008, 68000 or 68020 CPU with speeds ranging from 8 MHz to 16.67 MHz. The units provide up to 2M bytes of RAM and 256K bytes of ROM. They supply a built-in SCSI interface and support any rigid disk drive. An OS9/68K operating system is included. The computers occupy less than one square foot of space. \$2,095 to \$8,795. **Frank Hogg Laboratory Inc.**, 770 James St., Syracuse, N.Y. 13203, (315) 474-7856.

Circle 303

### Systems utilize VMEbus

- 68020 CPU
- 655K-byte flexible drive
- V/68 operating system

Desktop systems 1121 and 1131 are run by 16-bit 68010 and 32-bit 68020 processors, respectively. The VMEbus-based units handle three or four users while running the System V/68 operating system. Model 1121 comes with 1M byte of DRAM and a 40M-byte rigid disk drive. Model 1131 includes 2M bytes of DRAM and a 70M-byte rigid disk drive. Both devices provide a 655K-byte flexible disk drive. \$12,495, 1121; 14,995, 1131. **Motorola Semiconductor Products Inc.**, P.O. Box 20912, Phoenix, Ariz. 85036, (602) 438-3501.

Circle 304

### Portable computer weighs 23.6 pounds

Available in three configurations, the Compaq Portable II computer weighs 23.6 pounds and measures 7.5 inches high by 13.9 inches deep by 17.7 inches wide. The unit uses the 80286 microprocessor to run most business software 3-to-5 times faster than the IBM PC, PC/XT and 8088-based compatibles. Features include an 84-key keyboard, a dual-mode monitor and two expansion slots.

Models 1 and 2 supply one and two 360K-byte flexible disk drives, respectively, and 256K bytes of RAM. Model 3 offers a 360K-byte disk drive, one 10M-byte fixed disk drive and 640K bytes of RAM. \$3,499, Model 1; 3,599, Model 2; \$4,799, Model 3. **Compaq Computer Corp.**, 20555 FM149, Houston, Texas 77070, (713) 370-0670.

Circle 305

### Systems aim at OEMs, VARs

Aiming at OEMs, VARs and system integrators, the System 19 workstation utilizes single and multiprocessor open system architecture as well as a 32-bit, 12M-byte-per-second asynchronous bus. The 68020-based CPU contains from 2M to 5M bytes of RAM. An Ethernet LAN interface and two RS232C ports are standard. A pixel resolution of 1,280 by 1,024 is displayed on a 19-inch, 60-Hz non-interlaced monitor. Up to 256K bytes of on-board memory are provided. A color display processor provides 1,024-by-768 pixel resolution and four planes of display memory to support 16 simultaneous colors from a palette of 4,096. \$13,000 and up, single processor systems; \$21,500 and up, multiprocessor systems. **Counterpoint Computers**, 2127 Ringwood Ave., San Jose, Calif. 95131, (408) 434-0190.

Circle 306

### Computer systems target business

The Series 70, 930 and 950 are extensions of the HP 3000 family of Spectrum business computers. A Series 70 system offers 8M bytes of main memory, two I/O channels and a 6,250-cpi magnetic tape drive; the Series 930 supplies 16M bytes of main memory, an HP ALLBASE/XL database, an HP System Dictionary and fundamental operating software. \$150,000 to \$210,750, Series 70; \$225,000 to \$284,500, Series 930; \$300,000 to \$350,000; Series 950. **Hewlett-Packard Co.**, 1820 Embarcadero Road, Palo Alto, Calif. 94303. Phone locally.

Circle 307

# YOU CAN OFFLOAD YOUR PC COMMUNICATIONS JUST LIKE YOU WOULD A MAINFRAME.

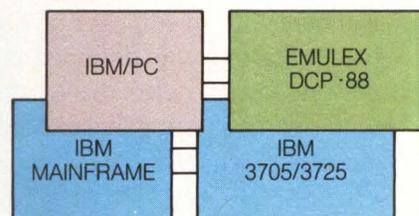
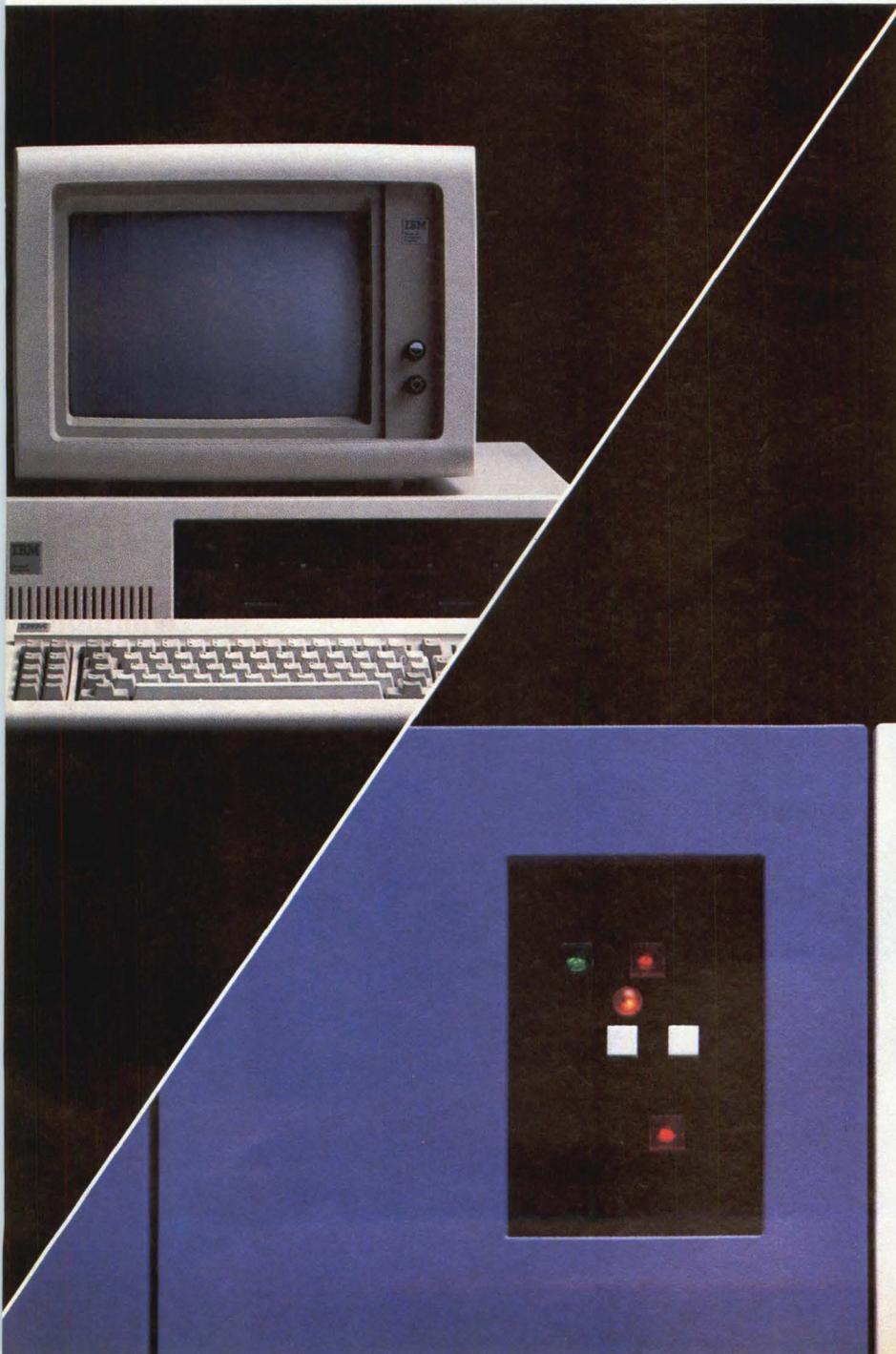
## DCP-88/VM, THE PLUG-IN FRONT END.

If communications overhead is wearing your system down, simply use our new DCP-88/VM Front End Communications Processor.

### ALMOST ENDLESS APPLICATIONS.

The DCP-88/VM is ideal for integrating workstations, like RJE, on-line reservation systems, manufacturing

automation and financial banking applications. It's equally recommended for protocol converters, instrumentation, process control, off loading printer control, or virtually any other application that involves communications processing on a PC.



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Get up to 512 KB RAM, four multi-protocol serial ports, a high speed parallel printer port—all on one board. Naturally, we support ASYNC, SYNC, BISYNC, SDLC and HDLC (X.25) protocols. And thanks to shared memory architecture, data and control information move at memory speeds.

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Emulex fully supports the DCP-88/VM with a wide variety of software. This includes Real-Time Executive. Plus PC/3780, PC/HASP, PC 3270 BISYNC, PC/3270 SNA and PC/X.25.

With so much to offer, it's no wonder we're fast becoming an industry leader.

So offload your PC with the DCP-88/VM, the plug-in front end from Emulex. Call toll free 1-800-EMULEX3. In California, (714) 662-5600. Or write: Persyst Products, Emulex Corporation, 3545 Harbor Boulevard, P.O. Box 6725, Costa Mesa, CA 92626.



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CIRCLE NO. 68 ON INQUIRY CARD

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Building world-class drives takes world-class design and manufacturing capabilities.

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Our 5¼" Winchester line is also designed and built with an emphasis on QA few vendors can match. Starting with designed-in quality, progressing to zero defect manufacturing and finishing with rigorous testing that exceeds typical industry practice.

The result is that all our drives provide lower cost of ownership. Extremely low reject rates. Lower support costs. And high MTBFs.

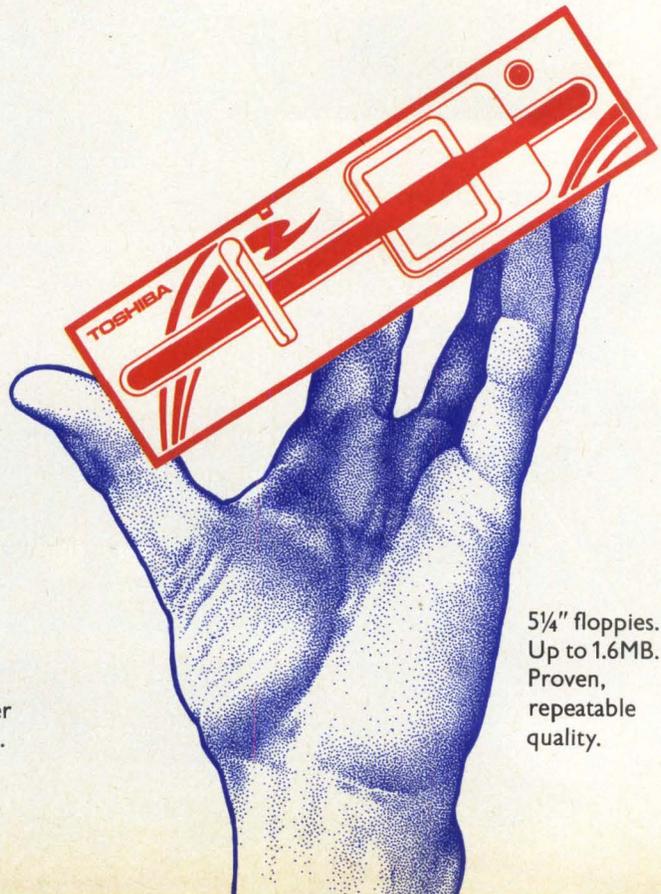
But building world-class quality into our drives is only half the story. Which is why every drive we build comes with world-class support.

Starting with support during your evaluation of our drives. We've probably already qualified your controller to make sure that our drives are compatible with your system.

Our systems engineers will help you keep systems integration time to a minimum. So you can get your product to market on time.



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3½" floppies.  
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We can supply all your storage needs: 5¼" and 8" Winchester; 3½" and 5¼" floppies; and a range of optical products. And we're investing right now in the technology of the future. So we can continue to work with you for years to come.

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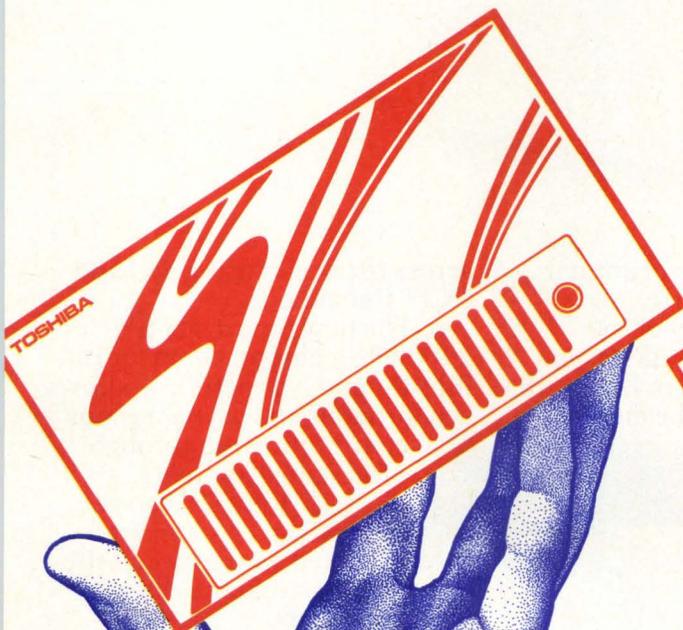
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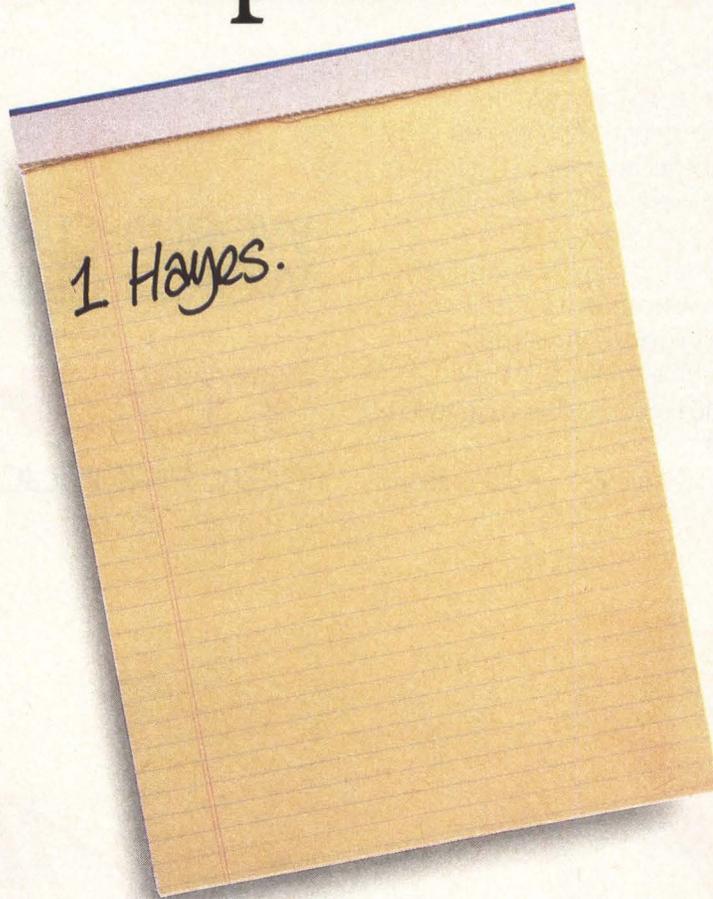
Field-proven.  
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Available now.



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CIRCLE NO. 69 ON INQUIRY CARD

# A complete list of things to know about 2400 bps modems.



Now that you've memorized that, here's a partial list of why a Hayes® Smartmodem 2400™ is best for you.

1. The Hayes Smartmodem 2400 allows you to communicate with the vast installed-base of 300,1200 and 2400 bps "Hayes-compatible" modems. The Hayes Standard "AT" Command Set allows you to use Smartcom II® and other software that communicates.

2. Through synchronous/asynchronous technologies, the Smartmodem 2400 permits your PC to access mainframes, minis, and on-line services previously inaccessible through asynchronous-only modems.

3. The Hayes Smartmodem 2400 is efficient...it pays for

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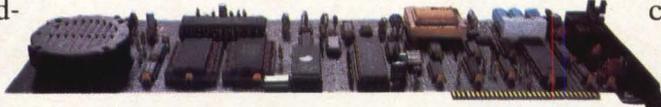
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Say yes to the future with Hayes.  
CIRCLE NO. 70 ON INQUIRY CARD

## Videotape backup subsystem suits IBM

- 80M bytes
- Disk-image backup
- File-by-file backup

Videotrax is a videotape-driven backup subsystem that provides 80M bytes of backup for IBM PC, PC/XT, PC/AT and compatibles. The unit employs standard videotapes and video cassette recorders (VCR). A circuit board converts data into a format that a VHS or Beta recorder can read. Running on menu-driven, MS-DOS-compatible software, the system offers two backup modes. High-speed, disk-image backup permits automatic detection of bad disk sectors for reassignment. File-by-file backup stores specific files by name. \$1,595. **Alpha Microsystems**, 3501 Sunflower, P.O. Box 25059, Santa Ana, Calif. 92799, (714) 957-8500.

Circle 308

## Optical disk subsystem stores 3G bytes

- SCSI interface
- 12-inch disk
- Voice, data storage

An optical disk subsystem for IBM PC, PC/XT, PC/AT, 3270 PC and compatibles, DISCUS 1000 stores up to 3G bytes of WORM data on a 12-inch, 1G-byte optical disk. The system controls up to 56 optical disk drives per computer. Each disk provides approximately 1 billion bytes of on-line storage. The SCSI-based unit utilizes proprietary host adapter interface cards and device driver software. All PC-DOS 3.1 functions can be used. \$21,500. **AGA Inc.**, 347 Fifth Ave., New York, N.Y. 10016, (212) 683-9160.

Circle 309

## CDROM drive holds 600M bytes

- 150K bytes per second
- 120-mm compact disks
- 1-msec access time

Aimed at OEMs and system integrators, the CM 100 ROM compact disk drive stores up to 600M bytes of data on standard 120-mm compact disks. Data is

digitally encoded, read optically by laser, decoded and then transferred to an output device or a computer. The unit has a track-to-track access rate of 1 msec and a data-transfer rate of 150K bytes per second. It is geared towards minicomputer and microcomputer environments. \$1,200. **Philips Subsystems and Peripherals Inc.**, 100 E. 42nd St., New York, N.Y. 10017, (212) 850-5125.

Circle 310

## Optical disk drive stores 100M bytes

- 5¼ inch
- 2.5M-bps transfer rate
- 200-msec access time

A 5¼-inch WORM optical disk drive, the 525 WC stores 100M bytes of formatted capacity and provides a 2.5M-bps data-transfer rate and a 200-msec average access time. The microprocessor-controlled unit offers built-in OROM and a standard ESDI interface. Average latency is 16.7 msec; rotational speed is 1,800 rpm. The device has 14,900 tracks with 32 sectors per track. Storage media is non-erasable. \$975, OEM quantities. **Information Storage Inc.**, 2768 Janitel Road, Colorado Springs, Colo. 80906, (303) 579-0460.

Circle 311

## Subsystem suits industrial OEMs

- 20M-byte storage
- 3½ inches
- Thin-film media

Targeting industrial OEMs, the HP 97503B is a 3½-inch, 20M-byte Winchester disk subsystem. The unit operates within a temperature range of zero to 60 C, without waiting for temperatures to stabilize after changes. Thin-film media contributes to higher shock tolerance. An electronic feedback system measures servo information written between each data sector, permitting the drive to read and write accurately. An IBM-compatible controller is also supplied. \$750. **Hewlett Packard Co.**, 1820 Embarcadero Road., Palo Alto, Calif. 94303, consult local directory.

Circle 312

## Optical system stores 100M bytes

- 200-msec access time
- 15,000-hour MTBF
- 2.5M bps

BP-100+ is a portable write-once laser storage system for the IBM PC, PC/XT, PC/AT and compatibles. Storing 100M bytes on one side of a proprietary 5¼-inch optical disk, the unit supplies a data-transfer rate of 2.5M bps and an average access time of 200 msec. Rotational speed is 1,800 rpm. The device comes with a board for plug-in power and interface connections. It weighs six pounds and has a 15,000-hour MBTF. \$4,995. **Portable Solutions Inc.**, Suite 250, 1701 Directors Blvd., Austin, Texas 78744, (512) 448-4965.

Circle 313

## Tape drive furnishes file-by-file backup

- 10M bytes
- 20M-byte cassette
- Three software modes

The MaynStream PCi 20 streaming-tape system backs up 10M bytes in 3 minutes, file-by-file, on a one-eighth-inch, 20M-byte data cassette. The internally-installed unit incorporates file-splitting and automatic read-after-write checks and backs up non-DOS partitions. Three software modes are offered: Save, Tmenu and Advanced Command Structure. A controller interface card is included. \$1,299. **Maynard Electronics**, 460 E. Semoran Blvd., Casselberry, Fla. 32707, (305) 331-6402.

Circle 314

## Disk drives provide 1M-byte capacity

Geared toward the portable computer market, the ND-351S and ND-352S are inch-high, 3½-inch disk drives. They have a capacity of 0.5M bytes, single-sided, or 1M byte, double-sided. The data transfer rate is 250K bps. The units have a 10,000 hour MBTF. \$100, sample price; OEM pricing available. **Toshiba America Inc.**, OEM Division, 2441 Michelle Drive, Tustin, Calif. 92680, (714) 730-5000.

Circle 315

## PRINTERS

**Printers run at 200 cps**

- 80, 136 columns
- IBM, Diablo 630 compatible
- 55 dB(a)

Printing 100 cps, letter quality and 200 cps, draft, models 1025 and 1020 of the 1000 series are dot-matrix, desktop printers with 80- and 136-column carriage widths, respectively. Hardware and software compatibility is achieved through plug-in cartridges that emulate the IBM Graphics Printer, Epson FX series, IBM Color Printer, Diablo 630 and the Genicom 3000 series. The units use an 18-pin, staggered printhead to produce 400-dpi-resolution graphics. A 2K-byte buffer is standard. Features include a 55 dB(a) noise level, bidirectional, double-strike and proportional printing and selectable fonts. \$699, model 1025; \$899, model 1020. **Genicom Corp.**, Waynesboro, Va. 22980, (703) 949-1188.

Circle 316

**Spooler cuts laser-printer costs**

- 150 to 19.2K baud
- Six ports
- 128K-byte buffer

An automatic, software-controlled, six-port switch and printer spooler, the PrintManager 128 provides a 128K-byte buffer to store output from up to five CPUs. It cuts the cost of laser printers to \$700 per workstation. The transparent unit can be switched while transferring data at 19.2K baud. Handling printers from 150 to 19.2K baud, the spooler is controlled through batch commands at the operating level and by selection codes sent by applications software. Six port models are available for four or five serial CPUs and one or two serial or parallel printers. \$945. **PrintManager**, 108 Water St., Watertown, Mass. 02172, (800) 243-2333.

Circle 317

**Color printers target OEMs**

- 30, 45 ppm
- Ion deposition
- 240, 300 dpi

Geared towards OEMs and system in-

tegrators, the S3000 and S4500 non-impact, ion-deposition page printers produce 30 and 45 ppm, respectively. Both units feature built-in diagnostics allowing for automatic self-test on startup and cut-sheet output. The desktop printers offer 240 or 300 dpi resolution. They can be configured with dual input trays and a 2,000-sheet capacity. Job separation and a 10-bin sorter aid word processing and graphics applications. Centronics or Dataproducts interfaces are standard. \$9,900, S3000; \$11,900, S4500. **Delphax Systems**, 315 University Ave., Westwood, Mass. 02090, (617) 461-1410.

Circle 318

**Dot-matrix printer offers color**

- 150 cps
- Four-color ribbon
- Raster, mosaic graphics

A dot-matrix, color microprinter, the 857 uses a four-color ribbon to create seven colors. The unit runs at 150 cps, draft, in a 9-by-9 dot matrix, and 35 cps, letter quality, in a 15-by-18 dot matrix. It provides interchangeable typeface fonts and raster and mosaic graphics. Parallel and serial interfaces are standard. The printer operates with virtually all personal computers. Features include friction and tractor mechanisms and a screen-dump utility disk. Uses 3-to-11-inch-wide paper. \$899. **Texas Instruments Inc.**, Data Systems Group, P.O. Box 809063, H-819, Dallas, Texas 75380-9063, (800) 527-3500.

Circle 319

**Laser printer breaks \$2,000 barrier**

- 78K-byte memory
- 300 dpi
- 68000 microprocessor

Costing 30 percent less than other non-impact laser printers, the QMS KISS prints up to 6 ppm while emulating Diablo, Epson and Qume units. It offers nine fonts that allow up to 40 print combinations, a Motorola 68000 microprocessor and 78K bytes of accessible memory that permit text and graphics to be intermixed on the same page. Resolution is 300 dpi, horizontal and vertical. Features include a 55-dB(a) noise level and a 256K-byte

system ROM. \$1,995. **QMS Inc.**, P.O. Box 81250, Mobile, Ala. 36689, (205) 633-4300.

Circle 320

**Dot-matrix printer achieves 200 cps**

- 8K-byte buffer
- 136 columns
- NLQ mode

Running at 200 cps, draft, and 40 cps, NLQ mode, the FX-286 dot-matrix printer is 30 percent faster than its predecessor, the FX-185. The 136-column FX-286 prints documents and forms with graphics and text on the same page. A dip-switch-selectable dual identity allows it to emulate the IBM 4201 Proprinter as well as to operate with many software packages. An 8K-byte buffer, expandable to 32K bytes, frees the host computer for other tasks while the printer is still printing. Features include IBM character sets, a parallel interface and over 160 type-style combinations. \$749. **Epson America Inc.**, Computer Products Division, 2780 Lomita Blvd., Torrance, Calif. 90505, (213) 539-9140.

Circle 321

**Color plotter suits personal computers**

- Seven colors
- 203.2 by 200 dpi
- Thermal transfer

A thermal-transfer plotter for personal computers, ColorMaster creates both color and monochrome graphics and text. It generates seven colors by directly overlaying dots in yellow, magenta and cyan. Resolution is 203.2 by 200 dpi. Up to 100 plain-paper copies or 50 acetate copies can be printed automatically at speeds of 1.5 minutes per color copy and 45 seconds per monochrome copy. The IBM PC-compatible unit offers a built-in rasterizer containing a 512K-byte buffer. The plotter is compatible with many software packages including Zenographics and Lotus 1-2-3. \$4,995. **CalComp**, 2411 W. LaPalma Ave., Anaheim, Calif. 92801, (714) 821-2142.

Circle 322

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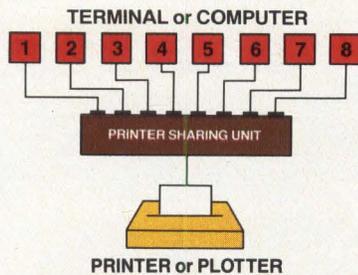
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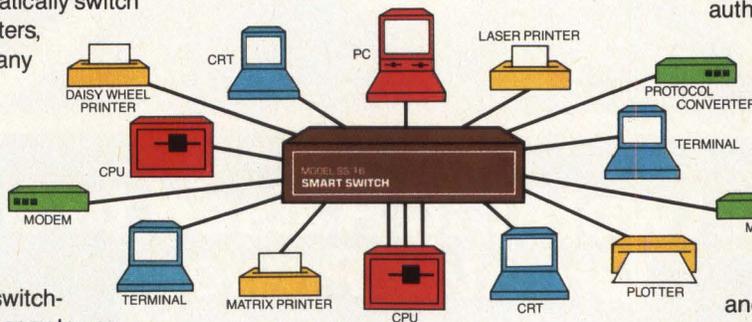


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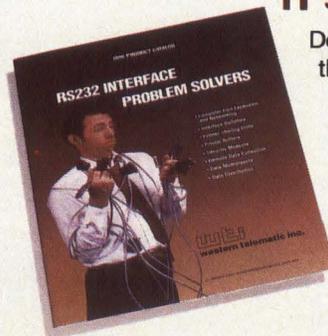
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CIRCLE NO. 72 ON INQUIRY CARD

MINI-MICRO SYSTEMS/May 1986

## Graphics terminal provides color

- 640 by 480 pixels
- 16 colors
- 14-inch screen

The MX-4000 color terminal utilizes a 16-bit Motorola MC68000 microprocessor for graphics and an 8-bit Motorola MC6809 for text processing. Display format is 32 lines by 80 or 132 columns on a 14-inch screen with a 60-Hz, non-interlaced refresh rate. As many as 16 colors are displayed from a 256-color palette. Resolution is 640 by 480 pixels. A minimum of 256K bytes of memory is provided for local pixel storage. The unit offers software-compatibility with Tektronix 4107, 4010 and 4014 terminals in graphics mode and DEC VT100 and VT220 terminals in alphanumeric mode. Features include horizontal and vertical pan, zoom and RS232C, RS423 and Centronics compatibility. \$4,995. **Pericom Inc.**, 51 Digital Drive, Novato, Calif. 94947, (415) 382-8800.

Circle 323

## Touch-screen system targets OEMs

- 3D crosspoints
- Five- to 25-inch displays
- 16 pressure levels

Based on surface-acoustic-wave technology, the acoustic touch screen offers crosspoints in three dimensions. The unit can be customized for color or monochrome displays ranging from five to 25 inches. It provides up to 50 touchpoints per inch (512 by 384 on a 14-inch diagonal display) and up to 16 pressure levels. \$150, Q2,000. **Zenith Electronics Corp.**, 1000 Milwaukee Ave., Glenview, Ill. 60025, (312) 391-8181.

Circle 324

## Display controller supplies graphics

- 256 colors
- 4M-byte RAM
- 1,024 by 1,024 by 8 bits

Displaying 256 simultaneous colors from a 16.7-million-color palette, the OMNI 1200 GDC is a single-board

graphics controller. The unit provides 2,048 by 2,048 by 8 bits of addressable video-memory with 1,024 by 1,024 by 8 bits of viewable resolution. Onboard memory consists of a 4M-byte display RAM, a 256K-byte display list and image-processing RAM and a 64K-byte EPROM containing OMNI GKS firmware. Local intelligence allows pictures to be defined using graphics elements such as circles, text, lines, polygons, ellipses and segments. \$5,500, Q50. **Omnicomp Graphics Corp.**, 1734 W. Belt North, Houston, Texas 77043, (713) 464-2990.

Circle 325

## Terminal suits IBM PC

- 14-inch screen
- 80 or 132 columns
- IBM compatible

Geared toward the IBM PC, PC/XT, PC/AT and compatibles, the PCTerm multiuser CRT terminal provides a 14-inch green or amber screen that displays 256 characters and supports 80 or 132 columns. It has two RS232C ports that can be configured as host ports. One port connects to the PC and the second to another host, simultaneously. The unit emulates the Wyse WY-50 and the TeleVideo 925 terminals. Features include non-volatile programmable function keys, 26 display lines and two pages of memory. \$649. **Link Technologies Inc.**, 2260 Paragon Drive, San Jose, Calif. 95131, (408) 943-0143.

Circle 326

## Terminal features DEC VT220 emulation

- 14-inch screen
- Up to 26 lines
- 80 or 132 columns

A graphics-display terminal, the GO-220 emulates DEC's VT52, VT100 and VT220 terminals. The unit displays 24, 25 or 26 lines of 80 or 132 columns on a 14-inch screen. Resolution is 9 by 12 dots in a 13-by-15 cell or 7 by 12 dots in an 8-by-15 cell. The terminal holds four pages of text locally that can be scrolled or paged. It supplies a 60-Hz non-inter-

laced refresh rate and 32 screen-intensity levels. Features include bidirectional, split-screen smooth scrolling; self-test; and a VT100 graphics-character set. \$995. **GraphOn Corp.**, Tower One, 1901 S. Bascom Ave., Campbell, Calif. 95008, (408) 371-8500.

Circle 327

## Terminal emulates Wyse WY-150

- 14-inch screen
- 16 programmable keys
- 80 to 132 columns

The 450 terminal emulates the Wyse WY-50, TeleVideo TV 910, 920 and 925; ADDS Viewpoint, Hazeltine 1500 and Esprit I and II terminals. It provides a 14-inch monitor that displays up to 222 characters in a 7-by-9-dot matrix in an 8-by-12 cell. ANSI X.34 emulation is standard. The unit offers 16 programmable function keys, a soft setup mode and variable-speed smooth-scroll. A single key automatically switches from 80 to 132 columns. \$595. **Micro-Term Inc.**, 512 Rudder Road, St. Louis, Mo. 63026, (314) 343-6515.

Circle 328

## Terminal contains 24K bytes of memory

- 9-inch CRT
- Eight function keys
- Built-in modem

The Whisper Screen Series model 1922DB communications terminal offers 24K bytes of memory expandable to 48K bytes. It displays 80 columns by 25 lines on a 9-inch CRT. The detachable ASCII keyboard has 75 keys, including eight function keys. A built-in 212A modem permits communication with 110-, 300- and 1,200-baud computers or terminals. Two RS232C ports are standard. Features include auto-dial and auto logon, selective polling, multiple terminal configuration and message memory. \$1,795. **3M Teleterminal Products**, P.O. Box 33600, St. Paul, Minn. 55133-3600, (612) 733-7837.

Circle 329

### Modem operates at 2,400 bps

- IBM compatible
- Board-level
- Dial-up or leased operation

An internal board modem for the IBM PC, PC/XT, PC/AT and compatibles, Smartmodem 2400B operates at 300, 1,200 or 2,400 bps over standard dial-up or leased lines. The unit supports asynchronous and synchronous data transmission through a personal-computer communications port. It is compatible with Bell 103, 212A and international V.22 and V.22 bis specifications. Features include diagnostics, automatic speed adjustments and Hayes Smartcom II communications-software compatibility. \$739. **Hayes Microcomputer Products Inc.**, P.O. Box 105203, Atlanta, Ga. 30348, (404) 449-8791.

Circle 330

### Board links PCs to IBM minis

- Twinaxial cable
- Screen formatting
- IBM interface

The PCOX/5251 TWINAX add-in board and software connect IBM PC, PC/XT, PC/AT and compatibles to IBM System /34, /36 and /38 minicomputers via a twinaxial cable. The connection enables PCs to emulate IBM 5250 series terminals, including 5251 model 11 and 5291 models 1 and 2 monochrome displays and the 5292 color display. The unit also allows PC-attached serial or parallel printers to act like host-addressable, 5256 dot-matrix printers. The board-and-software product provides access to seven concurrent terminal or printer sessions. \$895. **CXI Inc.**, 3606 W. Bayshore Road, Palo Alto, Calif. 94303-4229, (800) 225-7269.

Circle 331

### Communication package targets IBM PC/XT/AT

- X.25
- MS-DOS, UNIX
- 32 sessions

An integrated software and hardware X.25 communication package for the

IBM PC, PC/XT, PC/AT and compatibles, PC.25 operates under MS-DOS and UNIX. The software supports the CCITT X.25 standard and multiple physical links. Link-level protocol is HDLC/LAPB. Hardware consists of a board using an Intel 16-bit 8088 processor, 64K bytes of dual-ported memory and one or two dual channel 8530-SCC serial communications controllers. The unit supports up to 32 simultaneous communication sessions. \$1,350. **ARC Data Systems Inc.**, 1824-D Fourth St., Berkeley, Calif. 94710, (415) 644-1554.

Circle 332

### Multiplexer runs at 19.2K bps

- Eight ports
- RS232C
- Full duplex

The QUICK MUX short-haul multiplexer links remotely located RS232C devices to a host computer via eight ports. Each port accepts full-duplex data at rates to 19.2K bps and supports two control signals. A built-in line driver communicates over 5,000 feet of twisted-pair wires. Diagnostic features include visual displays of receive data and transmit data for each port. Switches force a local loopback or the remote multiplexer performs a live loopback. \$548. **Telebyte Technology Inc.**, 270 E. Pulaski Road, Greenlawn, N.Y. 11740, (516) 423-3232.

Circle 333

### Half-card modem suits IBM PC

- 300 to 2,400 bps
- Bell 212A compatible
- Non-volatile memory

A half-card internally mounted modem for the IBM PC and compatibles, the Avatex 2400 operates at 300, 1,200 or 2,400 bps. It complies with V.22, V.22 bis and Bell 103 and 212A standards. The unit supplies analog and remote-digital loopback diagnostics with self-test. Features include non-volatile memory, call-progress detection and auto-origination with pulse and tone dialing. Character format is 8, 9, 10 or 11 bits. \$459. **E+E DataComm**, 2115 Ringwood Ave., San Jose, Calif. 95131-1725, (408) 263-1833.

Circle 334

### Modem performs diagnostics

- 4,800 bps
- V.27 modulation
- Multipoint operation

The PL 4.8 Plus diagnostic modem runs at 4,800 bps. It provides V.27 modulation and suits point-to-point or multipoint operation. A synchronous fallback speed of 2,400 bps is achieved. The unit measures receive levels, sends 1,004-Hz test tones and initiates loopbacks by local or remote control. Built-in addressable modem responders allow diagnostics to be generated from any point in the network. \$1,600. **DCB Inc.**, 4 Henson Place, Champaign, Ill. 61820, (217) 352-3207.

Circle 335

### Package simplifies IBM communications

- Terminal emulation
- 4,800-bps modem
- Auto-dialer

Achieving a communications link between IBM Systems /34, /36 and /38 and remote IBM PCs and compatibles, PC/5251 MATE integrates IBM 5251-12 terminal emulation, a synchronous modem and an auto-dialer on a single board. The package comes in two configurations. Mate-24 includes a 2,400-bps 201C-compatible modem for use in dial-up operations. Mate-48 supplies a 4,800-bps modem for dial-up or leased-line applications. They provide a PC-controlled automatic dialer and allow parallel printers attached to the PC to emulate IBM 5256 or 5224 printers. A "hot key" feature permits switching between terminal emulation and PC-DOS without interrupting communications. \$1,395, MATE 24; \$1,995, MATE 48. **Emerald Technology Group Inc.**, Suite 102, 1601 116th N.E., Bellevue, Wash. 98004, (206) 462-8200.

Circle 336

### Multiplexer accepts eight data streams

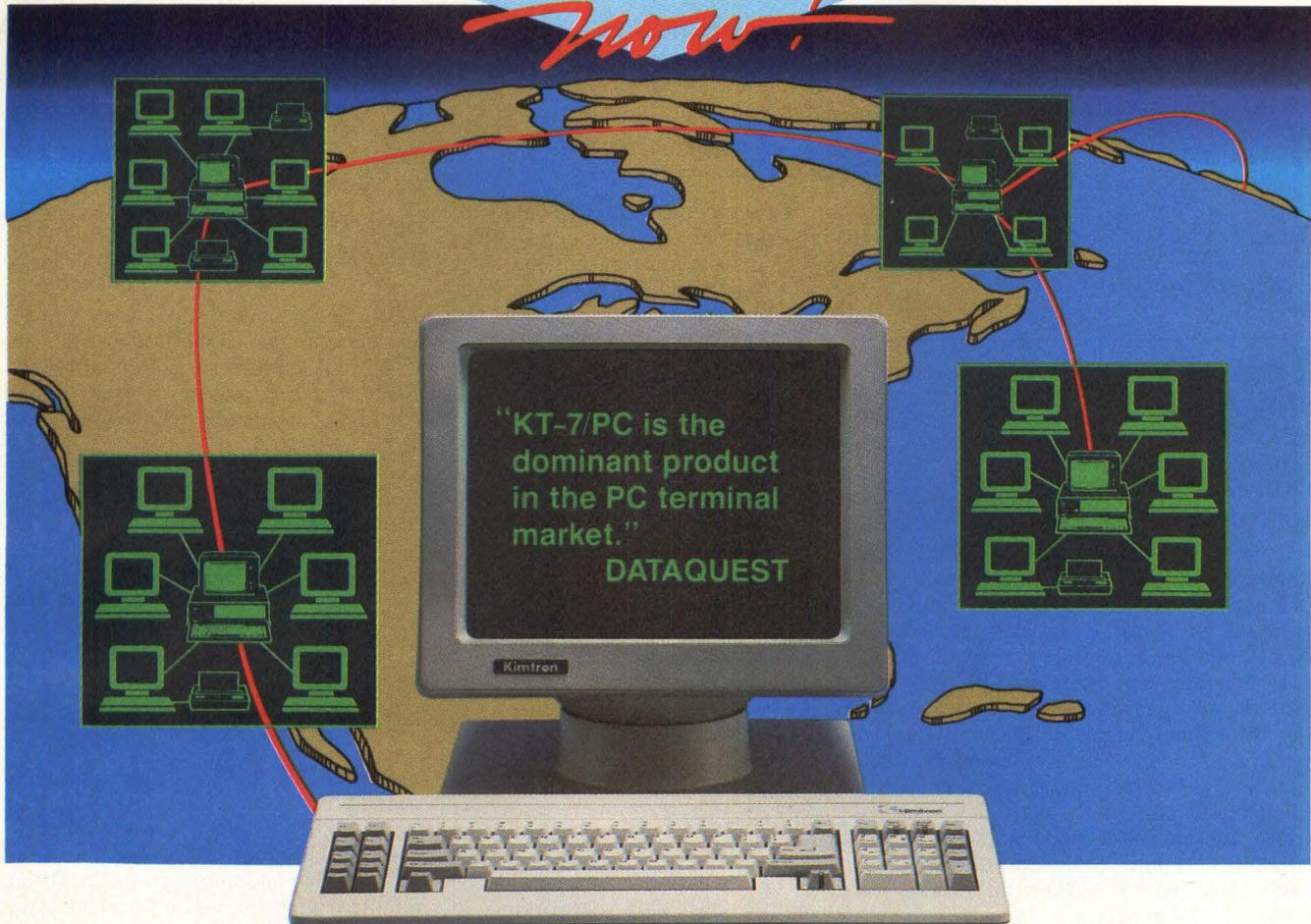
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CIRCLE NO. 73 ON INQUIRY CARD

sends them over a 14M-byte-per-second link to a companion multiplexer up to four kilometers away. It handles one or two I/O modules, each capable of accepting four T1 full-duplex inputs. The unit is transparent to all inputs and receives data from PBXes with T1 interfaces, T1 leased lines and T1 digital microwave channels. \$3,200 to \$4,700. **Raycom Systems Inc.**, 6395 Gunpark Drive, Boulder, Colo. 80301, (303) 530-1620.

Circle 337

### Gateways support IBM and DEC

- 100K bytes per second
- RJE interface
- Bidirectional file transfer

Integrating IBM's VM and MVS operating systems with Digital Equipment's DECnet, the 3711S gateways offer bidirectional file transfer and data access, data translation of all data types and an RJE interface. They support DEC and IBM security packages. Each unit handles throughput speeds of 80K to 100K bytes per second and eight sessions. Features include bidirectional terminal-emulation packages, an electronic mail bridge and an RSCS gateway. \$40,000. **Interlink Computer Sciences**, Suite 203, 39055 Hastings St., Fremont, Calif. 94538, (415) 792-6212.

Circle 338

### Controller operates at 64K bytes per second

- 16 channels
- 512K bytes of memory
- 68010 microprocessor

The ProtoCol 1000 is a Multibus-based communications-protocol controller. Processing up to 16 channels of full- or half-duplex communications at 64K bytes per second, the board integrates dual-processor architecture and 512K bytes of triple-ported memory. It supports standard and custom protocols including X.25, bisynch, 2780, 3270 and 3780. A 68010 microprocessor handles commands and buffer management; a five MIPS Signetics 8X305 microcontroller acts as an intelligent DMA and serial bit-stream controller. \$2,750. **Interphase Corp.**, 2925 Merrell Road, Dallas, Texas 75229, (214) 350-9000.

Circle 339

### Modem operates at 2,400 baud

- Hayes compatible
- Terminal emulation
- Stores 128 numbers

An asynchronous, internal modem, the IDEAcomm 2400 generates 300-, 1,200- or 2,400-baud transmission. It is Hayes software and hardware compatible and fits any full-length slot in the IBM PC, PC/XT or PC/AT. Terminal emulation; non-volatile, on-board RAM; and automatic dialing are provided. The unit stores up to 128 numbers. Menu-driven communications software includes automatic answering that can be programmed for interactive response. The modem supports the CCITT standard. \$795. **IDEAssociates Inc.**, 35 Dunham Road, Billerica, Mass. 01821, (617) 663-6878.

Circle 340

### System supports data networking

- 64K bytes per second
- Eight to 740 users
- Data over voice

DOVTREX data-over-voice switching system provides data networking at speeds up to 64K bytes per second over an existing Centrex or PBX telephone system, without affecting networking operations. The device, consisting of the DOVTREX and Line Miser 640 units, interfaces to individual telephone sets and collocated synchronous or asynchronous terminal equipment. It offers as many eight-channel data-over-voice multiplexers as needed. Each switching node supports eight to 740 users and attached devices. \$450 and higher. **Gandalf Data Inc.**, 1020 S. Noel, Wheeling, Ill. 60090, (312) 541-6060.

Circle 341

### Multiplexer supplies built-in modem

The DCX 812M four- or eight-port statistical multiplexer features a built-in modem. Operating at 9.6K and 14.4K bps, the unit provides error-free transmission and menu-driven operation. Tests include channel loopbacks, modem

loopbacks, fax message generation and error-rate tests. \$3,190 to \$4,960. **Case Communications Inc.**, 2120 Industrial Parkway, Silver Spring, Md. 20904-1999, (301) 381-2300.

Circle 342

### Board employs 80186 processor

An eight-channel serial communications board, the CD21/3518 utilizes an 8-MHz 80186 processor. The board functions as a bus master or slave while providing line options for asynchronous, X.25 and SNA protocols. On-board memory includes 512K bytes of parity protected, dual-port RAM and six DMA channels. \$1,555. **Central Data Corp.**, 1602 Newton Drive, Champaign, Ill. 61821-1098, (217) 359-8010.

Circle 343

### Modems operate at 2,400 bps

The CTS line of full duplex, Hayes-compatible modems operates at 110, 300, 600, 1,200 and 2,400 bps, synchronously and asynchronously. Standard features are auto-dial and auto-answer, local and remote diagnostics and integral adaptive equalizing. Options include MNP and X.PC correction protocol. \$395. **CTS Fabri-tek Inc.**, 6900 Shady Oak Road, Eden Prairie, Minn. 55344, (612) 941-9100.

Circle 344

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R	S		S	U	S	H	I		S	E	E
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### DBMS package supports IBM PC

- COBOL oriented
- 65,000 records
- 32 search keys

POUNCE, a COBOL-oriented DBMS package, supports the IBM PC, PC/XT and PC/AT. Each database contains up to 65,000 fixed-length records of 4,096 bytes while allowing the definition of 32 search keys. Key fields can be mixed between alphanumeric, numeric and binary-data types. A record-locating mechanism requires three bytes of disk storage per key. The software is available in single-user and network versions. The latter version incorporates as many as 1,200 record-locks per file, while permitting simultaneous search, sort and update. \$495, single-user; network, \$1,495. **Chattahoochee Computer Products Inc.**, 2872 Woodcock Blvd, Suite 125, Atlanta, Ga. 30341, (404) 457-6669.

Circle 345

### Software integrates PCs and mainframes

- VT100 emulation
- Remote computer access
- Error-free protocol

Remote Access Facility (RAF) enables personal computers to interact with remote computers. It offers personal computers such operations as automatic contact and login to remote computers, direct access of remote files and calling of remote subroutines. Other personal computer capabilities are remote execution of entire computer programs and access to networked remote computers. The software package provides a DEC VT100-emulation mode that is loaded directly with MS-DOS each time the personal computer is activated and error-free protocol. \$395, bulk agreements available. **Datability Software Systems Inc.**, 322 8th Ave., New York, N.Y. 10001, (212) 807-7800.

Circle 346

### DBMS package targets multiusers

- Password protection
- Multiple file access
- IBM PC compatible

A 16-bit microcomputer DBMS, dBASE III PLUS supplies built-in multi-user capabilities that permit several users to access the same file simultaneously. The software can be installed on a LAN to support one initial user. It runs on the IBM PC, PC/XT, PC/AT and compatibles and supports color monitors and printers that can handle 80 or more columns. A built-in proprietary Application Generator allows the creation of applications without programming. The package requires 256K bytes of RAM. Features include file and record locking and eight levels of password protection. \$695. **Ash-ton-Tate**, 10510 W. Jefferson Blvd., Culver City, Calif. 90230, (213) 204-5570.

Circle 347

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CIRCLE NO. 75 ON INQUIRY CARD

### Board nearly triples A/D throughput

- 130 kHz
- 12-bit resolution
- 16 lines of digital I/O

Acquiring data at 130 kHz, the DT2821-F IBM PC/AT board runs nearly three times faster than other products for the IBM PC. The single-board unit offers 12-bit resolution for 16 single-ended or eight differential analog inputs and supports interrupts and DMA transfers. A/D sampling is controlled by a 16-location, channel-gain list RAM. A proprietary DMA technique provides gap-free data acquisition via two DMA channels on the PC/AT while supporting continuous performance. Sixteen lines of digital I/O is standard. \$1,595. **Data Translation Inc.**, 100 Locke Drive, Marlboro, Mass. 01752. (617), 481-3700.

Circle 348

### Controller uses I/O architecture

- 256K bytes of memory
- 68010 processor
- Two RS232C ports

Based on the 68010 MPU, the PT-VME102 single-board controller features I/O architecture and an expandable I/O Pak module. The unit occupies one VME slot. It furnishes up to 256K bytes of program memory. Two RS232C serial I/O channels are standard. Software support is provided by the PDOS Real-Time operating system. Features include a system controller with a four-level bus arbiter, a seven-level programmable VME bus interruptor and front-panel status LEDs with reset and abort switches. \$2,195. **Performance Technologies Inc.**, 300 Main St., East Rochester, N.Y. 14445. (716) 586-6727.

Circle 349

### Circuit card suits IBM PC/AT

- DEC emulation
- 1.2M bytes per second
- I/O data transfer

An IBM PC/AT-compatible circuit card, the AT/11 provides emulation of DEC DRV11, DRV11-WA and DR11-W interface specifications. The unit offers programmed I/O and DMA compatibility. Under software control, the DRV11-WA or DR11-W mode replaces the DRV11 mode to furnish DMA performance. In either mode the PC/AT and the unit appear to external devices as a Q-bus, Q22-bus or Unibus system with the interface card resident within the PC/AT. Performance is 400K bytes per second in single-cycle mode and 1.2M bytes per second in block-transfer mode. \$500. **Omnicom Graphics Corp.**, 1734 W. Belt North, Houston, Texas 77043. (713) 464-2990.

Circle 350

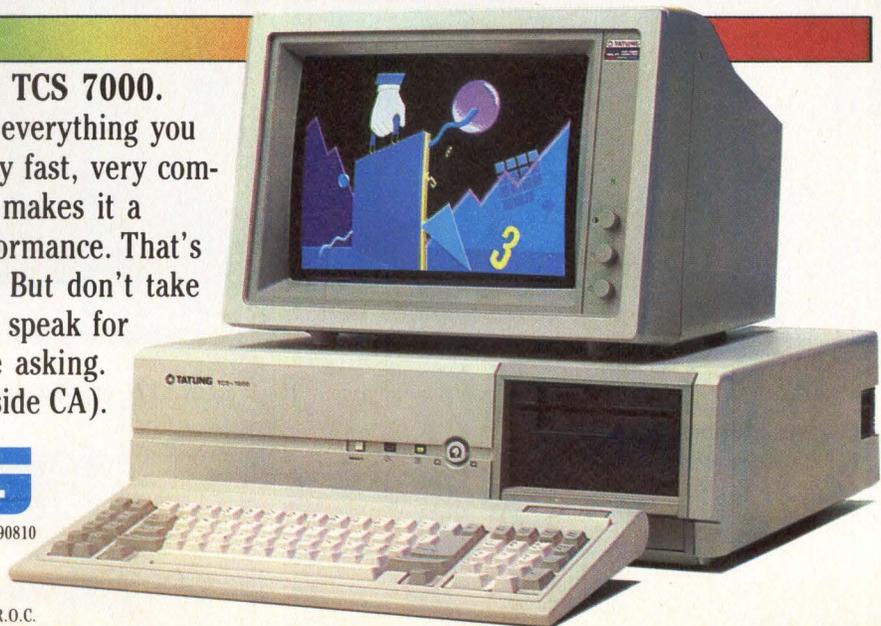
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**CIRCLE NO. 77 ON INQUIRY CARD**

**Directory describes  
184 multiplexers**

The *Multiplexers* directory provides specifications and pricing on 184 multiplexer models from 58 vendors. Each description defines the multiplexer type and application. The directory gives information on data-channel and composite-link parameters for STDM, diagnostics capabilities, visual indicators, pricing and support. Model descriptions are arranged alphabetically by vendor and are preceded by a reference chart. \$29. **Data Decisions**, 20 Brace Road, Cherry Hill, N.J. 08034, (609) 429-7100.

Circle 351

**Directory lists  
OEM and VAR companies**

The *National Directory of OEM/VAR Firms* is available in two volumes. Volume I lists 4,584 Eastern U.S. company names and addresses, OEM sales representatives, sic codes, company sizes and

number of employees. Volume II covers 3,852 Western U.S. businesses. \$295, Volume I; \$232, Volume II. **Electric Bookshelf Inc.**, P.O. Box 1409, Norcross, Ga. 30091, (404) 441-7973.

Circle 352

**Catalog describes  
board products**

The 1986 Micro-Link catalog describes over 60 STDbus and VMEbus microcomputer boards, firmware and support software and hardware. Entries include single-board computers, CPUs and I/O and communications products. Applications listed include process and industrial control, ATE and data-acquisition systems. Free. **Micro-Link Corp.**, 14602 N. U.S. Highway 31, Carmel, Ind. 46032, (800) 428-6155.

Circle 353

**Report analyzes  
IBM Corp.**

The 1,000 page, two-volume *IBM, Inc.*

analyzes the company's major product lines, telecommunications and personal computer activities and third-party distribution policies. The guide assists companies in planning market strategies based on IBM information. \$1,750. **Market Intelligence Research Co.**, 4000 Middlefield, Palo Alto, Calif. 94303, (415) 856-8200.

Circle 354

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PRESENTS

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A 2-1/2 day technical program devoted to discussing MULTIBUS and VMEbus issues, hearing about the latest MULTIBUS and VMEbus developments and promoting industry standardization.

**WHERE & WHEN**

The Irvine Hilton, Irvine, California, June 10 - 13, 1986

**FORUM  
STRUCTURE**

MULTIBUS and VMEbus Technical Sessions are either parallel or combined, depending upon the technical content. Exhibitors workshops are run in parallel.

**TOPICS/ISSUES**

- What are the structure and size of the MULTIBUS and VMEbus markets?
- How can higher performance for MULTIBUS and VMEbus be achieved?
- How do MULTIBUS and VMEbus handle intelligent peripherals?
- How do the many interface alternatives compare with one another?
- How do open and closed architectures compare?
- What MULTIBUS and VMEbus products are available today?
- Are MULTIBUS and VMEbus just for Supermicro applications?
- What are the problems associated with using a separate I/O Bus?
- How effective are local area networks in the MULTIBUS and VMEbus environment?
- Are MULTIBUS and VMEbus development systems important?
- What silicon support is there for MULTIBUS and VMEbus?
- How do you select the right SBC's?
- Are dedicated interrupts a handicap?
- Which arbitration scheme is right for you?
- How do the two buses handle multiprocessing applications?
- Will VME adopt UNIX?
- How do MULTIBUS and VMEbus systems compare to the MicroVAX?

**WORKSHOP**

In addition to covering "Leading Edge" MULTIBUS and VMEbus topics, Delegates may attend an optional MULTIBUS and VMEbus Principles Workshop on Tuesday evening, June 10, in order that they may derive more benefit from the technical sessions to come.

**EXHIBITORS  
PROGRAM**

Delegates will also have an opportunity to see the latest in MULTIBUS and VMEbus Products during the Exhibitors Reception Wednesday evening. Optional half-hour Exhibitors Workshops provide an additional opportunity to learn more about MULTIBUS and VMEbus products on Wednesday and Thursday evenings.

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The registration fee of \$995.00 for the 2-1/2 day MULTIBUS and VMEbus Forum covers attendance at all scheduled sessions, a Delegate Information Binder containing the Speakers' presentations and other material, and admission to a Welcome Reception, 2 Luncheons, the Exhibitors Reception which includes Cocktails and a Buffet, 3 Continental Breakfasts, a Mexican Theme Dinner, the Exhibitors Workshops, refreshments during breaks, gratuities and taxes.

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A block of rooms at the Irvine Hilton has been set aside for MULTIBUS/VMEbus Forum Delegates at special rates which are only available through Technology Forums.

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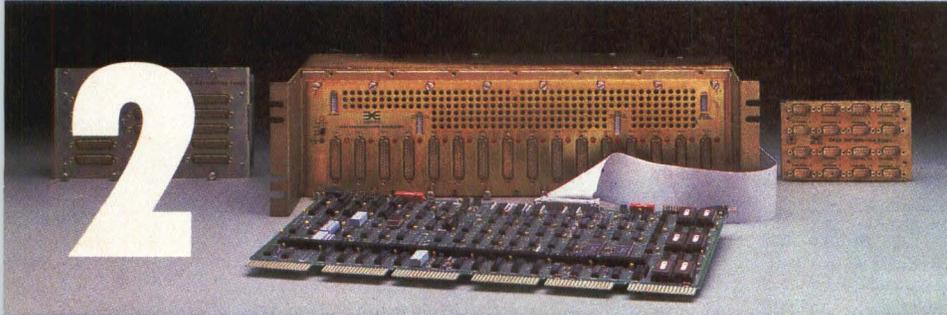
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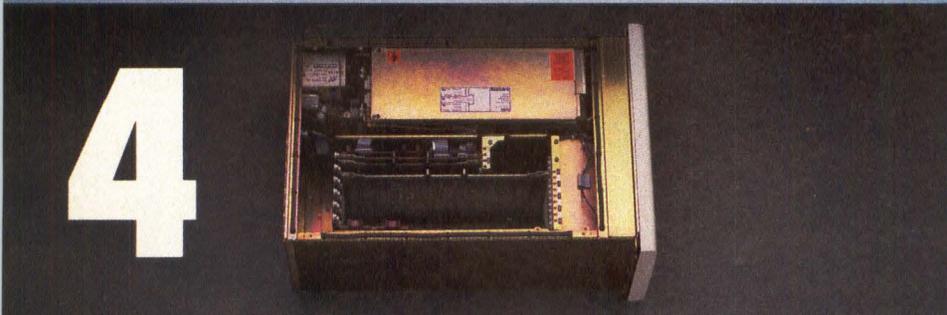


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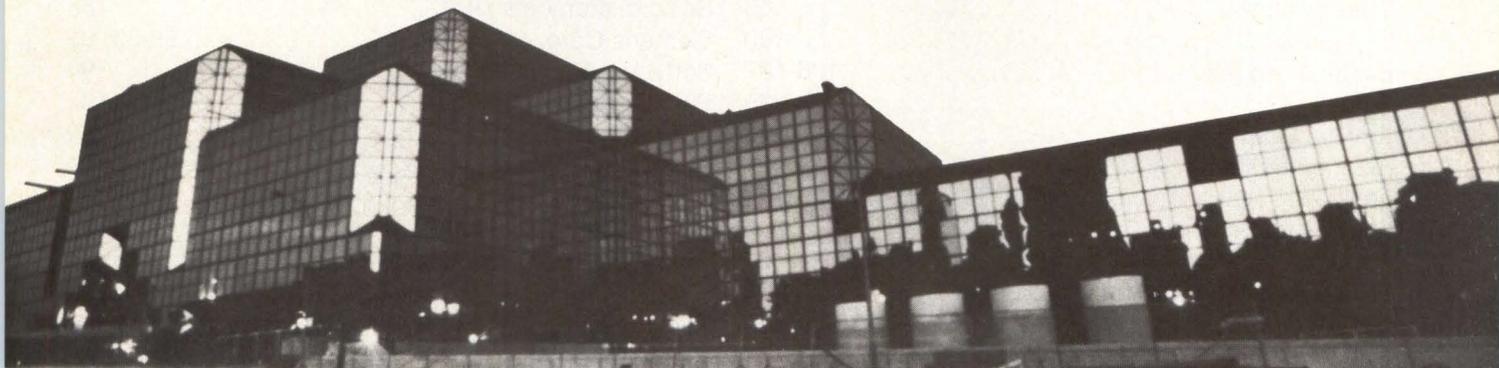
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|---|---|---|
| <input type="checkbox"/> 1 Computer consultant    | <input type="checkbox"/> 5 Service vendor     | <input type="checkbox"/> 8 Turnkey vendor         |
| <input type="checkbox"/> 2 Computer dealer/dist.  | <input type="checkbox"/> 6 Software developer | <input type="checkbox"/> 9 Value adder            |
| <input type="checkbox"/> 3 Computer OEM           | <input type="checkbox"/> 7 Systems house      | <input type="checkbox"/> 10 Other (specify) _____ |
| <input type="checkbox"/> 4 Office products dealer |   |   |

#### CORPORATE VOLUME BUYERS—YOUR COMPANY'S MAIN BUSINESS ACTIVITY

- |  |  |  |   |
|--|--|--|---|
| <input type="checkbox"/> A Accounting firm         | <input type="checkbox"/> H Engineering         | <input type="checkbox"/> O Management consultant | <input type="checkbox"/> T Retail sales           |
| <input type="checkbox"/> B Advertising             | <input type="checkbox"/> I Government/Military | <input type="checkbox"/> P Manufacturing         | <input type="checkbox"/> U Securities broker      |
| <input type="checkbox"/> C Banking                 | <input type="checkbox"/> J Hospital            | <input type="checkbox"/> Q Publishing            | <input type="checkbox"/> V Transportation (all)   |
| <input type="checkbox"/> D Communications          | <input type="checkbox"/> K Hotel               | <input type="checkbox"/> R Real estate           | <input type="checkbox"/> W Utility                |
| <input type="checkbox"/> E Construction/Architects | <input type="checkbox"/> L Industrial design   | <input type="checkbox"/> S Research/Development  | <input type="checkbox"/> X Wholesale/Retail sales |
| <input type="checkbox"/> F Credit                  | <input type="checkbox"/> M Insurance           |  | <input type="checkbox"/> Y Other specify _____    |
| <input type="checkbox"/> G Education               | <input type="checkbox"/> N Law office          |  |   |

#### YOUR JOB FUNCTION (Check main one only)

- |   |  |   |  |
|---|--|---|--|
| <input type="checkbox"/> AA Accountant        | <input type="checkbox"/> EE Creative arts (all)    | <input type="checkbox"/> II MIS Dir./Mgr.   | <input type="checkbox"/> NN Securities financial analyst |
| <input type="checkbox"/> BB Administrator     | <input type="checkbox"/> FF Designer (all)         | <input type="checkbox"/> JJ Programmer      | <input type="checkbox"/> OO Service technician           |
| <input type="checkbox"/> CC Consultant        | <input type="checkbox"/> GG DP/WP manager/operator | <input type="checkbox"/> KK Purchasing      | <input type="checkbox"/> PP Systems analyst              |
| <input type="checkbox"/> DD Corporate officer | <input type="checkbox"/> HH Engineer (all)         | <input type="checkbox"/> LL Sales/marketing | <input type="checkbox"/> QQ Other (specify) _____        |
|   |  | <input type="checkbox"/> MM Scientist       |  |

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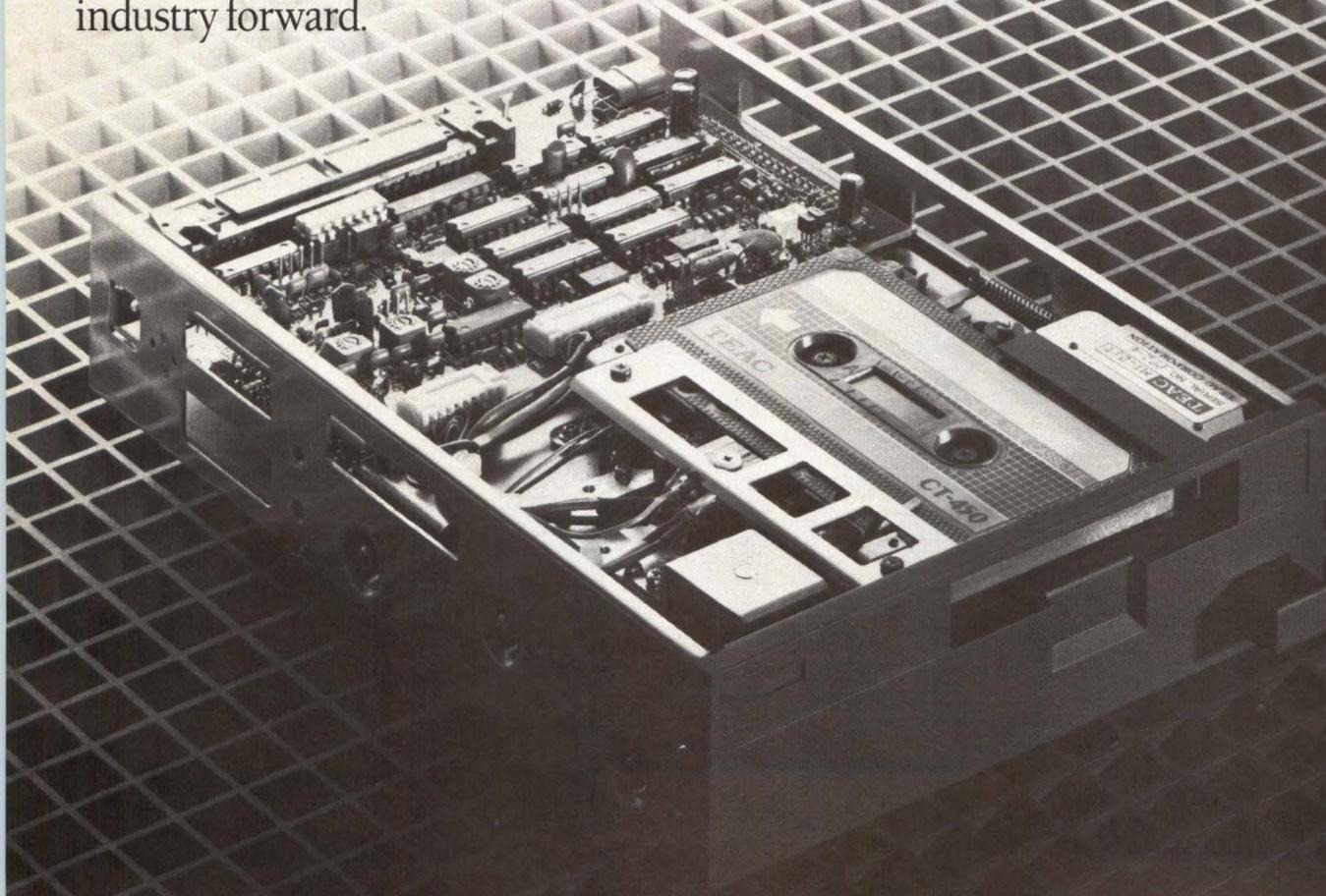
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by John K. Young

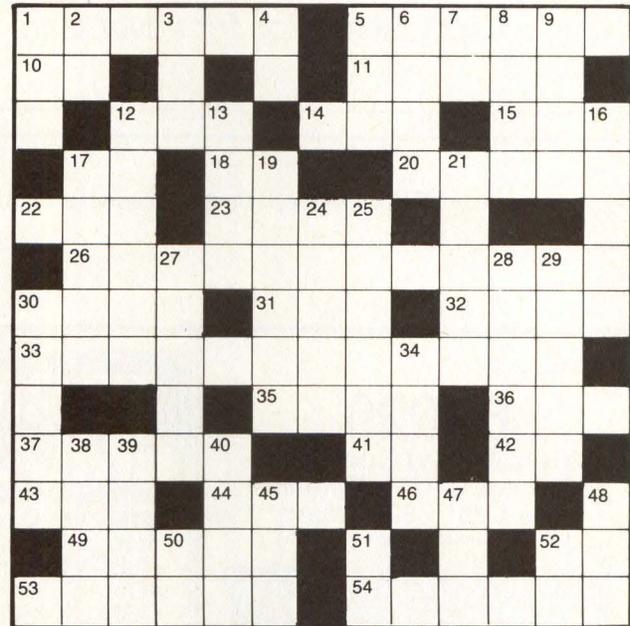
## ACROSS

- 1 Control Information
- 5 Command
- 10 Nutmeg State (Abb.)
- 11 \_\_\_ Computer
- 12 Eight-bit DOS
- 14 Pivoting
- 15 Massage
- 17 In the direction of
- 18 Jewish eleventh month
- 20 Commodore's newest machine
- 22 Function (Abb.)
- 23 The destroyer to Hindus
- 26 Causes inability to cope with computer technology
- 30 River crossing Maine to ocean
- 31 High mountain
- 32 \_\_\_ code
- 33 Printer spacing
- 35 Three feet
- 36 Temporary decrease in voltage
- 37 Commodore 64 graphics pad
- 41 Prefix meaning "early"
- 42 What say?

- 43 Tall, hardy shade tree
- 44 Smallest unit of data
- 46 Not square (Abb.)
- 49 Speed and problem-solving are two computer \_\_\_
- 52 Exclamation of grief
- 53 Hookup to beat breakdowns
- 54 Mass. computer company

## DOWN

- 1 Function
- 2 Salt Lake City is its capital (Abb.)
- 3 Program for moving information
- 4 Texas Instruments (Abb.)
- 5 Short for the guy who owns one
- 6 Runner's shoe available with built-in microprocessor
- 7 Data processing (Abb.)
- 8 Combining form meaning "air"
- 9 Gardener's basket
- 12 A home computer company
- 13 Soft mixture
- 16 Tropical American tree
- 17 Strait between Sakhalin Island and Asia mainland
- 19 Number system based on 2
- 21 Family of American painters
- 24 Italian physicist (1745-1827)
- 25 To be ambitious
- 27 Resin from tropical trees
- 28 Deleted
- 29 Word at end of verses in Psalms
- 30 Short urge in power voltage
- 34 Scent
- 38 Her name means "holy"
- 39 Deity associated with life and reproduction

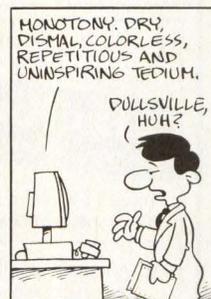


- 40 Manufacturer of Q-bus- and Inibus-compatible products
- 45 Belief
- 47 Daisywheel printer company
- 48 Command
- 50 Placed in *Mini-Micro*, it publicizes your product
- 51 Yours truly
- 52 Logical operation

Solution will be printed next month.

Answers to April's puzzle can be found on Page 136.

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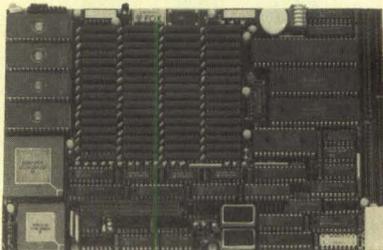
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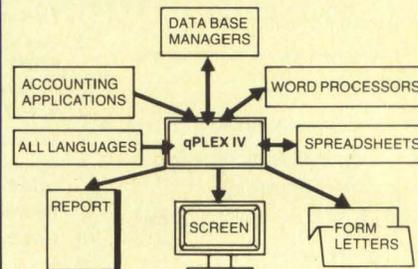
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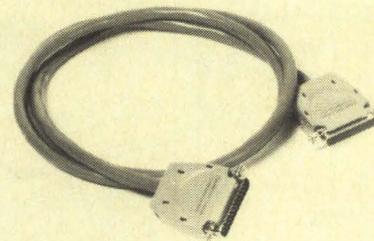


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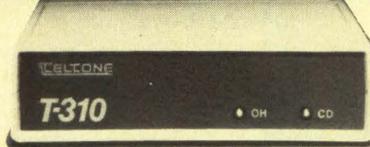
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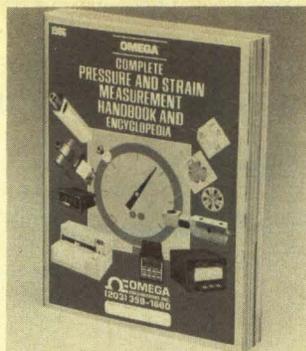
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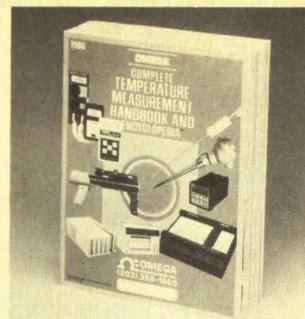
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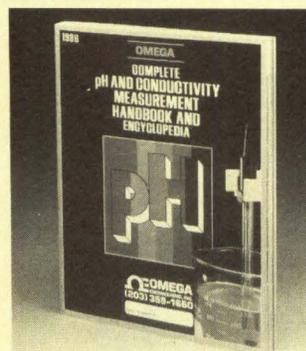
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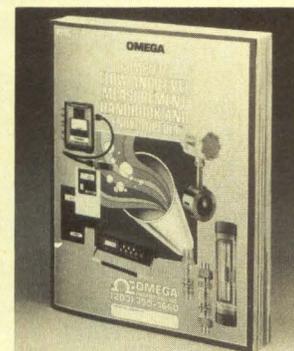
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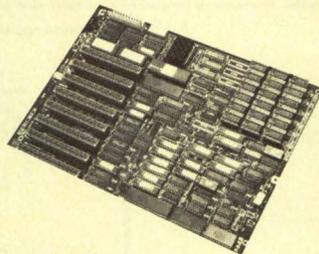


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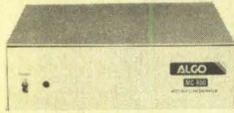
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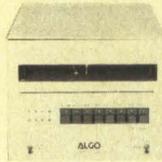
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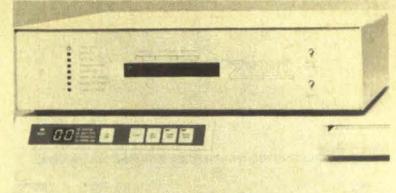
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\*PC World Magazine "World Class PC Contest" for 1984 and 1985.



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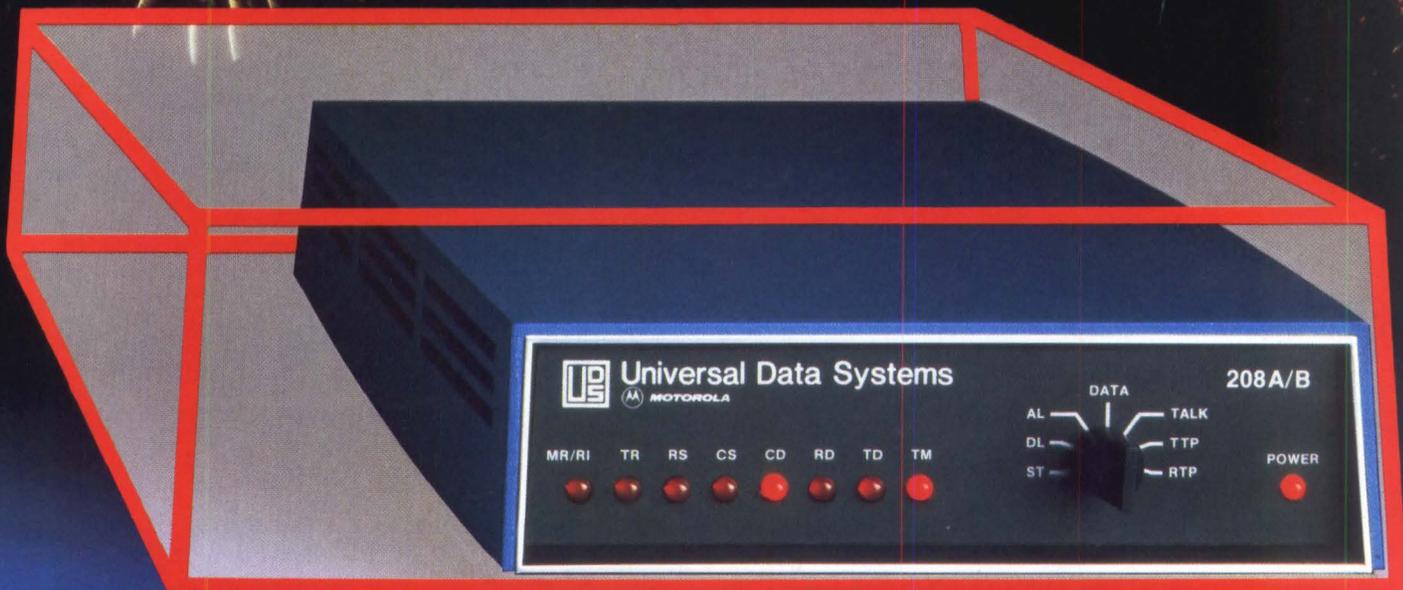
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