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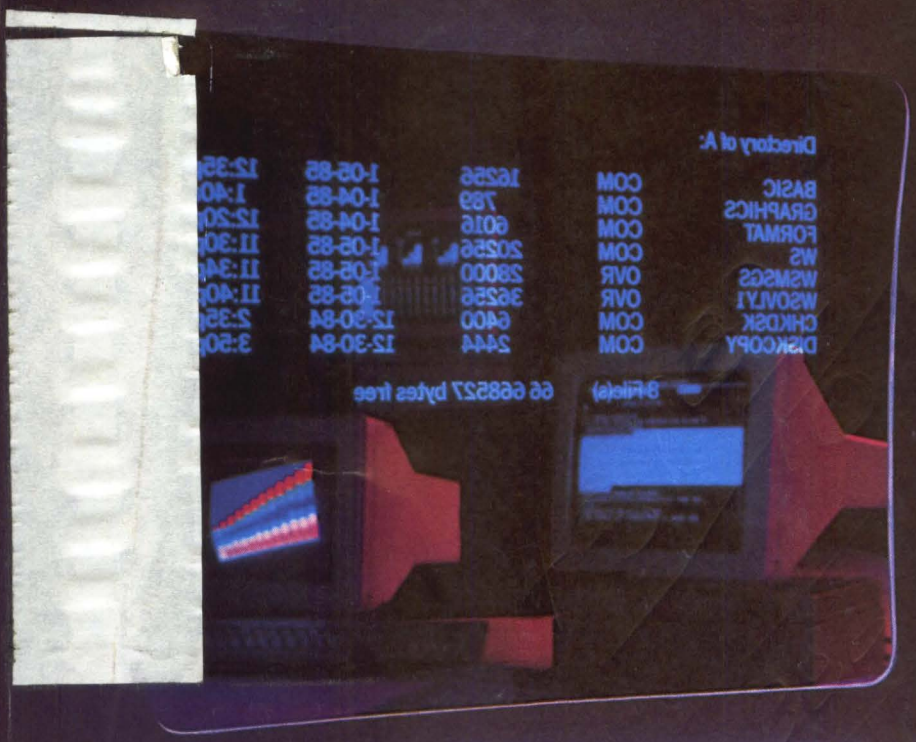
FEBRUARY 1985



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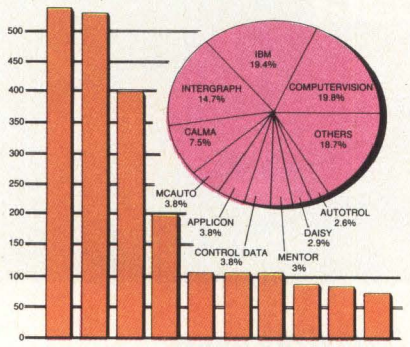

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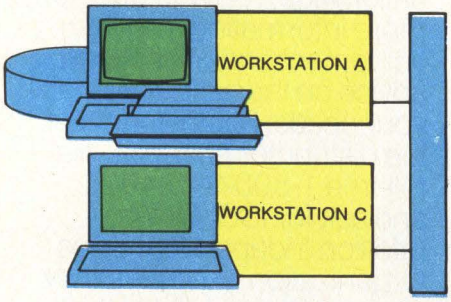

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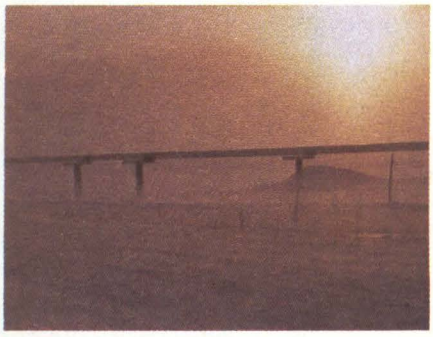

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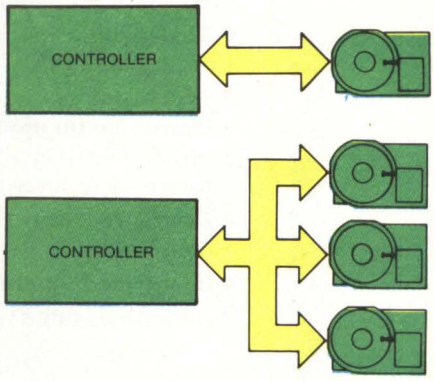

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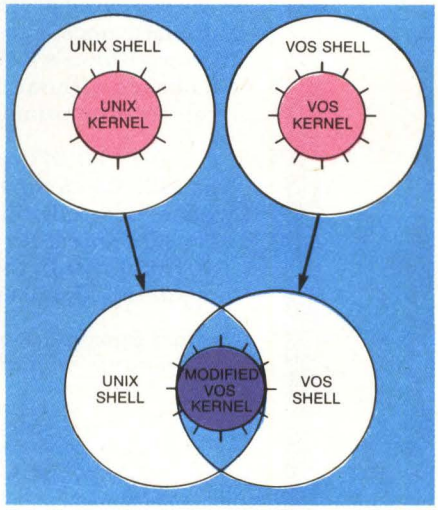

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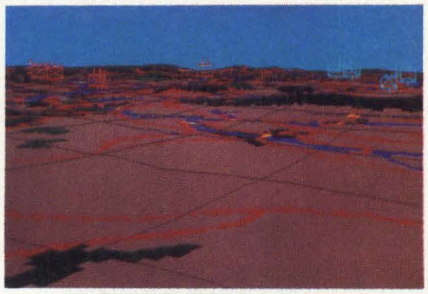
For over a decade, Lexidata™ has been advancing color graphics technology, especially in the area of computer-aided design (CAD), where our high-performance systems are being successfully integrated by both OEMs and end-users.



Computer-driven command and control battle simulators are using Lexidata graphics systems to display 3-D terrain appreciation maps. (Courtesy of The Singer Company, Link Simulation Systems Division)

We've set some very high standards against which we measure all our systems. And we see to it that our systems are built cost-effectively by us so they can be priced cost-effectively for you.

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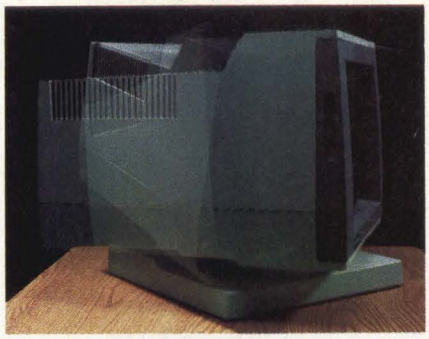
LEX 90™ is Lexidata's newest family of raster display processors. Its performance excites designers. Its cost-effectiveness excites business executives.



Lexidata's own monitor enclosure design features a unique, ergonomic tilt and swivel movement with smooth and easy operation. All monitor connections and peripheral power supplies are located in the enclosure's base.

Everybody in the LEX 90 family speaks to one another. Both the hardware and software architectures of the LEX 90 family have been designed to accommodate growth. As your application becomes more complex, your LEX 90 system can easily be upgraded. Adding processors or memory is never a problem. Or an unreasonable expense.

Every model in the LEX 90 family shares this flexible and compatible hardware/software architecture. You'll never have to sacrifice your initial investment should you wish to enhance your LEX 90 system's performance. And what performance!

The basic display controller writes vectors in 600ns per pixel and processes multiple read/write and arithmetic instructions concurrently. And LEX 90's software and firmware provide designers with every essential graphics primitive including vectors, text, circles, arcs, polygons, and area fills.

OUR RESOLUTION: A SYSTEM FOR EVERY NEED.

We offer a variety of systems with a variety of resolutions – medium, high, and medium/high. The latter refers to our exclusive SimulRes feature which allows simultaneous display of 640 x 512 and 1280 x 1024 images on the same screen. A True Color configuration offers two buffers of 640 x 512 x 24 with an 8-bit color lookup table for each color. And where high performance with high resolution is vital, there's a LEX 90 model that can support up to 24 planes of 1280 x 1024 display memory at 60Hz non-interlaced refresh.

For petrochemical surface modeling requirements, there's GEOVIEW,™ a three-dimensional geological interpretation package. And for solid modeling applications on the LEX 90, the extraordinary capability of our patented SOLIDVIEW™ technology is available.

INTRODUCING U.S. PATENT NO. 4,475,104. SOLID MODELING WITH A SOLID FUTURE.

SOLIDVIEW is Lexidata's patented z-buffer technology for the generation of 3-D graphics and display of solid models. It's part hardware and part

Using Lexidata's SOLIDVIEW, Honda design engineers view 3-D solid models of motorcycles as they would appear in real life – in seconds. (Courtesy of Honda Asaka Research & Development Center)

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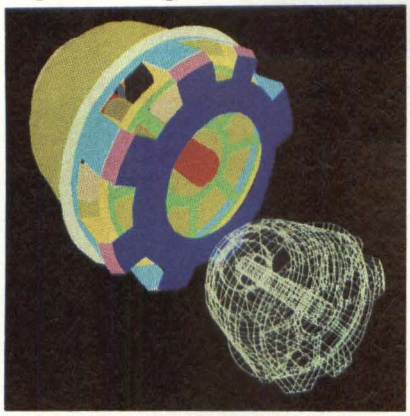
firmware. And the sum of those parts is a faster, simpler, more powerful and more interactive system for solid modelers than any other.

Other systems rely heavily on your host computer. They offer slow processes that require huge amounts of memory. But SOLIDVIEW shares the workload with the host. Parallel processing means that a smoothly shaded solid object can be displayed in just a few seconds.



LEX 90's SimulRes enables the designer to mix theory with reality by allowing the simultaneous display of a wireframe model with the real-life product.

WHAT WILL INDEPENDENT SOFTWARE COMPANIES THINK OF NEXT?

The support of Lexidata display systems by third party software companies is a good example of their popularity. Lexidata-compatible software packages are available for mechanical design/analysis, business graphics, mapping, and geological interpretation. And there's great potential for many more. So if you're an independent developer, come explore with us applications of our advanced technology.

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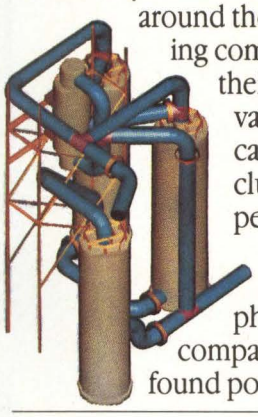
Lexidata systems are hard at work around the world, helping companies realize their goals in a variety of applications that include CAD/CAM, petrochemical, defense, medical, and graphic arts. These companies have found powerful, cost-effective solutions that can do the job for them now, yet grow with them later, keeping pace with rapidly expanding needs.



An integrated piping design as displayed by Lexidata's patented SOLIDVIEW system. (Courtesy of DIS/ADLPIPE, Inc.)

If that sounds like your kind of company — or your kind of customer — then we should talk.

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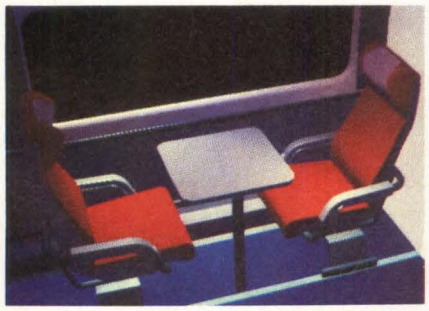

Students at the Royal College of Art in Kensington, England, use Lexidata's SOLIDVIEW to create designs such as these first-class passenger train seats.

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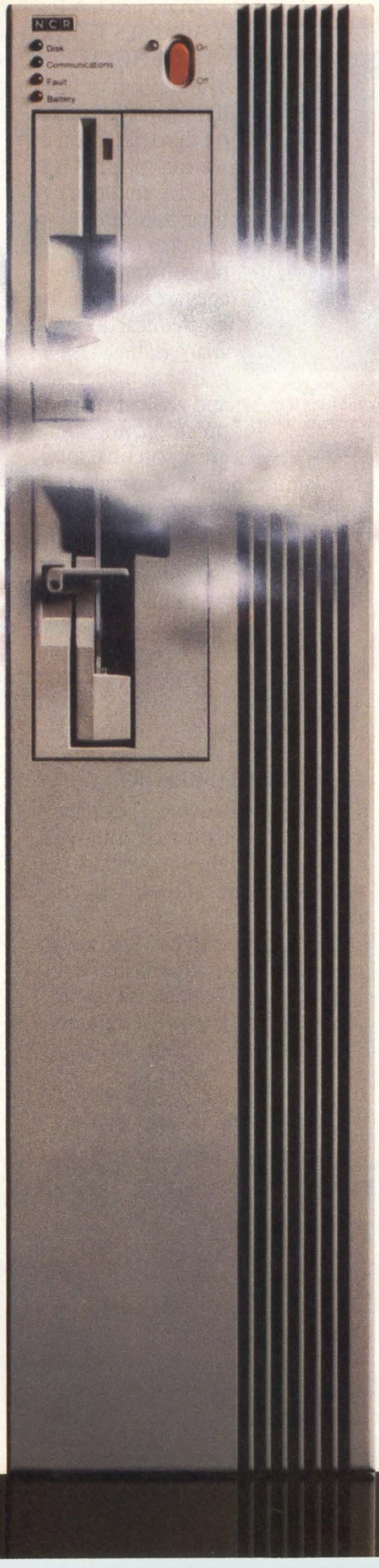
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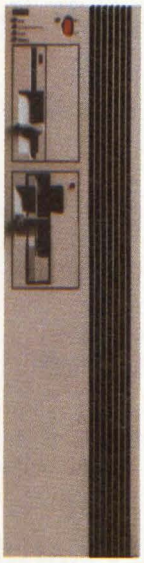

And it's a better UNIX for the experience.

The NCR-enhanced UNIX in the Tower XP is the first UNIX of true, commercial reliability.

It virtually never PANICs. Consequently, neither do your customers.

So that this UNIX might be all things to all users, we employed the Tower XP's menu builder to create the five faces of UNIX. A remarkable case of multiple menu personalities. One for each of five user levels, from sophisticated user to data duffer.

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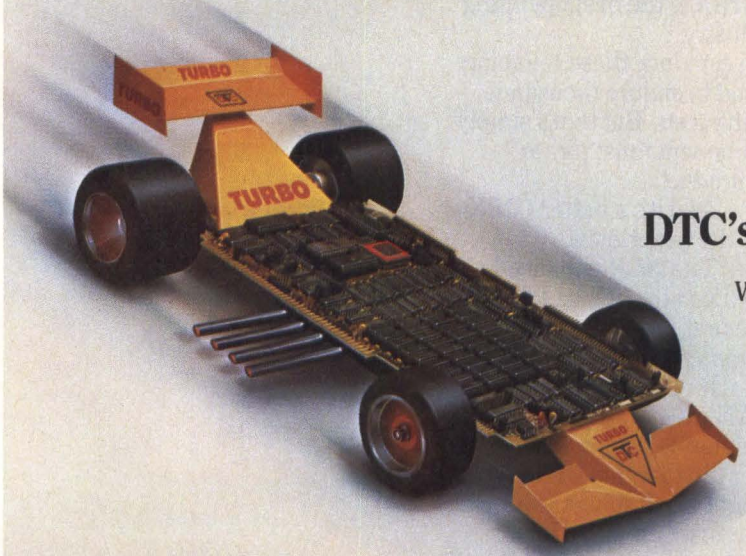

DTC's New Turbo-Disk Controller

We admit it. DTC's new Turbo-Disk is *unbelievable.* In fact, if we didn't make the controller ourselves, we'd have a hard time believing its remarkable performance. Take, for example, how Turbo-Disk speeds up UNIX™ operation in multi-user systems. Or how it interfaces to any existing Multibus™ System. Or even how Turbo-Disk automatically adjusts for variable cache memory sizes.

But that's not all. Because you'll also have a hard time believing Turbo-Disk's expandable high-speed disk caching memory... from 256 KB all the way up to 1 MB. Not to mention intelligent buffering of most often used files.

Still, the most unbelievable benefits of Turbo-Disk are what it can do for your system. This incredible controller will not only alleviate disk I/O bottlenecks, but dramatically enhance system throughput in multi-user applications.

The result: you can build the world's greatest Multibus computer.

DTC's RAM, Single-Board Computer and Controller Boards.

And while you're building that system, you should consider DTC's other boards. Like the world's fastest 512 KB or 2 MB dynamic RAM board. Or the industry's most powerful Multibus 68000 SBC and fastest memory-mapping implementation possible.

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We know it all sounds too good to be true. But seeing our great family of Multibus boards is *truly* believing. Contact DTC today, or your local Hamilton-Avnet or Arrow distributor.

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World's Fastest 512 KB or 2 MB Dynamic RAM Board • Gives minimum read access of 20 msec • Improves system performance • Combines dynamic RAM with 4 KB of distributed cache on board • Self initializing during power up	Industry's Most Powerful Multibus 68000 SBC • 12.5 MHz with 256 KB or 1 MB of on-board no-wait-state RAM • True dual ported memory • Dual bus architecture allows for future upgrade to 68020 • Full UNIX implementation	Fastest Memory Mapping Implementation Possible • Allows for up to 128 context switches • Allows for virtual memory implementation • Real time battery backed up clock	The Final Ingredient for the World's Greatest Multibus Computer • Dramatically enhances system throughput in multi-user applications • Alleviates disk I/O bottleneck • Expandable high speed disk caching • Interfaces to any Multibus system

RAM, TURBO-DISK, MMU & CPU are all IEEE 796 Compatible.

DTC has controllers for all industry standard drives...Winchester, Tape and Floppy.

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EDITORIAL

A REDESIGN FOR YOU

This issue of *Mini-Micro Systems* incorporates several graphics changes and editorial additions. These modifications aim at making the magazine more visually appealing and more intellectually interesting. Most of the alterations, however, are subtle in nature and deal with appearance. In fact, unless you're adept at typography, you might even miss the changes at first glance.

But why modify an established and successful publication? Readers and advertisers recognize *Mini-Micro Systems* as the leading monthly computer magazine in its field. The answer is that we're making the changes to benefit you, our readers—value-added OEMs, value-added system integrators and value-added users.

In short, we've selectively instituted distinctive graphics and type faces throughout the magazine to present a more modern, more attractive and more readable look. And we've added editorial content to give you more useful and practical information. Keeping pace with expanding computer technology calls for periodic magazine analysis and implementation of updated graphics and text. The result? Printed information in *Mini-Micro Systems* looks neater, reflects comprehensive information and, more important, helps you do your job better.

Our editorial concept, purpose and thrust, however, remain unchanged. *Mini-Micro Systems*' articles serve system integrators who are actively involved in the purchase of computers, peripherals, software and systems. Our total editorial package helps system integrators evaluate, select, configure, integrate and implement minicomputer and microcomputer systems by providing a balanced mix of news stories, interpretive articles, integrated-applications information, feature articles and new product announcements.

Besides brightening up the magazine's look, new editorial columns expand our computer-coverage universe. One such column is "Market Track." This one-page, staff-written overview of the computer marketplace reviews several market research reports available from leading consulting companies. The overview spotlights product and technology market trends and forecasts, primarily on unit shipments and sales.

Another new column is "System Integrators' Notebook." This one-page, staff-written summary describes helpful application hints that solve knotty system interface and operation problems. These hints are based on actual product and system integration and usage pitfalls encountered on the job by our readers.

Yet another new column is Artful Intelligence, our crossword and word arrangement puzzles. To lighten the magazine's technical dryness, but on an educational level, the two puzzles employ computer-industry words and terms. The intent is to offer our readers an opportunity to relax while testing their computer terminology skills.

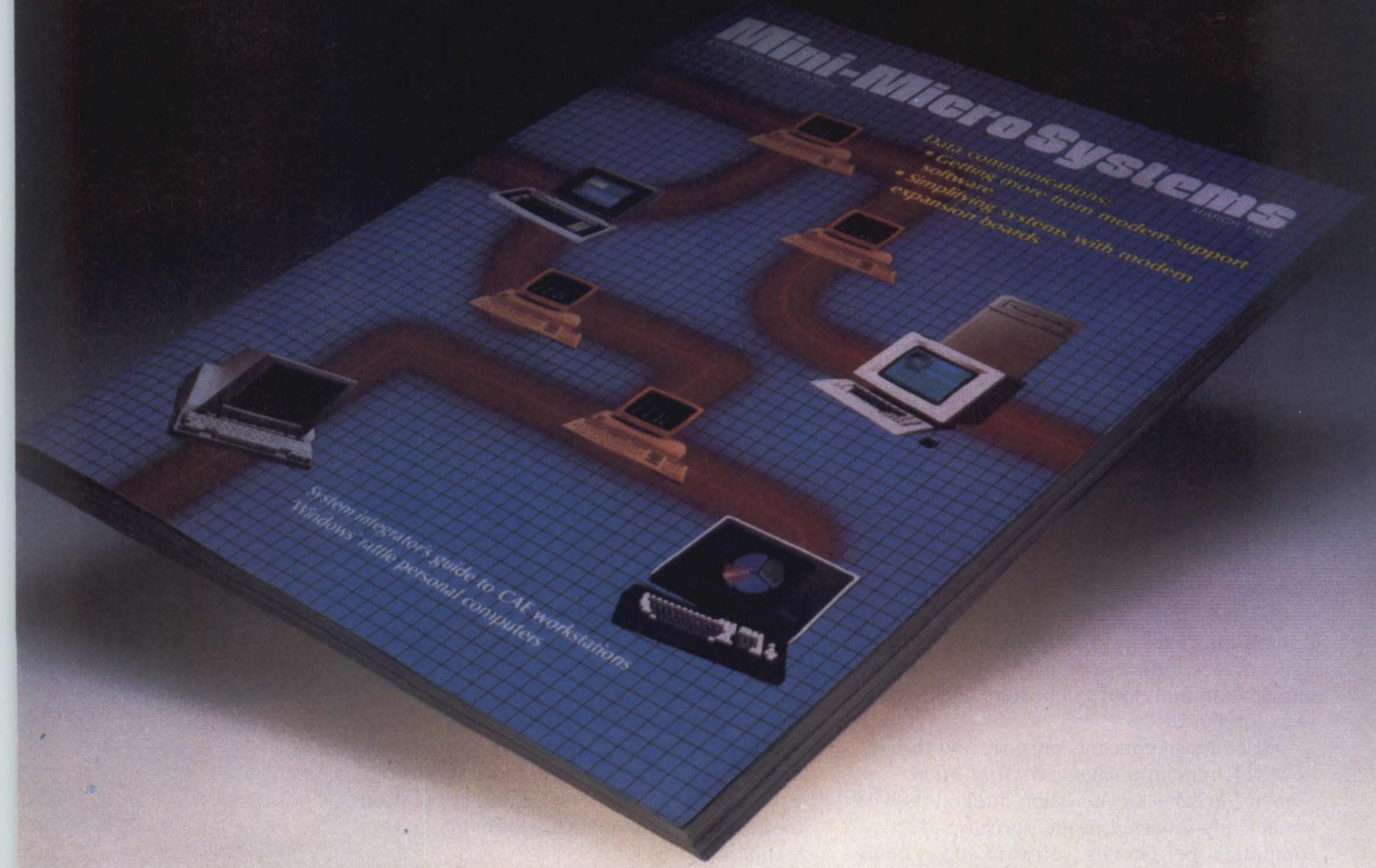
Two other comprehensive assessments of microcomputer and data-communication developments—PC Perspective and Communications Carrier—will appear aperiodically in the Features section. These analyses, both contributed and staff-written, will focus on methodologies and applications that represent innovative system-integration techniques.

Note on the front cover, however, that the *Mini-Micro Systems* logo stays the same. Easily recognizable in the past, this same logo will represent the magazine in the future as well, with improved graphics and editorial. The goal is still, as always, to satisfy our readers' needs. Let us know how the new look affects you.

George V. Kotelly

George V. Kotelly
Editor-in-Chief

This year Mini-Micro Systems readers will spend almost $50 billion on Minicomputers and Microcomputers*



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CIRCLE NO. 8 ON INQUIRY CARD

LETTERS

PRICE CORRECTION

To the editor:

We appreciate your coverage of the new Sun-2/50 Desktop SunStation (MMS, January, Page 60). While the article content was very good, there was a typographical error in the price of the system. You showed the price as $19,900 rather than the actual list price of $9,900.

The Sun-2/50, introduced in November, was the first full-function workstation to be priced under $10,000. Obviously, this is a breakthrough in the industry and it's unfortunate that this was not clear in your article.

Jackie Rae
Marketing Communications Manager
Sun Microsystems Inc.
Mountain View, Calif.

SPEAKING FRANC-LY

To the editor:

I certainly do not wish to belittle the enormous size of the worldwide COBOL investment of $100 billion (MMS, October 1984, Page 207). Yet, in comparing COBOL to other major financial expenditures, the figure of $36 billion given for the gross national product of Switzerland is badly in error. The 1984 Swiss GNP is estimated at 225 billion Swiss francs. At current exchange rates this [figure] corresponds to $93 billion. While the Swiss may not be quite as wealthy as is sometimes assumed, they aren't *that* poor!

A.P. Speiser
Director of Research
Brown, Boveri & Co. Ltd.
CH 5405 Baden, Switzerland

CIMBUS VS. MULTIBUS

To the editor:

I was interested to read the article written by Steven McGinness of National Semiconductor Corp. (MMS, October 1984, Page 125) in which he expounded the virtues of his company's CIMbus range of products when compared to an equivalent Multibus solution.

Although I can understand the bias of the article, I feel that he did not give the Multibus approach enough consideration in the light of recent developments. For example, both Intel and my own company have designed an on-board internal bus structure which allows a multibus-compatible measurement and control interface board to be customized by small plug-in modules.

In the application discussed by Mr. McGinness, the Multibus approach could be reduced to just two boards: the processor board and a single interface board such as our DMS531 Multibus-compatible I/O system. The DMS531 is user-configured with plug-in CMOS analog and digital I/O modules, and I estimate that this alternative approach would reduce the total power dissipation to a maximum of 25W, thus allowing a battery supply to be used as in the CIMbus approach.

When using the same costs quoted by Mr. McGinness, the price of the Multibus system is reduced from $4,181 to under $1,600, almost half the price of the equivalent CIMbus configuration.

Geoff Readman
Sales and Marketing Director
Di-An Micro Systems Ltd.
Cheshire, England

RONALD FRANK, 1934-1984: A PERSONAL REMINISCENCE

Ron was best known as *Computerworld's* communications editor for 10 years. I knew him before then, when he was a technical editor for Honeywell, and after he left *CW* in 1979 to publish his own newsletter, *Telecom Times and Trends,* and contribute to *Datamation.* He also published in *Mini-Micro Systems.*

Ron could invariably be found at industry conferences typing away in the press room. His copy was tight, trenchant and perceptive, a reflection of himself. Ron was what he wrote about.

My favorite Ron Frank story dates from the mid-1970s. I was the dinner speaker at a Digitronics Users Conference in St. Louis, and Ron was there to cover the conference. After the dinner, Ron and I drove off in his rented car for a private drink. Ron insisted on driving, but he was too small for the seatbelt, and the car's warning buzzer would not shut off unless Ron drove standing and leaning against the seat back. It must have been a very uncomfortable trip, but Ron was determined to make it and did.

Ron also was determined to be the best data communications writer in our business and he was. We'll miss him.

—Alan R. Kaplan, Executive Editor

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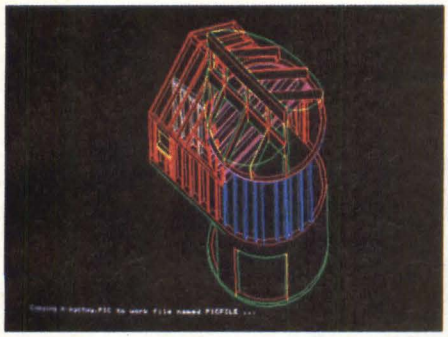
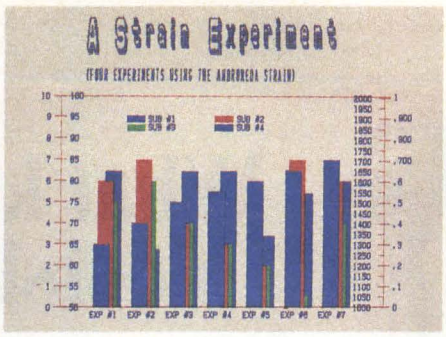
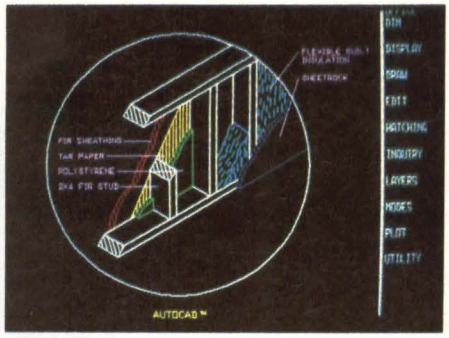


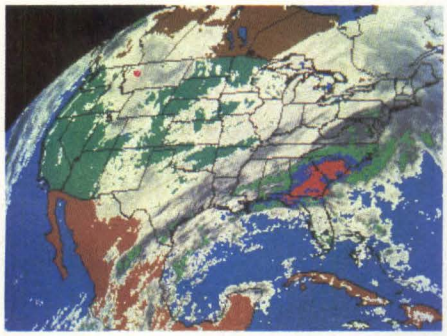
1. High Speed (MicroCAD Software)



2. Dual Display Modes (Energraphics Software)

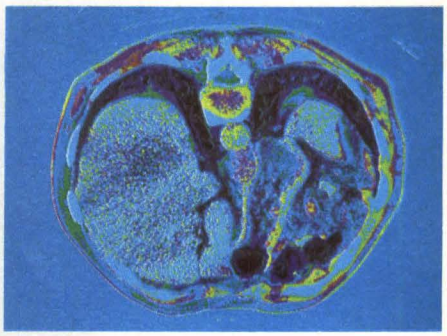


3. Simplified Processing (AutoCAD Software)



4. 9 Bit Planes (Courtesy WSI Inc., Bedford, MA)

5. 16.8M Color Shades (Courtesy Catherine Del Tito, Wave Graphics)



6. High Resolution (Courtesy University of North Carolina at Chapel Hill, Depts of Computer Science and Radiology)

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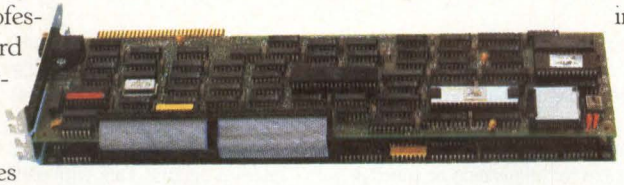

add an extra dimension of sharpness and clarity to your image that must really be seen to be appreciated. That's why it's not surprising to see Vectrix color cards in applications such as medical imaging, weather satellite data mapping, computer aided design and drafting, and graphics arts, to name a few.

What you will find most surprising, however, is the price. Our VX/PC Board Set was designed with the OEM in mind. So when comparing the performance of Vectrix with the competition, check the price too. You'll like what you see. For more information, contact Vectrix Corporation, 2606 Branchwood Drive, Greensboro, North Carolina 27408. Phone (919) 288-0520. Telex 574417.

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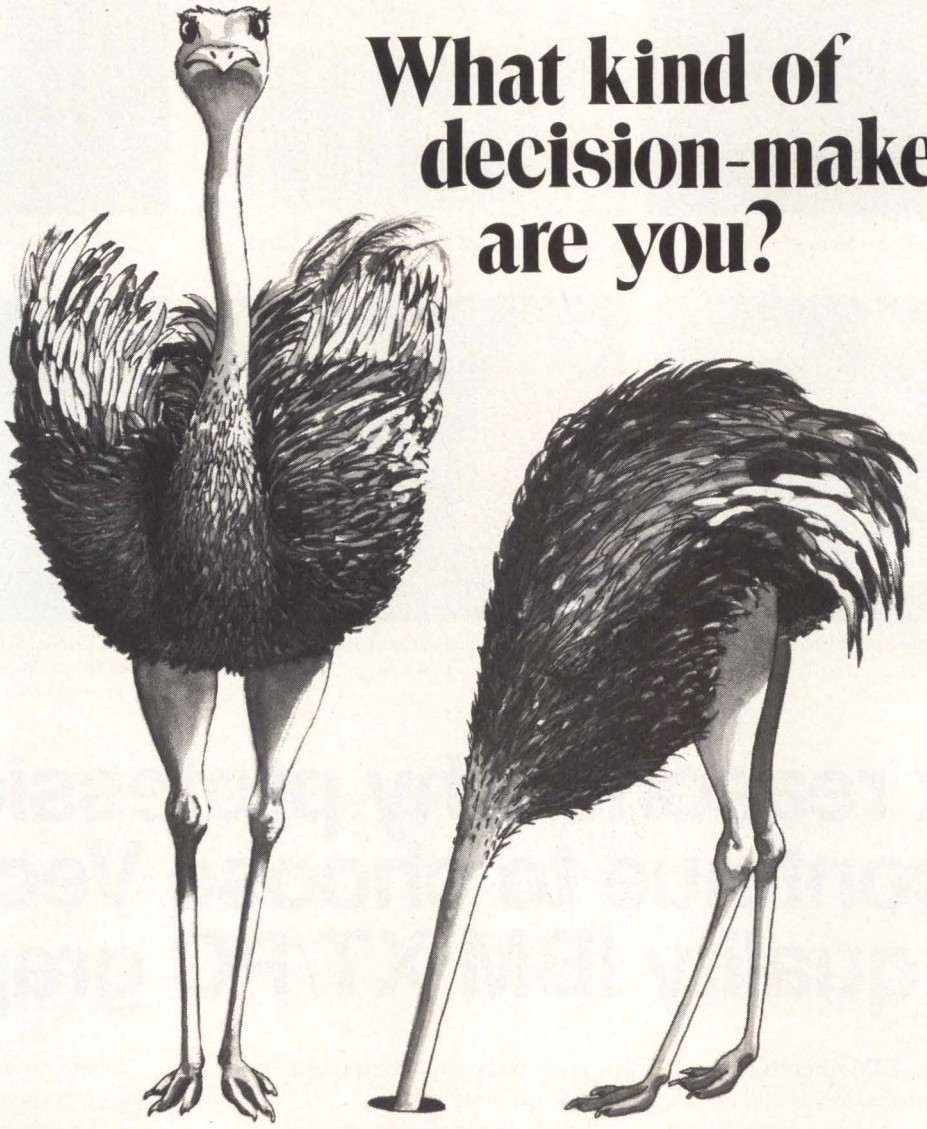

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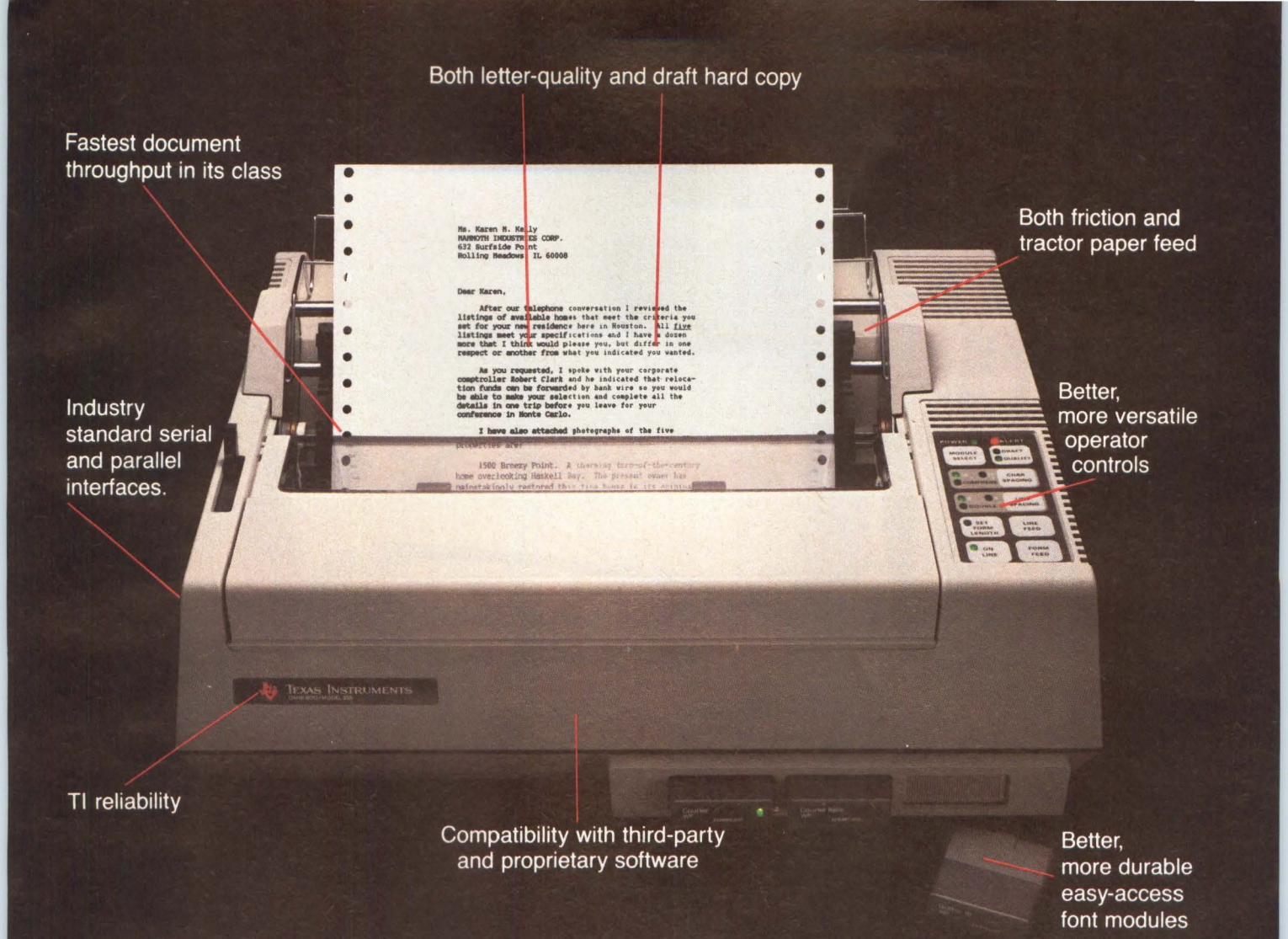

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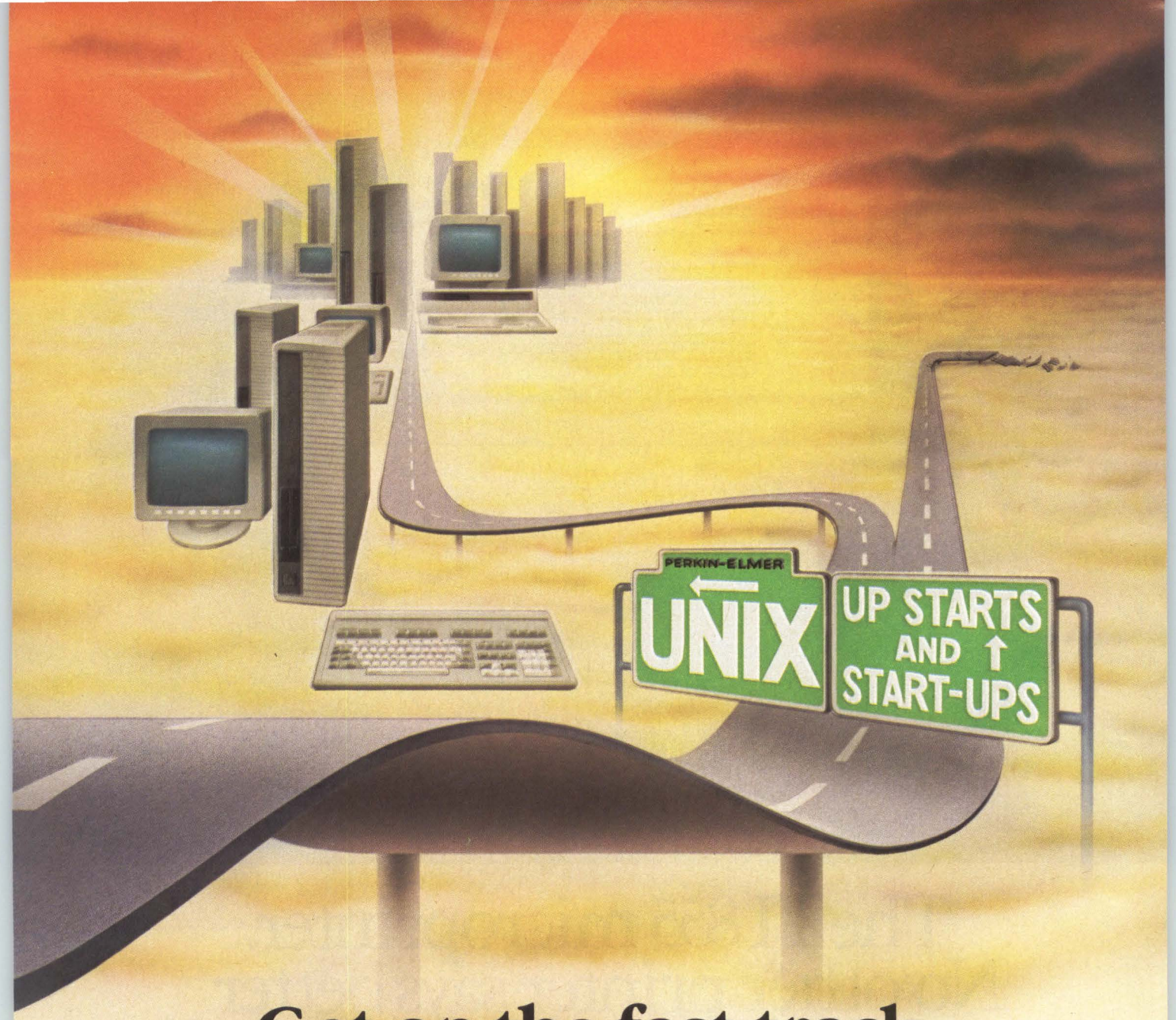

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- 8MHz MC68000
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- Floppy Disk
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BREAKPOINTS

APPLE EYES $300 MILLION MACINTOSH ORDER FROM FRENCH GOVERNMENT

Apple Computer Inc., Cupertino, Calif., was sitting on the brink of a $300 million, 250,000-unit Macintosh order from the French government at press time. The contract, if Apple snares it, could be a plum. The Mitterand government, seeking new ways around France's mounting economic and unemployment crises, wants to set up computer centers in each of the country's 36,500 cities, towns, villages and hamlets so that children and adults alike can become computer literate—and hence employable. Such an unparalleled undertaking could put at least six Macintoshes in each center. The "workshop" scheme is the brainchild of France's 3-year-old, government-backed World Center for Computer Sciences and Human Resources, which recommended the Macintosh. The choice of a foreign machine has raised numerous objections from French companies such as Groupe Bull and Thomson CSF, which protest that the award should go to a national company. For that reason, Apple founder Steven Jobs and president John Scully were in Paris recently, discussing ways to give Apple a little French polish—either by way of joint venture or local manufacturing.—M. O'Gara

JAPANESE SHOWING BATTERY-POWERED MICRO WINCHESTER DRIVES

JVC Electronics Ltd., Tokyo, is quietly showing a 10M-byte, 3½-inch half-height, battery-powered Winchester disk drive to selected OEMs. Dr. Peter Horn, managing director of research and development for British microcomputer manufacturer Advanced Computer Techniques (Holdings) Plc., says the drive has an unusual interface and that it sacrifices performance in favor of low power. Reportedly, the JVC drive operates at about 1,200 rotations per minute, more than halving the industry-standard transfer rate offered by ST506 interfaces; has a 7.5W start-up power requirement; and operates at 2.5W. Matsushita Communications Industrial Co. Ltd., Yokohama, Japan, and YE-Data Inc., Tokyo, have also reportedly shown similar drives to portable computer manufacturers.—C. Warren

PHOENIX READIES PC-AT-COMPATIBLE ROM BIOS, MACINTOSH TOOLS

Phoenix Software Associates Ltd., Norwood, Mass., this month plans to introduce an IBM Corp. PC-AT-compatible basic input/output system (BIOS) in ROM. The company, which claims to have written the majority of MS-DOS ports for PC-compatible manufacturers, also will offer GWBASIC, utilities, MS-DOS and code for the PC-AT keyboard's 8042 processor. That system software, bundled with the ROM BIOS, will carry a license fee of $420,000. The company claims the PC-AT-compatible ROM BIOS takes into account IBM's implementation of the Intel Corp. 80286 processor. The company also will sell a PC-AT motherboard design. Reportedly, the company plans to branch out beyond IBM's universe to provide software development tools for Apple Computer Inc.'s Macintosh.—L. Valigra

BREAKPOINTS

INTEL EPROM CHIP ERECTS BARRIER TO SOFTWARE PIRATES

A 128K-bit, keyed-access, EPROM semiconductor due this month from Intel Corp., Folsom, Calif., is said to control access to its own instructions and thereby thwart efforts of would-be software pirates. Two such semiconductors are used together, each containing an encrypted number. When the numbers of the two match, the memory can be unlocked. Intel is scheduled to present a paper on the device at this month's International Solid State Circuits Conference in New York.—L. Valigra

CORVUS TO OFFER RESELLERS A BARE-BONES UNIX COMPUTER

Next month, Corvus Systems Inc., San Jose, Calif., plans to provide system integrators and value-added resellers a stripped-down version of the Corvus Concept, a 10-MHz Motorola MC68010-based UNIX computer. Code-named "Mercury," the new product should be priced at less than $7,000 and support as much as 4M bytes of internal memory. Features include a speedy direct-memory-access disk drive controller that can handle two floppy and two Winchester disk drives. Resellers can add their own UNIX, although Corvus recommends using the Berkeley UNIX Version 4.2 on the system.—C. Warren

SWISS COMPANY TO LAUNCH TWO COLOR PRINTERS FOR IBM PCs

Hermes Precisa International SA, Lausanne, Switzerland, is launching four matrix printers for use with IBM Corp. PCs. Among them are two color models, one printing at 240 characters per second (cps) and the other at 480 cps. The other two models are black-on-white printers running at 120 and 480 cps. All four are part of Hermes' PC-Printer series and should be available from Hermes Products Inc., Linden, N.J., by midyear.—K. Jones

SONY PACKS 540M BYTES ONTO A COMPACT, READ-ONLY OPTICAL DISK

With the market for optical-disk technology expected to heat up this year, Sony Corp., Tokyo, is ready to introduce its compact ROM disk drive, the CDU-1. The 4¾-inch-diameter drive stores as much as 540M bytes on spiral tracks, has an average access time of 50 msec and can transfer data at 150K bytes per second. Evaluation models should be available this month with a Small Computer Systems Interface (SCSI) for $1,600, with production scheduled to begin in March. OEM price is expected to be $225 in quantities of 1,000. Sony also will offer a duplication service to translate data from tape to the compact disk ROM for as low as $6 each for 10,000 copies. — C. Warren

WANG ENTERS MANUFACTURING AND ASSEMBLY AGREEMENTS WITH CHINA

Wang Laboratories Inc., Lowell, Mass., recently extended its Asian operations with three joint-venture agreements with China valued at $150 million. One venture is for assembly of Wang's Professional microcomputer

PERKIN-ELMER USERS:

The first compatible disk controller that's an intelligent alternative.

Completely compatible with Perkin-Elmer's IDC system.

Full emulation permits disk pack exchange with P-E drives.

Macrolink performance, pricing and support.

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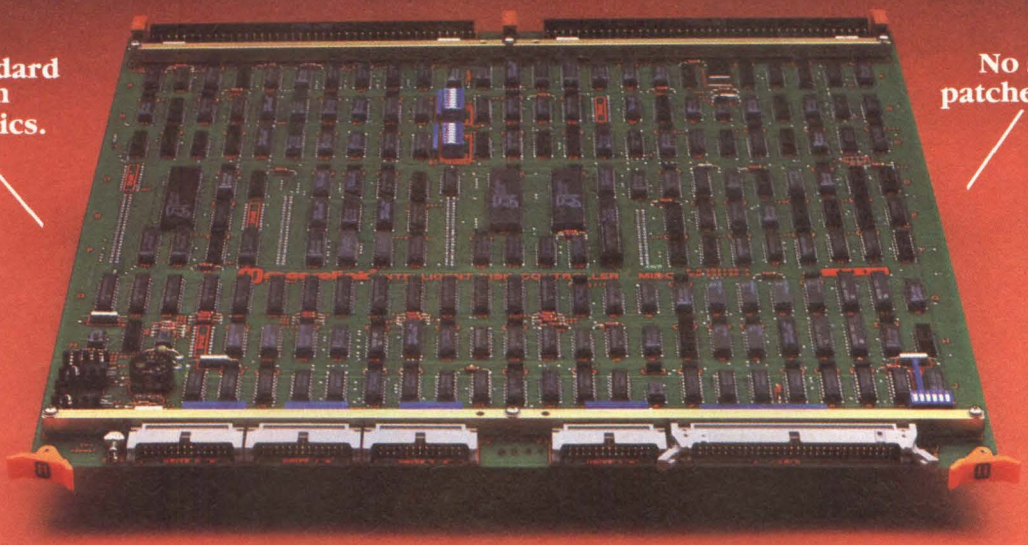
No software patches required.



Only our Macrolink Intelligent Disk Controller (MIDC) offers full software and disk pack compatibility with the P-E IDC system. Using such advanced features as on-board ECC logic and micro-coded bit slice technology, MIDC corrects errors of up to 11 bits without operating system overhead. And when you plug this single-board controller into your Series 3200 CPU, you can mix or match four SMD drives from independent suppliers to put up to 2400 Mbytes on line.

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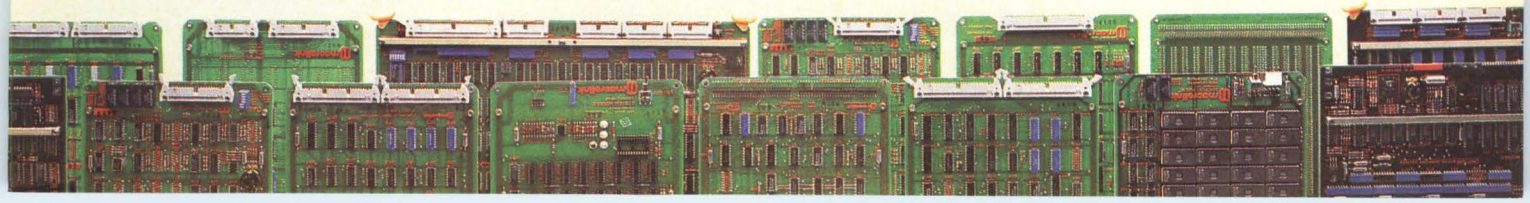
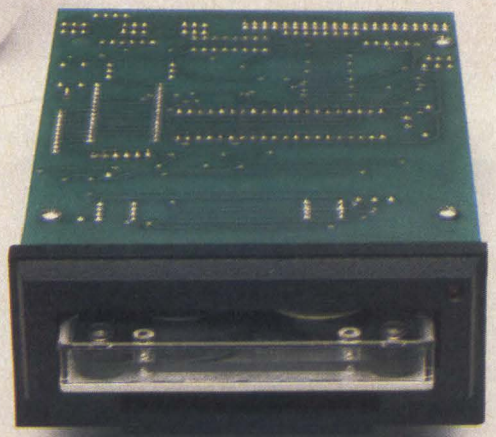
CIRCLE NO. 13 ON INQUIRY CARD

Everything for Perkin-Elmer systems, except the computer.



Introducing the little backup with the 20 megabyte appetite.



When Irwin came out with the Irwin 110 and 210 tape drives, both of which fit 10 megabytes of formatted capacity in a DC-1000™ cartridge, a lot of people said we bit off more than we could chew.

A lot of people ate their words.

Now we're backing you up with the Irwin 125 tape drive—20 megabytes of formatted data on a DC-1000 cartridge.

The Irwin Recipe: Simplicity, Reliability, and Ease of Use.

Because the Irwin 125 has a standard minifloppy interface, it daisy chains right onto your existing controller — without any additional cables, controllers or hardware. Add a simple software driver and an applications program for file transfer or streaming, and the Irwin 125 is ready to go.

And if you are PC DOS compatible we'll provide you with all the software required—without charge!

Irwin's closed-loop servo technology guarantees simpler operation, media interchangeability and greater reliability. With an error rate of 1 in 10^{11} and MTBF greater than 12,000 hours, the Irwin 125 is one of the most reliable, trouble-free back-up drives available anywhere today.

The Biggest Surprise is the Little Price.

Best of all, the cost of the Irwin 125 tape drive is about the same as a floppy disk drive. And it provides from 20 to 40 times the storage capacity on a single cartridge.

For those who don't need 20 megabytes of storage capacity, there's the Irwin 110, a 5¼-inch half-high and the Irwin 210, a 3½-inch form factor. We put a big byte in every backup we build.

If we've whetted your appetite, perhaps it's time you ordered a 125 tape drive for evaluation.

Irwin Magnetics. We back you up with integrity.

The DC-1000, 185 feet of .150" width tape, is a trademark of the 3M Company.

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IRWIN™ MAGNETICS

CIRCLE NO. 14 ON INQUIRY CARD

BREAKPOINTS

in Xiamen, China, a "special economic zone" which allows tax breaks for foreign investors. Wang expects to assemble about 30,000 units there and later to spread its business throughout China. Another agreement calls for a joint venture between Wang and China's Ministry of Electronics Industry, a government organization responsible for computers, to produce low-end Wang VS computers and software. The contract is worth about $50 million over the next three years. The third agreement is to manufacture 50,000 Wang Office Assistant systems in Shanghai over the next five years and for Chinese-language software development. Wang also has a 200,000-square-foot manufacturing plant in Taiwan.—L. Valigra

PERSYST TURNS IBM PC INTO COMMUNICATIONS FRONT-END PROCESSOR

The Persyst subsidiary of Emulex Corp., Costa Mesa, Calif., plans to introduce this month the model DCP-88/VM variable-memory distributed communications processor board. The board adds an extra 8088 microprocessor and as much as 512K bytes of memory to an IBM Corp. PC or compatible for handling such communications tasks as systems network architecture, bisynchronous, 3270 and other mainframe protocols. The $695 board can support up to four multiprotocol communications lines and a high-speed parallel port for a 600-line-per-minute printer. Because the system uses the onboard 8088 and memory, programs for the DCP-88/VM can operate independently of the system processor.—C. Warren

PERKIN-ELMER ADDS LOW-END, HIGH-END SUPERMINIS

Perkin-Elmer Corp. (P-E) plans to bolster its superminicomputer family early this month with low-end and high-end systems. The low-end "slimline model" 3203, which lists for $16,600, supports as many as 16 users in commercial and scientific environments. The more powerful 3260 MPS can contain as many as 10 processors and is targeted for heavy number-crunching applications. Both machines run P-E's proprietary OS/32 operating system and should be compatible with the company's other superminicomputers. Prices for the 3260 MPS begin at $185,000. The 3203 and 3260 MPS are slated for March and April availability, respectively.—D. Bright

NETWORK SERVER HOUSES UP TO 14 IBM PC CARD SLOTS

California Network Systems, Milpitas, Calif., late last month introduced the NetServer communications system that provides eight or 14 IBM Corp. PC card slots, with one slot allocated as the bus master. The network server is for use with other new products from the company such as a local-area-network interface card and an 80188-based board that supports systems network architecture / synchronous data link control protocols at speeds as high as 9,600 bits per second and that interfaces with I/O

BREAKPOINTS

channels on the IBM PC, PC/XT and PC-AT. Software for the board converts an IBM PC or compatible into a gateway to an SNA network. The board sells for $990 and the NetServer, with eight slots, sells for $2,170, both in OEM quantities of 500. The software is $580 in OEM quantities.—L. Valigra

IBEX PUTS NINE-TRACK, ½-INCH TAPE ON IBM PC/XT, PC-AT SYSTEMS

Ibex Computer Corp., Chatsworth, Calif., plans to introduce next month a low-profile, ½-inch, reel-to-reel tape subsystem that connects to an IBM Corp. PC/XT or PC-AT computer system. Priced at $5,950, the TS-100 subsystem relies on a special direct-memory-access controller card that plugs into the PC. Backup software for the system, provided on a floppy disk, is compatible with the PC-DOS operating system syntax. An available controller can match IBM's bus to the industry-standard Pertec interface, so any ½-inch tape drive can be plugged in. The controller is priced at $2,300.—C. Warren

SOFTWARE LINKS IBM MAINFRAMES TO DEC VAX MINICOMPUTERS

FlexComm Corp., Seattle, expects to offer software next month that links IBM Corp. mainframes to Digital Equipment Corp. (DEC) VAX superminicomputers and other systems. Called FlexLink, the package reportedly enables transparent communications without regard to the specific machines or operating systems. Prices range from $15,000 for a DEC VAX-11/780 link to $40,000 for an IBM 3081 link. A kit for making the physical connections is optional. The company's products now intermix systems from IBM, DEC, Apollo Computer Inc., Gould Inc. and Sun Microsystems Inc. The company also is developing links to Honeywell Information Systems Inc. and Data General Corp. minicomputers for late 1985 availability.—D. Bright

DRIVETEC CLOSES DOORS

Disk drive manufacturer Drivetec Inc., Milpitas, Calif., ceased operation in mid-January. The company was preparing for March shipments of a new 3.3M-byte, 5¼-inch flexible disk drive but failed to land a large contract with Wang Laboratories Inc. for the drive. After that disappointment, Drivetec's investors declined to put any more money into the 2-year-old company, according to a Drivetec spokesman.—D. Bright

TECH FILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS

RANDOM DISK FILES: While one segment of the microcomputer industry is looking for low-power Winchester disk drives, another wants more capacity in a small form factor. To meet this demand, drive manufacturers **Matsushita Communications Industrial Co. Ltd.,** Yokohama, Japan, **YE-Data Inc.,** Tokyo, and **Rodime Plc.,** Glenrothes, Scotland, all are expected to unveil 3½-inch drives ranging in capacity from 30M to 50M bytes. Rodime's model

IBM's® Unix™-based system of the future is the CIES system of today.

"Let's wait and see what IBM does."

Sound familiar? Maybe some of your customers are holding off on a UNIX-based system purchase until IBM introduces its own version.

You can't blame them, in a way. Their nightmare goes something like this:

The ink isn't even dry on the contract they've signed with you when, suddenly, the new IBM is unveiled in all its glory.

What a machine. It supports 12 terminals, or maybe even 40. Not only that, each of the 40 users can run a different job simultaneously.

What engineering. The 10 MHz processor performs with no wait states.

What a big memory. Up to 2 MB RAM, upgradeable to 8 MB.

And get this. A hard disk from 84 to 300-plus MB. Along with a 500 KB floppy and a 20 MB cartridge tape drive for backup.

Maybe you should tell them that the systems of their dreams are available from you, today, at an affordable price. Better yet, they've already had two years of on-the-job experience and refinement engineering. They're the 680/100 and 680/200 from CIE Systems.

And if they say they're more comfortable with a big company, tell them that multi-national C. Itoh & Company, Ltd., with $60-billion in sales and over 125 years of experience, is behind CIES.

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MORE OUTPUT

Benson's B-90 is the only convenient, high-resolution plotter.

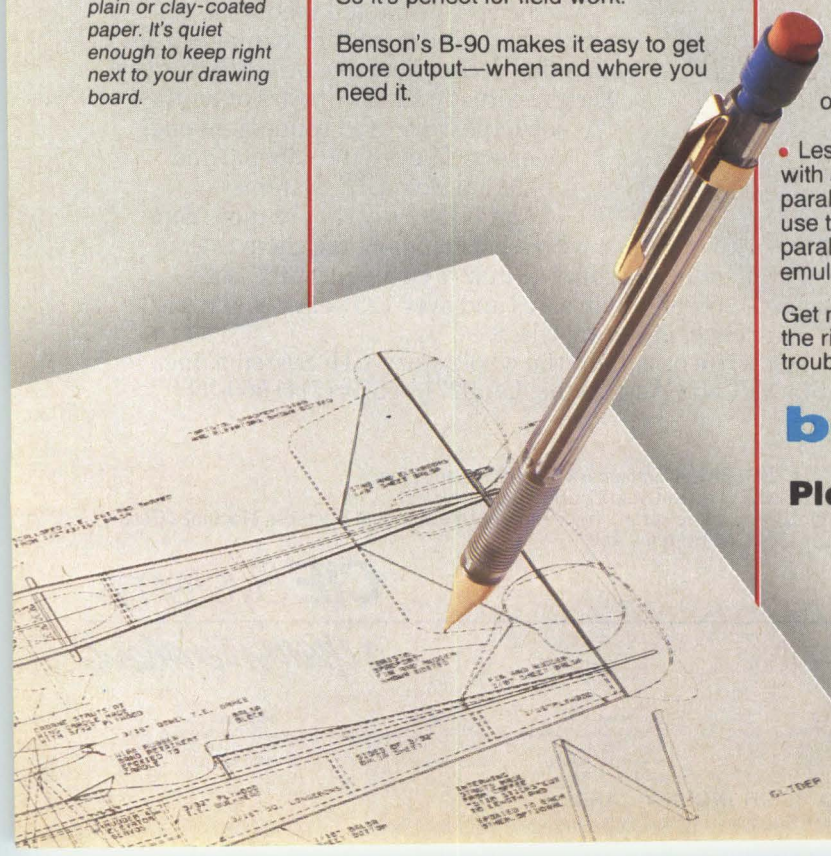
This dry-toner technology monochromatic plotter gives you great resolution—240 DPI—and it's perfect for a quick, hassle-free print-out of your latest revision.

The B-90 is not an electrostatic plotter. Impressions are made when the thermal head heats the smudge-free ink-coated polymer on a roll. You can plot on plain or clay-coated paper, roll or fanfold; whichever you prefer for penciling in your changes.

The Benson B-90 gives you quick, accurate output on plain or clay-coated paper. It's quiet enough to keep right next to your drawing board.

The B-90 does not have to be level to operate, and it's lightweight. There are no chemicals to spill in transport. So it's perfect for field work.

Benson's B-90 makes it easy to get more output—when and where you need it.



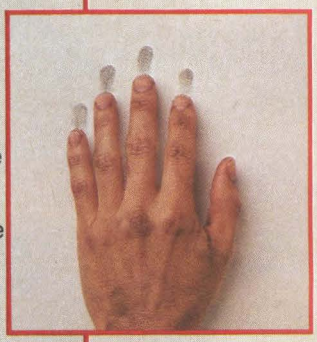
LESS INPUT

How much do you invest to get more? Only $6995.

The B-90 requires less from you:

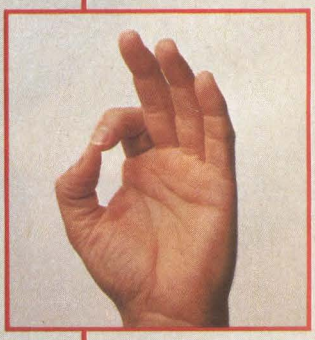
- Less money. Thousands of dollars less than its closest competitor. And supplies are less expensive, too—since the B-90 uses plain or clay-coated paper (a lot cheaper than electrographic paper), no toner, and wide efficient rolls of inked polymer.

- Less attention. The B-90 has Benson reliability built-in. We've designed and produced it to the same strict standards as our other plotters. And there are no toner pumps or complex drive mechanisms. The Benson B-90 is very quiet. You can rely on the B-90 to give you trouble-free, unobtrusive operation.



This hand just changed the toner on "their" electrostatic plotter.

- Less mess. You could rub the inked polymer roll all over a white shirt and it wouldn't leave a mark—the ink won't leave the polymer film until heated by the thermal head. There are no toners, no pumps, and no hoses. All you do is change the inked roll cartridge . . . in seconds, without getting anything on your hands.



This hand just changed the smudge-free inked roll on the Benson B-90. Guess which hand can go right back to work?

- Less hassle. The B-90 comes with a standard Centronics 8-bit parallel interface, or you can use the standard Benson parallel interface or Versatec emulator.

Get more—for less. The B-90 is the right choice for quick, trouble-free output.

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CIRCLE NO. 16 ON INQUIRY CARD

BREAKPOINTS

is expected to use the Small Computer Systems Interface.—C. Warren

To match the enhanced transfer rate of 1.8M or 2.4M bytes per second in the Eagle disk drive from Fujitsu America Inc., San Jose, Calif., **MDB Systems Inc.,** Orange, Calif., has developed the model MLSI-DK11 Storage Module Device (SMD) interface, capable of handling data rates up to 2.5M bytes per second. The $2,330 controller has a 22-bit address architecture, allowing direct address and transfer of as much as 4M bytes of data. It is designed to be transparent to Digital Equipment Corp.'s operating systems and can accommodate two physical drives and four logical drives. The controller is expected to be available in quantity this quarter.—C. Warren

MICRO FILES: Atari Inc., Sunnyvale, Calif., demonstrated its new ST series of Apple Computer Inc. Macintosh-lookalike computers at the recent Winter Consumer Electronics Show in Las Vegas. The computers use the same processor chip as Macintosh and employ internal software programming that mimics the Macintosh's interactive capabilities. Dubbed the "Mac-alikes" by show attendees, the ST microcomputers are priced from $399 to $599 and should be available in the second quarter of this year.—S. Shaw

CHIP FILES: Harris Corp., Intel Corp. and **Motorola Inc.** have submitted the first applications for copyright protection of microprocessors under the Semiconductor Chip Protection Act that was signed into law last November. Under the application procedures established by the U.S. Copyright Office, each company was required to submit a $20 filing fee, four copies of their chips and a visual representation of the mask designs, either a photograph, plastic overlay or composite plot of each design layer. The companies' applications are currently under review at the Copyright Office, which is required under the new law to either accept or reject the applications within 60 days. A decision is expected in early March.—S. Shaw

NOTES FROM OVERSEAS: Pacific Telesis, one of the first Bell Operating Companies to develop a yen for foreign waters, is going to take the plunge into Britain's value-added networks business. Step one is the acquisition of the year-old U.K. electronic mailbox start-up Kensington Datacom for an estimated $1.2 million. Step two will be eliminating the software bugs Kensington has been having with its service. The takeover is Pacific Telesis' first in an expected series of acquisitions and joint ventures.—M. O'Gara

Taiwan's **Multitech Industrial Corp.,** one of the country's largest manufacturers and distributors of computer equipment, has become the exclusive Taiwanese value-added reseller for AT&T Corp.'s 3B series of 32-bit, UNIX-based computers. Multitech chairman Stan Shih says he expects Taiwanese sales of the 3B2, 3B5 and 3B20 computers to reach $3 million by the year-end. In order to support the series, Multitech plans to

BREAKPOINTS

develop a Chinese version of UNIX—the world's first, according to Shih. Multitech has already paid $43,000 for a source license from AT&T, says Shih, which gives Multitech the legal right to undertake modifications necessary in the conversion process. An additional fee of $25,000 will be paid to AT&T for what Shih calls "unlimited" copy rights. Multitech's version of UNIX will eventually become an independent product, says Shih, able to run on computers outside the 3B series. It will also be able to accept English language input, he says. The firm also plans to develop a wide range of Chinese-language utilities for UNIX.—C. Hintermeister

The second of three phases of **Japan's Fifth Generation Computer Project** is about to begin officially, although the research is actually already under way. The research is to continue until 1991, and has $11 million in backing from the Japanese government. Kazuhiro Fuchi, director of Japan's Institute for New Generation Computer Technology, the organization established by Japan's Ministry of International Trade and Industry to supervise artificial intelligence research, said the first phase, which officially ends in March, produced a prototype relational database machine for rapid execution of multiple operations. The second phase involves testing parallel tasking functions and translating information from Japanese to English.—I. Kakehashi

The French are developing their own 200-megaflop supercomputer, scheduled for completion by 1988. The project unit has been christened Marisis and will be a collaborative effort shared by **Groupe Bull, Sintra,** the French National Research Institutes and the universities of Nice and Rennes. The initial project calls for the development this year of a 50-megaflop version, dubbed Isis, followed in 1987 by a low-end 30-megaflop version, code-named Maria. Marisis itself will consist of one to seven Isis units run by an operating system called Mariane.—M. O'Gara

Japanese manufacturers have stepped up production of 32-bit microprocessors after watching the warm reception given to sample shipments of Motorola Japan's MC68020 and National Semiconductor Japan's 32000 Series. **NEC Corp.** expects to have its own 32-bit devices in production in 1987. **Hitachi Ltd.** has already shown prototypes of its 32-bit, Motorola-compatible devices, and plans to start production late in 1986. Hitachi is working with Motorola on a second-source contract to build the MC68020. **Fujitsu Ltd.** recently expanded its second-source contract with Intel Corp. for production of the 80386, which is to be ready by mid-1985. Sales of 32-bit processors could exceed $100 million in 1987, according to industry sources. Asked about the threat from domestic competition, a spokesman for Motorola Japan observed that most of the devices are two years away, and added, "We don't intend to just wait for them to catch up."—I. Kakehashi

Viasyn (vī′ uh sin) *n.* [L., *via*, a way or road; Gr., *syn*, together or integrated], formerly *CompuPro*. 1. *n.* a twelve year old manufacturer of microprocessor systems, subsystems and components, notably multi-user computers used in business, science and industry. 2. *adj.* related to Viasyn, formerly *CompuPro*, quality, i.e., possessing extraordinary reliability, performance, modularity and ruggedness. See *CompuPro* (previous name).

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We did it on our 8" Winchester drive. Which makes our 8" Winchesters two to three times as reliable as anybody else's.

You can expect superior reliability from NEC drives in any size. And that includes our 5¼" and our new 3½" drives.

We go to greater lengths in building and testing.

Our drives are more reliable because we take extra care. From the initial design through manufacturing and testing.

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Take a nice, long drive with NEC.

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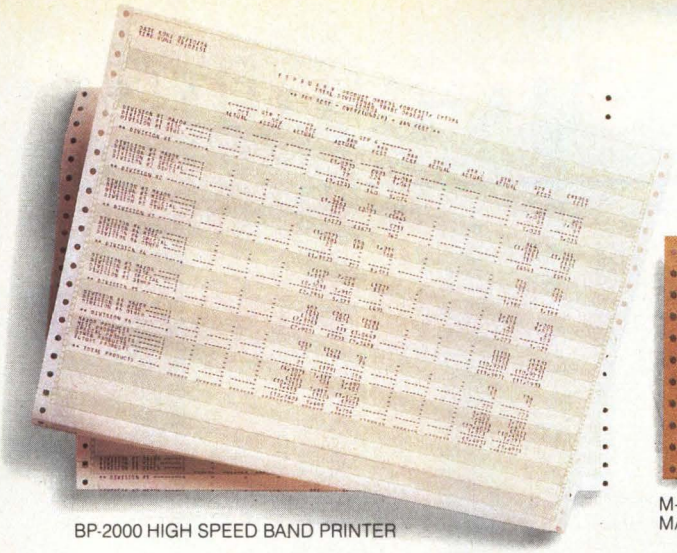
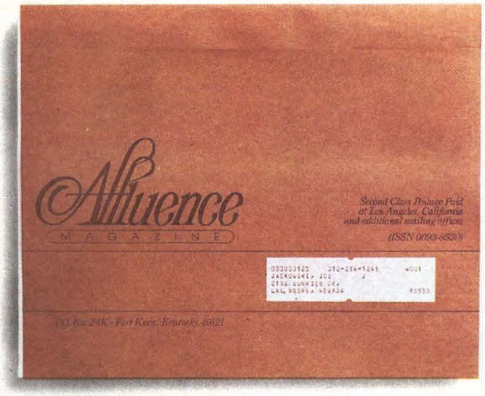
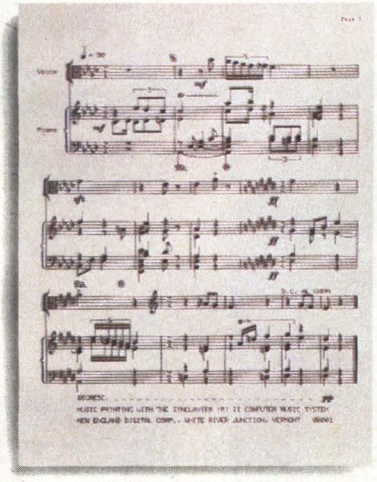


BP-2000 HIGH SPEED BAND PRINTER

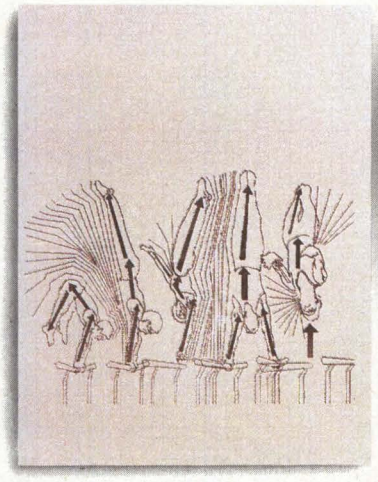
M-100L
MATRIX PRINTER



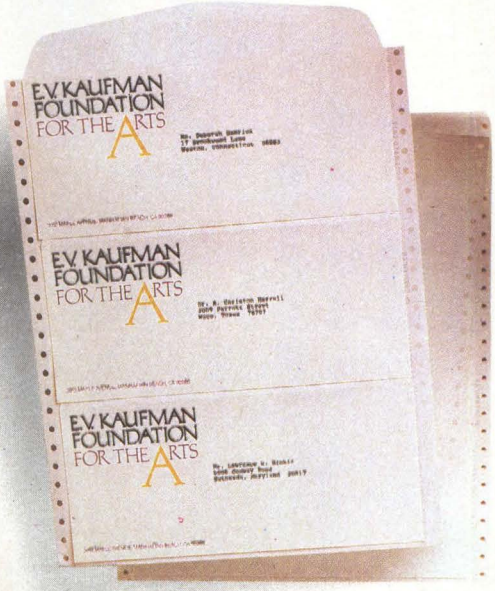
B-600 MEDIUM SPEED BAND PRINTER



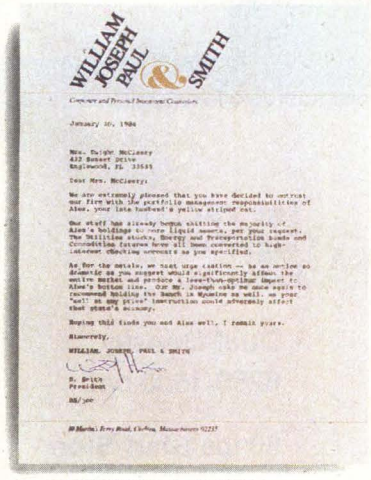
8010 MATRIX PRINTER



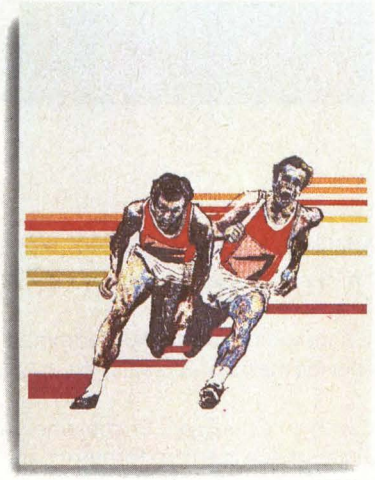
8020 MATRIX PRINTER



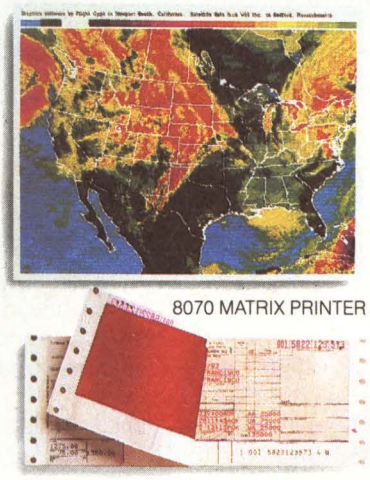
DP-55 DAISYWHEEL PRINTER



DP-35 DAISYWHEEL PRINTER



8050 MATRIX PRINTER



8070 MATRIX PRINTER

M-120 MATRIX PRINTER

...and so on.

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Dataproducts printers.
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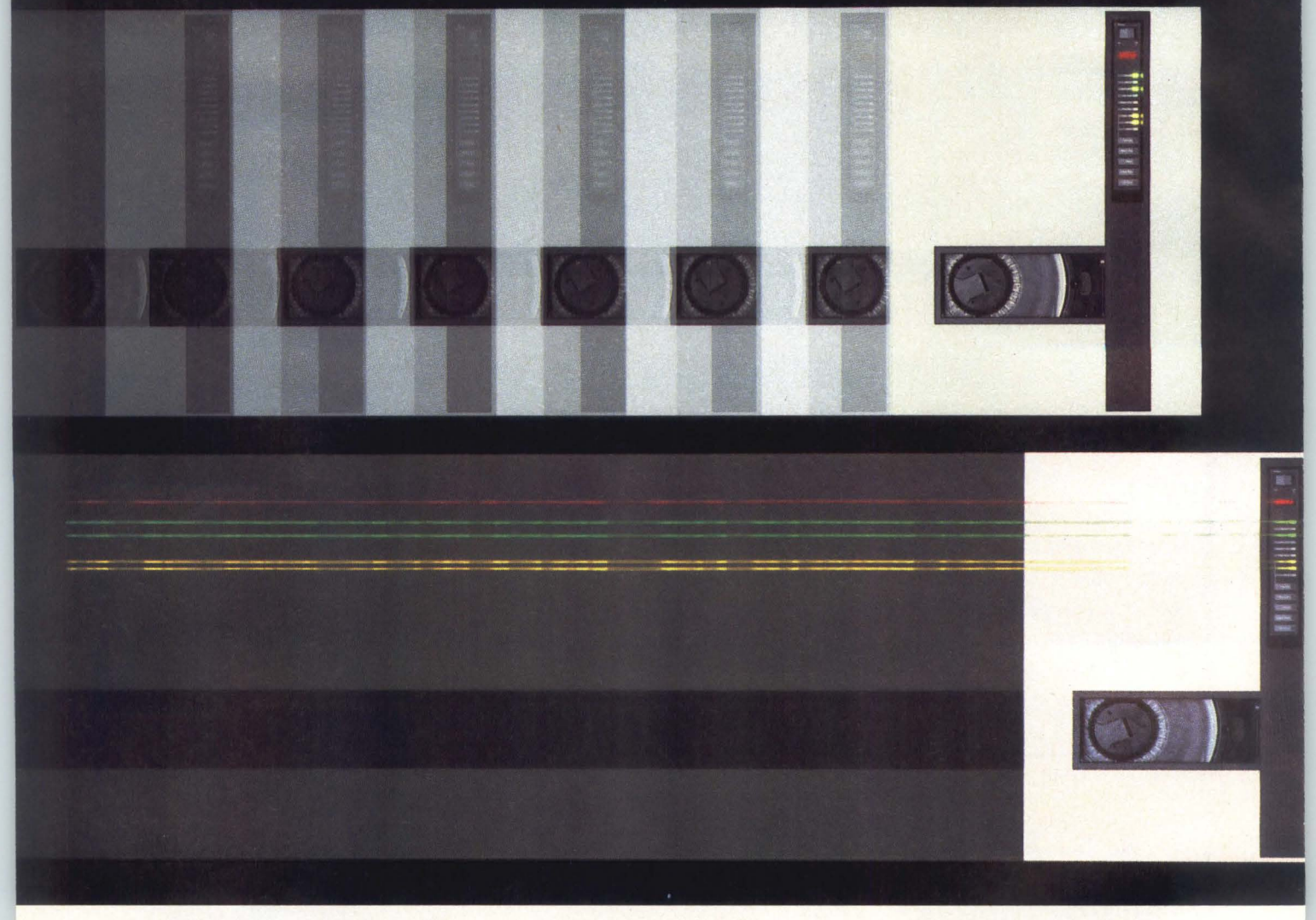
Start/Stop or Streaming?



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In 1982, Storage Technology introduced the industry's first low-cost 6250 bpi tape subsystem. Operating at 50 ips with a full start/stop capability, the 2920 established a new price/performance standard for ½-inch magnetic tape drives.

Now we've enhanced this 2920 with an added 100 ips streaming capability. Combined with the 2920's existing start/stop capability, it makes this device the most versatile, low-cost tape subsystem on the market today.

The 2920's innovative mechanical design coupled with an extensive LSI implementation provides outstanding subsystem reliability and simplicity-of-service. It performs equally well whether off-loading a disk drive or executing a sort/merge. As a start/stop device, the 2920 features a very fast 5 ms start time. As a streamer, the 2920 will back-up a 100 MByte disk in 2.7 minutes using less than one reel of tape.

For a well rounded tape subsystem that can handle all of your tape needs — at a price you can afford — with performance and quality you can appreciate, contact OEM Marketing at Storage Technology Corporation, (303) 673-4066, and inquire about our 2920 Tape Subsystem's new dual-speed feature. Or write Storage Technology Corporation, OEM Marketing, Mail Drop 3N, Louisville, Colorado 80028.

The 2920 OEM Tape Subsystem Features:

- **Dual-Density 6250/1600 bpi**
- **50 ips Start/Stop**
- **100 ips Streaming**
- **Automatic Threading**
- **CMOS LSI**

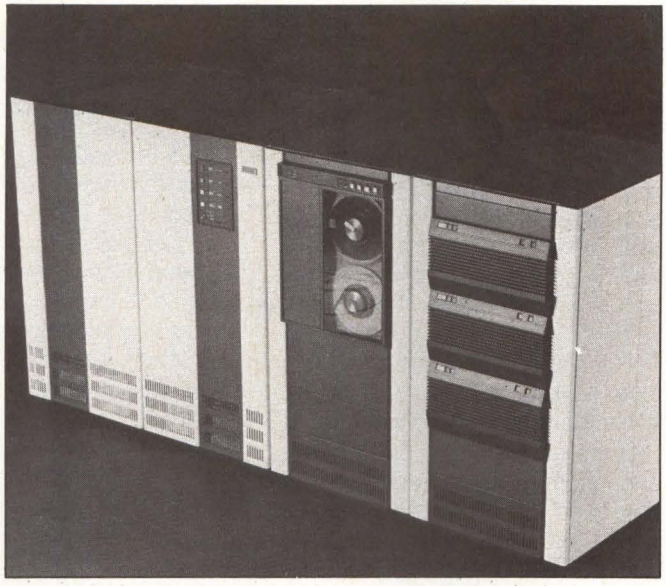
StorageTek

CIRCLE NO. 21 ON INQUIRY CARD

Prime answers DEC with 4-MIPS supermini

The Model 9955 claims performance comparable to the VAX 8600. Delivery is scheduled to start this month, two months ahead of VAX.

David Bright, Assistant Editor



Although both machines use *the same size chassis, Prime's new 9955 superminicomputer outperforms the 9950 that it replaces by as much as 60 percent. The 9950 can be upgraded to the 9955 for $45,000.*

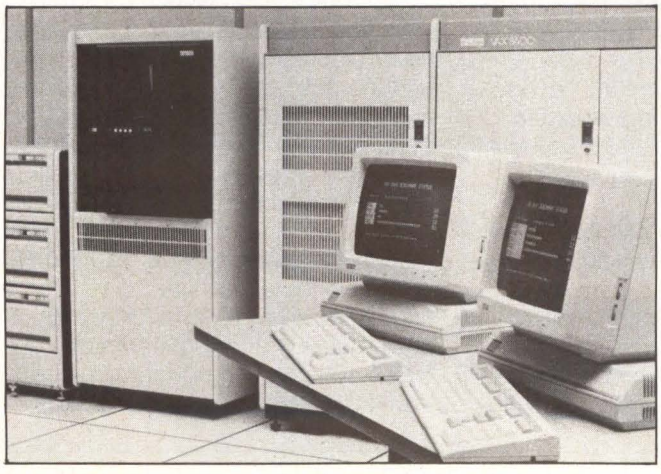
Responding to Digital Equipment Corp.'s (DEC) announced price/performance standard-setter, the VAX 8600 superminicomputer, Prime Computer Inc. has introduced a 4-million-instructions-per-second (MIPS) machine. The Natick, Mass., company's new 9955 model incorporates faster emitter coupled logic (ECL) circuits and several other improvements to better its previous high-end 9950 system's performance by as much as 60 percent.

At the same time, it costs $20,000 less. The $351,000 price tag includes 4M bytes of RAM, a 315M-byte Winchester disk drive and an enhanced version of the Primos virtual memory operating system.

DEC won't give a performance rating for the 8600, but industry sources put it at 4 MIPS. Prime's 9955 should appeal to end users and value-added resellers (VARs) who want comparable performance at a significantly lower price, says product marketing director Wendy Wheeler.

The entry-level VAX 8600, however, includes 12M bytes of RAM, a 456M-byte Winchester disk drive and provides 4G bytes of virtual memory, compared to 512M bytes on the Prime 9955. While DEC is scheduled to begin 8600 shipments in April, Prime plans to get a two-month jump by starting shipments this month.

Despite the revamped price/performance structure and early shipments,



The VAX 8600 is about *the same size as the VAX-11/780, but is said to provide as much as 4.2 times the older machine's performance.*

NEWS

Wheeler expects Prime's target customers to remain split evenly between business and scientific environments, with 80 percent going to end users and 20 percent going to VARs. About half of Prime's $600 million business comes from outside the United States.

Five-stage pipelined processor

The 9955 replaces the 9950, which was the company's biggest revenue producer. Like the 9950, the 9955 employs 64K-bit RAM chips to support up to 16M bytes of main memory. Wheeler says Prime won't use 256K-bit RAMs to boost memory for about a year, when the chips should be more affordable. As on the 9950, the 9955's five-stage pipelined processor overlaps five instructions in each 80-nsec cycle: cache access, instruction decode, effective address formation, virtual memory mapping and instruction execution. Time is saved with the processing of several operations at once.

Much of the improved performance of the 9955 is obtained through the use of more advanced ECL, which cuts the main memory access time from 84 nsec to 58 nsec. In addition, a bank of six Motorola Inc. ECL Macrocells enables the system to perform multiplication in less than half the time of any other Prime system.

Other performance enhancements include an increased cache memory, the addition of branch cache memory, a larger high-speed address buffer, soft error recovery, quad-precision floating point capability and operating system refinements. Due to the hardware and software refurbishment, the new system supports 254 terminals, nearly twice the 9950's capacity of 128 terminals.

DEC VAX 8600: The new supermini standard

The top-of-the-line VAX 8600 superminicomputer replaces the 7-year-old VAX-11/780 superminicomputer as Digital Equipment Corp.'s flagship product. DEC officials continually point out that the new machine (formally code-named "Venus") delivers as much as 4.2 times the performance of the 11/780, which until now has served as the de facto industry standard. While DEC rates the 11/780 (which it still sells) at just over 1 million instructions per second (MIPS), the company has yet to provide an actual MIPS performance rating for the 8600. "Our customers want transactions accomplished per day, not instructions per second," explains president Ken Olsen. Industry sources put the performance rating of the 8600 at a little more than 4 MIPS.

To reach banks and other customers in high-transaction environments, DEC is promoting the 8600 as a key part of the VAXcluster, which loosely links as many as 16 VAX processors or hierarchical storage controllers. In several areas, such as print and batch queueing and file sharing, the VAXcluster performs much like a distributed system. Bruce Ryan, manager of the VAX marketing group, contends that a VAXcluster can equal the performance of IBM Corp.'s 3084 high-end mainframe at a much lower price. A $6.7 million VAXcluster comprising seven 8600s, one 11/780 and 40G bytes of disk storage provides the same power—30 times that of a single 11/780— as a $10 million IBM 3084 configuration with 40G bytes of disk storage, says Ryan.

Although the 8600 is the first VAX to use emitter coupled logic chips, four-stage pipelining and a write-back cache memory, it incorporates the VAX instruction set and thus is compatible with all other VAXes, including the MicroVAX microcomputer, according to DEC officials. The 8600 has a dedicated memory bus and an optional, second input/output bus to speed high-volume applications. The superminicomputer requires VMS 4.0, the latest version of DEC's proprietary operating system.

Despite its increased power, the 8600 is about the same size as the 11/780 (and its faster sister VAX, the 11/785, introduced last April) and is said to consume just slightly more electricity.

Configured as the basis of a VAXcluster, an entry-level system with 12M bytes of memory, a hierarchical storage controller, star coupler, VMS and DECnet licenses, a 456M-byte disk drive, a tape drive and a console terminal lists for $576,000. A processor with 4M bytes of memory and VMS is $351,000.

Although DEC had been criticized for delaying the new system's announcement by two years, Olsen says the system was actually no more than six months late, which, he jokingly adds, is right on schedule for him: "My wife says I'm six months late in every project I start at home." Nevertheless, customers will have to wait until at least April—nearly six months from the product's formal introduction—for volume shipments to begin.

Meanwhile, DEC is facing increasing pressure from IBM. IBM recently filled in its mainframe line with two new computers: the dual-processor 4381 Group 3 and the 3083 CX, which is the 308X-family's entry-level processor. The 4381 Group 3 is said to better the previous top-of-the-line 4300 processor's performance by as much as 70 percent. The 3083 CX can be field-upgraded to all other processors in the family to enhance performance tenfold. With respective prices of $825,000 and $830,000, the two new mainframes fall into the high end of the VAX 8600's price range. In addition, Big Blue has lowered 4361 Group 4 and 5 prices by 10 percent. A Group 5, which competes in performance with the $195,000 VAX-11/785, now sells for $180,000.

The central processor's bipolar cache memory has been quadrupled to 64K bytes, resulting in an access time of 40 nsec. The cache memory second-guesses the processor by storing frequently used data and program instructions within the processor, instead of in main memory. The information the processor is looking for can be found in the cache in more than 90 percent of all cases, thereby increasing system efficiency.

The use of branch-cache memory is a technique borrowed from the mainframe world. The 1K-byte branch cache augments the pipeline structure by acting as a second type of instruction prefetch. By predicting program branching, it helps to make sure that the correct instruction is in the pipeline.

The 512-word segment table lookaside buffer, which is four times the size of the 9950 buffer, stores frequently used virtual-to-physical address translations so that the operating system can find the necessary physical address 99 percent of the time.

When a parity error is detected, the soft-error recovery function reloads the problem location from memory without halting the system.

The quad-precision floating point capability is built into the instruction set. Prime's FORTRAN compiler has been enhanced to take advantage of the quad-precision feature. The other machines in the 50 series achieve this capability through software, thereby maintaining software compatibility between the new system and other systems in the group.

The VAX 8600 uses some similar performance-enhancing features as the 9955, such as four-stage pipelining and an 8-byte lookahead buffer, but officials at both companies stress that relative throughput is the only true performance qualifier.

VAX: THE OLD AND THE NEW

	11/780	11/785	8600
Logic	Schottky TTL	Schottky TTL	ECL
Word length (bits)	32	32	32
CPU cycle time (nsec)	200	133	80
MIPS	1.1	1.6	*
Maximum memory (M bytes)	32	32	32
Virtual memory (G bytes)	4	4	4
Cache memory (K bytes)	8	32	16 write-back
Price	$145,000 (w/2M bytes memory, VMS)	$195,000 (w/2M bytes memory, VMS)	$351,000 (w/4M bytes memory, VMS)

*DEC has not given a MIPS rating to the 8600 but says the system's performance can be as much as 4.2 times that of the 11/780.

COMPARING PRIME HIGH-END SYSTEMS

	9950	9955 (replaces 9950)
Logic	ECL	advanced ECL, Motorola ECL Macrocells
Word length (bits)	32	32
CPU cycle time (nsec)	80	80
MIPS	2.5	4.0
Maximum memory (M bytes)	16	16
Main memory access time (nsec)	84	58
Virtual memory (M bytes)	512	512
Bipolar cache memory (K bytes)	16	64
I/O bandwidth (M bytes per sec)	9	9
Price	$371,000 (w/4M bytes memory, 315M-byte disk drive, Primos)	$351,000 (w/4M bytes memory, 315M-byte disk drive, Primos)

Faster operating system

To ensure software compatibility among machines, all Prime 50 series users will receive a free copy of the new Primos 19.4 operating system that the 9955 requires. Primos 19.4 includes programmer productivity aids and improvements that boost FORTRAN performance even on the older machines.

Although the new system is more powerful than the unit it replaces, it uses the same chassis, which measures 53 by 53 by 35 inches. By swapping CPU boards, the 9950 can be upgraded to the 9955 for $45,000.

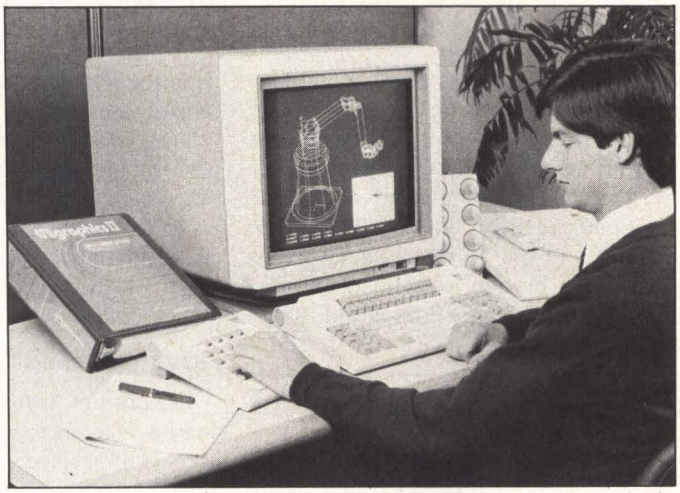
While Prime competes against IBM Corp. in the CAD/CAM area, Prime's general strategy is to coexist with Big Blue. In line with that strategy, the company has simultaneously introduced Prime/SNA, a series of subsystems that tie Prime systems to IBM's Systems Network Architecture and a Performer terminal required to run the SNA products. □

CAD/CAM leaders team up to expand market share

Lori Valigra, Senior Editor

IBM Corp.'s march into the computer-aided design/computer-aided manufacturing (CAD/CAM) market is becoming increasingly intrusive. The company already ranks second in direct system sales, and now it is signing on its top competitors as value-added resellers (VARs) of IBM equipment. IBM stands to increase its market penetration by the move, and its VARs will benefit from IBM's brand name.

McDonnell Douglas *is reselling IBM 4361 computers and 5080 terminals with its own Unigraphics II CAD/CAM software.*



The newest VAR is McDonnell Douglas Corp.'s Computer Integrated Manufacturing Technology Co., St. Louis, Mo. That company is part of the McDonnell Douglas Automation Co. (McAuto), which ranks fifth in the CAD/CAM market, according to figures from Daratech Inc., a Cambridge, Mass., CAD/CAM market-research concern. McDonnell Douglas joins top-ranking Computervision Corp. and General Electric's fourth-ranking Calma Co. as IBM VARs.

IBM looks for a bigger prize

But the symbiosis of IBM and its competition should lead IBM beyond the $2.8 billion CAD/CAM market, projects Daratech president Charles M. Foundyller. The real prize, he contends, is the $15 billion scientific and engineering computer market, into which CAD/CAM systems are sold. That means IBM is going after the main customer base of large minicomputer makers—Digital Equipment Corp. (DEC), Data General Corp. (DG) and Hewlett-Packard Co. "CAD/CAM is a pawn being used by IBM to win the scientific/engineering market chess game," explains Foundyller, "and the VARs are the key to the kingdom."

Foundyller expects IBM to make VARs out of as many of its competitors as possible in its effort to get IBM equipment into scientific and engineering environments. Historically, IBM has sold "closed," complete systems, and thus customers wanting to add value turned to DG and others for bare-bones computers. Now that IBM has made its equipment attractive to VARs, Foundyller says, engineers will begin to specify IBM's brand more and more.

The VAR agreement, which is for the United States only, although the two companies are working to extend that to other countries, calls for McDonnell Douglas to integrate, market and install systems for end users, and to train them. The company will purchase IBM's 4361 minicomputers and mainframes, 5080 raster terminals, mass-storage devices, operating systems and utilities. To those IBM products, McDonnell Douglas will add its Unigraphics II mechanical CAD/CAM software, which runs under IBM's VM/CMS operating system. The company plans to debut its system at next month's National Design Engineering Show in Chicago.

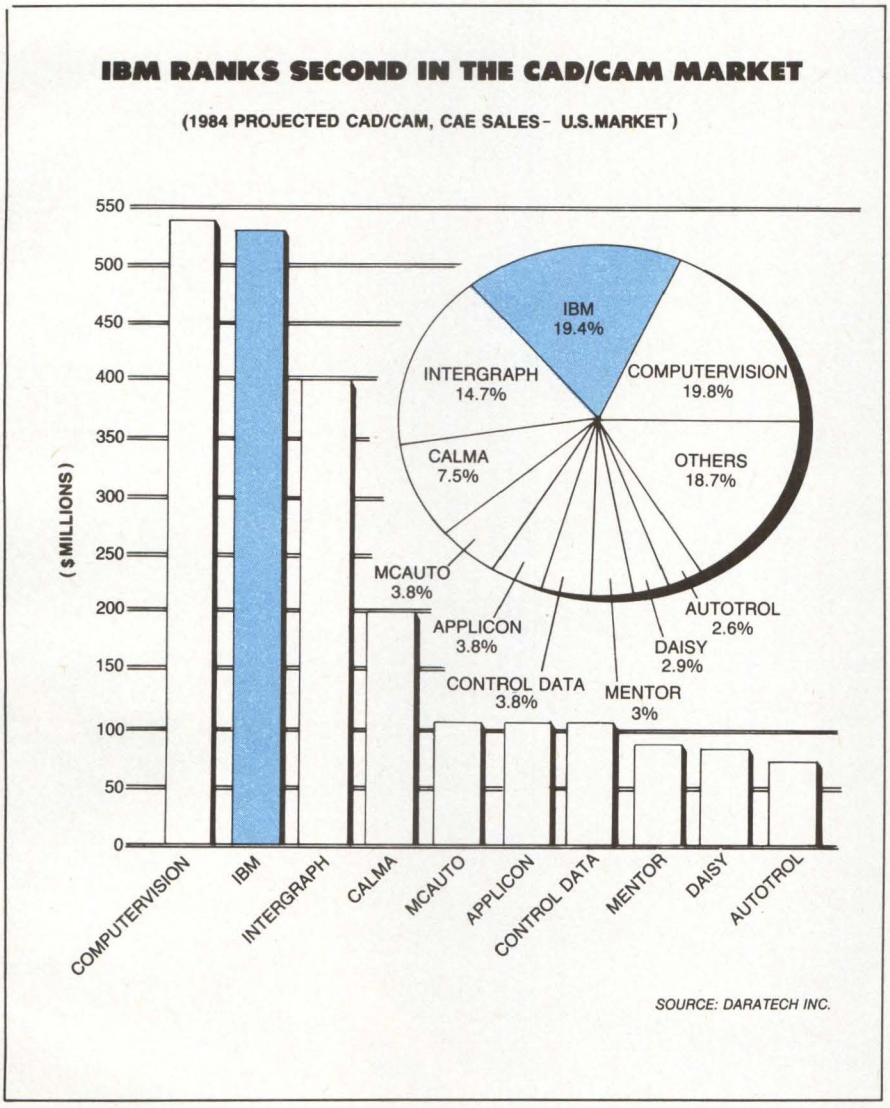
Sales should double

Although McDonnell Douglas jumped to its fifth-place market position by reselling CAD/CAM systems based on DEC and DG computers, it's expecting the IBM products to help double sales over the next two years. McDonnell Douglas' Computer Integrated Manufacturing Technology Co. was expected to reach $105 million in revenues by the end of last year, a 50-percent increase over 1983. The company planned to deliver 174 CAD/CAM systems and about 900 graphics workstations last year.

The target market for McDonnell Douglas' systems is $50-million-or-more companies with IBM equipment installed, and those needing discrete manufacturing applications.

"We expect IBM to emerge as the leading CAD/CAM supplier in two years, during which time our business will double," says John J. Clancy, a senior vice president at McDonnell Douglas. McDonnell Douglas will continue to market the DEC and DG products, but it is not certain that the IBM equipment will supplant the DEC and DG products. Buyers develop a brand loyalty and generally stick to it, notes George F. Meister Jr., senior vice president and general manager of the Computer Integrated Manufacturing Technology Co. "The customer many times has a preset notion of what he wants. If that's IBM, then we were not in the competition until [now. And if the preset notion holds true], we won't see much migration from DEC or Data General equipment to IBM."

Daratech's Foundyller agrees that customers have a brand-name preference, but he says price considerations also are important. For example, he says McDonnell Douglas will quote the



price for the brand requested by a customer, but also will supply a quote for a more economic brand. "They have converted some people," from brand preferences to more economical systems, says Foundyller.

Price seems high

Analysts question the comparatively high price of a McDonnell Douglas system. The price for a four-terminal system with disk drives, a plotter and McDonnell Douglas' Unigraphics II software—$600,000—is about double that of IBM's CAD/CAM offering, a 4300 series system with four terminals and running the CADAM Express interactive 3-D computer-graphics augmented design and manufacturing program. But the company claims it is offering more than IBM in service, support and training.

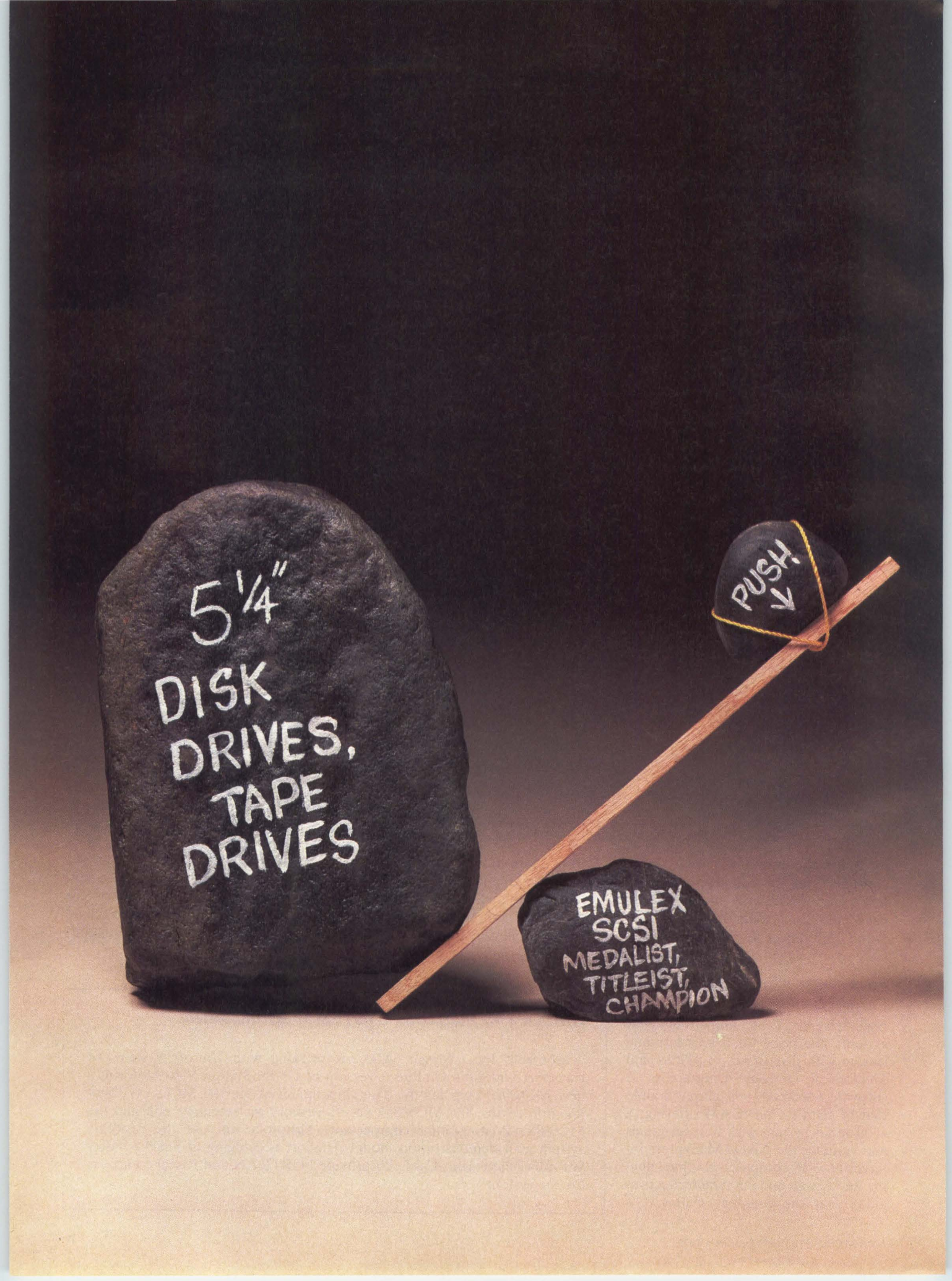
Like McDonnell Douglas, DEC is touting more comprehensive offerings as its best defense against IBM. DEC has gained prominence in CAD/CAM mostly through its resellers. The company claims it gives resellers a wide choice of low-end to high-end computers, all of which are compatible. "Long-term, we'll concentrate on a narrow product line, for example CAD, and offer one system [solution] from small to large machines," says Kenneth H. Olsen, DEC president. Late last year, DEC rented the Hynes auditorium in Boston to show 8,000 customers how its computers work over networks and run common software. Olsen says that is one way to combat IBM's advances. "IBM does not have the spectrum we do," he claims.

IBM has moved into the industrial-automation market with a series of products ranging from microcomputers to mainframes, not all of which are compatible. One recent example in the low-end CAD/CAM market was the introduction of the PC/ES engineering and scientific version of the PC, which runs PC-DOS. It runs different programs than IBM's earlier laboratory computer, the System 9000, based on a Motorola Inc. MC68000 processor and running either the XENIX UNIX-like operating system or an IBM-proprietary operating system (MMS, December 1984, Page 38).

The IBM-based McDonnell Douglas system is scheduled for delivery next quarter. The 5080 terminal initially will be driven by host system software. In the fourth quarter, McDonnell Douglas plans to incorporate a high-level interface module to support the 5080. The company also plans to convert other CAD/CAM programs for use on IBM systems. Those include solids, robotics and printed circuit-board design packages. □

UNISOFT IS PORTING SYSTEM V TO MC68020

Motorola Inc., Tempe, Ariz., is working with Unisoft Systems to transport UniSoft's UniPlus+ version of UNIX System V to Motorola's new MC68020 chip family. The chips involved are the MC68020 32-bit microprocessor, the MC68851 paged-memory management unit and the MC68881 floating-point coprocessor. Motorola will use the resulting system as a demonstration model. UniSoft is bringing in Silicon Valley Software, Palo Alto, Calif., to provide FORTRAN and Pascal compilers for the system.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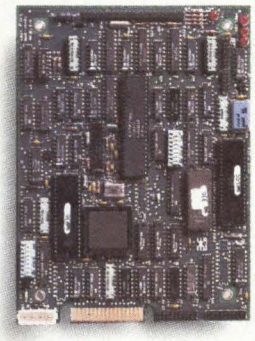
*Titleist MTO2 requires +12 VDC.



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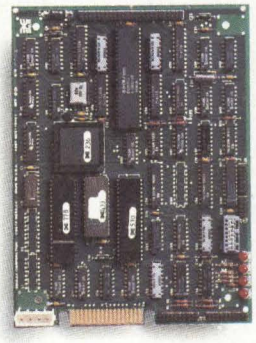

CHAMPION ESDI/SCSI DISK CONTROLLER.

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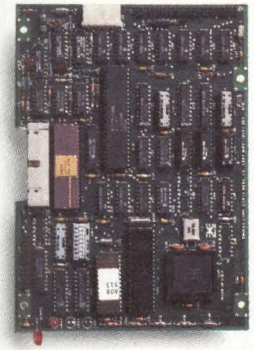

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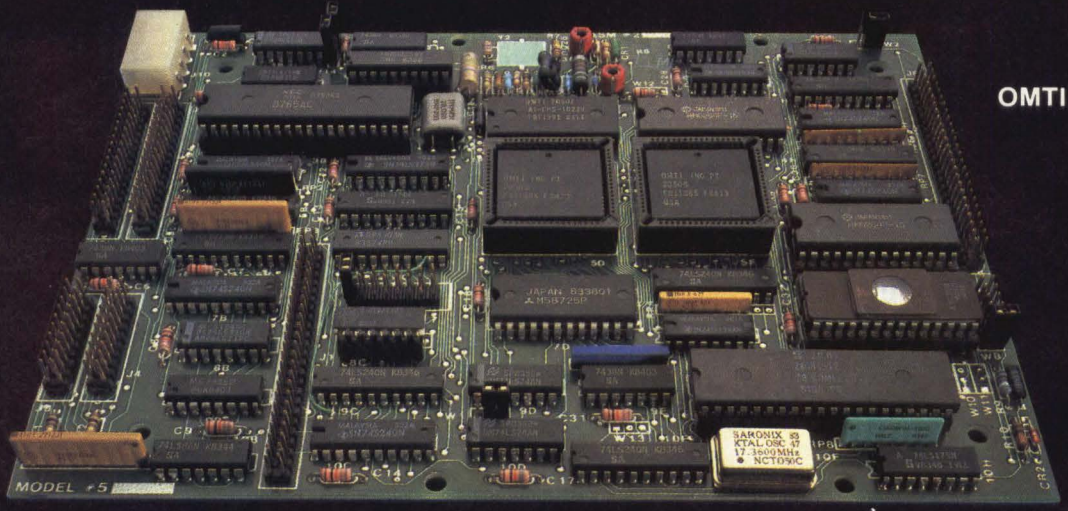

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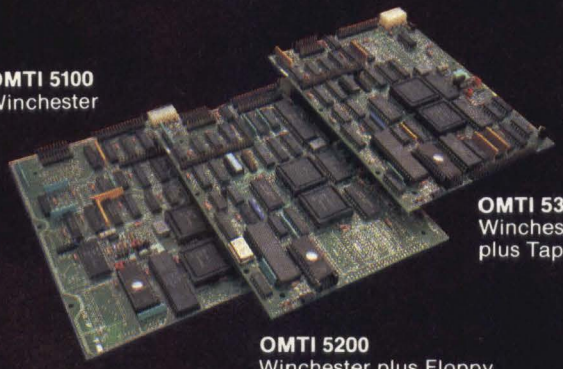

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CIRCLE NO. 23 ON INQUIRY CARD

HEARD ON THE HILL

Tax simplification plan is complex for high tech

Stephen J. Shaw
Washington Editor

Like most political compromises, there's a little to like, a lot to hate and several unresolved questions in the Treasury Department's plan to overhaul and simplify the federal tax system.

The announcement of the plan in late November by Treasury Secretary Donald T. Regan set off a mad scramble among trade associations, economists and corporate tax planners to assess the impact of the proposed changes. Although opinions vary on how the plan will affect different segments of the computer industry, there are at least two points on which everyone agrees: The plan, billed as a "tax simplification" measure, is anything but simple, and it promises to alter profoundly the way computer and other high-technology companies make their basic business decisions.

Treasury's plan is "a collection of about 22 trial balloons," as characterized by one computer industry executive. Released without the strong support of President Reagan, the plan's sweeping provisions are likely to undergo extensive revisions as politicians and industrialists react. In the House of Representatives, Rep. Dan Rostenkowski, D.-Ill., chairman of the House Ways and Means Committee, has already indicated that he will oppose any tax legislation that does not raise additional revenue to reduce the federal deficit. Those with special interests, including computer industry associations and company executives, have stated that they endorse the concept of a simpler tax system, but do not want to lose existing deductions and credits.

Specifically, the Treasury proposal calls for the following modifications to the U.S. tax system:

- Reduction of the maximum corporate tax rate from 46 percent to 35 percent
- Increase of the capital gains tax rate from 20 percent to 35 percent
- Elimination of the 60-percent exemption on profits from long-term capital gains
- Elimination of the Accelerated Cost Recovery Schedule that allows businesses to depreciate investments on equipment more quickly
- Elimination of the investment-tax credit that allows companies to deduct up to 10 percent of the cost of new equipment

The plan's most obviously attractive features for the computer industry are the reduction of the overall corporate tax rates and the retention of the R&D tax credit. In endorsing the plan, Vico E. Henriques, president of the Computer and Business Equipment Manufacturers Association, says that these two provisions will redress a tax imbalance imposed on high-technology companies. "For too long, major high-tech companies have suffered under high effective taxes. We've been paying more than our share, while at the same time our products were contributing to productivity in every economic sector. The Treasury proposal would move the nation toward a much more fair tax system," Henriques says.

On the minus side, the increase in the capital-gains tax could dry up venture-capital funds needed by start-up computer companies. The tax rate on capital gains had been reduced from a whopping 49-percent rate in the early '70s to its present 20-percent level. This downward trend is credited with raising the amount of investment capital available to fund new companies, from approximately $50 million in 1977 to $4.1 billion in 1983, according to estimates prepared by the American Electronics Association (AEA).

"The capital gains differential is the very lifeblood of America's high-risk, high-tech companies. Not only does it free growth funds and make these companies more attractive as investments, but by stimulating the growth of job-creating, tax-paying companies, it helps reduce the federal deficit," comments Dean O. Morton, AEA chairman and chief executive officer of Hewlett-Packard Co.

In opposing the capital-gains provisions on behalf of the industry association, Morton points out that the 1978 reduction in the tax rate allowed venture-capital money to boost employment prior to the cut. To reverse the downward trend of capital gains taxes now, he says, would jeopardize the continued growth of the electronics industry at a time when U.S. trade deficits are increasing sharply.

The proposed increase in capital-gains taxes is slightly offset by allowing the rate of inflation to be considered in computing the tax. For instance, investors would be able to reduce their taxable gains on stock sales by deducting the amount of inflation during the time they held the stock. But the amount saved will be relatively insignificant when compared to the increased tax liability. "Despite the inflation indexing, Treasury is simply going in the wrong direction in its treatment of capital gains," comments Stephanie Biddle, vice president of the Computer and Communications Industry Association.

The elimination of an accelerated schedule for equipment depreciation and the 10 percent investment tax credit could slow sales of computer systems and related equipment by effectively adding the increased tax to their cost. Biddle notes that without the current tax incentives, the decision to purchase expensive office-automation equipment must now be based on a different set of economic calculations.

The largest challenge facing computer equipment suppliers and system integrators is to determine the bottom-line impact of these proposed tax changes on their individual companies.

The Treasury plan is expected to be submitted to Congress early this year. It will be considered alongside two similar measures authored by Rep. Jack Kemp, R-N.Y. and Sen. Bill Bradley, D-N.J. Observers predict that some combination of the tax measures could be enacted as early as June.

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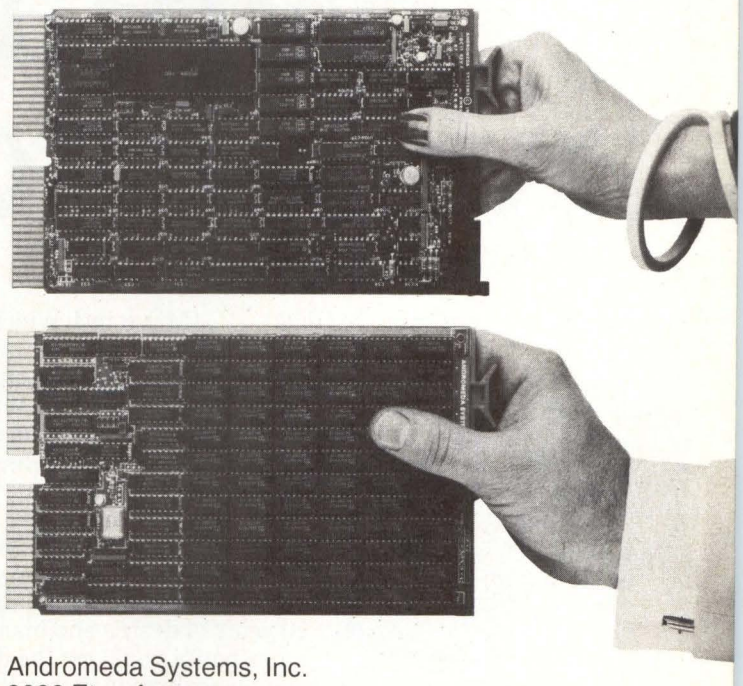

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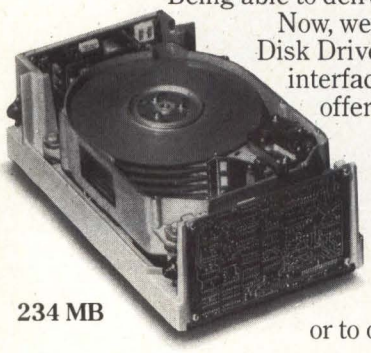

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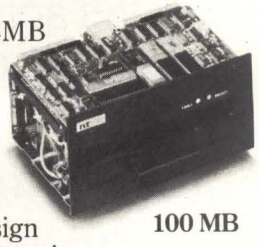

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Networks 1.0 provides IBM compatibility

Keith Jones, European Editor
and **Marjorie Stenzler-Centonze,**
Associate Editor

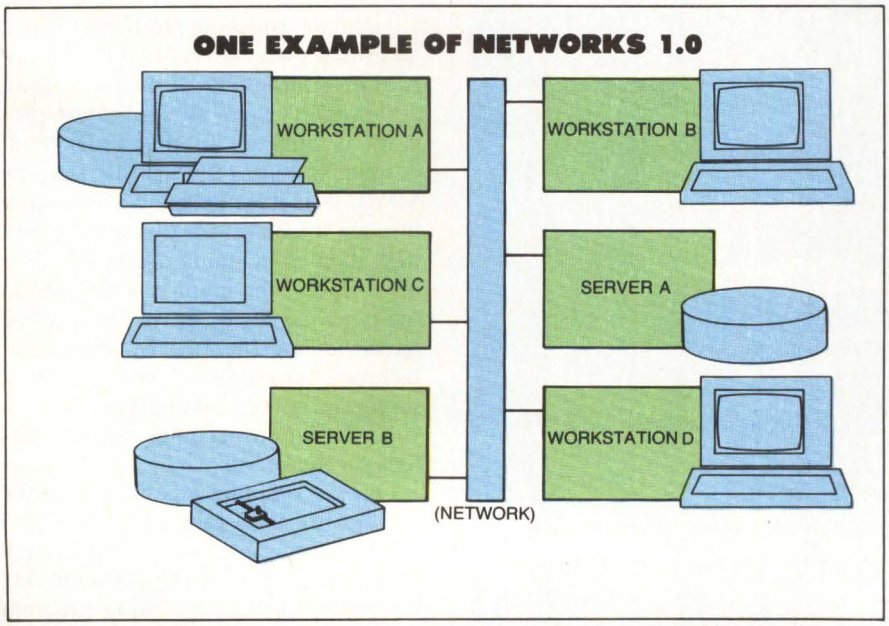
IBM Corp. is set to ship software for its PC Network broadband local area network (LAN). In anticipation, a small army of IBM's competitors in the commercial microcomputer market is adopting Microsoft Corp.'s new Networks 1.0 software to provide compatibility with IBM's networking scheme.

Networks 1.0 runs under the new MS-DOS 3.1 operating system, and Microsoft, Bellevue, Wash., claims any program written for MS-DOS 3.1 can run under IBM's PC-DOS 3.1, expected to be available this quarter. PC-DOS 3.1 will support IBM's equivalent to Networks 1.0, the PC Network program, also due out this quarter. Both software products support access to file and printer servers over LANs for multiple workstations.

IBM's competitors do not need to use the same LAN hardware as IBM does, according to Microsoft sources, because Networks 1.0 is hardware-independent. Manufacturers can achieve compatibility for their network cabling and interface cards, provided their interface and driver software are implemented to a level equivalent to Layer 4, the transport layer of the Open Systems Interconnection (OSI) networking standard model defined by the International Standards Organization (ISO).

Networks 1.0 takes hold

Manufacturers of networking products as well as major computer systems vendors are preparing products to support Networks 1.0. Michael D'Addio, president of Corvus Systems Inc., San Jose, Calif., an early Networks 1.0 licensee, says the new software will give LAN vendors a standard. Ralph Ungermann, president of Ungermann-Bass Inc., Santa Clara, Calif., agrees:



Networks 1.0 *supports any brand of hardware running MS-DOS 3.1. Networks 1.0 redirects inquiries to the location of the device housing the file. That means files held locally on the computer are addressed via the MS-DOS 3.1 BIOS. Files on servers are addressed by a network device driver.*

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"Networks 1.0 will offer the applications programmer standards to which he can write software and know it will run on different pieces of hardware across different networks."

Microsoft's group manager for systems product marketing, Leo Nikora, explains that manufacturers wanting compatibility with Networks 1.0 will receive the necessary interfacing information. He adds that they can follow IBM's lead, if they wish, and implement some Networks 1.0 functions in firmware for faster performance.

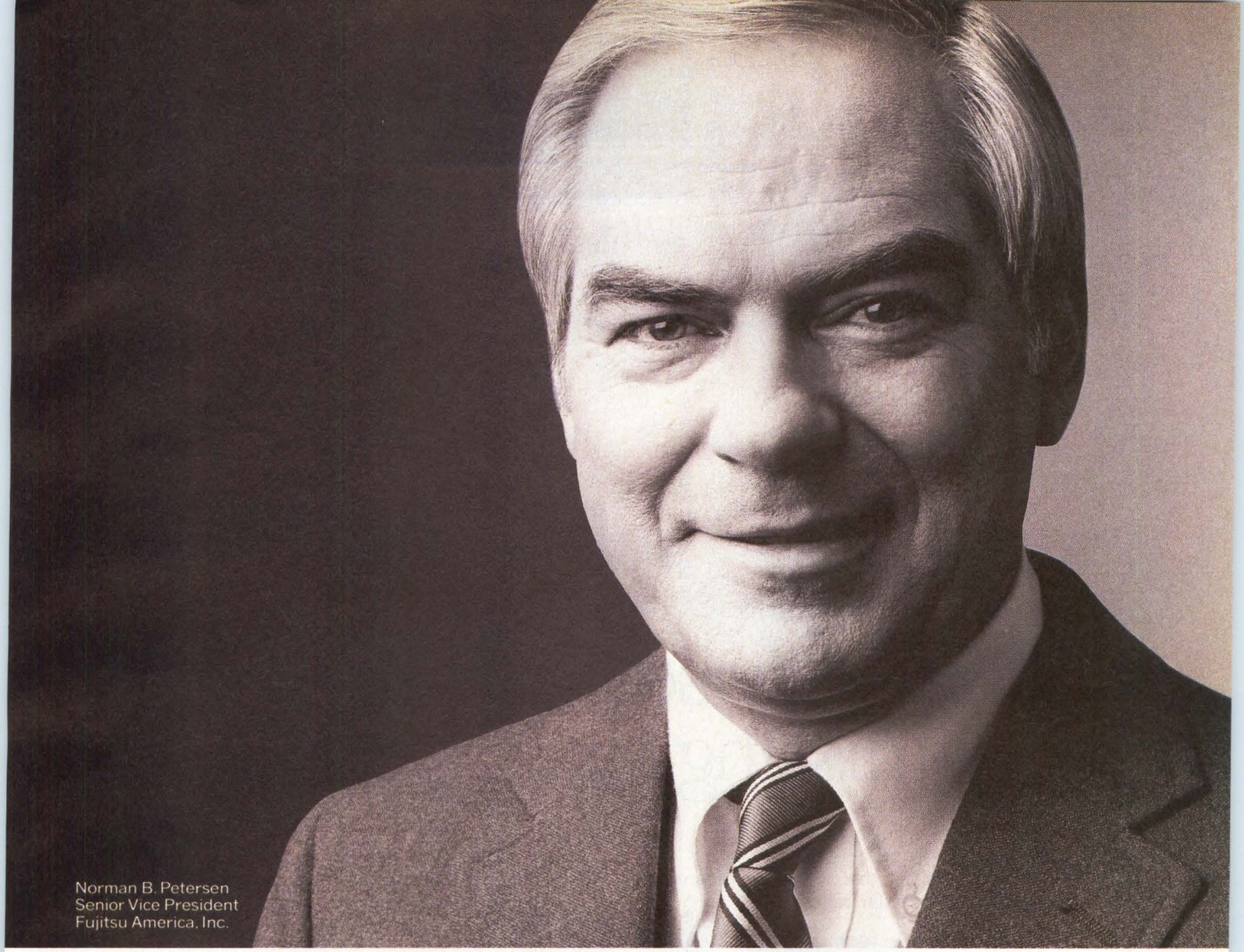
The PC Network (MMS, October 1984, Page 37), includes a PC adapter card with ROM and an interface IBM claims is equivalent to Level 5, the session level of the OSI model. The protocols on the IBM card are licensed from Sytek Inc., Mountain View, Calif., says Sytek director of systems engineering, Gregory Ennis. These protocols implemented by IBM on its adapter card interface with the PC-DOS 3.1 operating system.

Philip Buggins, technical director of Microsoft Ltd., Windsor, England, says the PC Network program is the same as Networks 1.0, except that IBM has written its own server software.

MS-DOS 3.1 works with a Networks 1.0 module called the redirector, which determines whether a file is held locally or on a file server. If the file is local, a file inquiry from an application program is directed to the basic input/output system (BIOS), an existing MS-DOS feature normally customized by a manufacturer for this specific configuration of I/O units. But if the file is on a server, the inquiry is directed to the network device driver, part of the interface implemented by the manufacturer for communication with a server or servers. MS-DOS 3.1 provides the user with commands to access files on the server.

Once a computer is connected to the server, the user can access files and printers attached to that server as if they were on his own workstation. He can then run an application program that uses a file on the server, accessing it over the network.

Like each workstation, each server runs MS-DOS 3.1 and is equipped with a device driver. The Networks 1.0 soft-



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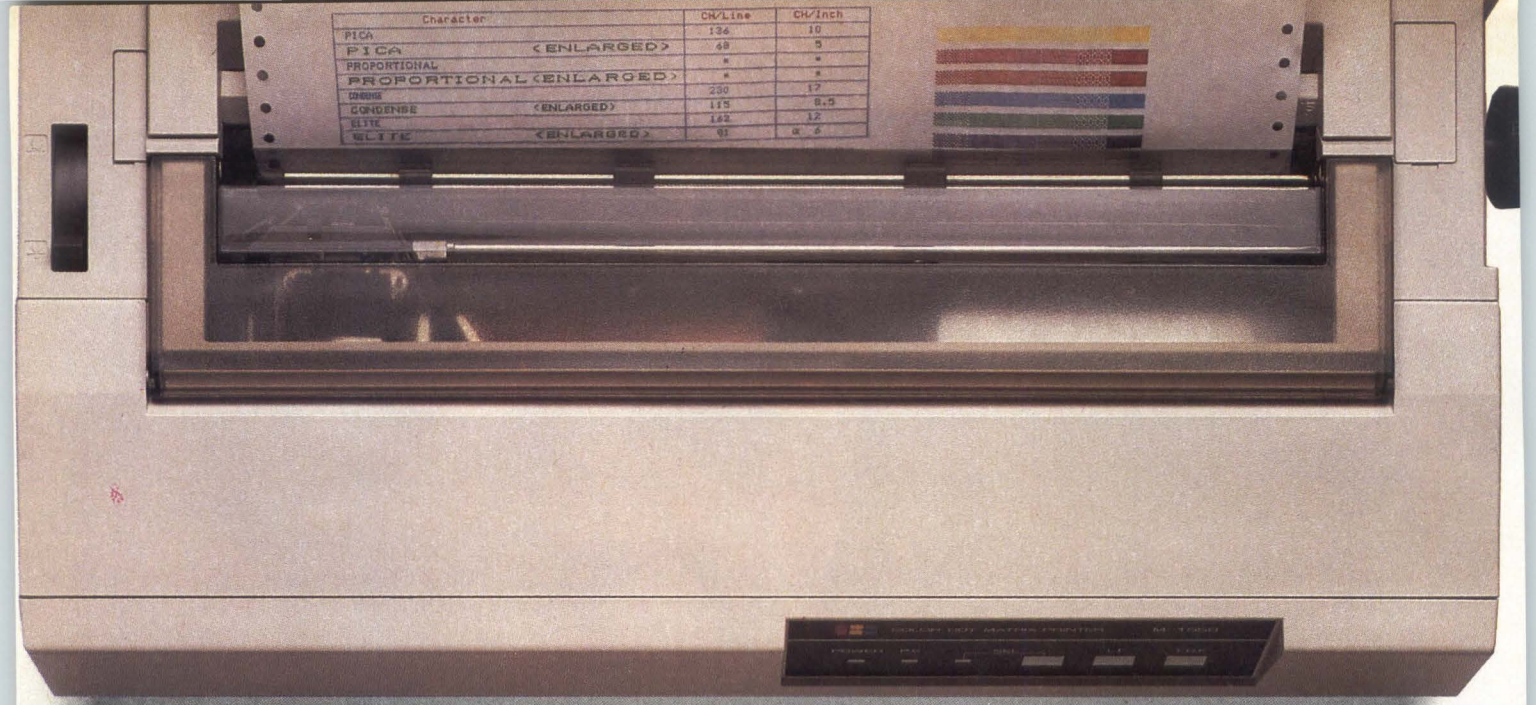

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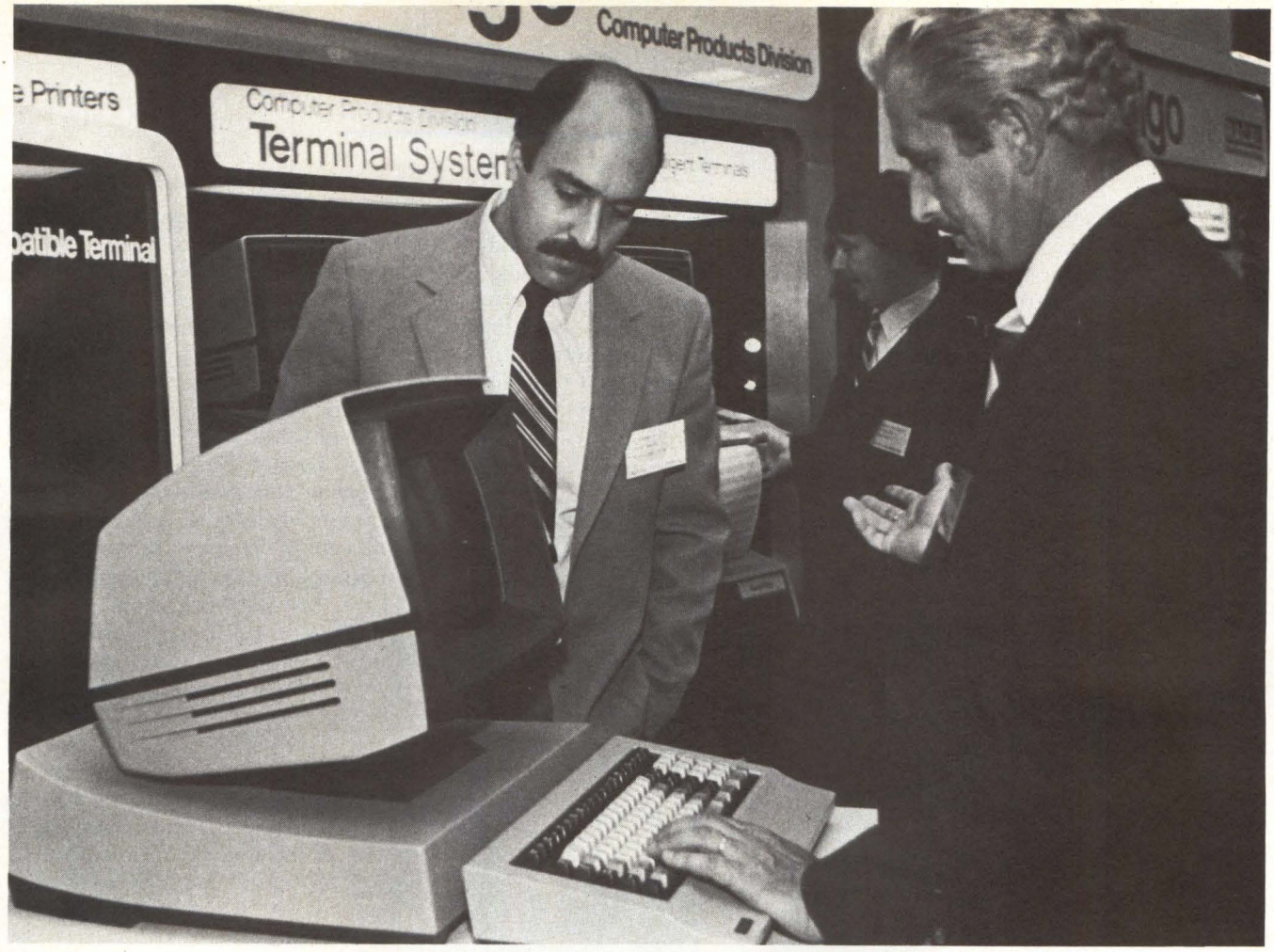

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ware for each server deals with the security problems posed by multiuser access to files. It can assign passwords to directories and permit access to a file only if a workstation has permission to use it. MS-DOS 3.1 specifically deals with the problems created should several users try to inquire into or update a file simultaneously. The operating system provides file locking for applications like word processing, and record locking, which synchronizes access between various users in applications such as order processing.

Plans for Networks 1.0 include its integration with Microsoft's UNIX System III-based operating system, XENIX. The protocols in Networks 1.0 will enable a workstation running under MS-DOS 3.1 to use files on a server running under XENIX, and vice versa.

Some of the microcomputer suppliers Microsoft lists as implementing Networks 1.0 are Digital Equipment Corp., Hewlett-Packard Co., Texas Instruments Inc. and Intel Corp. Manufacturers of networking products that will supply interface cards for Networks 1.0 implementers include 3Com Corp., Davong Systems Inc., Corvus and Ungermann-Bass.

One company already shipping a networked microcomputer system employing Networks 1.0 is Applied Computer Techniques (Holdings) Plc. (ACT), Birmingham, England, whose products are sold in the United States through Apricot Inc., Santa Clara, Calif. ACT's system, Apricot Point 32, uses a Corvus Omninet network interface card with a transfer rate of 1M bit per second. The network uses the CSMA/CD protocol over a baseband bus. An ACT spokesman declined to say when Point 32 will be available in the United States.

Digital Research Inc., Pacific Grove, Calif., has its own network product, called DR Net, which was introduced last April as part of its Concurrent DOS operating system. Digital Research's vice president of European operations, Paul Bailey, says DR Net provides all the features of Networks 1.0. He adds that the multitasking capabilities of Concurrent DOS enable any workstation on a network to act simultaneously as a server and a workstation. □

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- MMS's Spring edition of the Peripherals Digest will appear April 19.
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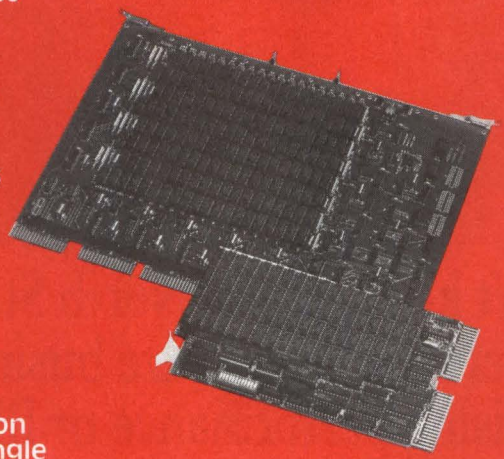

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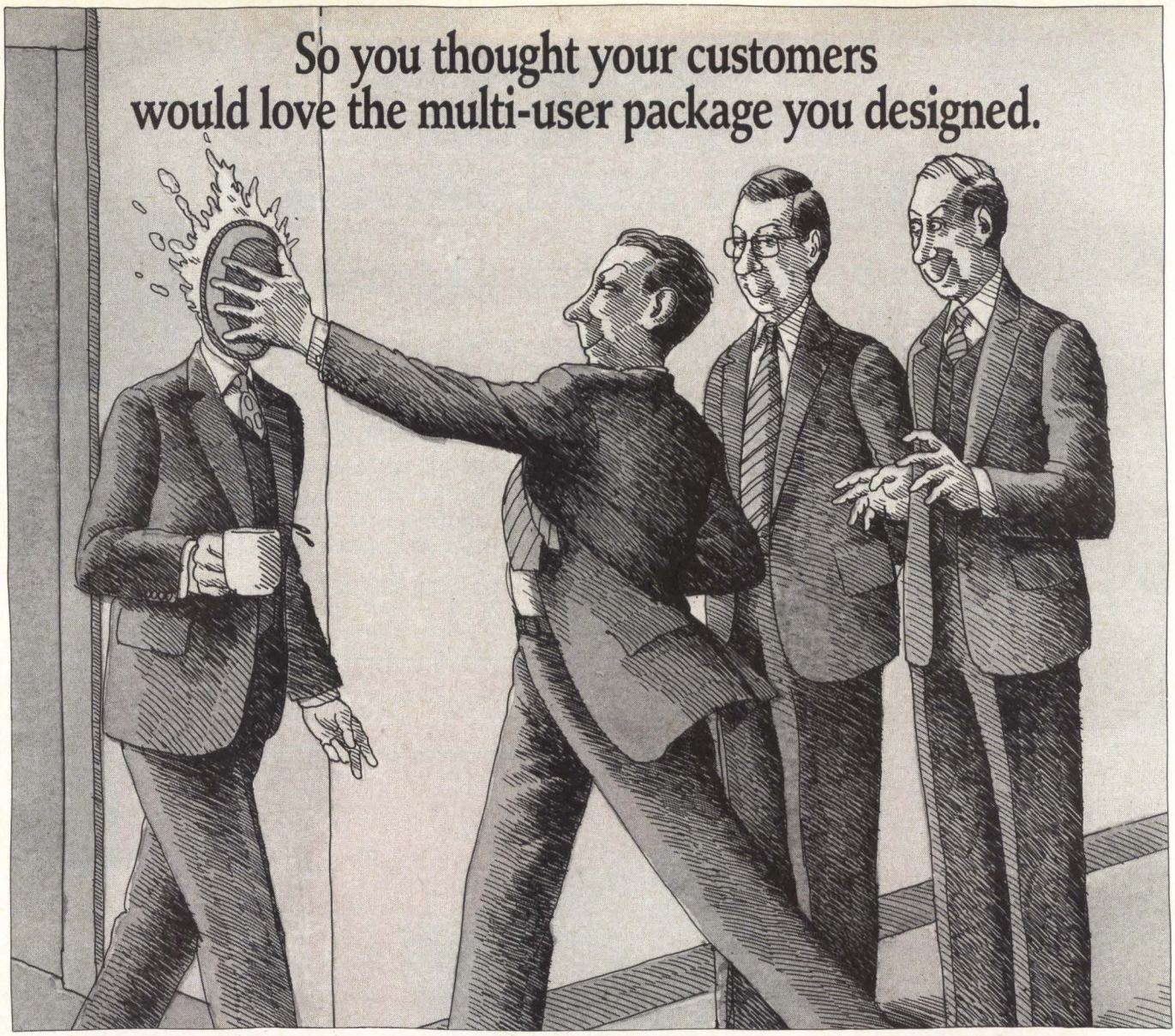

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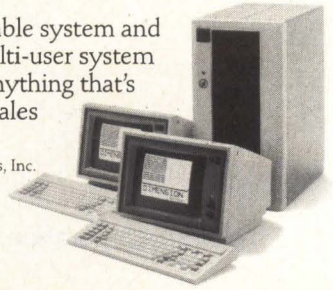

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Efficient Prolog pushes AI into wider market

Tom Moran, Associate Editor

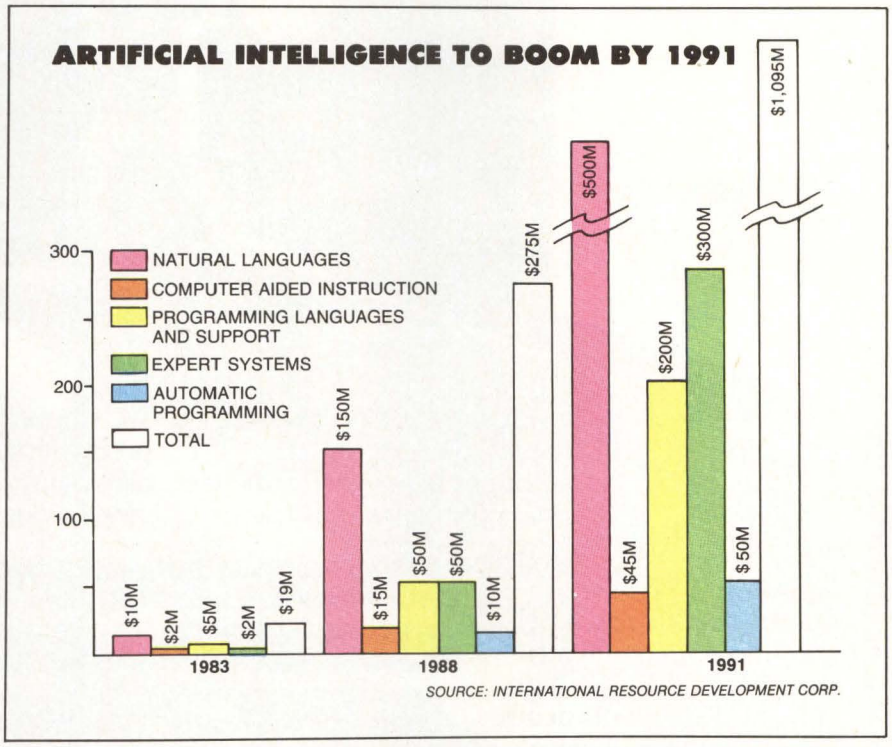
Quintus Computer Systems Inc., Palo Alto, Calif., is announcing this month an advanced development system for artificial intelligence (AI) applications software. The company claims that Quintus Prolog Release 1.0 offers a significant price/performance improvement over previous versions of the Prolog logic-programming language, and that this will give AI a wider market appeal. Quintus Prolog includes an integrated development system designed to speed applications programming and save the expensive time of artificial intelligence programmers.

Polishing Prolog's image

According to vice president of marketing Carolyn Morris, Quintus is targeting machines with "some fairly hefty capability," because the company wants users to see Prolog's potential. "LISP has been around a long time, and there are a lot of people who think Prolog is a toy, so [we want to offer] a system with a lot of features so users can develop applications that are not toys."

Because LISP is a low-level language, closer to assembly language than Prolog, LISP is more powerful for the experienced user. It requires a LISP or Prolog shell to assist less-knowledgable users. Prolog is a higher-level language that is easier to understand than LISP, but does not afford complete programming control at all levels. Also, since Prolog information searches have been less flexible and therefore slower, Quintus optimized Prolog by analyzing the cases in which normal Prolog searches are inefficient. Quintus claims the result is a speed three to four times that of previous Prolog versions run on the same hardware.

Morris adds that: "If you really want to do something significant [with AI]



Artificial intelligence *will grow slowly at first, but eventually penetrate most or all of the computer market.*

Digital Equipment Corp. taps AI software

Digital Equipment Corp. (DEC), is putting the final touches on agreements with a number of independent producers of artificial-intelligence (AI) software to market jointly AI software packages on DEC's VAX and personal computer systems.

The agreements represent one of the first full-fledged moves by a major manufacturer to support and market AI software from independent vendors. The arrangements are also a logical extension of DEC's announcement in June of its VAX LISP programming environment, an implementation of COMMON LISP, which, in turn, is a widely recognized version of the standard LISP programming language that is becoming the de facto standard for AI programming applications.

According to DEC, cooperative-marketing agreements have been reached with:

- Carnegie Group Inc., Pittsburgh, Pa., for SRL and PLUME packages
- Gold Hill Computers, Cambridge, Mass., for GCLISP
- Inference Corp., Los Angeles, for ART
- Prologia, Marseilles, France, for Prolog II
- Information Sciences Institute, Marina del Rey, Calif., for InterLisp

Other manufacturers have reached similar agreements with AI software producers.

—Stephen J. Shaw

Xebec's New Owl Reduc Storage To

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Microcomputer storage history has progressed by a series of small "next logical steps." A replacement of a component here, a refinement of technology there. But now Xebec has taken a giant step, with its Owl intelligent disk file.

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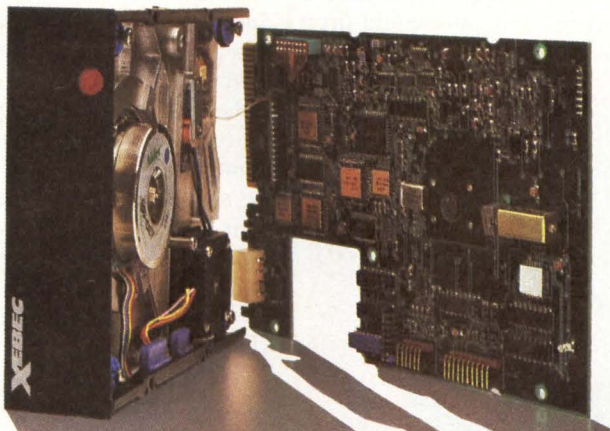

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you have to have a certain performance level. Quintus feels very much that [Quintus Prolog] is a headliner, not just in the area of [performance of] logical inferences per second (LIPS), but also in the area of core requirements." Core requirements for other AI systems can range from 8M bytes to 16M bytes of RAM and from 32M bytes to 64M bytes of virtual memory. Quintus' development environment runs in 1M byte of RAM, and run-time applications run in as little as 512K bytes of RAM.

Morris also says that intelligence can be built into existing computer systems in a modular way. "Expert systems are only one application. You could drop [a workstation with] Prolog in between a human and a computer system and extend the ability to logically manipulate the system."

Analysts are cautiously optimistic about the future of artificial intelligence. Ken Bosomworth, president of International Resource Development Inc. (IRD), a Norwalk, Conn., market research group, says: "It's going to be a while before AI is [near] approaching either the personal computer or office automation market of today. We see some fast growth, but it's not going to be a billion-dollar market in the next year." IRD predictions show the AI market will total $275 million by 1988 and slightly more than $1 billion by 1991, not including large military purchases.

The first major practical application of AI may be natural language interfaces, which would allow people and computers to converse in English as opposed to structured computer languages. Prolog is efficient at parsing sentences, a requirement for natural language systems, says Peter Brown, director of market planning for Quintus.

Prolog defines relationships

In Prolog the programmer creates a series of logical relationships and defines rules for the interaction of the relationships. A typical statement in Prolog might be: "works (John, Mary)" which indicates that John works for Mary. Programming in Prolog remains at the level of problem solving and therefore frees programmers from concerning themselves with how the computer is manipulating the data.

Quintus Prolog operates on Digital Equipment Corp.'s VAX minicomputers under Berkeley UNIX Version 4.2, Convergent Technologies Inc.'s MegaFrame and Sun Microsystems Inc.'s MC68000-based Sun 2 workstation. The development system requires 1M byte of RAM to run and includes a text editor interface said to reduce most editing operations to one keystroke, a style checker to detect input errors, a comprehensive debugger and an incremental compiler that permits selective compiling of part of a program. A C

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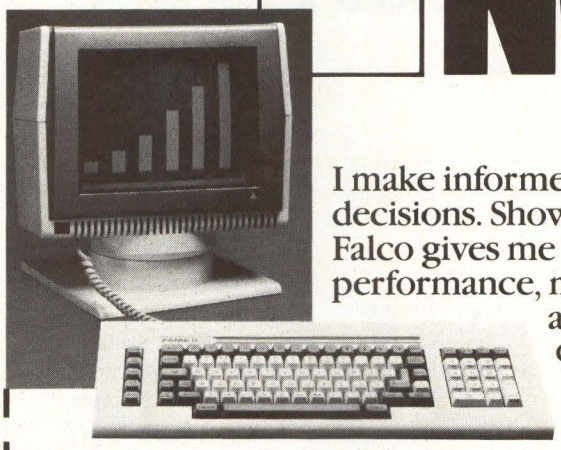

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Processing LIPS

The Japanese invented the term logical inferences per second (LIPS) for what once were called 'procedure calls per second.' The logical inference process begins with the goal of a statement, then sorts through facts and rules until the program finds evidence that the goal is true or false.

For example, to answer whether John works for Mary, the system would gather all statements with the word "works" and then examine those statements until it finds "John" attached to one of them. Prolog then examines the information attached to "John" in the context of "works," either proving or disproving the original proposition.

language interface lets programmers call C programs from within Prolog.

Quintus designed its latest Prolog to be compatible with its previous release, DEC-10/20 Prolog, which lacks a text editor and has a less-sophisticated debugger. Quintus Prolog is also compatible with C-Prolog, which was developed at the University of Edinburgh, Scotland, by Fernando Pereira, one of the founders of Quintus.

The Convergent and Sun versions of Quintus Prolog will be priced at $8,400 each, and Prolog for VAX systems will be $17,500. The versions should be available now. Quintus is negotiating OEM contracts and will also distribute Prolog through direct sales. □

Burroughs enters UNIX systems market

Marjorie Stenzler-Centonze
Associate Editor

Dipping its toe into a fast-growing market, Burroughs Corp., Detroit, Mich., introduced the model XE 550, a multiprocessor computer system running UNIX. In so doing, Burroughs gave the XE 550's developer, Convergent Technologies Inc., Santa Clara, Calif., another outlet for its OEM computers. Prices for the XE 550 range from $43,000 to $102,855.

This market is entirely new to Burroughs, said Robert Holmes, senior vice president of worldwide marketing. Holmes says the growth of UNIX as a standard for the multiuser system market influenced the company's new strategy. The market for UNIX-based systems, which totalled about $2 billion in 1984, is expected to reach about $7 billion in 1988, according to Yates Ventures, Palo Alto, Calif. President Jean Yates says the majority of UNIX-based systems funneled through system integrators cost $25,000 to $50,000. Most systems sold by manufacturers are priced from $50,000 to $100,000, she explains.

The Burroughs XE 550 *is based on the MC68010 processor from Motorola, but includes auxiliary processors based on Intel's 80186.*

The heart of the XE 550 system is the Application Processor (AP) board, which executes the CENTIX, UNIX-like operating system and application programs. The XE 550 supports multiple APs, each based on the Motorola Inc. MC68010 virtual memory processor and housing 512K bytes of memory, expandable to 4M bytes. The APs each run their own CENTIX kernel, which, in turn, supports as many as 16 users. AP boards include a memory management unit with 3½M bytes of virtual address space per user. CENTIX is an enhanced version of the UNIX System V operating system.

The XE 550: features and future

Burroughs expects its XE 550 to open opportunities in the educational market, in state and local governments and in distributed data processing environments, where demand is strong for UNIX-based applications software.

Other components of the XE 550 include several Intel Corp. 80186-based processors that offload tasks from the AP. The File Processor, for example, assumes file-oriented data management processing for the AP. It has 256K bytes of memory, expandable to 768K bytes. The Storage Processor supports tape drives, while the Terminal Processor handles terminal activity on the system.

Software for the XE 550 includes the centreSPHERE productivity tool, which comprises spreadsheet, word processing, applications development, database management, administrative functions and networking program components. Language support includes COBOL 74, FORTRAN 77, BASIC, Pascal and C.

Prices for an entry-level, 12-user system with 2½M bytes of memory and 75M bytes of Winchester disk storage start at $43,000. A high-end, 32-user system with 8M bytes of memory and 345M bytes of disk storage is priced at $102,855.

The XE 550 system is an extension of the XE 520 introduced in May 1984. The XE 520 is a shared resource processor using Burroughs' proprietary BTOS operating system; the XE 550 provides both a UNIX environment and connections to the shared resource BTOS environment. □

Benjamin West. *The Death of General Wolfe*, 1770. Courtesy The Bettmann Archive.

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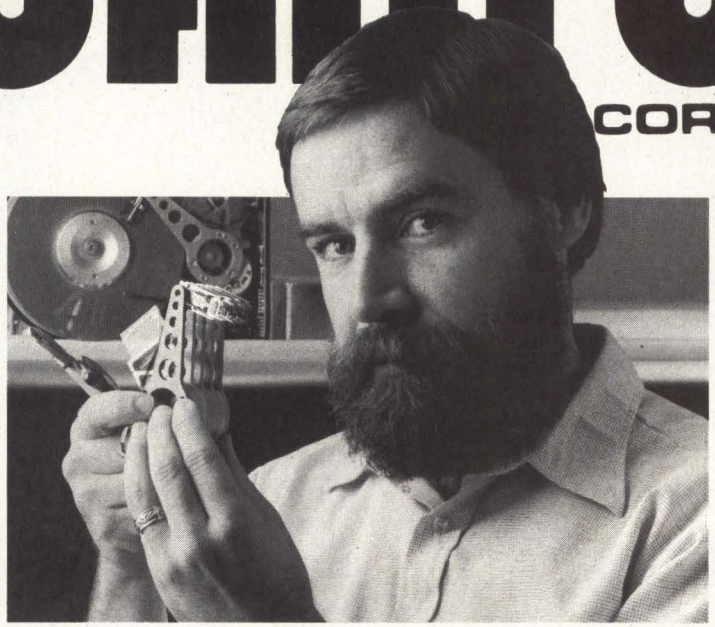

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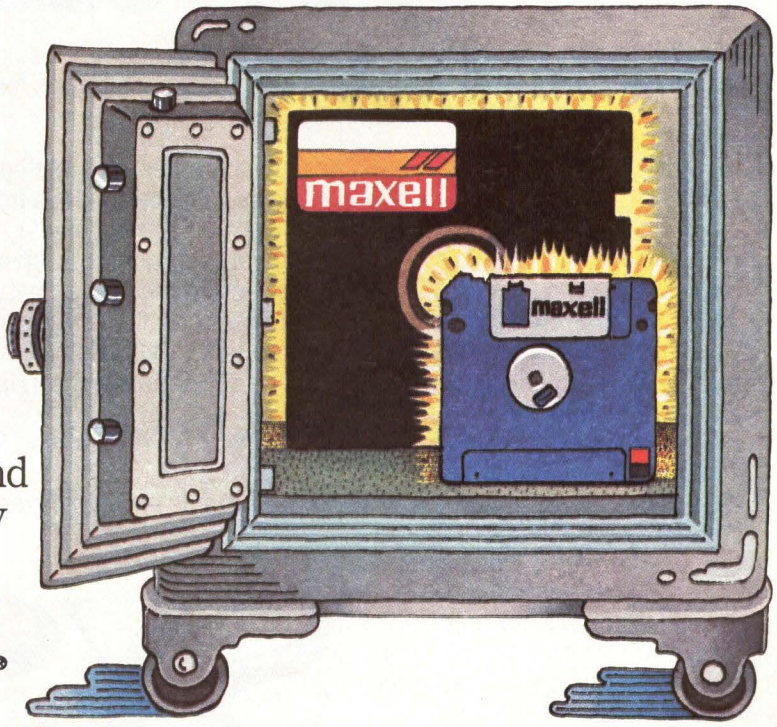

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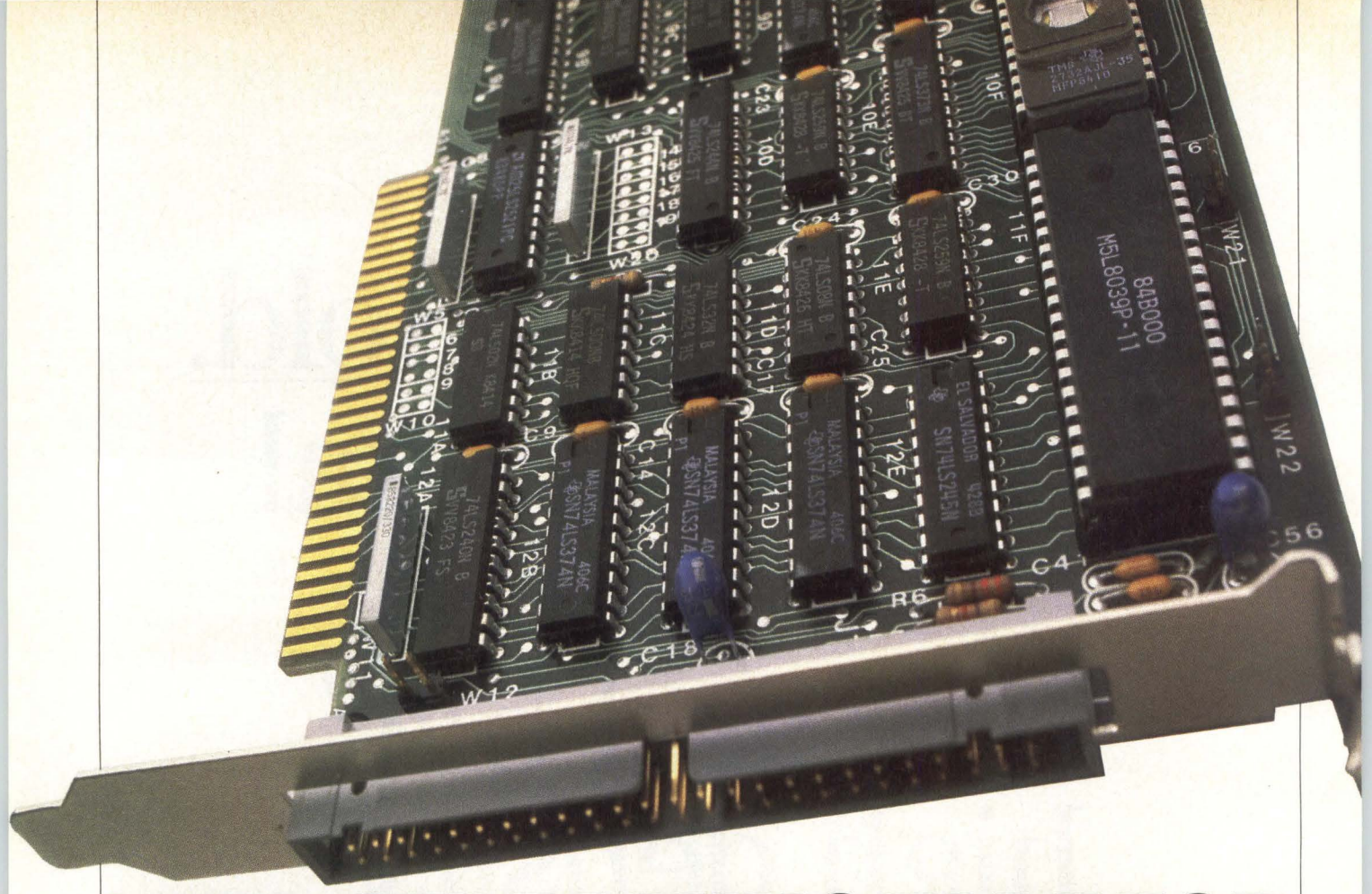

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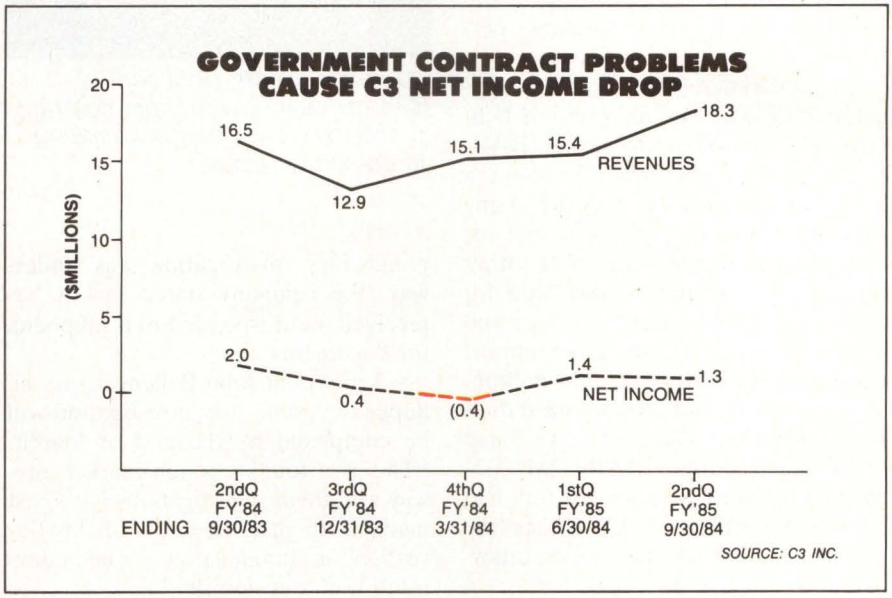
System integrator rebounds with large government orders

Stephen J. Shaw
Washington Editor



Despite a morass of legal problems with the U.S. government, Virginia system integrator C3 Inc. is rebounding with millions in federal contracts.

Initially, two suspensions from conducting business with various federal agencies and a current grand jury investigation contributed to the company's first revenue decrease and net loss in its 11-year history during the fourth quarter of fiscal 1984, which ended almost a year ago on March 31, 1983. Since then, however, C3 has won several government contracts worth potentially $155 million. It further bounced back in December with its first service and maintenance agreement with a computer manufacturer, Convergent Technologies Inc. of Santa Clara, Calif.

The suspensions, imposed by the Army for alleged contract irregularities, delayed the issuance of delivery orders under existing contracts and put subsequently awarded contracts in abeyance, according to the company.

Awards reverse revenue drop

The new contract awards have helped to reverse a drop in revenues caused by the suspensions and investigations. While the company's 1984 fourth quarter revenue was down 33.8 percent, to $15.1 million, compared with the same period a year earlier, revenue has since been edging up to reach $18.3 million in the second quarter of 1985. The company's backlog of orders from government contracts that authorize future purchases rose to $230 million by the end of last year, compared with $80 million at the beginning of the year.

The company's tribulations began in late 1982 when it was suspended from doing business with any agencies of the executive branch of the U.S. government. The Army had accused C3 of making false claims and statements concerning a contract with the Defense Supply Agency to furnish minicomputer systems to the Army's Material Development and Readiness Command (DARCOM). The company denied the charges and the Army lifted the suspension within two weeks. However, the suspension was raised conditionally, pending completion of further investigations by the Army and the U.S. attorney for the Eastern District of Virginia.

C3 was suspended again in January 1984, this time for alleged improper conduct in connection with another Army contract to provide computer equipment and follow-up support to the White Sands Missile Range in New Mexico. The company was also informed that it could face permanent debarment from doing business with any Department of Defense agency. Debarment would have prevented those agencies from not only awarding new contracts to C3, but also from renewing or extending existing agreements. The potential revenue loss to the company would have reached hundreds of millions of dollars.

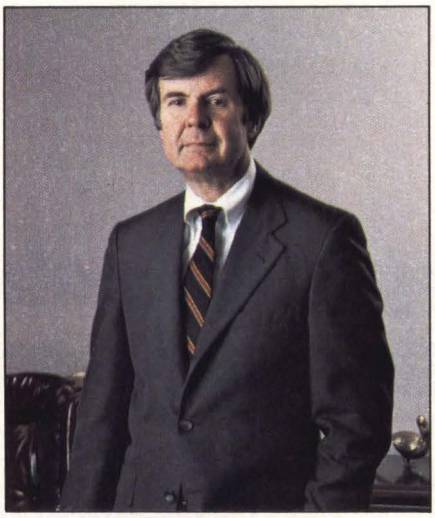
C3 fights back

After answering to these new allegations, C3 was successful in getting the Army to drop the debarment proceed-

ing. In terminating the proceeding and lifting the temporary suspension, however, the office of the Army's assistant advocate general asserted that C3 had overcharged the Army on the White Sands contract by approximately $425,690. The Army's contracting office unilaterally reduced the contract price by $343,838, according to a company filing with the Securities and Exchange Commission. Except for the contract modification, the company states, no other action on this issue has been filed by the Army, but C3 has submitted claims to the Army totalling $1.36 million for systems software and maintenance services already performed on the White Sands contract.

At approximately the same time, the company filed a lawsuit with the U.S. Claims Court over the earlier DARCOM contract dispute. C3 sought a $1.7 million payment from the Army that the company stated was due for equipment, maintenance and other services. The company also sued for interest payments, attorneys' fees and assorted costs. The government countersued in May for $9.4 million, alleging fraud and misrepresentation by C3. The Army claimed that C3 had overcharged on the DARCOM contract by delivering equipment that had not been authorized. C3 insists the equipment delivery had been authorized.

An Army spokesman said that both lawsuits were stayed temporarily in June so that they would not interfere with a federal grand jury investigation into both the White Sands and DARCOM contracts. Although a spokesman for the U.S. attorney's office refused to confirm or deny whether any grand jury investigation was underway, the company stated that it has received and responded to a subpoena for documents.



John Ballenger, *president of C3 Inc., says government contract problems have been devastating to company morale.*

C3 president John Ballenger says he hopes the grand jury investigation will be completed by the end of March. "This is a tough enough market anyway and these investigations have just made it tougher. In terms of this [investigation] dragging on, it's been devastating to our morale."

Report supports C3

According to a 1984 report prepared by the New York stock brokerage company Rooney, Pace Inc., C3 is likely to be found innocent of all charges. "We speculate that C3 is being victimized by a small investigatory group determined to uncover overcharges," the report states.

Despite the threat that the grand jury investigation could spark another round of government litigation and civil lawsuits, C3 aggressively pursued and won several major computer contracts last year. The contracts include:

- The agreement with Convergent to allow C3 to act as the service company for Convergent's line of workstations and supermicrocomputers.
- An agreement with the Navy to provide up to 200 minicomputer systems, including software, training and systems maintenance. The contract could be worth as much as $70 million over the 10-year term of the agreement.
- An option that was exercised on an existing contract with the Army for delivery of 541 videodisk memory systems. The contract is valued at $5.3 million.
- A three-year contract with the Navy to supply, install and support up to 1,500 terminals and printers for integration into Burroughs Corp. computer systems in the Navy Supply Command. The value of the agreement could reach $7 million.
- A contract with the General Services Administration to supply, install and maintain up to $73 million worth of office-automation equipment at GSA offices throughout the United States during the next 9 years. C3 will provide up to 4,299 N-Gen and Megaframe series workstations, manufactured by Convergent, and associated peripheral devices, including printers, plotters, magnetic tape units, disk drives, RAM expansion boards and software. □

BRIEFS

Financings

Attaché Software Inc., an Ann Arbor, Mich., developer of personal-computer accounting software, has received $4.4 million in a second round of venture capital financing, bringing total funding to $6.6 million. The company, founded in Sydney, Australia, in 1982, moved its headquarters to the United States last year. Investors include Michigan Capital and Service Inc., State of Michigan Employees Retirement Systems and First Ohio Capital Corp. Each of the six modules in the Attaché accounting package can be used separately, integrated together, or linked to such business programs as Lotus Development Corp.'s Lotus 1-2-3 and Ashton-Tate's dBASE II.

Celerity Computing, San Diego, Calif., recently received $8.5 million of venture financing to help bring its 32-bit UNIX-based engineering workstation to market. Investors included Hambrecht & Quist, Oxford Ventures and Southern California Ventures.

Charles River Data Systems, Framingham, Mass., and Datapoint Corp., San Antonio, Texas, have signed agreements making Datapoint both an

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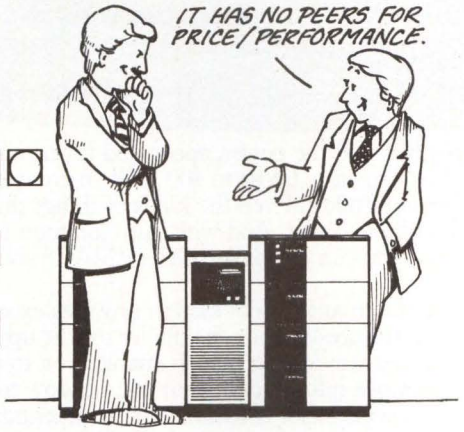

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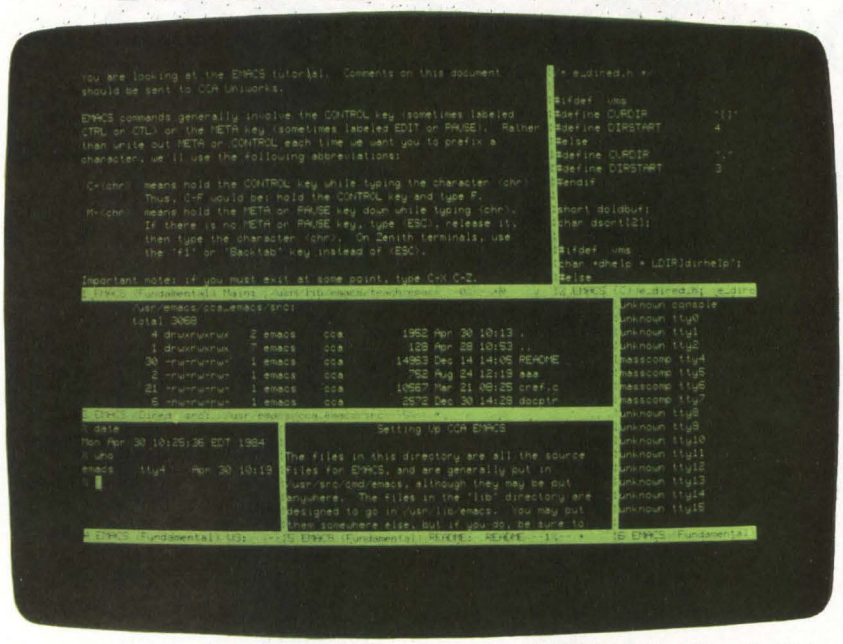

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CORPORATE AND FINANCIAL

investor in, and an OEM customer of, Charles River. Datapoint contributed an undisclosed amount to Charles River's $5 million, third round of common stock financing and will use Charles River's Universe 68 supermicrocomputer system in a forthcoming product.

Digital Sound Corp. of Santa Barbara, Calif., has acquired $5.7 million of venture capital to manufacture its recently introduced DSC-2000 Voice Server voice messaging system. Investors include the General Electric Pension Fund Trust and Brentwood Associates. Digital Sound, Santa Barbara, Calif., also makes the DSC-200 audio data conversion system.

DMA Systems Corp., has obtained $7.1 million in venture capital to increase production of its model 360 half-height 5¼-inch, removable cartridge disk drive. The Goleta, Calif., company's venture funding now totals $25.7 million. New investor Aetna Life Insurance Co. joins Brentwood Associates, Boston University and other early investors.

Milpitas, Calif.-based **Drivetec Inc.,** which manufactures a 5¼-inch half-height floppy disk drive with a storage capacity of 3.3M bytes, has raised $7 million in a private stock placement. Drivetec will use the proceeds to boost inventory of the drives and buy more manufacturing equipment. Participants in the funding include Concord Partners, the Nordic American Bank and Hambro International.

Graphics systems supplier **Mosaic Technologies Inc.,** Billerica, Mass., has received $9.6 million of venture capital for increased production and continued new-product development. The investors include Atlantic Venture Co. Inc., John Hancock Venture Capital Management Inc. and E.F. Hutton Investment Partnership.

The Eastman Kodak Co. has invested $20 million in **Sun Microsystems Inc.,** a Mountain View, Calif., graphics workstation vendor. The investment represents a 7-percent ownership in the company. In a separate financing, Sun received a $27 million line of credit from First National Bank of Boston and

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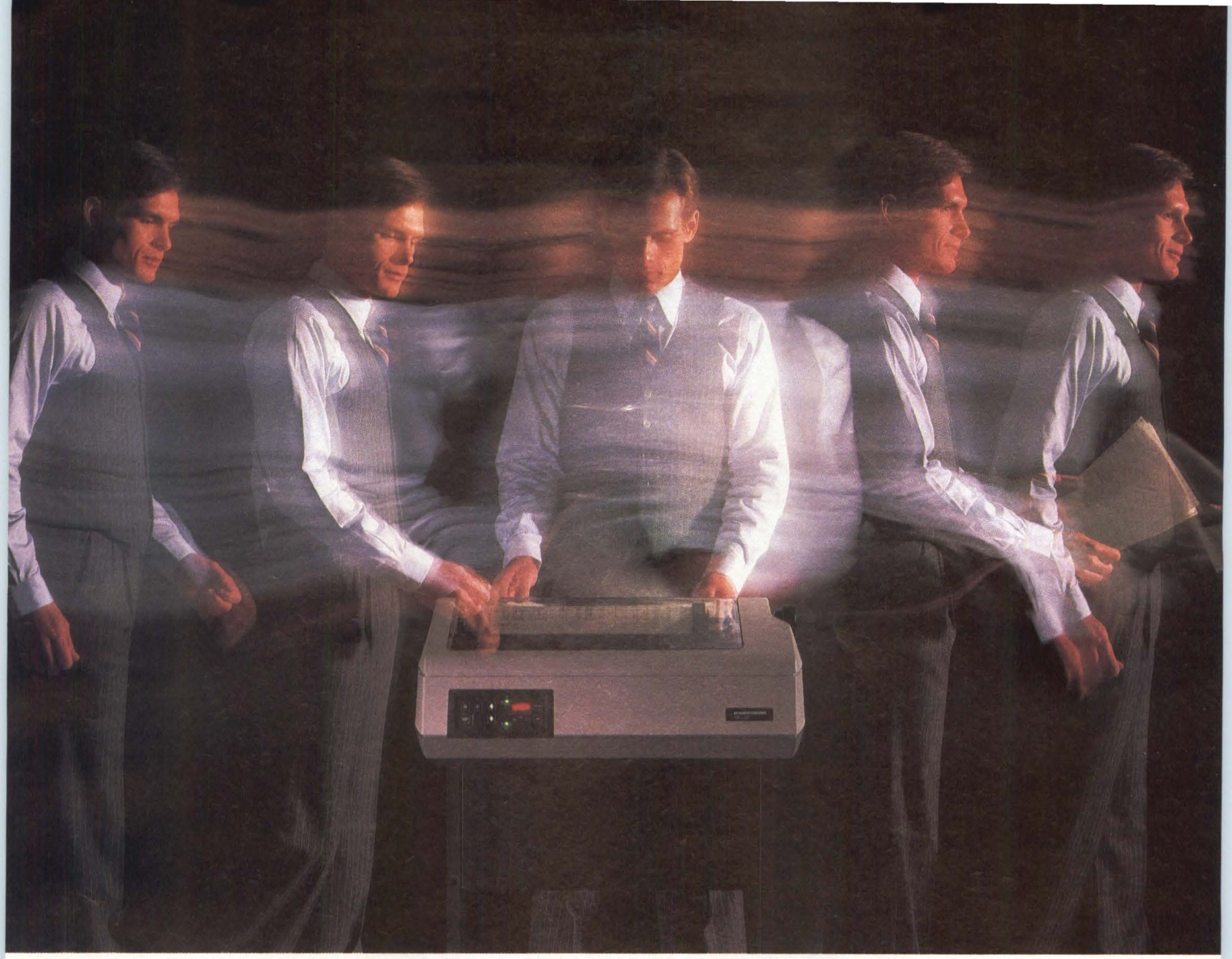

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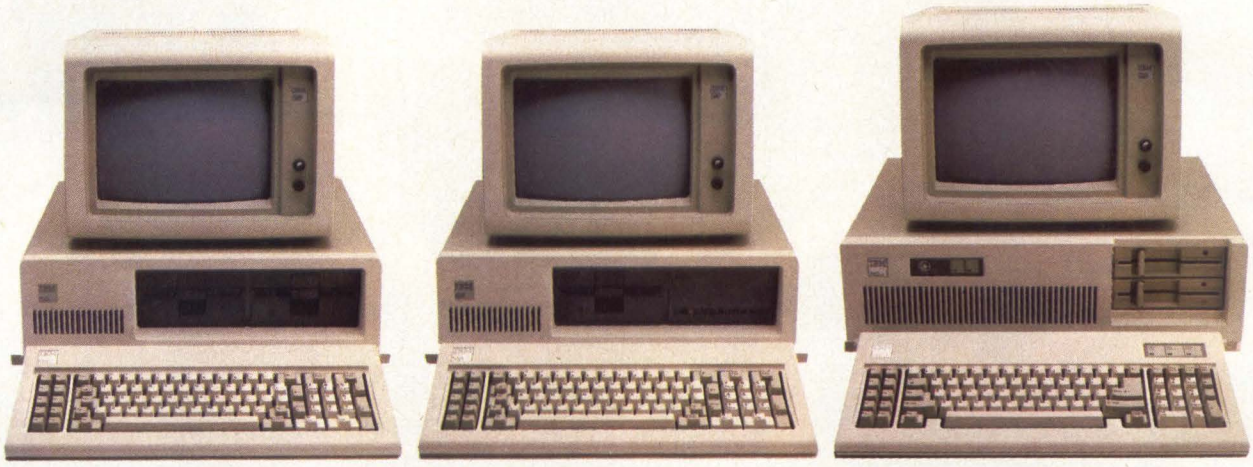

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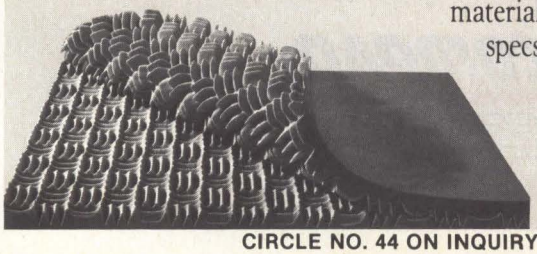

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techniques with foams

CIRCLE NO. 44 ON INQUIRY CARD

CORPORATE AND FINANCIAL

Bank of the West. The monies are for working capital and to sustain the company's expected growth.

TeleSoft, a San Diego, Calif., developer of Ada language compilers and software tools, has attracted $2.2 million of venture capital. The company said it will use the funds to "retire" existing debts and as working capital. Investors include Accel Partners and Adler & Co.

Contracts

By 1988, most of the 5¼-inch and smaller Winchester disk drive platters shipped will use thin film media, predicts analyst Jim Porter, author of *Disk/Trend Report.* **Ampex Corp.,** Redwood City, Calif., one of the key players in that market, recently signed a one-year, $3.3 million contract with Tulin Corp., San Jose, Calif. According to the contact terms, Ampex will supply Tulin with alar thin film plated media for use in Tulin's high-capacity half-height 5¼-inch Winchester disk drives.

Archive Corp., Costa Mesa, Calif., will supply $6 million worth of its ¼-inch half-height Scorpion streaming tape drives and controllers to Micro Design International over a one-year period. The drives will be used as back-up devices in Micro Design's IBM PC, PC/XT and PC-AT storage upgrade kits. Archive has already begun deliveries.

In a $10 million contract, La Commande Electronique will distribute **Ashton-Tate's** business software products in France. French-language versions of the Culver City, Calif., company's packages—the Framework integrated system, as well as the dBASE II and dBASE III database management systems—will be included in the distribution.

Culver City, Calif., electronics distributor Hamilton/Avnet wants to make sure its customers have immediate access to **Intel Corp.'s** new CHMOS 256K-bit, dynamic random-access memory chips, says executive vice pres-

FOUR WAYS TO IMPROVE YOUR MEMORY.

Teac's family of memory systems offers a complete array of floppy disk drives, Winchester drives and tape drives to fit your design requirements.

For example, our FD-55 Series has set the industry standard for half-high, half-power 5¼-inch floppy disk drives.

Our FD-35 Mini-Disk Series includes special Power Saver models that run on a mere 1.72 watts with a standby power of only 27 milliwatts.

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FD-55 Series
5¼-Inch Half-High Floppy Disk Drives
Capacities from 250 KB – 1.6 MB.
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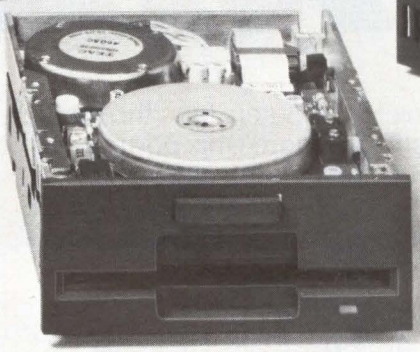
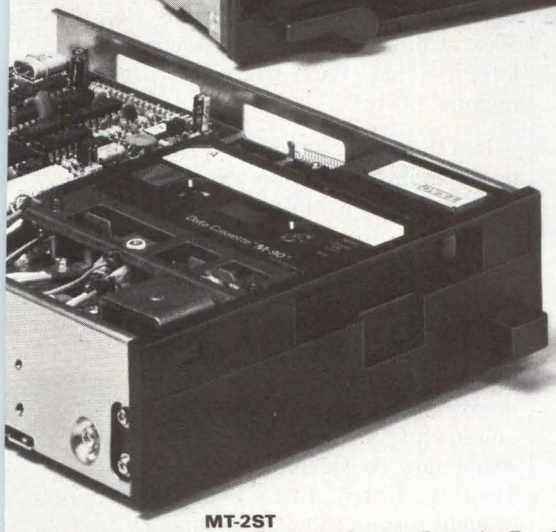
Brushless DC Direct Drive Motor.

SD-510
Half-High 5¼-Inch Winchester Disk Drive
12.76 MB unformatted, 10 MB formatted storage cap.
5 MB per sec. transfer rate.
Industry standard ST-506 interface.





FD-35 Series
3.5-Inch Micro Floppy Disk Drives
Capacities from 250 KB – 1 MB.
Interface Compatible with 5¼" Floppy Disk Drives.
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MT-2ST
Half-High Digital Cassette Streaming Tape Drive
Backs-up 20 MB in 4 min.
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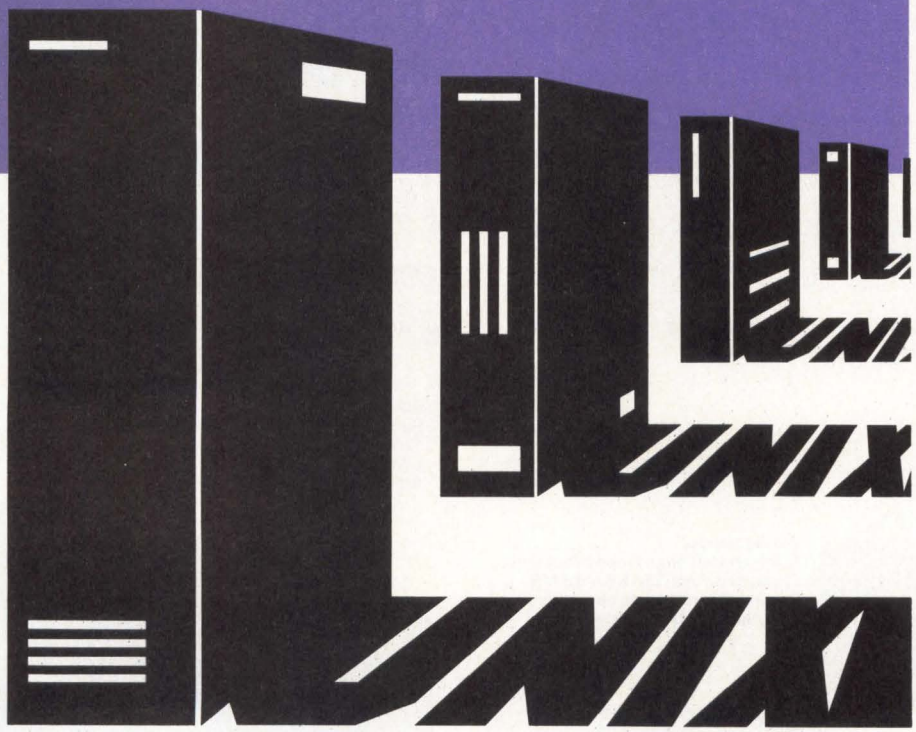
We've Built Unix Into More Micros Than Anyone Else...

and that's standard at UniSoft.



UniSoft has built Unix™ into 90 microcomputers (and the list is growing) from 60 manufacturers. That's more Unix porting and supporting than anyone else. And more manufacturers who have saved time and money, because of our experience. UniSoft can typically do the job for one fifth of the in-house time and expense. When the port is over, we don't vanish. Our standard family of services includes on-line updates, maintenance, software checks on our mainframe, and documentation (the clear, understandable kind). We also offer application and communications software.

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CIRCLE NO. 46 ON INQUIRY CARD

CORPORATE AND FINANCIAL

ident Edward Kaniger. The company has placed a $31 million order with Intel, Santa Clara, Calif., for the chips.

Rodime Plc., Glenrothes, Scotland, best known for providing Compaq Computer Corp. and other companies with its 3½-inch Winchester disk drives, now supplies Convergent Technologies Inc. with 5¼-inch Winchester disk drives. A $5.5 million contract calls for drives, with capacities of up to 53M bytes, to be integrated into Convergent's MiniFrame UNIX computer system.

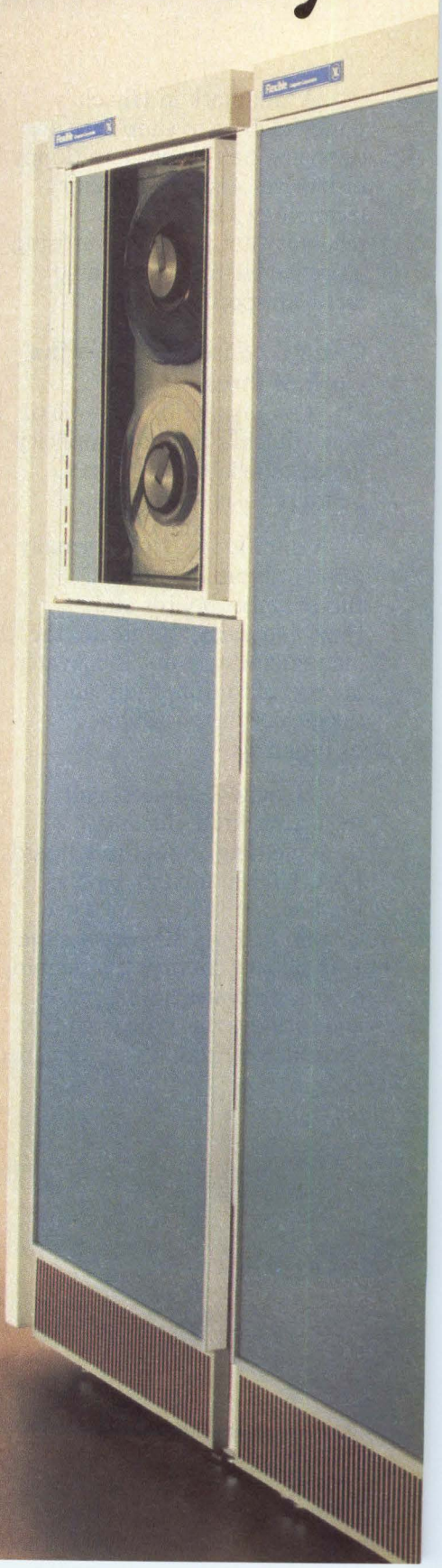
Industry monitor

Data General Corp., Westboro, Mass., has entered into its first distributor agreement in the People's Republic of China. Under the $10 million agreement, Data General will supply its Desktop Generation microcomputer and Eclipse MV/4000 superminicomputer systems, as well as sales and service training, to the Tianjin Computer Co., Tianjin. Long-range plans call for the establishment of a service center, manufacturing and system assembly at Tianjin and joint development of Chinese versions of Data General terminals.

To expand its penetration of the worldwide programmable controller market, General Electric Co., has signed **Wuxi Electric Apparatus Co.,** Wuxi, China, to distribute GE controllers in China. Wuxi will set up eight regional offices.

In a three-year agreement, **Xidex International,** Mountain View, Calif., is helping the Shanxi Provincial Electronic Industry Corp. set up a 5¼-inch floppy diskette assembly facility in Shanxi Province, China. Xidex is providing hardware, raw materials and technical support. The plant's initial capacity will be more than one million floppy disks per year to fill local requirements. Export opportunities are also being considered. China United Trading Corp. Ltd., New York, brought together the two companies. □

Parallel computer. Unparalleled capability.



Introducing the Flex/32 MultiComputer™. A revolutionary parallel computer with performance that's scalable from supermini to supercomputer – a capability for growth beyond the needs of any application.

An entry-level Flex/32™ system starts you out with two 32-bit superminis, 2 megabytes of local memory, 128 kilobytes of common memory and two VMEbus interfaces. That's more power than two standalone superminis. But that's just the beginning.

Each Flex/32 MultiComputer cabinet can contain up to twenty supermini CPUs, each with 1 megabyte of RAM and a VMEbus interface, each performing more than one million instructions per second. And since there's no limit to the number of cabinets you can connect, Flex/32 can be configured and reconfigured easily as your applications demand. In fact, Flex/32 is the most change-tolerant system available today.

What's more, since Flex/32 is a MultiComputer, it can provide true concurrency in processing. Which means it can run many programs at precisely the same instant in time. That's the kind of teamwork you need in large-scale real-time and scientific applications.

The Flex/32 comes with the software tools you'll need to help make the best use of its outstanding processing capabilities. Like our concurrent UNIX™ System V operating systems. And languages like C, our own ConCurrent C™, FORTRAN 77 with ISA extensions, RATFOR and the Flex/32 ConCurrency Simulator. A performance evaluation option is available to enable you to tune run-time performance for optimized applications.

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CIRCLE NO. 47 ON INQUIRY CARD

The facts behind Hitachi's superior drive.

A landmark in Hitachi's powerful drive to simplicity are these new half-height minifloppy disk drives. Using proprietary technology, Hitachi makes reliability not just an advertising adjective but a demonstrable fact with specific benefits.

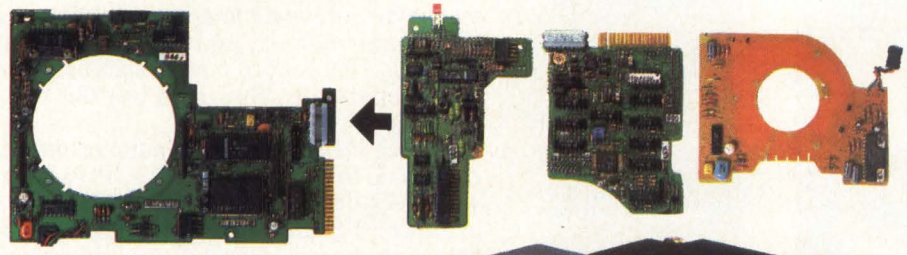
One PC board that does the work of three

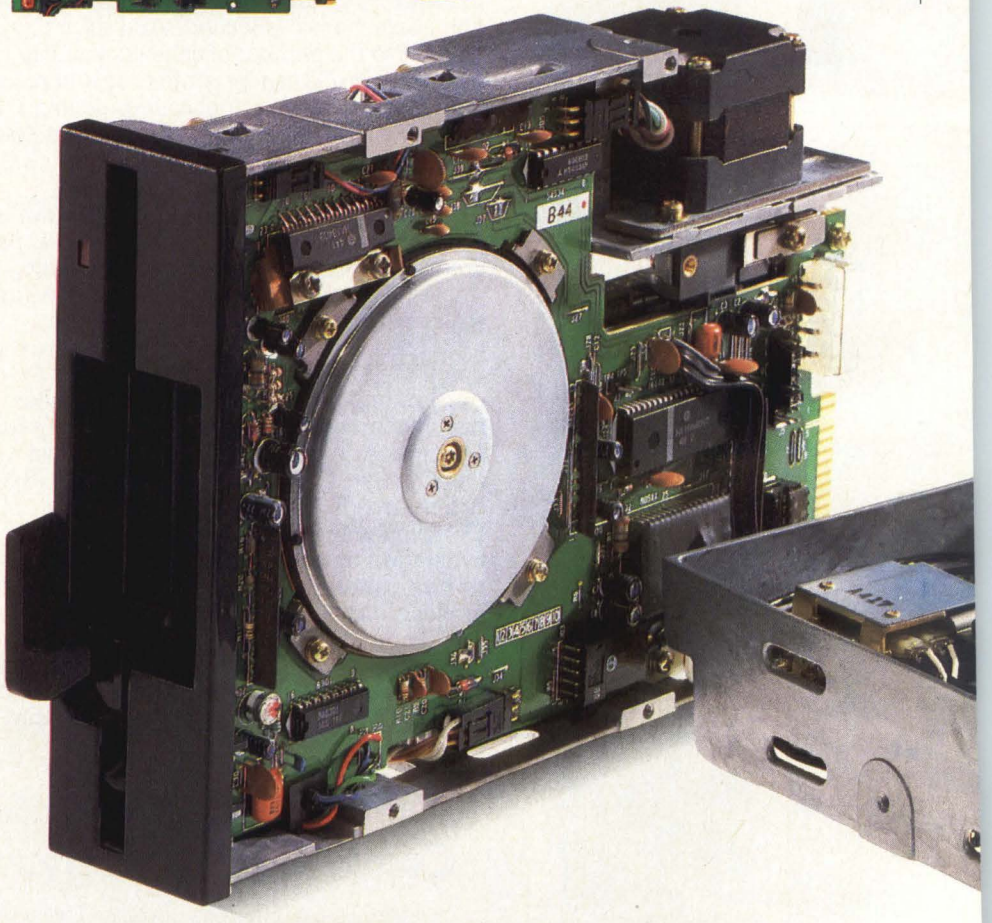
An outstanding example of how Hitachi's drive to simplicity increases reliability is the PC board problem.

A minifloppy drive normally has 2 or more PC boards. But the more boards and chips and parts, the greater the manufacturing costs, the greater the power consumption, and the greater the possibilities of problems.

Hitachi's engineers and research team decided to do something about those boards. First, Hitachi used its bipolar MOS expertise to create a new custom LSI which processes the I/O signals, controls the stepping motor, generates timing pulses and includes the write circuit. Second, hybrid IC's were designed for the read amplifier, waveform shaper and peripheral circuits. By developing such a new custom LSI and hybrid IC chips, Hitachi created one single PC board that more than does the work of the previous three.

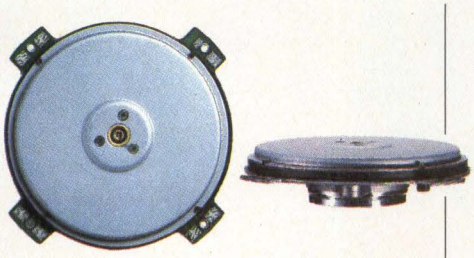
This automatically reduces power consumption, manufacturing costs and, even more important, increases reliability and working life. Compared with our previous drives, total parts have been reduced by more than half.





HFD516C

HUMANICATION™



Closing the distance

A normal motor requires a specific distance between the rotar and stator. That distance naturally diminishes efficient use of energy and can cause problems in high power consumption. By using a new design and a flexible printed board (FPC), Hitachi radically reduced that distance.
So the drive is thinner and the torque is higher. Since energy efficiency is increased, power consumption is reduced. The brushless DD motor offers virtually noiseless operation, the highest rotational accuracy, and a longer working life.

Clamping during disk rotation

Clamping occurs the moment the motor starts rotating after the drive lever is locked. Since the disk is turning during clamping, centering is exceptionally precise.

8″ floppy data compatibility

Hitachi now offers a minifloppy diskdrive, HFD516C, that has the same capacity as 8″ floppies — 1.6 Mbytes. This is clearly a powerful convenience for transferring data and increases applications and the versatility of your drives. Your entire system's size can be reduced.

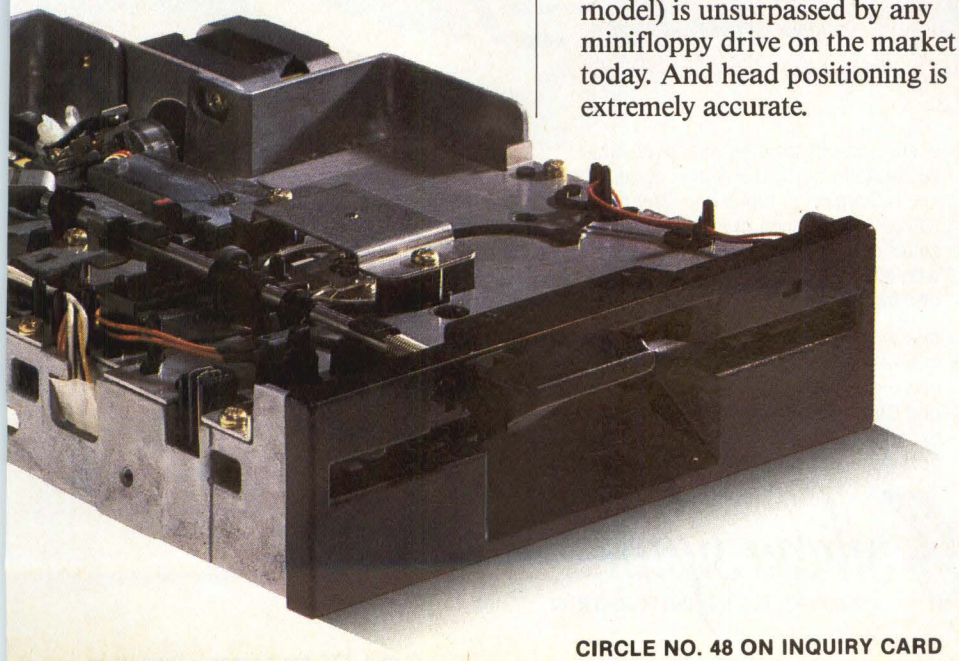
High access speed

Access speed depends upon the head positioning device because head positioning is crucial for all read/write operations. With a steel belt and hybrid step motor, Hitachi's track access time of 3ms (96 tpi model) is unsurpassed by any minifloppy drive on the market today. And head positioning is extremely accurate.

The critical trio: value, reliability, quality

When it comes to value, these drives are far ahead of the rest because Hitachi's ultra-modern production techniques set industry standards for efficiency. If you choose the 0.5 Mbyte, 1 Mbyte or 1.6 Mbyte model, capacity differs but reliability is identical. That's because Hitachi reliability goes beyond impressive specs.
It's grounded on reliability proven not just for 5 years but for over 5 decades.
The bottom line is that Hitachi's drives and other OA products offer the very best investment in quality today.

Hitachi's new half-height minifloppy drives — HFD505C/510C/516C. Driving toward simple superiority.



CIRCLE NO. 48 ON INQUIRY CARD

HITACHI

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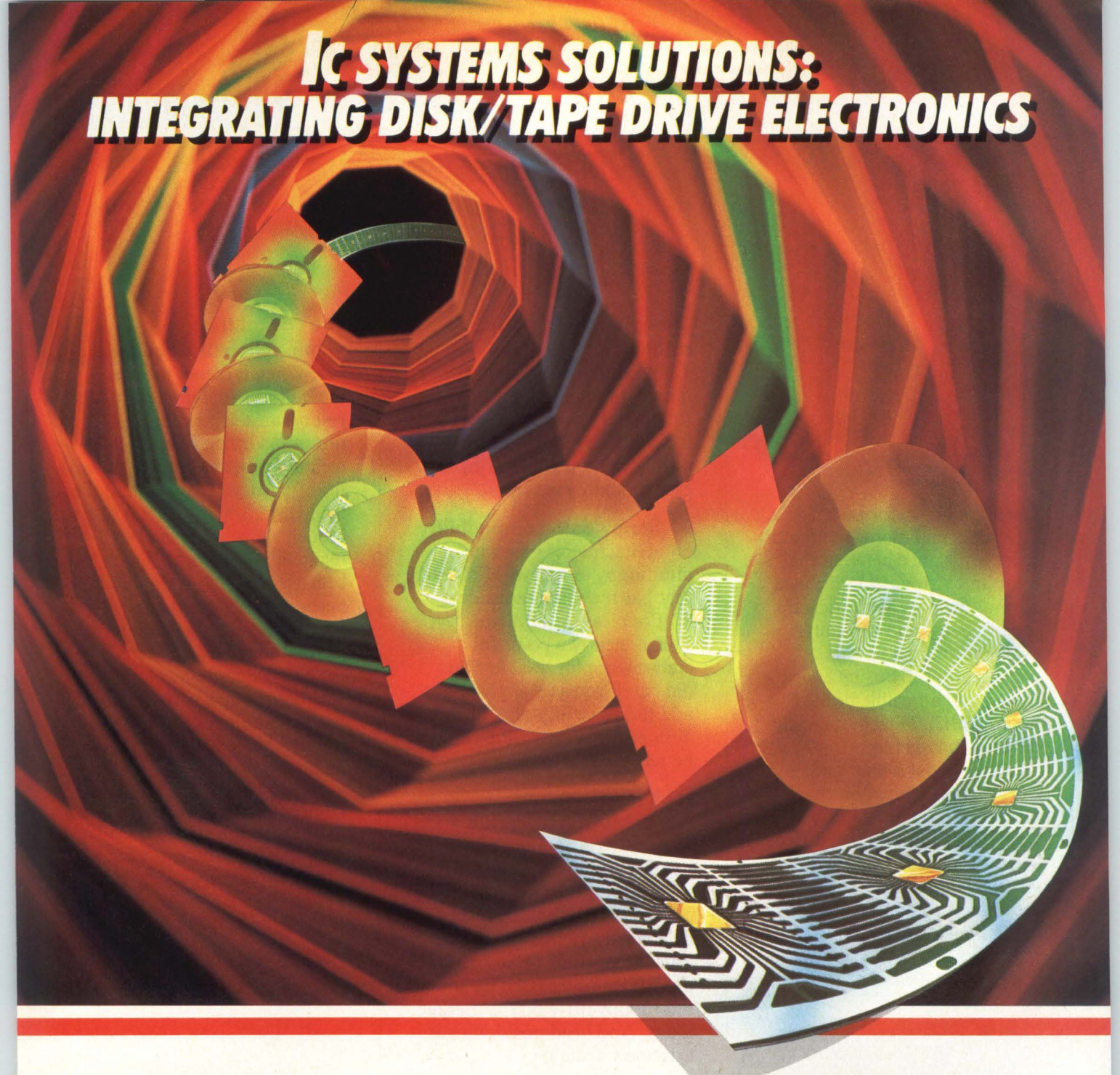
IC SYSTEMS SOLUTIONS: INTEGRATING DISK/TAPE DRIVE ELECTRONICS



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Circle 171 for career information

Personal computer fever spreads to China

Lori Valigra, Senior Editor

China—with one billion people, millions of bicycles and rudimentary capital machinery—hardly seems a comer in high technology. Its 100 or so computer companies contributed only $417 million to the country's economy, or 0.1 percent of the gross national product, in 1983.

But China's government wants to build a home-grown computer industry and to modernize capital equipment in more than 400,000 outdated factories. To do both, it has on tap billions of dollars in foreign reserves to buy technology and manufacturing know-how. With that potential bonanza before them, foreign companies are rushing at a frenetic pace into China to do business.

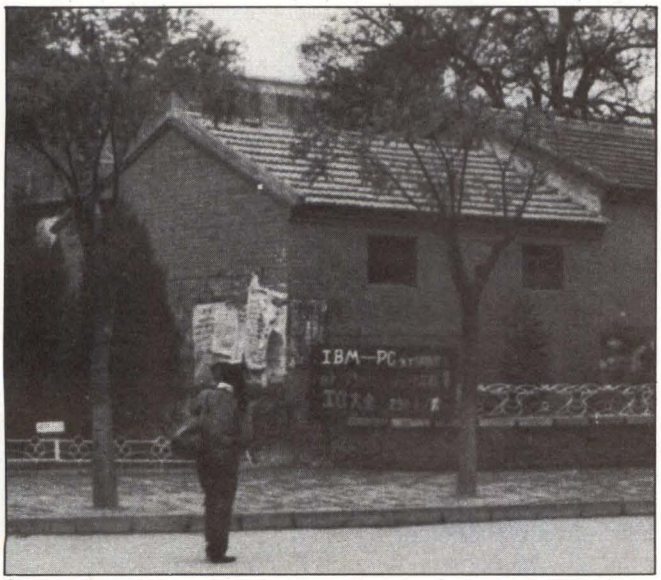
Personal computers already are beginning to play a big role in education, factory automation, weather stations and other vertical applications. The Chinese are buying as many personal computers as they can get, because microcomputers are low-priced and pass through U.S. export controls quickly—about six months after an export license is requested.

"China has a crying need for microcomputers, and we are trying to sell them here," says Pete Sillari, a representative of retailer Computerland International at its Beijing (Peking) office.

Jumping in early to meet the demand for personal computers are IBM Corp., which recently set up a Chinese subsidiary, and Apple Computer Inc., which is stepping up distribution activities. Datamedia Corp., Digital Equipment Corp., NEC Corp., Intel Corp. and others also are making forays into the Chinese market.

At the end of 1983, 30,000 microcomputers were being used in China, says Chen Liwei, chief engineer at the Administration of Computer Industry of the Ministry of Electronics Industry in Beijing. The ACI is the primary government organization behind China's computer industry. Chen says most of these are 8-bit machines, but he adds that 16-bit machines are becoming popular, too.

Chen is not sure how much money China will spend on computers and related equipment this year. Market research is a discipline that has hardly ever been used in China's socialist system.



Computer retail stores *are popping up in China as personal computers become popular.*

INTERNATIONAL

To date, most American companies have shipped complete systems into China. But that is likely to change soon for two main reasons. First, the Chinese were expected to impose a 100-percent import duty on all fully configured systems as of January 1. This would make locally assembled machines comparatively less expensive. Second, the Chinese prefer to gain manufacturing expertise, and so they want to assemble imported knock-down kits. Apple, IBM and others intend to export knock-down equipment.

The 100-percent import tax on fully configured personal computers will encourage the domestic Chinese computer industry, says Chris Brown, deputy director for the National Council for U.S.-China Trade in Beijing. The pattern was set when the Chinese placed import restrictions on 8-bit microcomputers. Brown explains the Chinese then began bringing in kits and, once they were able to make the 8-bit computers themselves, they restricted imports of kits as well. Now this could happen with the 16-bit computers.

Brown says manufacturers of counterfeits already are shifting their assembly base into China. A Western diplomat says there is a tremendous illegal trade in knock-down IBM PC-compatible systems brought in from Taiwan. He says the Chinese started importing counterfeits probably because they couldn't get sufficient quantities of microcomputers because of American export restrictions. "They [the Chinese government] don't like imitations coming in, but haven't denied their importation because it is a way of getting computers," claims the Western diplomat.

Apple, whose computers *are often counterfeited in China, and its distributor, Sime Darby, recently showed the real systems to attendees at the China Comm industry exhibition in Beijing.*

Apple and IBM have found a ready-made market for their machines because the Chinese have been purchasing counterfeit IBM PCs and Apple II computers, or have been obtaining real ones illegally (not through the proper U.S. export control channels) for years. And the Chinese have their own imitations, the most popular of which is the Great Wall, an IBM PC-compatible. Another machine, the Venus, is Apple-compatible.

Imitations outnumber real Apples

Apple only recently began formal sales into China through distributor Sime Darby, a $2.5 billion Singapore company. There are 50,000 to 75,000 real Apple computers installed in China, Hong Kong, Taiwan and Japan, and more than 300,000 Apple II imita-

Microcomputer makers rush to set up Chinese assembly

To get personal computers to the Chinese market more quickly and in greater numbers, many manufacturers besides IBM Corp. and Apple Computer Inc. plan to set up joint ventures aimed at assembling their microcomputers on the mainland.

Wang Laboratories Inc., Lowell, Mass., may sign a joint venture early this year with the Beijing Wireless Communication Plant, a telephone-switching-system maker that wants to move into computers, according to a Wang source. Initially, Wang plans to assemble about 10,000 personal computers a year in China. The source says the Chinese government predicts they need 50,000 units a year. He adds that Wang expects to sell some software, but that generally, "Chinese people don't want to buy software. They think software should be free because it is intangible, so they copy it."

The Wang source says a major aim of local assembly is to improve the market share. He says Wang expects to double Chinese sales yearly over the next two years to reach more than $40 million in mid-1985. Wang has installed 200 VS and 2200 computers and more than 1,000 personal computers in China in one year, he claims.

Datamedia Corp., Pennsauken, N.J., hopes to manufacture its MC68010-based 932 UNIX microcomputer in China. But there are several factors limiting volume production, explains Raymond S. Shimrak, director of international sales at Datamedia. "There's no climate control, power is intermittant, there's lots of dust and there's no static electricity control." Air conditioning is a luxury, he says.

NEC Corp. also is considering assembling its 8086-based PC9801F personal computer in China, but only after it has developed a method to handle Chinese characters, says a company spokesman.

A source at Western Digital Corp., Irvine, Calif., says the company plans to begin assembly of hard-disk controllers for personal computers in China this month. Last year the company sold 2,000 units, and this year it plans to sell 5,000 to 10,000 units. The products will come in through Hong Kong in kits.

THERE'S NO COMPARISON.

The DBS 16 is in a class by itself.

The minicomputers that rival it for features can't touch it for price. In fact, the DBS 16 with two or more terminals even costs less than the same number of personal microcomputers.

But personal computers – no matter how they're strung together – can't offer the features and performance of the DBS 16. Designed for business from the bottom line up, the DBS 16's networking capabilities are built in from the beginning. Sixteen bit processors and exceptional data-transfer techniques offer speed and power. So the system expands – from one to 28 terminals – with ease. Inexpensively.

Your customers become clients, returning time and again as their computing needs expand.

As time goes by, they – and you – will be glad they bought DBS 16's expandability. Other multi-user micros offer fewer bits, fewer bytes, less storage, and proprietary buses that limit their usage.

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Face it. There isn't any (fair) comparison to the DBS 16.

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tions, claims Jon Covington, international markets manager for Apple, Cupertino, Calif. Covington says Taiwanese manufacturers make about 40,000 counterfeit Apple IIs each month. Those imitations are priced at $500 to $700, as much as half off the tag on the real machines.

Sources say some university students also are producing copies and are becoming quite resourceful at it. For example, says one source, some parts, such as 64K-bit memory chips, are hard to come by. As a result, he says, some individuals are purchasing extra memory with large machines and then using that memory in microcomputers.

"There's not a lot we can do here about the fakes," says Covington. "One of the main reasons we [exhibited at a recent convention] in China is that we wanted the Chinese to experience what a real Apple is, and what the reliability and service are."

Covington says genuine Macintosh computers also are being sold in China. "We don't know who sells them. Most come from the United States, and some from Hong Kong and Singapore. The Chinese can bring them in free of duty." Covington says it takes 24 hours to get a computer export license in Hong Kong.

To combat some counterfeit production in state-run Chinese factories, Apple's Covington says his company plans to provide genuine Apple kits for assembly in the factories. He says the government won't halt production of counterfeits because that would mean a loss of jobs; the Apple kits will provide assembly work in some of those factories.

Covington says that, if Apple approaches the Chinese market through proper distribution channels, software package offerings and development expertise, its business in China could be $40 million yearly. But he points out that Apple still doesn't have enough Apple IIs and Macintoshes to supply U.S. buyers.

Last November, IBM set up IBM China Inc., a wholly owned subsidiary

Modernization opens up China's vertical markets

To upgrade its 400,000 factories and to narrow its more than 10-year lag in industrial technology, China is pushing its local computer industry and acquiring resources from more developed countries.

Local computer manufacturing efforts have been hampered by reliance on slow, manual labor, which drives the price of the computers up and causes them to be less reliable, explains a Western diplomat.

Adding to manual labor problems is China's general lack of experience in turning a laboratory design into a producible, commercial product. Chris Brown, deputy director in Beijing for the National Council for U.S.-China Trade, explains that although R&D expertise is strong at the very top layer of Chinese research institutes, this expertise has not filtered down through the management structure. "There's a great discrepancy in the lab versus the factory," he says.

To give a shot in the arm to its modernization efforts, the Chinese government has opened 14 cities to foreigners. These so-called "special economic zones" are test beds of capitalism that are set up to attract foreign investment. They offer lower tax rates (15 percent compared with the usual 30 to 50 percent) and better services (transportation, telephone, etc.).

Because the Chinese are so eager to innovate, Western diplomats, U.S. companies and Chinese industry sources all have expressed concern about the sluggish import control procedures. Each end user must complete an 18-page statement about how the equipment will be used and detail its performance parameters.

Depending on the complexity of the machinery, it takes from six months to two years or more to ship equipment into China. A semiconductor plant in Wuxi (near Shanghai) has been waiting for more than a year for capital equipment purchased from the United States. In the meantime, part of the plant remains idle. Chen Liwei, chief engineer at the Chinese Administration of Computer Industry, says it took one year for a research institute to get power-supply and network-control products from a U.S. company. The equipment has been delayed because of rules imposed by the U.S. Commerce and COCOM, a European organization that controls the export of high-technology goods to Communist countries.

Personal computers, however, take only about six months to go through import channels, which makes them attractive purchases for the Chinese. Capital Steel and Nail Co. near Beijing, has been buying personal computers to help modernize its factory. Since 1979 the company has imported 126 minicomputers and 450 microcomputers, says Chen. Fourteen of the minicomputers are used for staff training, 41 for production control and business management and the remaining 71 for process control.

One U.S. company became a value-added dealer for IBM Corp. PCs so it could automate some of its and China's exploratory activities. Western Geophysical, Houston, sells a color IBM PC/XT with 512K bytes of memory. English-language software for geophysical applications ranges in price from $250 to $12,250.

John Y.B. Hood, business development specialist at the company, explains that Western Geophysical has been exploring in China for five years, and has an IBM 3033 mainframe there to process data for oil exploration. The company also is a value-added dealer for Sperry Corp.'s IBM PC-compatible computer.

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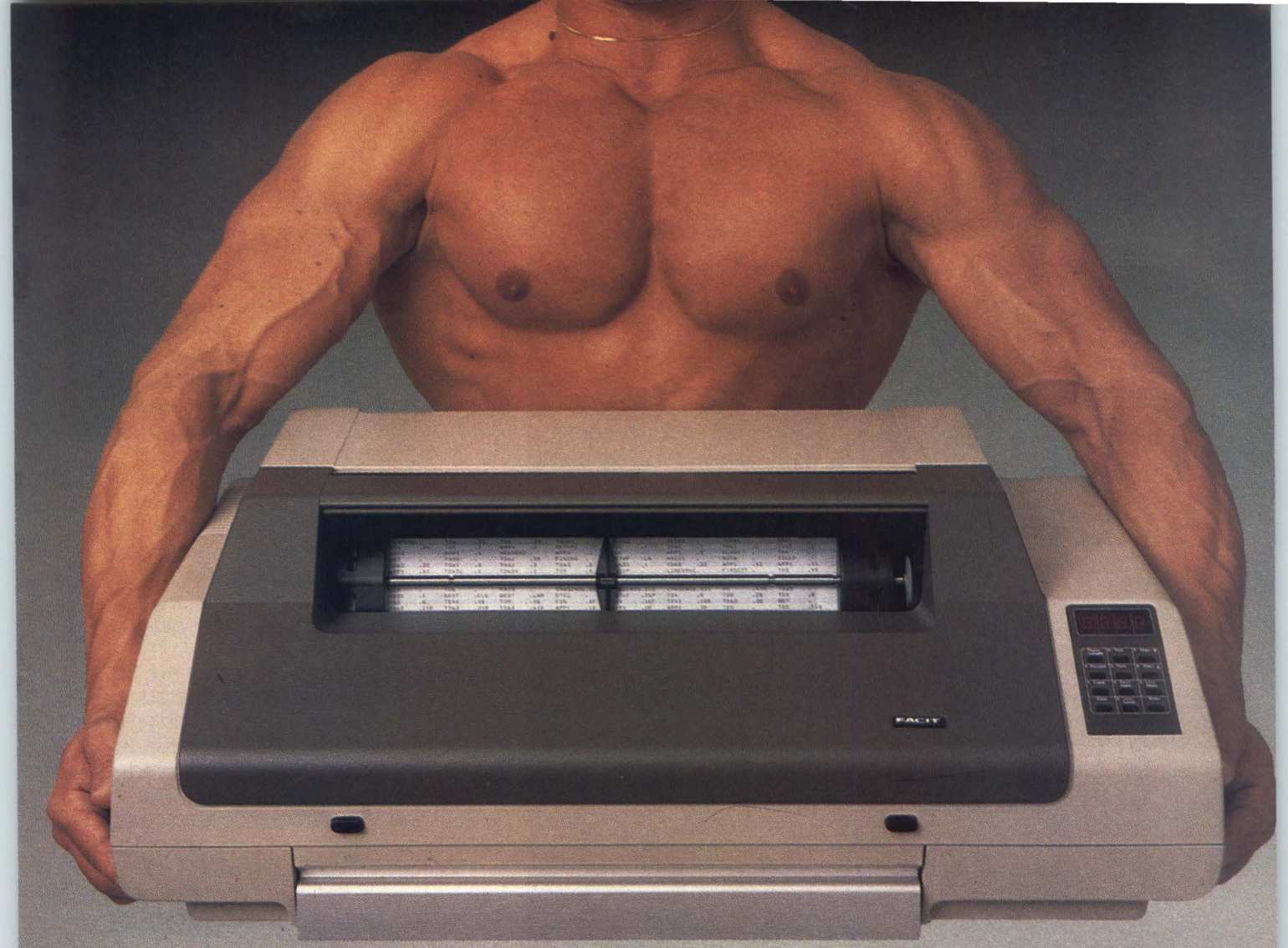

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of IBM World Trade Americas/Far East Corp., with operations in Beijing and Shanghai. Previously, IBM had been selling PCs in China through seven authorized dealers. Sources say there are about 10,000 PCs in China now, and about 1,000 of those are licensed.

Although IBM disclosed little about

PACIFIC PERSPECTIVE

U.S. unitary taxes deemed harmful to trade

Ichiro Kakehashi
Tokyo Correspondent

It should be dawning on American state legislators that Japan's large electronics manufacturers were serious when they threatened to relocate capital investment unless unitary tax laws were rescinded.

The unitary tax is levied on all earnings made by a multinational corporation with operations located within a state, regardless of how much of the earnings were made in that state.

In the past few months, Sony Corp., Kyocera Corp. and Fujitsu Ltd. have shipped capital investments from unitary-taxing California to non-unitary tax states. And NEC Corp., one of the largest Japanese electronics investors with nine manufacturing facilities in operation or under construction in the United States, decided to build a $12.24 million plant in McDonough, Ga., partly because Georgia does not levy a unitary tax. Georgia gained 200 jobs.

The importance of the tax to Japan arises from the fact that electronics contributes even more than automobiles to Japan's economic growth. The Japanese are especially concerned about retaining operations in Silicon Valley. Akio Morita, Sony's chairman, toured the United States in May with a delegation from Keidanren, the Japan Federation of Economic Organizations. They visited 23 states, of which 12, including California, actively enforce a unitary tax.

The delegation's lobbying effort rankled some states' unitary tax supporters, who accused the Japanese group of putting unfair pressure on state legislators. The Keidanren, in turn, said its mission was not much different from that of business groups from other countries who try to convince Japan to liberalize its trade policies.

The Japan-U.S. Businessmen's Conference, a private group led by Norishige Hasegawa, chairman of the Japan's Sumitomo Chemical Co., and Edson Spencer, chairman and chief executive officer of Honeywell Inc., lists the unitary tax among factors most harmful to international trade.

European countries have joined in the unitary tax criticism. The subject of the tax was broached through diplomatic channels early last summer at Europe's Economic Summit. Following appeals there by Britain and Japan, the Reagan administration undertook a study of the issue.

The gist of the study was that, while the federal government regards the tax as a "disincentive to foreign investment," there is not much it can do to get states to abolish the tax. The U.S. Treasury Department has pledged to help states improve tax-collection efforts and find other ways to raise revenue, without resorting to the unitary tax. Frustration over the inaction caused Japanese foreign minister Shintaro Abe to submit a formal note to urge the federal government to move more strongly to ease the trade friction.

The states with unitary taxes have argued that worldwide unitary taxation is the only way to keep multinational companies from hiding their profits to avoid taxes.

A Keidanren survey of leading Japanese companies found that California has a special appeal for investments. Eighty-eight companies would spend more than $5.71 billion on expansion that would create more than 11,000 jobs in California if the state would drop its unitary tax law, according to the survey. But the California legislature ended its last session in August without acting on a bill that would have changed the law. About 400 Japanese companies have subsidiaries in California.

According to Kyocera, it decided to build a $30 million integrated circuit package and ceramic components plant in Vancouver, Wash., because of California's unitary tax. Sony has announced plans to spend about $20 million for a disk-making plant in Terre Haute, Ind., after having exacted pledges from Gov. Robert Orr and a bipartisan legislative committee that the state would abolish a unitary tax that is on its books, but is not being imposed.

Oregon has been the most recent focus of Japanese relocation investment money. Oregon's legislature has decided to end its unitary tax next year to attract business. As a result, Fujitsu is building two facilities near Portland. The pair represents about $170 million in capital spending.

For Oregon, however, abolishing the tax was an expensive move. The state had gained almost $35 million of its $145 million in tax revenue last year from the unitary tax. Oregon's governor said he expects to recover some of that in additional personal income taxes and other, indirect, taxes that will be generated by the new employment the Japanese expansion will bring.

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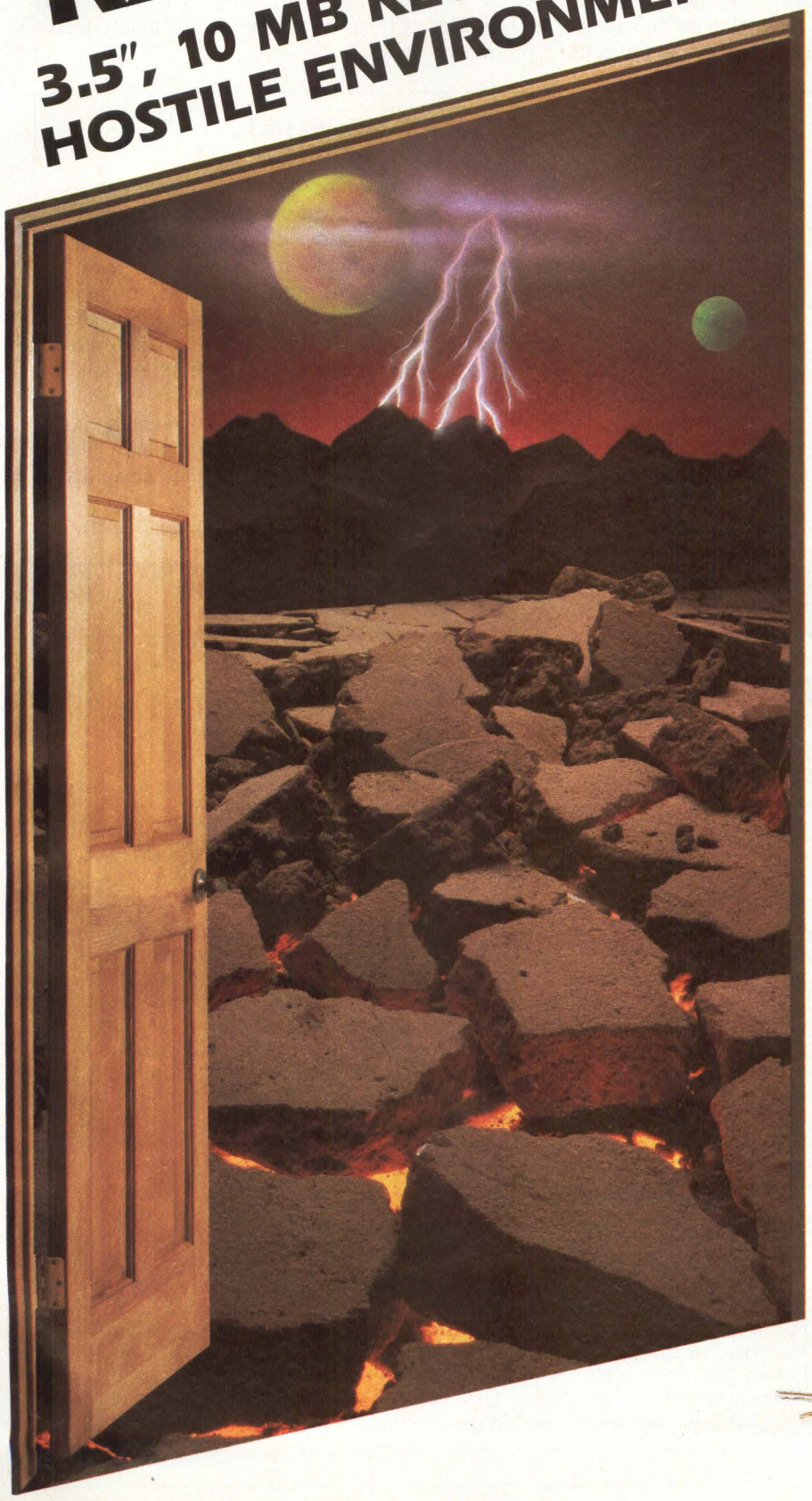

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INTERNATIONAL

the activities of the new company, it announced that it would:

- Form a joint-venture facility with China's Ministry of Electronics Industry to assemble and test Chinese-character 5550 Personal Computers
- Cooperate with the Ministry of Machine Building Industry and the Beijing municipal government to establish a center for data services and customer education
- Work with the Ministry of Electronics Industry on several software development projects
- Install several Series/1 computers throughout China to demonstrate industrial automation.

To celebrate IBM China's formation, IBM agreed to give away 100 5550 workstations valued at $1.7 million to Chinese universities. The company also held a large party at the Great Hall of the People in Beijing. That party was "a gesture [to show] how seriously IBM is committed to China," comments Computerland's Sillari. □

TEKTRONIX ADDS 3-D SOLIDS MODELING

Tektronix Inc., Wilsonville, Ore., has added 3-D solids modeling to its line of color raster terminals for computer-aided-design/computer-aided-manufacturing (CAD/CAM) applications. There are three terminals in the 4120 series, but the 3-D solids modeling element is found in the top-of-the-line 4129. Tektronix begins the series with the 2-D 4125 terminal ($19,950); next in line is the 3-D wireframe 4128 terminal ($25,000). The 4129 goes for $35,000. Users can upgrade within the 4120 series and from the established Tektronix 4115B 2-D color terminal with "field kits" (printed circuit boards) which range in price from $3,000 to $10,000. Industry sources say Tektronix needed color 3-D solids modeling to compete in the design-engineering terminal field with companies like Megatek Corp., San Diego, Calif., which already provide that capability on their terminals.

OVERHEAD OVERSEAS

IBM learns from its mistakes

Tim Palmer
European Correspondent

As unquestionably as its Personal Computer was a failure there, IBM Corp.'s new PC-AT is shaping up to be a big success in Europe, market observers say.

The low price for high performance of the PC-AT may show that IBM intends to leave little opportunity for manufacturers of compatibles to undercut it. The potential customers for the PC-AT not yet covered by IBM are those seeking support for more than three users; IBM only offers a three-user version of the XENIX, UNIX-like operating system.

IBM's decision to delay the European launch of the PC until January, 1983—more than a year after its U.S. introduction—set the stage for poor sales in markets like Britain, Italy and, to some extent, West Germany. In the interim, companies marketing machines like the Victor Technologies Inc. model 9000 sold computers for a full year without competition from IBM.

The PC has been a modest success in Britain, where the installed base is estimated by market researchers to be approaching 60,000. In France, the French daily newsletter *Le Courrier de l'Informatique* quotes internal IBM sources as saying that the company came close to hitting its 1984 target of 40,000 machines sold. About 9,000 PCs were sold in 1983. But West Germany, usually a market which votes the IBM ticket all the way, absorbed, at best, 7,000 PCs in 1983, and the latest figures suggest that IBM sold just over 20,000 PCs there in 1984. In Italy, the Editrice Italiana Software SpA market group estimates just 4,200 PCs were sold in 1983, and 18,000 in 1984.

A comparatively high price for the PC also made sales sluggish. To sell more machines, IBM reduced PC prices in Europe several months before its first price cut in the United States. Unlike their U.S. counterparts, European small-computer users place much more importance on getting value for their money than on whether or not a machine has an IBM badge.

This is why the PC-AT, which offers a lot of power for the money, will be a better sales performer for IBM than the PC. Even in the United States, where the PC has been an enormous success, analysts project more success for the PC-AT.

For those doubting the penny-pinching attitude of European users, particularly on the Continent, a good example comes from the West German subsidiary of ICL Plc., London. ICL sells its System Ten small business computer worldwide as its standard retail point-of-sale terminal controller and concentrator. But according to Dieter Kruschel, director of corporate affairs at the German subsidiary, "our [European] customers liked the terminals but they thought the System Ten was too expensive. We had to write [more powerful] control software for the baby ICL 1500 terminal computer in order to win their business."

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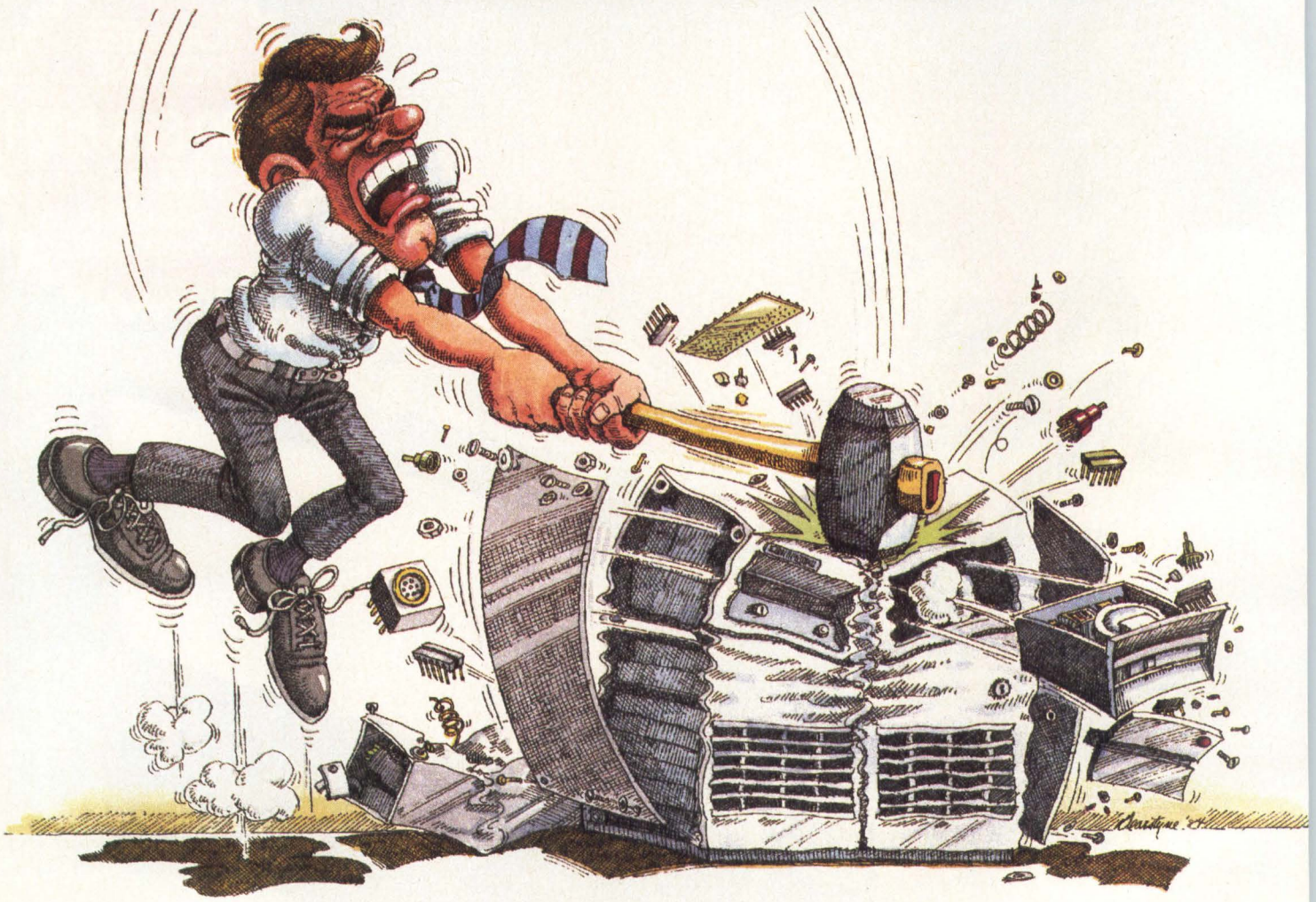

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INTERPRETER

An analysis of news, issues and trends affecting the computer industry

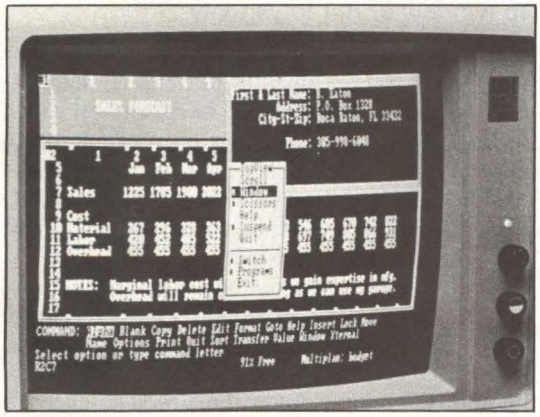
SOFTWARE INTEGRATION: WHO'S ON FIRST

Software makers seek wider customer base, third-party software developers and vertical markets

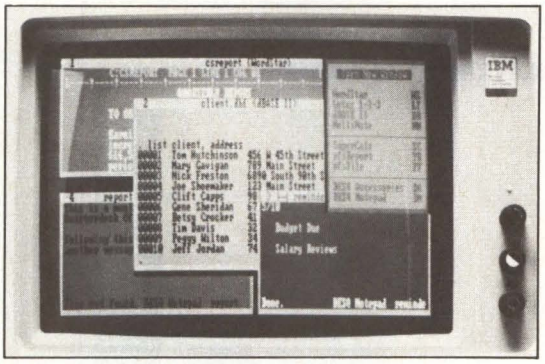
Lynn Haber, Associate Editor

With the total combined value of integrated and integrating software shipments expected to exceed $1 billion by 1988, the question facing developers is not whether to integrate, but how.

A recent market report prepared by Venture Development Corp., Wellesley, Mass., indicates that shipments of integrated packages will increase from 425,000 units in 1983 to over two million in 1988 and those of integrating packages will skyrocket from 20,000 units in 1983 to 1.6 million in 1988. By year end 1983, approximately 40 vendors participated in this relatively young software market, up from less than five in 1982.



IBM Corp.'s TopView software *provides the capability to integrate unmodified software and also provides additional functionality to unmodified applications. (Shown above on the company's Personal Computer AT.)*



DesQ, *the multiwindowing software integrator from Quarterdeck Office Systems, allows users to run existing PC-DOS and MS-DOS applications.*

"At some point, integrated software and integrating software will merge into a flexible package that will allow the user to do any number of functions without the limitations currently inherent in these products," says Leone Pease, market analyst for Venture.

Demand for integrators to increase

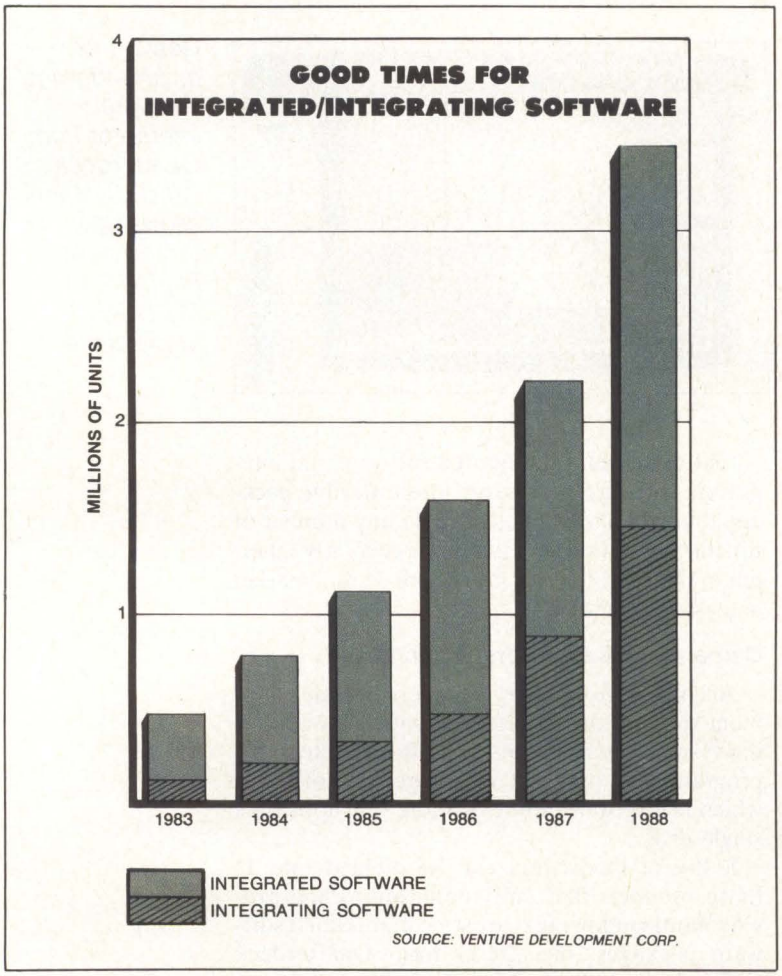
According to industry watchers, the development trend in this technology is towards operating system environments, or software integrator programs, as opposed to integrated software, which incorporates three or more functions on a single disk.

Software integrators can be divided into 1) those products that unify applications and provide multiwindowing to existing unmodified software packages, like DesQ from Quarterdeck Office Systems, Santa Monica, Calif., but do not necessarily provide uniform user interface, and 2) environment management products that provide a common user interface and data transfer between operations on custom-written applica-

tions. Typical is the VisiOn System from VisiCorp., San Jose, Calif., which includes VisiOn Plan for financial analysis, VisiOn Graph for business graphs, and VisiOn Word for word processing.

Two factors influencing the surge in software integrating products are advances in hardware technology and IBM Corp.'s announcement this past summer of its upcoming TopView software integrator. TopView is designed to integrate unmodified software and also provide additional functionality to modified applications. It will reportedly be available for $149 in the first quarter of 1985.

"Most users compare anything they buy to IBM," says Pease. "Other companies will be forced to keep up or keep ahead." Independent software developers will also be likely to feel ripples in the marketplace, should hardware vendors start marketing their own software packages, she adds.



Shipments of integrated packages *will increase from 425,000 units in 1983 to over two million in 1988 and integrating packages will skyrocket from 20,000 units shipped in 1983 to 1.6 million in 1988.*

Developers ignore hardware limitations

In their enthusiasm to devise a better integrating product, software developers have ignored hardware limitations imposed by today's technology, according to Todd L. Corenson, a principal at Enlon Associates, a Cupertino, Calif., marketing research and software development company.

"In many cases you find that software developers aren't perceiving hardware limitations and proceed with concepts that shouldn't be implemented on something like an IBM PC," he says. "What these developers are looking for is a popular user device on which to implement a product."

Windowing is an example of a software concept which is limited by today's hardware technology. Originally developed at Xerox Corp.'s Palo Alto Research Center (PARC), windowing is a graphics-user interface design based on bit-mapped environments. Windowing works best when implemented on more powerful processors and displayed on a high-resolution screen.

"Developers are attempting to implement windows on machines that don't have the capability to fully support them and don't provide full functionality," contends Corenson. "The problem is that people then see these things and say they aren't useful, but they haven't seen these concepts implemented on machines designed to support this type of software."

To window or not to window

Although many industry analysts concur that windowing is a reasonable approach to integrating products, the preferred hardware on which to implement this concept is only beginning to appear in the marketplace.

Many of the integrated or integrating software products available today target 16-bit machines, most commonly the IBM PC, PC compatibles and Apple Computer Inc.'s Macintosh. Integrating products typically require 512K bytes of RAM and a hard disk, and integrated software about 256K bytes of memory and, depending upon the product, either a floppy or hard disk.

IBM's recently released PC-AT, based on Intel Corp.'s 80286 microprocessor, is a dream machine for software developers. The PC-AT reportedly delivers almost five times the user memory and more than twice the data storage

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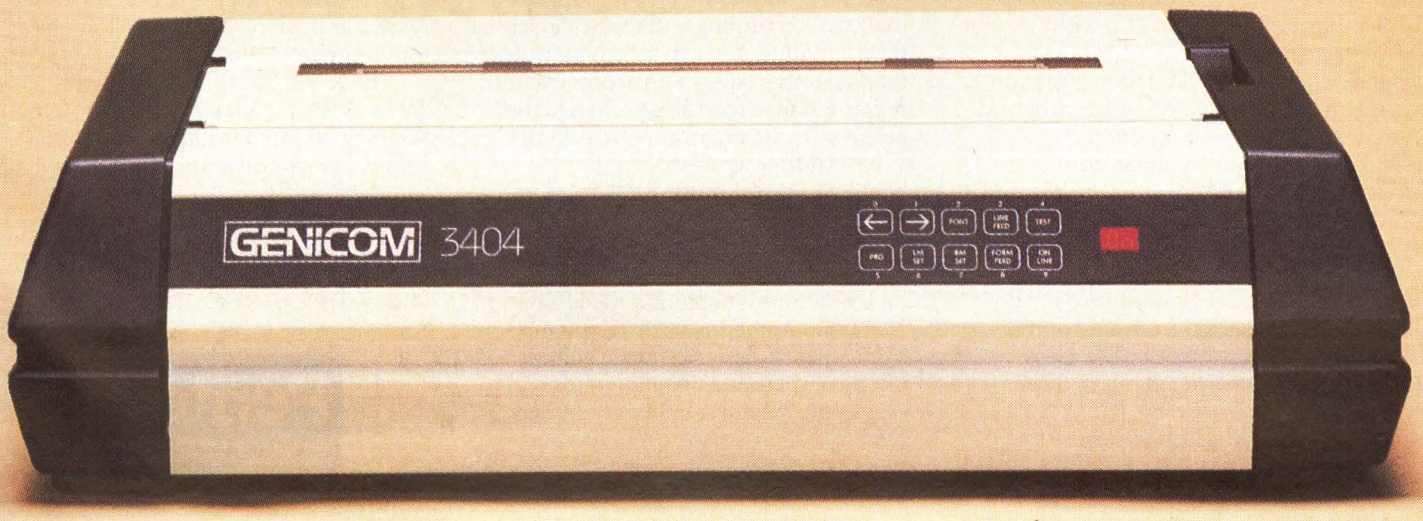

CIRCLE NO. 55 ON INQUIRY CARD

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□ Cluster up to six Perigrafs, linked by DMA for parallel data transfer at up to 250,000 bytes per second.

□ Network our Ethernet combined with a dedicated I/O processor on a split bus to maximize speed.

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Summing up, Perigraf's entire open-architecture design was conceived to accommodate technological advances readily and adapt to new applications requirements easily.

Basic $14,500.00 price includes 11/73 CPU, 512 Kb RAM, 2 RX50 type floppies, 36 Mb hard disc, 4 port serial I/O, RT clock and graphics interface.

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CIRCLE NO. 56 ON INQUIRY CARD

capacity previously available on the company's PC.

The degree of functionality a user can derive from windowing is, in part, dependent upon the level of software integration.

For example, the VisiOn System employs what is known as "tight" integration. This means that applications which run on that product are specifically written for VisiOn. To control multiple activities, VisiCorp uses windows on the screen, which enables the user to view different documents at the same time and also to transfer data between windows.

On the other hand, DesQ is based on "loose" integration. While Quarterdeck claims a user can select from over 150 unmodified off-the-shelf packages, not all the software will achieve full windowing functionality. Only applications accompanied by an "agent," an interface between DesQ and the program, allow the program to run in windows. Programs running without an agent operate full screen. Quarterdeck currently offers 12 agents. (see "Software packages supported by DesQ," below).

Taking a different approach, Cullinet Software Inc., Westwood, Mass., decided not to employ windows in Goldengate, its integrated software product. Maurice B. Shore, senior systems engineer at Cullinet, believes that windowing is a reasonable way to approach integration, but that a well-designed integrated product eliminates the need for windows.

"Windowing also takes some of the computing resources which could otherwise be put toward some of the functionality within the system," he comments. "I don't feel that because certain products have come out with windowing, products that don't use this approach are missing the mark, or are technically or functionally inferior."

Robert Lewis, product manager for Framework, an integrated software product from Ashton-Tate, Culver City, Calif., believes integrated software development is approaching the limit of what the current generation of hardware can support.

"I think the trend in integration is toward increased ease of use, but today's hardware imposes speed limitations and memory limitations," says Lewis. "As memory gets larger and cheaper and as CPU power increases and costs decrease, I think we'll begin to look for the incorporation of things like artificial intelligence to facilitate getting jobs done, and adaptive types of programs that will learn individual work styles."

Venture's Pease says, "I think the hardware vendors will determine the future of software," but adds, "the software independents are going to drive the hardware people into staying on top of technology."

'Most users compare anything they buy to IBM. Other companies will be forced to keep up or keep ahead.'

Customizing encouraged

Stifled by hardware, yet determined to keep pace with the competition, developers of integrated software are busy devising ways to upgrade their products.

One trend of particular interest to the system integrator is to encourage independent software developers to customize these software products for vertical market segments.

Therese Myers, president of Quarterdeck, says that DesQ, the company's multiwindowing software integrator, will address special markets. "Eventually, there'll be products like DesQ for physicians, DesQ for lawyers, etc., always using independent software developers' products as the tool," she claims.

In a similar fashion, Lotus Development Corp., Cambridge, Mass., announced last Sep-

Software packages supported by DesQ

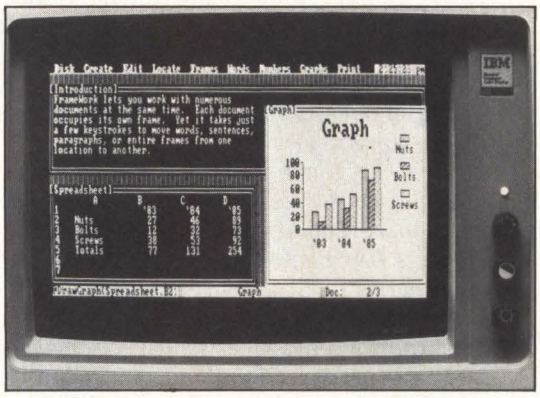
Data management:
dBASE II (Ashton-Tate) All releases through 1983
pfs:file (Software Publishing) All releases through 1983
pfs:report (Software Publishing) All releases through 1983

Graphics:
Fast Graphs (Innovative Software) Releases 1.1, 1.11

Integrated:
1-2-3 (Lotus) Release 1A

Spreadsheet:
Multiplan (Microsoft) Release 1.06
SuperCalc/SuperCalc2 (Sorcim) Release 1.12, 1.0
SuperCalc3 (Sorcim) Release 1.0
VisiOn Plan (VisiCorp) Release 1.2

Word processing:
MultiMate (Multimate International) Releases 3.11, 3.20
pfs:write (Software Publishing) All releases through 1983
WordStar (MicroPro) Releases 3.2, 3.24, 3.3



Ashton-Tate's Framework integrated software *for the IBM PC reportedly allows users to place "frames" containing graphs, documents or spreadsheets anywhere on the program's "desk" work area.*

According to industry analysts, the trend is towards operating system environments or software integrators.

tember plans to release proprietary data on Symphony, the company's integrated software product, to encourage third-party software developers to cater to niche markets.

Another popular way of broadening the appeal of these products is via a micro-to-mainframe connection which enables users to tap into the corporate database.

"People favor a systems approach rather than having their PC sit there by itself," says market analyst Pease. "This concept has almost become a market requisite."

Cullinet, a major supplier of corporate database software and applications, considers its micro-to-mainframe concept true integration, as opposed to a link. "There's links and then there's mainframe-micro integration. I haven't seen anything other than the Information Database-Goldengate concept that really satisfies that idea," asserts Vic Morris, Cullinet vice president of marketing and international operations.

As a standalone, integrated software product, Goldengate offers word-processing, database, spreadsheet, graphics, and information management functions. Used with the company's micro-to-mainframe Information Database (IDB) software product, which resides in the mainframe, provisions are in place to access additional internal data sitting on any number of different databases, according to Morris.

If a company is a customer of Cullinet's Information Relational Database Management System (IDMS/R), the three mentioned products can be integrated into a complete corporate information system.

"We're approaching integration from the point of view of giving people flexibility but having control, and letting it reach back into applications and databases because many organizations have tremendous investments in their applications and databases," says senior systems engineer Shore.

Lotus recently entered a joint venture with Informatics General Corp., Woodland Hills, Calif., to link virtually any IBM mainframe database with Lotus' 1-2-3 and Symphony packages. The price of the currently available micro-mainframe product Answer/Lotus is $45,000, including connections to one mainframe and 50 PCs, according to an Informatics spokesman.

Shore explains one difference between Cullinet's approach to mainframe integration and that of Lotus. "It boils down to comfort from the user's point of view, and being able to feel like that data is sitting on your hard disk even though it's on the mainframe."

From a user's standpoint the number of vendors involved is also a consideration, according to Shore. "We provide a single-vendor, single-support source as opposed to having one vendor for the link, a vendor for a microproduct and a vendor for the database," he says.

Integrating concepts still evolve

Despite the tradeoffs and compromises in the various approaches to integration, the concept of creating a working environment most natural and comfortable to the user is here to stay.

"As users become more sophisticated, they're going to demand a more sophisticated product. They will also want something that can be used immediately," says Pease. "That's why expanding to vertical markets and more open integrating environments will gain popularity."

The exploratory environment, characterized by the integration of operating system, applications, programming language and data, will be the next generation of integrating environments, according to Enlon's Corenson.

"The exploratory environment allows you to dynamically make modifications to applications and to determine how these modifications affect the applications or environment," he explains. "This enviroment is for the system integrator and for those in general who are developing specific applications or enhancements to applications," Corenson concludes. □

Interest Quotient (Circle One)
High 816 Medium 817 Low 818

Building New UNIX Networks

Mainframes to Micros

INTERACTIVE Systems Corporation and its OEMs are introducing a series of new products that allow users to distribute their computing tasks among central computers, departmental computers, and personal computers running UNIX and/or PC DOS.

Announced To Date

First, INTERACTIVE introduced the Workbench (IS/WB) and IS/3 systems for distribution by its own sales force to DEC users. IS/WB is a set of key UNIX tools running as extensions to DEC's VMS operating system. IS/3 is an enhanced version of the standard AT&T UNIX operating system for PDP and VAX computers. Both support INed, a proprietary full-screen editor that is the primary user interface on all INTERACTIVE operating systems. Both systems also support INmail, an electronic mail system, and INnet, a networking package that links computers so that they share resources and exchange mail.

At the 1983 Fall COMDEX, SCI Systems demonstrated a new family of multi-user microcomputers (SCI 1000) running IN/ix, which is a version of IS/3 with INed. SCI offers INmail and INnet as applications.

At the UNIFORUM show in early 1984, IBM demonstrated PC/IX, a version of IS/3 with INed, on the IBM PC XT, IBM PC XT/370, and the IBM PC with Fixed Disk Expansion. At the same show, INTERACTIVE demonstrated software that allows personal computers running PC DOS to act as intelligent terminals to any system running INed.

In June, IBM announced that INmail, INnet, and INfort, INTERACTIVE's Fortran 77 compiler, were available as applications for PC/IX. In July, IBM announced VM/IX, a version of IS/3 with INed, which runs as a guest operating system on their Virtual Machine/System Product (VM/SP). And at the fall Expo '84 in LA and UNIX Expo in NYC, IBM announced and demonstrated PC/IX on the new IBM Personal Computer AT.

The Net Effect

INTERACTIVE is the only company to offer a complete network of UNIX-based operating systems, utilities, and applications for building corporate communications systems. Our products provide compatibility across a wide range of processors, making virtually any configuration of PC's, minis, multi-user micros, and mainframes possible. We are also unique in offering full-service support and maintenance, as well as extensive training programs to assist our customers in implementing UNIX networks.

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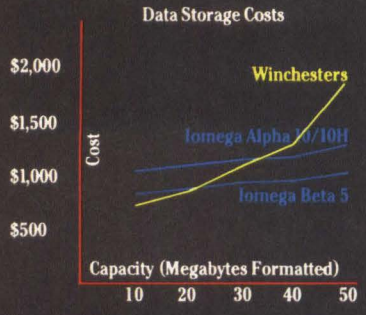
CIRCLE NO. 57 ON INQUIRY CARD

A DECLAR
DATA INDE

When In The Course Of Business Events . . .

OEMs designing systems for today's businesses face two realities. One, data processing is rapidly becoming more decentralized. It is pushing outwards into individualized work units, defined more by job function and applications, performed by more people in more places, demanding more data flexibility—more data independence.

Which brings OEMs face to face with a second reality. Winchesters. Because the prevailing mass storage technology—in the form of large storage units used for access or downloading, or smaller, high capacity desk-top mechanisms—continues to head in the opposite direction. Rather than freeing users to operate effectively in the new environments of distributed data processing, Winchesters keep them device-dependent, keep them tied to a shared system of storage.

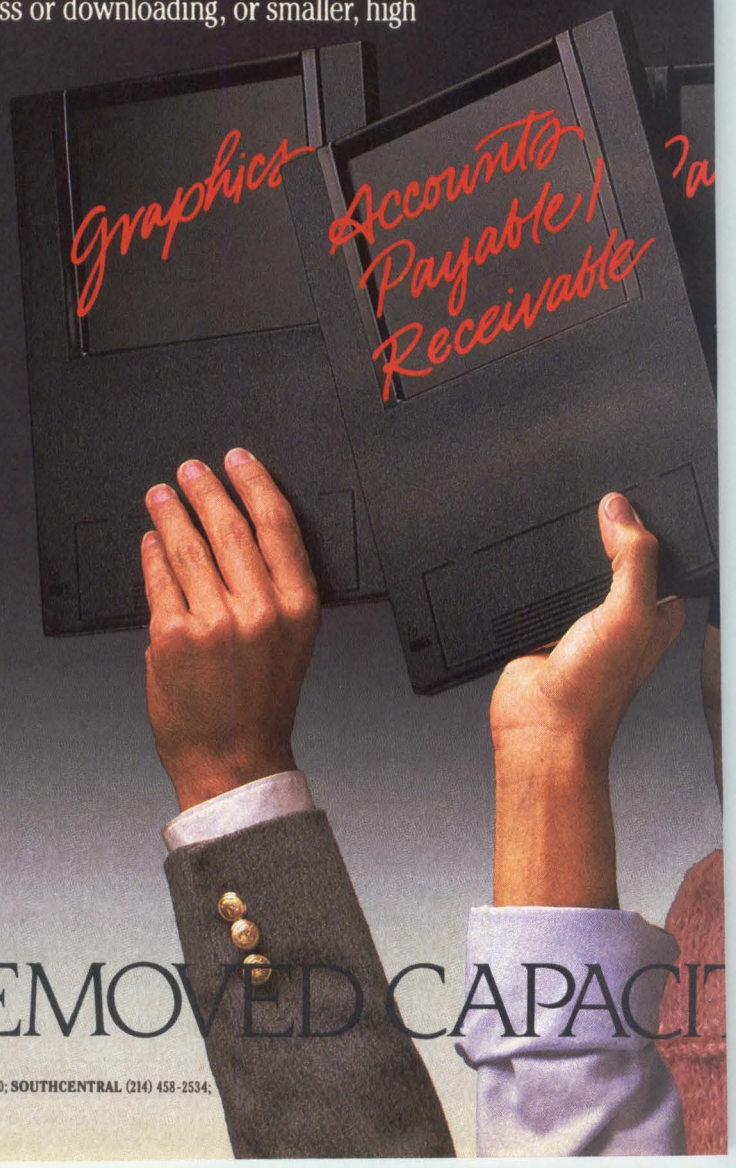


Slavery By Any Name . . .

There are lessons here. That the central issue isn't more data, but more data dynamics. And that Winchesters are hardly data dynamic at all.

Consider the aggravations of "wait your turn" access, or the need for lots of "system savvy" on the user's part. Consider the time consumed in backing up and restoring data. And consider the ever-present risk of a system going down or files lost to expensive head crashes.

Now consider the alternative.



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IOMEGA's Distributed Data Storage: Freedom Of Information.

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	IOMEGA BETA 5	IOMEGA ALPHA 10/10H	TYPICAL WINCHESTER
Formatted Capacity	5.0 Mbytes per cartridge	10.0 Mbytes per cartridge	10.0 Mbytes fixed
Data Transfer Rate	5.0 Mbits/Sec	9.0 Mbits/Sec	5.0 Mbits/Sec
Average Access Time	50 msec includes settling	35 msec includes settling	85 msec
Form Factor	5.25"	8"/8" Half Height	5.25"

The key is "in/out" simple—the IOMEGA cartridge. Think about downloading data and software to a single 5- or 10-megabyte cartridge, then manipulating, updating, and uploading with maximum convenience and cost efficiency. And think about a total enterprise solution, about storing individual applications, complex software programs, or data sets—all of which can be passed along to others without expensive networking resources. And when you need more storage, you use more cartridges, not more hardware.

Accept No Other Alternatives.

IOMEGA's distributed data storage solutions—in full- and half-height 8-inch 10-megabyte solutions, and a 5-megabyte, 5¼-inch version as well—give OEMs Winchester performance and reliability, and floppy convenience and cost efficiency. They are proven, risk-free solutions. And of the few cartridge opportunities on the market today, IOMEGA's—besides being available—are the only ones that are rugged, absolutely interchangeable, and inexpensive. As such, they give OEMs the most precious commodity of all: *the freedom of designed-in freedom.* The freedom your customers require.

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CIRCLE NO. 58 ON INQUIRY CARD

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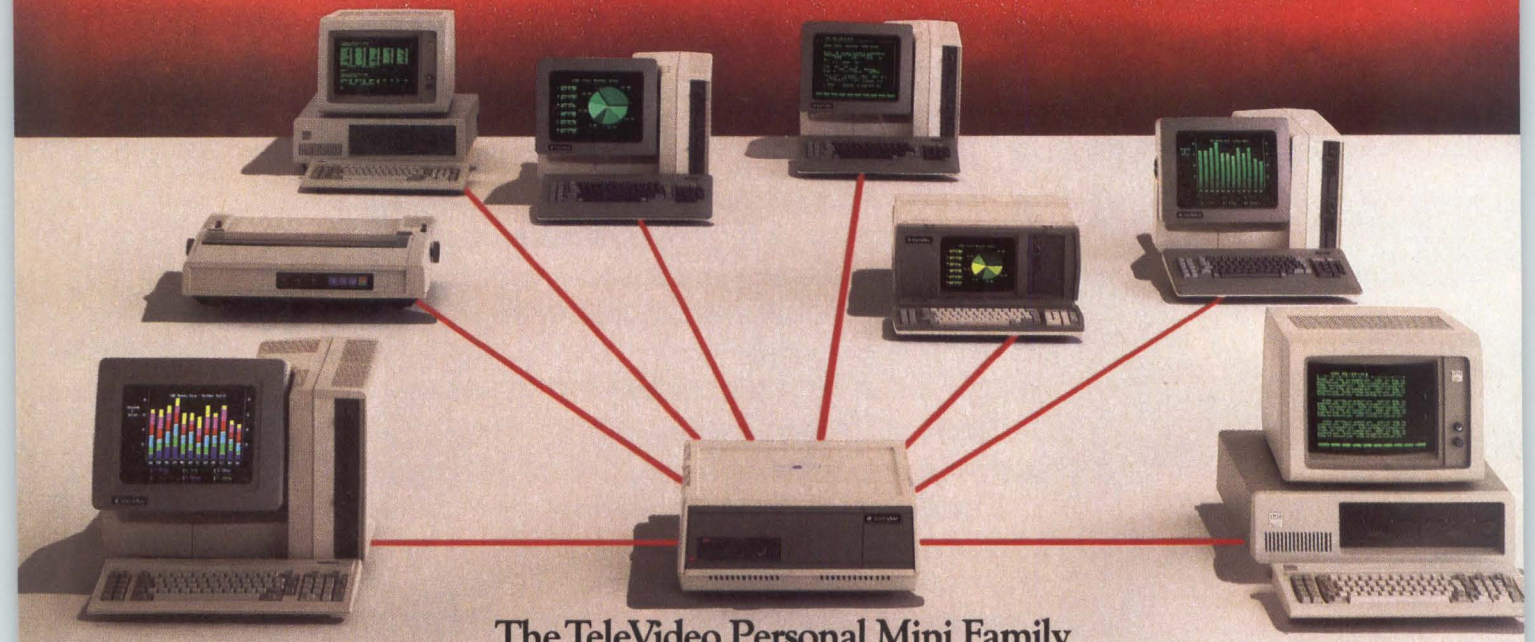

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TeleVideo Systems

TeleVideo Systems, Inc.

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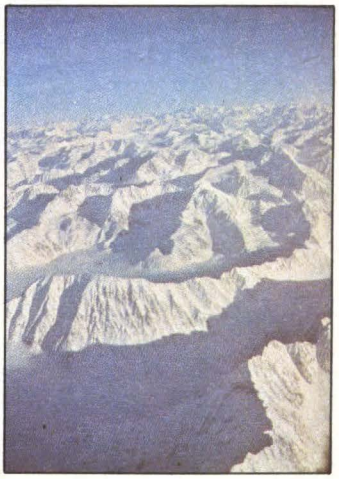
'RUGGED' MINIS MEET NORTH SLOPE CHALLENGE



Construction company uses TI minicomputers to streamline payroll processing, job-cost estimating and other tasks in Alaskan Pipeline projects

Gary Whitney and **Thomas Hughes**
Wright Schuchart Inc.

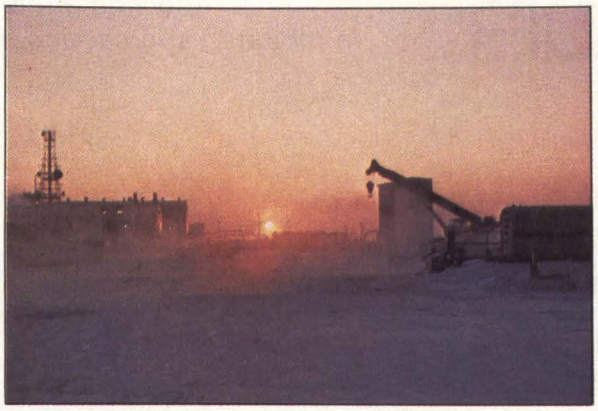
Until 1982, Wright Schuchart Harbor Co., a Prudhoe Bay, Alaska, construction company, found payroll processing and job-cost reporting burdensome and expensive. The company, which builds two- to three-story oil-drilling modules for companies drilling for the Alaskan Pipeline, employs people at various sites on Alaska's North Slope. Because oil companies have strict reporting requirements and because labor in Alaska is expensive, Wright Schuchart must closely monitor payroll and job costs. But the company's information-processing methods were cumbersome.

For example, to process its payroll, the company had to mail the data to Wright Schuchart Inc. headquarters in Seattle. There, a mainframe computer processed the data, and the company's data-processing center produced the employees' checks. Finally, headquarters' employees mailed the checks back to Prudhoe Bay, where they arrived barely in time to meet payroll.

In a move to streamline procedures, company officials decided to try using minicomputers to provide on-site, standalone computing power. They believed that such power would be essential for any future, large job contracts on which the company might bid.

After winning one such contract in 1982, Wright Schuchart officials outlined their require-

Wright Schuchart uses TI minicomputers *to process payrolls for employees drilling oil for the Alaskan Pipeline.*



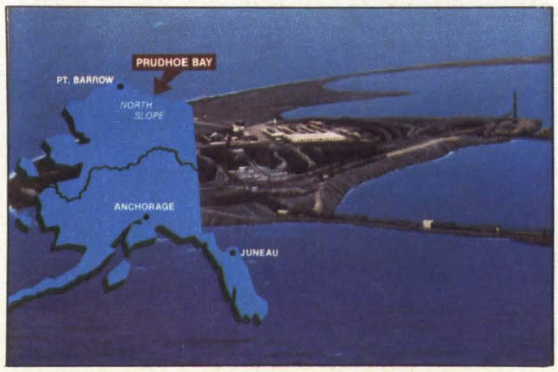
Using reliable computer equipment is especially important *on Alaska's North Slope, where temperatures can dip as low as −75 degrees Fahrenheit.*

ments for a payroll-processing minicomputer system. Although the company's main concern was to process payrolls and print the checks on a timely basis, company officials also wanted a system that could generate job-cost reports, equipment-cost reports, accounts payable and purchase orders. Moreover, the selected system would have to perform in a construction trailer while outside temperatures dipped as low as −75 degrees Fahrenheit.

Software generates payroll

Because of time constraints, the company's project team reviewed systems from only three vendors. After the review, the team members chose a Texas Instruments Inc. 990 model 7 minicomputer with construction-management software from Timberline Systems Inc. Wright Schuchart officials believed that the Timberline software, which runs only on TI hardware, would meet their needs because it generates job- and equipment-cost reporting, payroll, accounts payable and purchase-order generation. As for the hardware, the 16-bit, 512K-byte, multiuser, multiprogramming 990 model 7 was rugged enough to operate in sub-freezing temperatures without special adjustment. The price to Wright Schuchart for the initial TI system with the Timberline software was around $60,000.

Wright Schuchart Harbor Co. uses a Texas Instruments 990 model 7 *and Timberline software.*

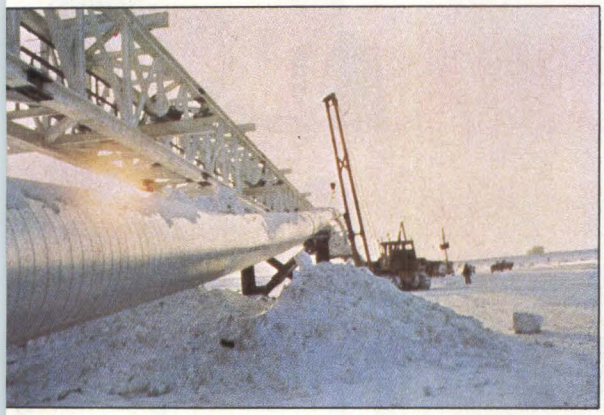


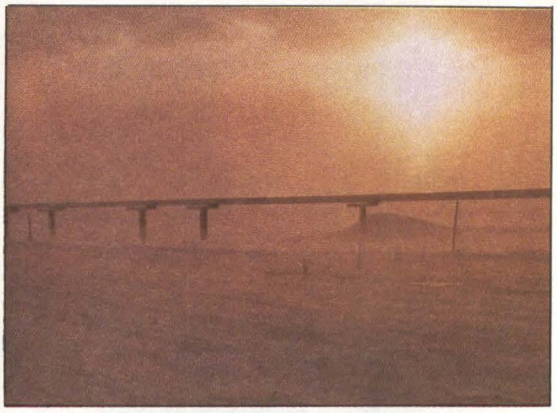
To process the payroll, codes are assigned to each worker's daily activity. Wright Schuchart uses these labor and material codes for cost-vs.-budget reports, expense forecasts and cost overrun and underrun estimations. The forecasts enable employees to monitor a job, identify problems and correct mistakes before they become serious. TI printers provide hard copies of payroll or expense forecasts. In addition, the system acts as a project-management tool that can generate accurate and frequent job-cost reports. With the Timberline software, users can access self-prompting screens; user-designed reporting of variables; and multiuser, real-time and batch processing. Timberline also offers documentation and nationwide, toll-free telephone support.

One-source hardware persuasive

Another factor in Wright Schuchart's choice of the TI system was that the hardware all came from a single manufacturer. The other two systems that Wright Schuchart had reviewed had included a mix of hardware—terminals, printers and disk drives—from different vendors. But using hardware from different vendors would have meant relying on several vendors to service the hardware—a big constraint in the harsh climate in which the systems would be working. Although company officials emphasized software in their selection of a system, they found that TI could provide the reliability and support of a large, established vendor on a timely basis in a rugged, difficult-to-reach area.

In addition, TI offered short lead times between ordering and installing the equipment. For example, Wright Schuchart's Seattle office received the hardware for the Prudhoe Bay project two working days after it was ordered. After the equipment's arrival, TI and Timberline trained Wright Schuchart employees in Seattle on the system for two days. The company then shipped the system and trained personnel to Prudhoe





Bay, and the system began to produce its first payroll four days later.

TI offered what Wright Schuchart considered better maintenance coverage than the other two vendors reviewed. In one instance, an employee at Prudhoe Bay discovered a hardware problem in the minicomputer at 4:30 a.m. and called TI's office in Austin, Texas, to order a replacement part. TI shipped the part on the same day from Austin to Seattle, and Wright Schuchart shipped it from Seattle to Anchorage and from Anchorage to Prudhoe Bay, where it arrived by 7 o'clock that night.

System sits on man-made island

Wright Schuchart has used TI minicomputers at other construction sites in Alaska besides the Prudhoe Bay project. For example, its subsidiary, Arctic Slope Wright Schuchart, used a TI Business System 672 minicomputer on-site at the construction of Mukluk Island, a man-made island 700 miles from the North Pole. The 16-bit model 672, part of TI's Business System 600 series, offers 256K to 2M bytes of memory and can support 16 concurrent users. For the Mukluk Island project, Wright Schuchart leased the system from TI. To buy a typical configuration, including a 256K-byte memory, a 43M-byte disk, a terminal and a dual controller would have cost around $30,950.

While Wright Schuchart was building Mukluk Island 26 miles offshore, employees set up a base camp on Thetis Island, eight miles from shore. A helicopter carried the TI system and the printer to Thetis Island, where employees placed them in a typical construction trailer surrounded by 1.25 million cubic yards of dusty gravel destined for the construction site. Despite the low temperatures inside the trailer and the dust caused by the gravel, the 672 was able to produce job- and equipment-cost reports and to process a payroll. The trailer lacked an air-conditioning or air-filtering system, so employees did occasionally have to clean dust from the machine's own built-in air filter.

At Mukluk Island, 700 miles from the North Pole, *Wright Schuchart used a TI Business System 672 minicomputer to report job costs.*

Wright Schuchart employs TI equipment in typical office environments, as well as in harsh climates. In Anchorage, the company uses a Business System 861 for accounting applications. In the home office in Seattle, a model 872A upgraded from 43M bytes to a 138M-byte capacity uses Timberline's AccuBid estimating package. AccuBid handles quantity surveys in automatic, manual or combination modes. The screen display changes to reflect data as it is entered, and users can choose whether to view the estimate on the screen or on a printout.

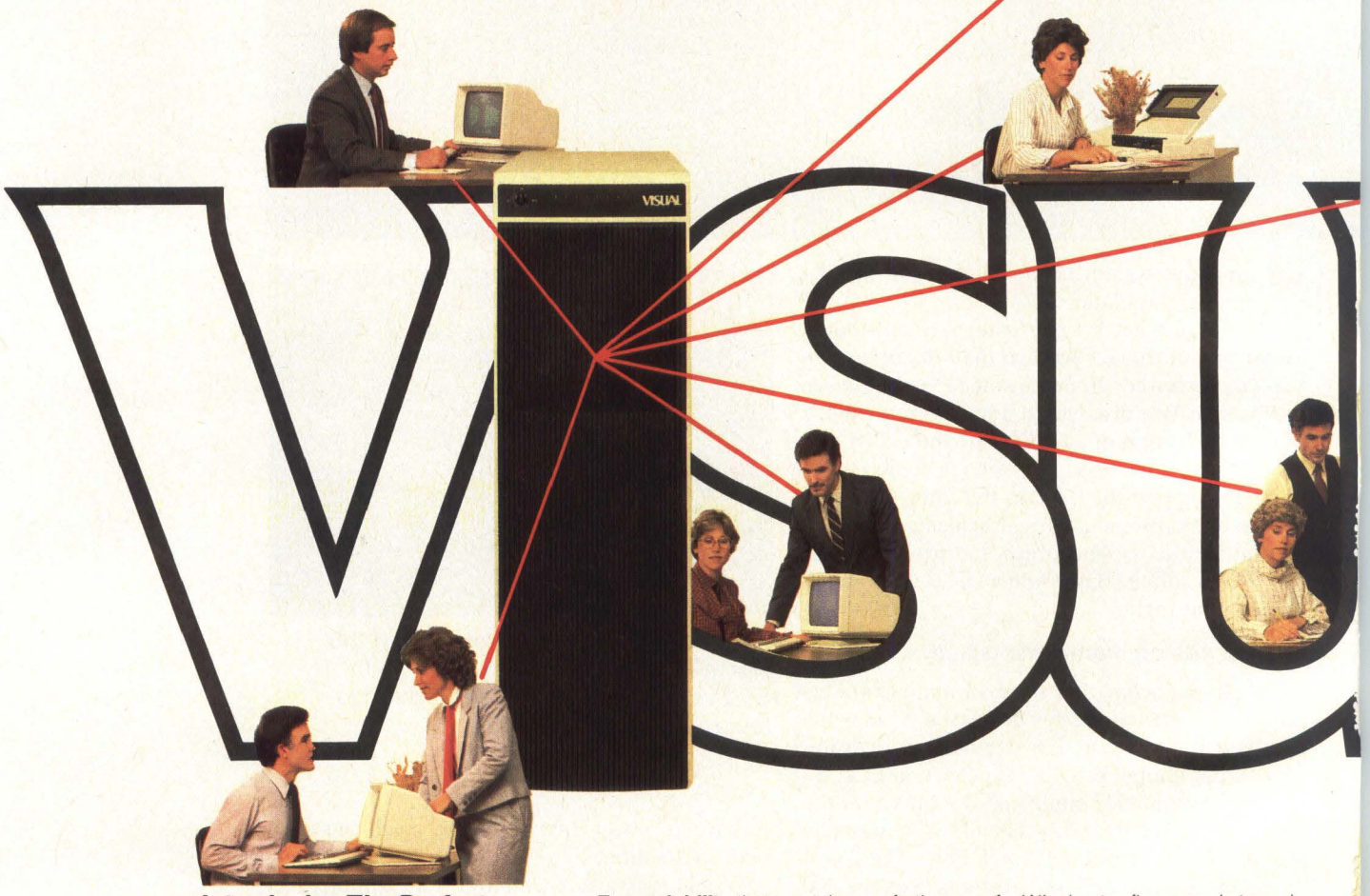
In Seattle, Wright Schuchart uses a model 372 for inventory, and, in Anchorage, Alaska, the company uses a model 861 upgraded to a capacity of 435M bytes. Wright Schuchart leases equipment from TI when needed. □

Interest Quotient (Circle One)
High 819 Medium 820 Low 821

Gary Whitney is manager of information systems at Wright Schuchart Inc., Seattle. He was previously with Lockheed California Co. and Hydraulic Research Textron.

Thomas Hughes is project leader of construction information systems at Wright Schuchart. He was formerly with Boeing Computer Services.

The Power of a Mini, The Cost of a Micro, The Clout of UNIX.



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With the VISUAL 2000, we've designed the perfect tool for system builders and integrators. A multi-user computer system that supports more terminals, offers more expandability, and gives you more configuration flexibility than any other system in its price range. Truth is, it outperforms a lot of higher priced systems as well.

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Power to support more on-line users in demanding applications—up to 16 independent terminals or workstations.

Flexibility to accommodate a remarkable variety of application requirements, thanks to an open architecture, compatibility with mainstream industry standards, and a full spectrum of configuration options.

Expandability that can take you further than any other system in its class—an unrivaled upgrade path to protect your system investment.

Put the Full Power of Intel's 286 in Your Systems

The Intel 286 is today's chip of choice for UNIX-based systems. Only the 286 gives you: on-chip memory management; an instruction set optimized for multi-tasking; pipelined architecture; and an optional 287 numeric coprocessor which can speed up floating point by a factor of 10. What do these features mean to the end user? Faster response time, more users supported, and lower system cost.

A "Mainframe" on a Single Board

The VISUAL 2000's single-board base-level design is the key to higher performance, greater reliability and lower cost. A single high-density board includes the 286 CPU; 512KB-2MB of RAM; controllers for Winchester, floppy and streaming tape; an intelligent communications processor; six RS-232 ports; and a parallel printer port. There's even a real-time clock with battery backup. A few short years ago a system with these features might have been called a mainframe.

From a Multi-User System to a Multi-System Network

With the VISUAL 2000 you never pay for more system than you need, and never have to settle for less. Up to 6 megabytes of RAM. 4 Winchester disk drives. Floppy. Streaming tape backup. And mainframe communications. All in a small stand-up enclosure which looks right at home ne to a desk.

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And if a fully expanded VISUAL 2000

VISUAL 2000

isn't enough, you can connect up to 254 systems in an ARCNET® local area network.

In all configurations, the VISUAL 2000 achieves an exceptional ratio of price/performance.

Software: A Complete System Builder's Tool Kit

Ultimately, the strength of a system is the strength of its software. And there too, the VISUAL 2000 really shines. Start with XENIX™, Microsoft's enhanced version of UNIX™, which gives you everything you expect from UNIX *plus* greater speed, reliability and ease of use in business applications. Then add all the tools you need to deliver end-user applications quickly and easily. Languages such as C, SMC BASIC, RM/COBOL™, TOM BASIC™, SOFTBOL™, and MicroFocus Level II COBOL™ to give you instant compatibility with hundreds of proven business applications. Plus sophisticated system foundations such as INFORMIX™ database management and RealWorld™ modular accounting. And professional productivity software such as 20/20™ spreadsheet modelling and XED™ word processing.

The Bottom Line

High performance. Superior flexibility. Extensive software. And low cost . . . VISUAL 2000 systems start at under $10,000, suggested list. No one gives you more in a UNIX-based multi-user system.

And when you consider that VISUAL has long been a leader in video terminals, and can supply a full range of compatible terminals and workstations, we think you'll agree that VISUAL is the system builder's system supplier.

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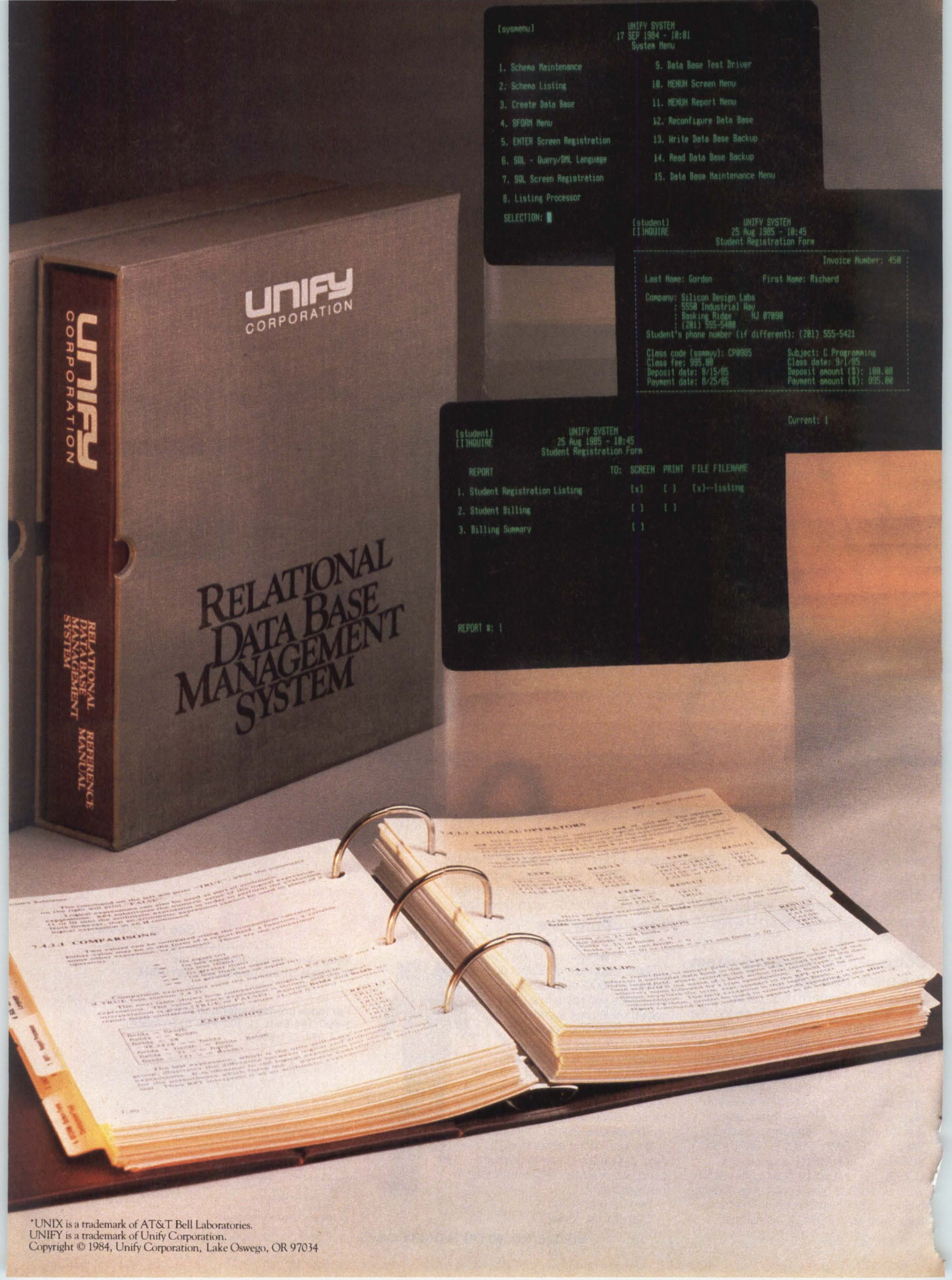

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The KT-7

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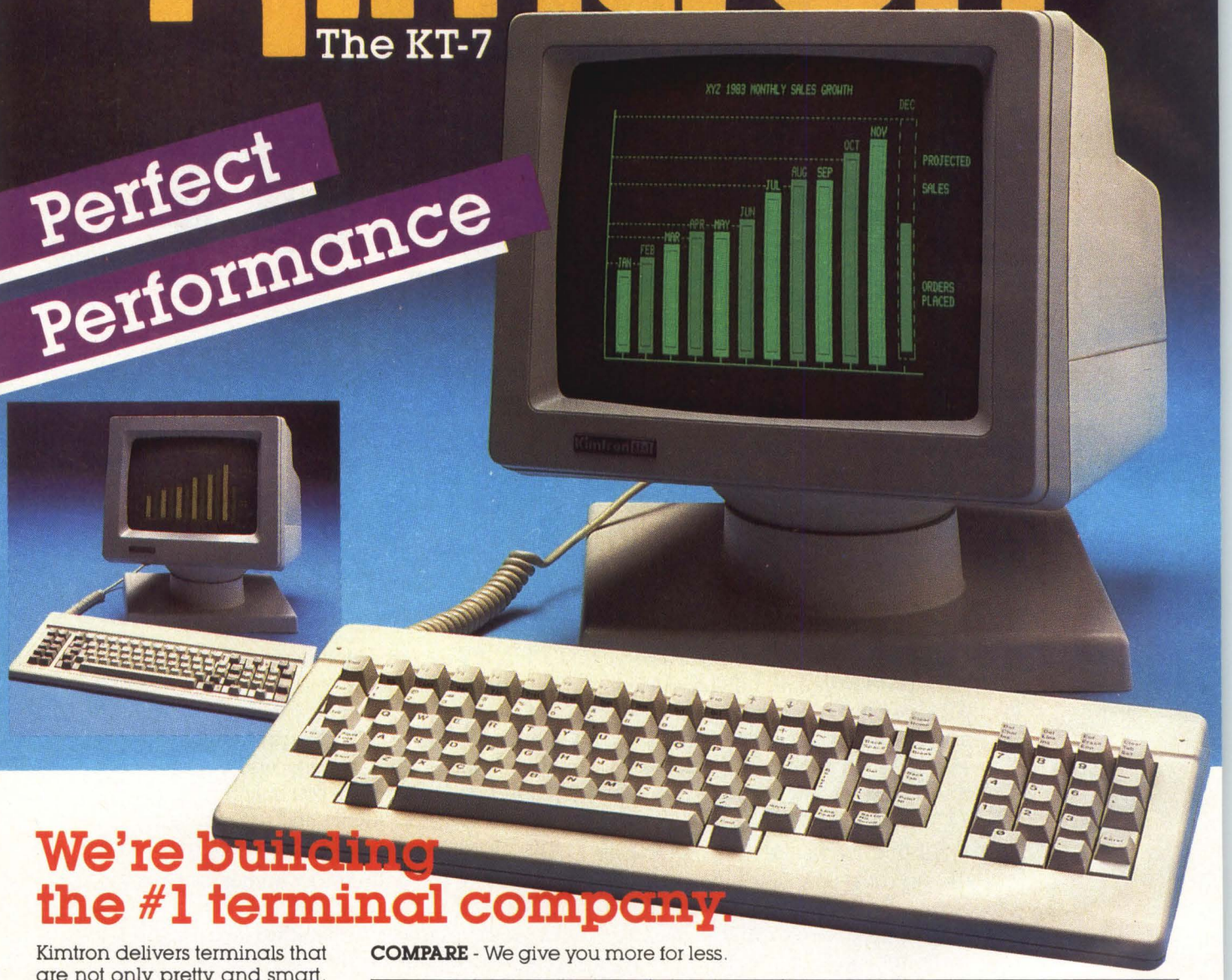

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Kimtron delivers terminals that are not only pretty and smart, but so reliable they seldom fail. Kimtron technology enables many useful features to be available at no extra cost like user selectible Hidden/Embedded attributes, so you're not limited to Embedded attributes as you are with the others. Plus, we make the only low-cost terminals to take true Ergonomic standards that extra step - to provide adjustable display height in addition to swivel and tilt. Kimtron terminals are designed to be flexible and compatible to systems like IBM PC/XT/AT, DEC, DG, and many more to avoid obsolesence.

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Yes	No	No	Yes	TeleVideo 925 Emulation
Yes	No	No	No	DG D100/200 Emulation Option
Yes	Yes	Yes	No	14 inch screen available
Yes	No	No	No	Amber option at no extra cost
Yes	No	No	No	Selectible Hidden/Embedded Attributes
Yes	Part	No	No	Programmable Function Keys in NVM
Yes	No	No	Yes	Bi-Directional Aux Port
Yes	No	No	No	96 Business Graphics Characters
Yes	No	No	No	4 Page Memory Option
Yes	No	No	No	Height Adjust, Tilt & Swivel
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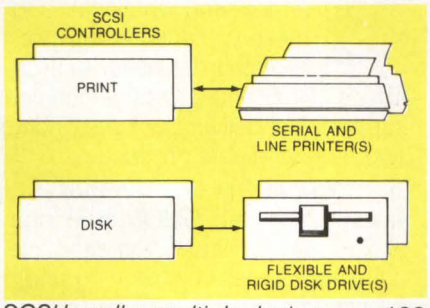
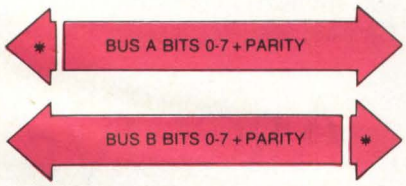
FEATURE HIGHLIGHTS

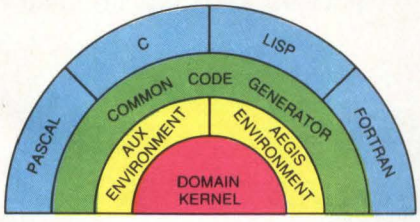
70M bytes and quick access . . . p.111



SCSI handles multiple devices . . p.123



A close look at disk interfaces . . p.135



UNIX takes on new shapes . . p.149

DISK DRIVES: HALF-HEIGHT DRIVE PACKS 70M-BYTE POWER 111

Converting single-user, Winchester-based systems to a multiuser, multitasking environment presents a problem: How can you enhance disk performance to meet the demands of the multiuser environment? One answer is an ST412-based half-height disk drive packing 70M bytes and boasting an average access time of 25 msec.

CONTROLLERS: SCSI BUS EASES DEVICE INTEGRATION 123

The Small Computer Systems Interface (SCSI) is getting a lot of attention these days, not least of all for the wide range of benefits and options it offers system integrators. Some of those benefits include service to multiple hosts and devices, full arbitration and message-passing. Our in-depth look at the SCSI bus also includes a chart of all the major players, from chip-set manufacturers to disk and tape drive makers.

INTERFACES: VARIED DRIVE INTERFACES MYSTIFY INTEGRATORS 135

New tape and disk drive interfaces are beginning to replace the old mainstays. If you're using ST506/412, SA1000, SMD or QIC-02, it's time to take a close look at ESDI, SCSI, IPI or QIC-36.

OPERATING SYSTEMS: UNIX EMERGES AS A UNIVERSAL TOOL KIT 149

The movement to make UNIX the minicomputer operating system standard seems stalled, but a notable new trend is under way: UNIX is emerging as a versatile programming environment, providing users with a common software tool kit adaptable to a wide spectrum of machines. Nevertheless, UNIX isn't the only game in town. Our feature also includes a comprehensive listing of all operating systems and their characteristics. **(p. 164)**

Take a fast step forward in backup.

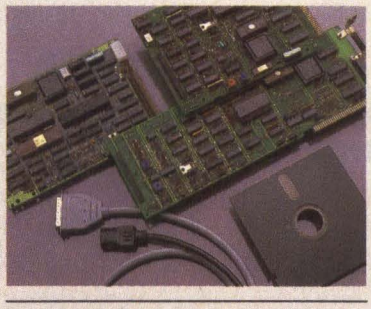
Introducing FasTape, the fully assembled subsystem from Archive. Now systems integrators, VARs, VADs and OEMs can add streaming tape to their Winchester disk-based systems almost as fast as you can say "backup."

Get Serious.

You can't turn a PC into an effective engineering workstation, office automation file server, small business accounting system or any sort of "serious" computer without backup.

Today's advanced personal computers have more power than yesterday's minis, and with 20MB to 100MB Winchesters, they have backup needs to match.

FasTape is the answer. It's the serious solution for serious data.



FasTape is a complete solution, including ¼" streaming tape drive, power supply, switch selectable 115/230VAC, enclosure, cables, and utility software, with controllers available to interface FasTape to your system.

It's About Time.

Until now if you wanted to add tape backup to your system, you had two choices. You could take the time, invest the money and put up with the aggravation of selecting a drive, bending metal, specifying a power supply, adding a fan, building a controller and developing software. Or you could pay a small fortune to have a subsystem house do it for you.

Now just call Archive. We've done all the work for you. So you save time. And money.

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As the industry's leading manufacturer of ¼" streaming tape drives we're able to offer 20MB, 45MB and 60MB backup systems at low OEM pricing.

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Take the first step. Call Archive today at (714) 641-0279 and you can have a FasTape system up, running and fully integrated in less than a megasecond. Or write for more information. Archive Corporation, 3540 Cadillac Ave., Costa Mesa, CA 92626.

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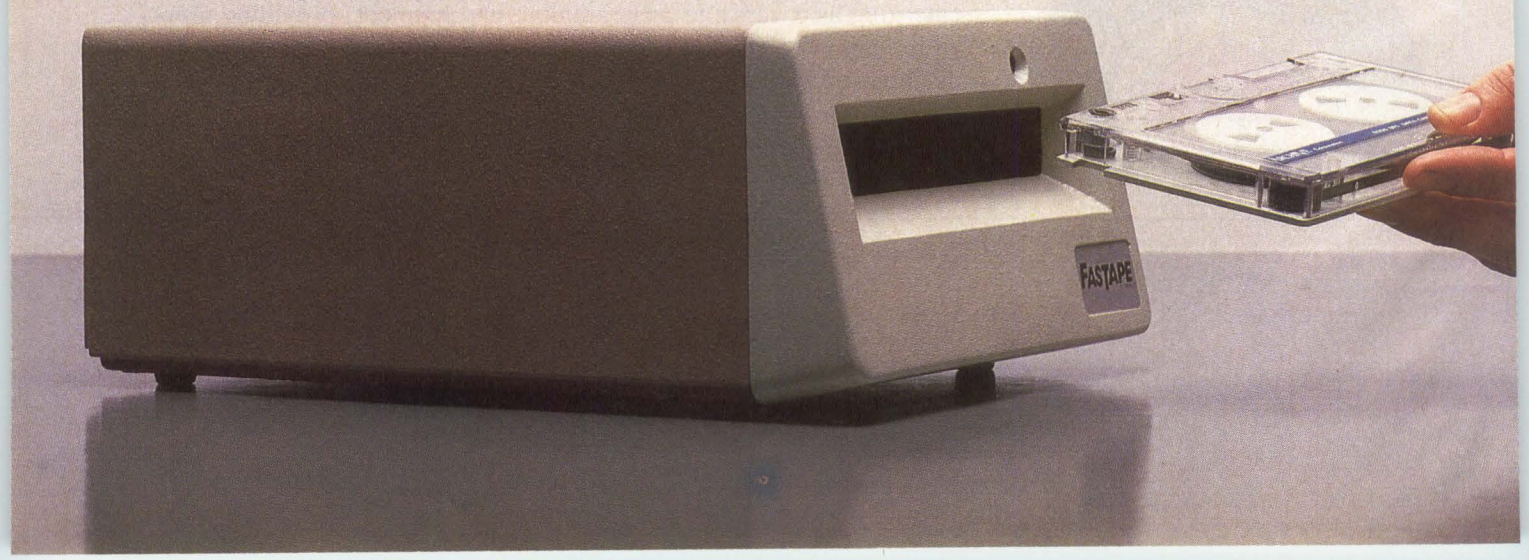


HALF-HEIGHT DRIVE PACKS 70M-BYTE POWER

High recording density, fast access times and standard interface allow cost-effective, hard-disk-drive upgrades to multiuser, multitasking systems

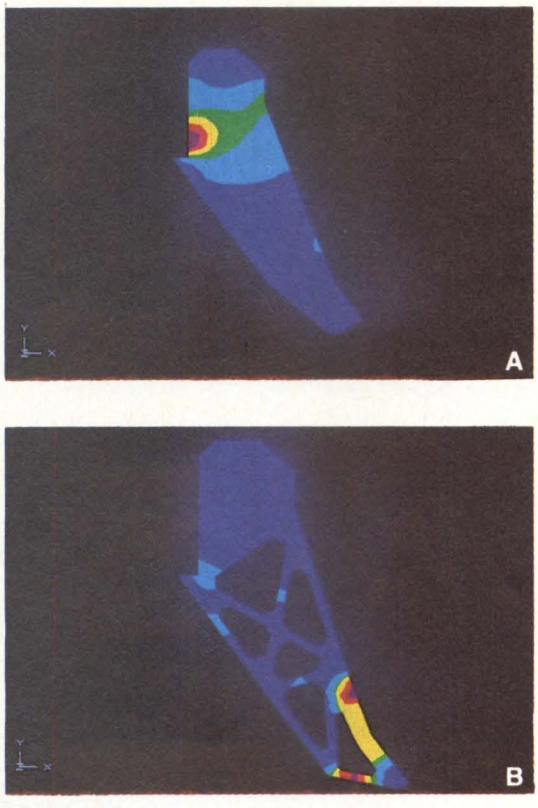
David W. Basehore and
Henry B. Hazebrouck, Priam Corp.

System integrators attempting to convert their existing single-user, Winchester-based, computer systems to multiuser, multitasking environments confront a serious problem: How to enhance disk-drive and system performance without significantly increasing hardware complexity and cost. The biggest challenge involves low-end, 5¼-inch, full-height and half-height drives. Typical low-end Winchesters with storage capacities of 5M to 20M bytes and average access times of 85 msec fall short of the performance levels needed for multiuser, multitasking applications. Achieving a higher drive density, on the other hand, might require sacrificing system compatibility by using an interface other than the standard ST506/412.

However, Priam Corp.'s Model 201 half-height 5¼-inch Winchester disk drive surpasses the minimum storage density and access-time specifications required for multiuser environments, yet uses the industry-standard ST412 interface. Incorporating 70M bytes of unformatted storage with an average access time of 25 msec, it achieves this performance with a closed-loop servo system and conventional Winchester MFM recording schemes and design techniques.

To understand the problems and tradeoffs involved in configuring single-user computer systems for multiuser, multitasking applications, consider a typical low-end 10M-byte Winchester drive that's being used in a single-user word-processing application. System integrators can easily configure the hardware to accommodate additional users. The only trade-off might be a slight reduction in the system's operating speed and the amount of storage available to individual users.

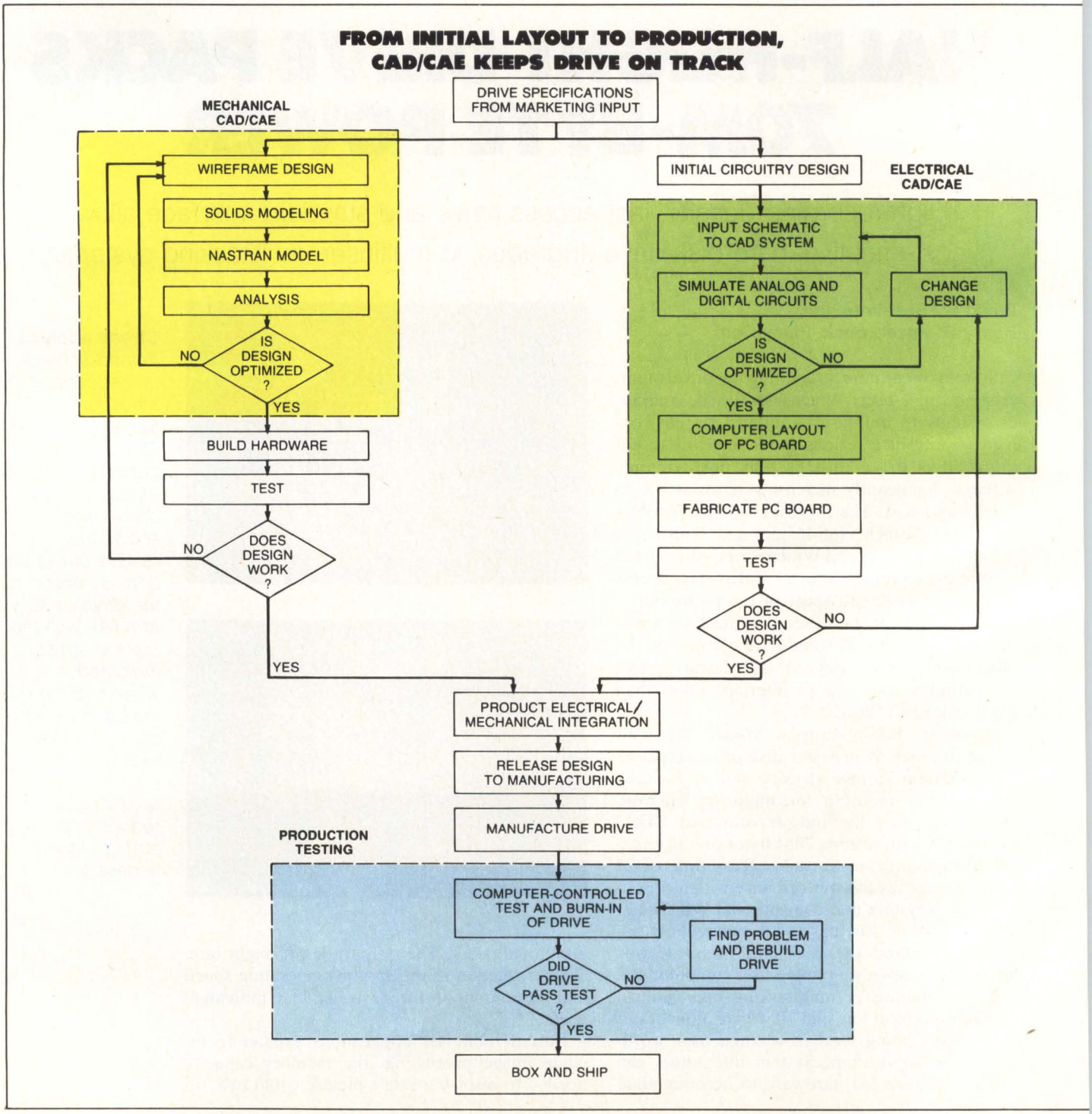
But, if multiuser applications expand to include image processing, the memory capacity needed to display a single picture could take up



Stress analysis *helped achieve fast access times for the Model 201 drive. This computer-generated model of stress distribution shows the relative stress on a solid version of the drive's rotary arm (A), with the highest stress indicated in violet and the lowest in dark blue. In a later redesign (B), cutouts redistributed and reduced stress, and improved access time.*

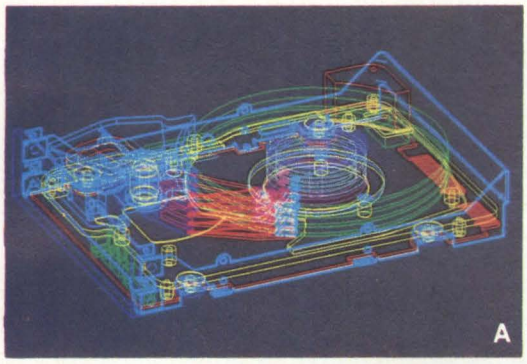
1M byte of storage. In that case, several system users would quickly run out of disk space. In fact, one user's application might, by itself, require the Winchester's whole storage capacity. Such applications require about 30M bytes of storage. Indeed, industry consensus places the minimum storage requirement for multiuser systems at 50M bytes.

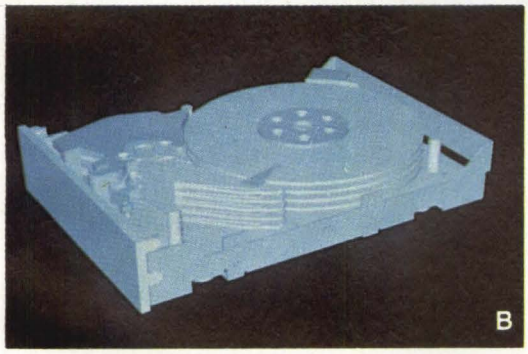
Multiuser environments, moreover, demand speedy access from a Winchester drive, as well as large memory capacity. A drive's average access time critically affects multiuser performance. System integrators, for example, attempting to configure a 32-user, shared-resource system with



a drive that accesses data in 85 msec would encounter a significant throughput bottleneck. For instance, with a drive specifying an average typical latency of 8.33 msec and transferring data in less than 2 msec, a typical disk request can be processed in about 95 msec.

This figure would allow approximately 20 seek operations per minute for each of the 32 users. In a system operating environment using UNIX, for example, where as many as 45 seek operations might be necessary to obtain data, it could take more than two minutes for one user to retrieve a file—clearly an unacceptable situation.





Computer-aided design and computer-aided engineering (CAD/CAE) *guided the design of the Model 201 from initial layout to final testing and production. A wireframe model (A), with mechanical subsystems highlighted in color, maximizes the limited space in the half-height form factor. A solids model (B) allows prediction of drive access time and aids in actuator balancing for the production version (C).*

Faster access aids system performance

Fortunately, because access time consumes almost 90 percent of seek operations, improvements in this specification can dramatically enhance system performance. In a 32-user network, for example, a drive with an access time of 55 msec performs nearly 30 seek operations each minute. An access-time improvement to 30 msec accommodates approximately 47 seeks per minute—the minimum level consistent with adequate multiuser performance.

Processing power also improves with faster access time. A faster access reduces the processor's idle time—the time it consumes waiting for disk I/Os to finish. And the gain in processing power becomes especially significant for system integrators trying to improve overall system performance using the same central processor or configuring virtual-memory systems.

A higher performance Winchester, however, can't just be dropped into a computer system without considering disk-controller and interface compatibility. System integrators configuring multiuser systems can only maintain compatibility with the 5M- to 20M-byte drives currently in use by upgrading with a Winchester that incorporates the ST506/412 interface. Although it limits data-transfer rates to 5M bits per second (bps)—a figure some argue is too slow for multiuser networked environments—the interface has become the standard for personal computer systems. And as personal computers continue making inroads into multiuser environments, system integrators face a difficult decision: Maintain compatibility with existing Winchester controllers at the 5M-bps transfer rate by using the ST506/412 interface or choose a higher performance interface, like SCSI or the proposed 10M-bps ESDI, and integrate new hardware.

Maintaining ST412 compatibility serves two purposes. First, it preserves system compatibility with a known, reliable and industry-accepted interface standard, allowing a system to be integrated more easily and brought to market sooner. Second, it makes available the variety of full-height 5¼-inch Winchesters that deliver 30-msec access times and greater-than-50M-byte storage capacities. Although these full-height drives meet certain system application needs and packaging requirements, a half-height version also offers certain benefits.

System integrators configuring multiuser systems can only maintain compatibility with the 5M- to 20M-byte drives currently in use by upgrading with a Winchester drive that incorporates the ST506/412 interface.

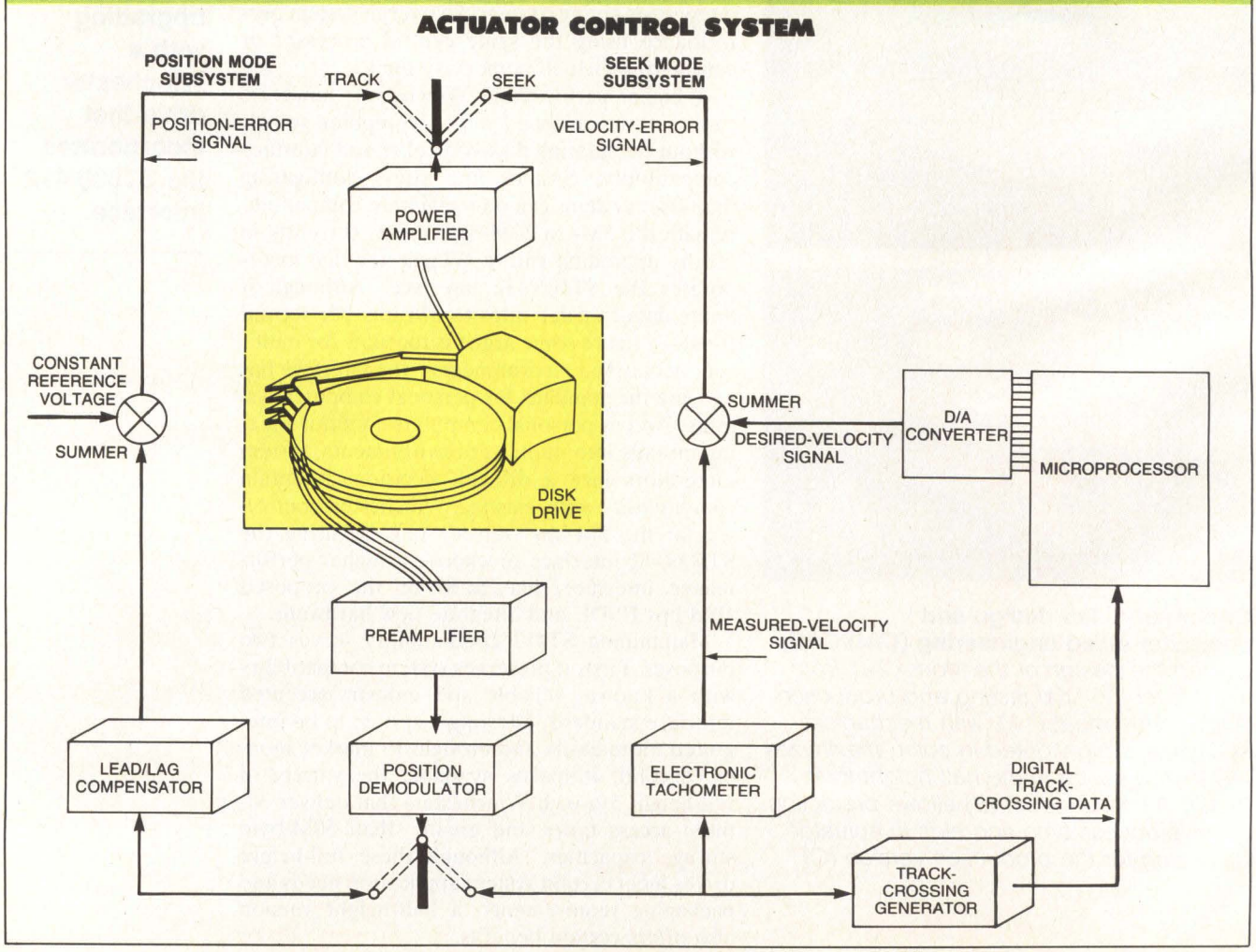
For example, two half-height, high-capacity drives mounted in place of a low-capacity Winchester can significantly improve storage density and system performance for multiuser applications. If data is spread over the two drives, overlapping seek operations reduce effective access time by having one drive seek the next string of data while the current string is being read by the other drive. Such a configuration can accommodate more users sharing the same resources than a system integrated with a single full-height, high-capacity Winchester. If, on the other hand, one half-height drive meets system storage and access requirements, then the additional half-height space can be used for tape backup systems —an essential requirement for multiuser systems

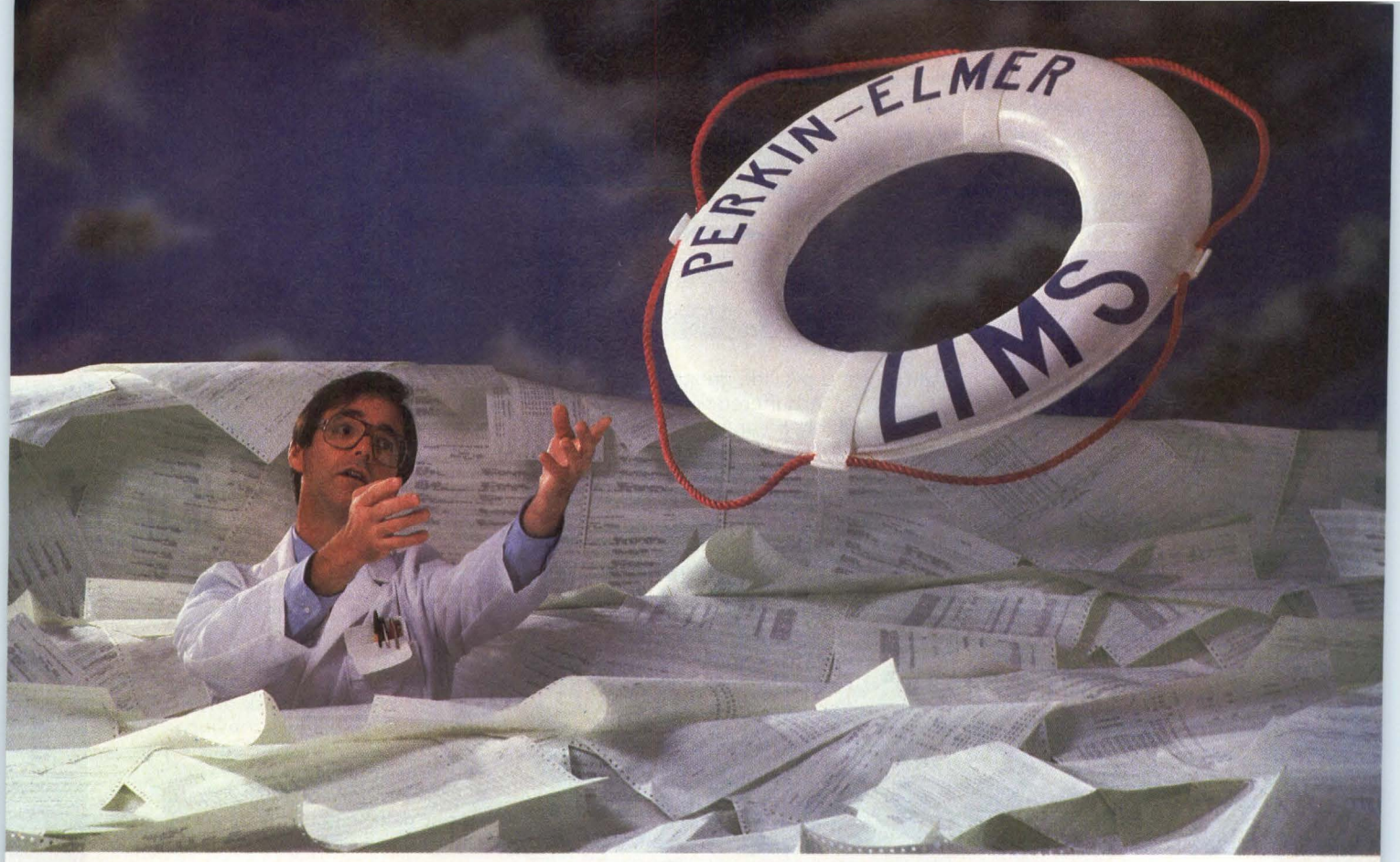
How the drive zeros-in on the right track

The Model 201 uses a two-step process to access a track on one of its four drive platters. **Seek mode** moves the actuator to the desired track. **Position mode** centers the head precisely over the track.

In **seek mode,** the drive controller tells the drive how far it must move the actuator to reach the right track. The **microprocessor** sends the desired head velocity (as a function of the seek distance) to the **power amplifier,** which enables the head to move the correct distance. The microprocessor monitors track crossings by using data from the **track-crossing generator.** If the actual head velocity, as measured by the **tachometer**, does not equal the desired velocity after comparison by the **summer circuit**, the **velocity-error signal** slows down or speeds up head movement.

In **position mode,** the **lead/lag compensator** prevents head oscillation as it zeros-in on the track. The **position-error** signal guides corrections when the **summer circuit** indicates that the head output voltage does not equal the constant reference voltage.





For the small lab, it's often sink or swim. Here's help from Perkin-Elmer.

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The smaller lab is often a hectic environment. You have oceans of paperwork. And workloads are heavier, with no budget to increase your workforce. With our LIMS (Laboratory Information Management System) for the small lab, you can: provide rapid response to submitter inquiries; produce backlog reports for scheduling and workload analysis; obtain information to construct reports on turnaround time, productivity, and quality; make workload projections; reduce your paperwork and provide automatic report generation. Just for starters.

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STRAIGHTALK

No claims. No boasts. Just straight facts and commitments from Jeffrey Liu, president of Microscience, on our growing family of half-height Winchester disk drives.

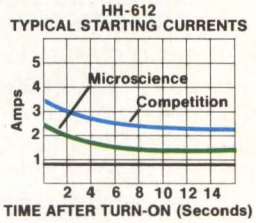
"By introducing the new HH-725 20 MB 5.25" and HH-312 10 MB 3.5" half-height Winchester disk drives to our product line, we now offer the proven quality and performance most OEMs need in volume today.

"Combined with our HH-612 10 MB 5.25" half-height disk drive, Microscience now provides a product family of superior quality and better performance than any other drives available.

"Time after time, we have proven that Microscience has the performance, quality, and price personal and portable computer manufacturers demand.

"The secret is the way we design and manufacture drives for you.

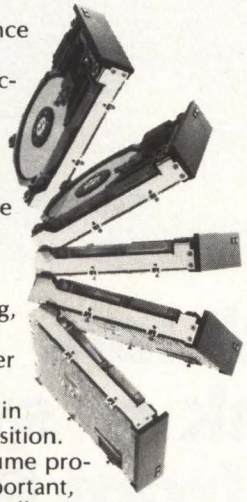
"Microscience disk drives have extremely low voltage requirements because small business and portable computers don't have the luxury of excess power or cooling capacity.



"We've used procedures and components that will be power misers, yet they still provide long-term performance and reliability.

"Our drives feature a thermally isolated stepper motor for precise head alignment and optimum seek performance. A proprietary linear actuator assembly was employed to ensure data reliability and provide greater drive durability.

"A buffered seek mode and highly accurate proprietary microprocessor-controlled closed-loop servo positioning system keeps the head precisely on track. This maintains data integrity through a wide range of operating conditions regardless of thermal expansion, system hysteresis, or long-term wear.



"Microscience drives are not limited to functioning horizontally. Because of the growing use of portable computers and increasingly compact packaging, we designed our Winchester drives so you can use them in almost any position.

"While volume production is important, what you're really concerned about is the quality of product you use in your system or application. We have made a major commitment to manufacturing and quality programs.

"Microscience test equipment and tooling have been carefully selected to meet our exacting standards.

"This ensures Microscience ships only zero defect half-height Winchester product that does not eat away at your profits . . . and your reputation.

"There's a lot more I could say about the Microscience half-height Winchester disk drive family. But what will convince you is using a Microscience drive in your application.

"For more straightalk regarding your half-height Winchester needs, call or write us today."

Jeffrey Z. Liu

President,
Microscience
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Corporation

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CIRCLE NO. 65 ON INQUIRY CARD

where multiple users rely on the same database.

The Model 201 incorporates four thin-film-media platters to achieve its 70M-byte storage capacity. Seven disk surfaces are used for data and one for servo-positioning information. A spindle with an internal motor permits the packaging of all four disks in the standard half-height form factor.

To help achieve 25-msec average access time, a low-mass rotary actuator positions the heads, and a closed-loop servo system ensures that the actuator moves precisely to the desired track. Using the low-mass actuator enables the drive to operate on less power and run cooler—as evidenced by its typical-power-dissipation specification of less than 20W. System integrators, therefore, probably won't have to upgrade power supplies when converting existing computers to accommodate this drive.

Servo increases access times

The closed-loop servo system also plays a major role in achieving fast access times. Model 201 incorporates a dedicated, rather than embedded, servo system. Continuous monitoring of head and track positions feeds data back to the servo circuits for head-position corrections. In contrast, embedded servo systems open all media surfaces for data storage, but do not read servo information on a continuous basis. They provide position data only one or two times per revolution for ST506/412-compatible drives instead of the several thousand times of a dedicated servo. A dedicated servo thus permits the actuator to move to a given track faster than an embedded servo.

The closed-loop system serves another function as well. The increased accuracy achieved using this technique allows data tracks to be spaced more closely together, maximizing the amount of data that can be stored on a disk. Model 201's track density specification of 1,000 tracks per inch and recording density of 10,000 bits per inch more than compensates for the storage capacity lost by dedicating one media surface to servo data.

A "fine-track" feature prevents data from being written unless the heads are precisely on track. Thus, if the servo head leaves the servo track by more than approximately 100 microinches, the drive will not perform a write function.

In addition, the servo system easily tracks most of the thermal distortions encountered in open-loop drives. Model 201's approach results in typical drive error rates of one soft error in 10 billion bits (1 in 10^{10}) and one hard error in 1 trillion bits (1 in 10^{12}).

Several mechanical aspects of the drive help isolate it from shock and vibration, suiting it for transportable-computer applications. A dedicated landing zone ensures that the heads don't touch portions of the media where data is recorded, and an automatic carriage lock keeps heads on the landing zone. High-damping shock isolators between the frame and head-disk assembly guard against head and data damage. The actuator assembly incorporates a counterweight, reducing the effects of external shock and vibration. With the exception of the preamplifiers, the electronics for the drive, including eight semicustom LSI chips, are packaged on one printed-circuit board.

Model 201's 70M-byte storage capacity and ST412 interface make it a natural choice for IBM Corp. PC/XT- or AT-based applications that currently employ a full-height 5¼-inch Winchester drive and a full-height floppy disk drive. Two half-height floppies, the half-height Model 201 and a half-height, ¼-inch tape cartridge backup system can be housed in the same space as the full-height Winchester and floppy disk drives. Replacing one of the floppy disk drives with another Model 201 Winchester provides the computer with full data image backup. So configured, several single-user computers with limited resident-storage capabilities can be networked to one Model 201-based IBM PC with improved performance over individual PC/XT or AT systems.

Although the PC-DOS operating system limits Winchester storage to two 32M-byte drives, con-

Using the low-mass actuator enables the drive to operate on less power and run cooler.

Spec summary

- **Manufacturer:** Priam Corp., 20 W. Montague Expressway, San Jose, Calif. 95134
- **Product:** Model 201 half-height 5¼-inch Winchester disk drive
- **Storage capacity:** 70M bytes unformatted
- **Average access time:** 25 msec
- **Transfer rate:** 5M bps
- **Recording density:** 10,000 bpi
- **Track density:** 1,000 tpi
- **Average latency:** 8.33 msec
- **Rotational speed:** 3,600 rpm
- **Recording method:** MFM
- **Control:** Closed-loop servo
- **Interface:** ST412
- **MTBF:** 20,000 power-on hours
- **MTTR:** 15 minutes
- **Dimensions:** 1.62 by 5.75 by 8 inches
- **Weight:** 4.5 lbs

troller manufacturers like Adaptec Inc., Milpitas, Calif., provide controller boards that circumvent this storage limit. For instance, the company's ACB-2010A controller board can partition a large drive into as many as eight logical disks, each with as much as a 32M-byte capacity.

Another application for the Model 201 is a shared-logic word-processing, or other multiuser, multitasking, computer system. Such a system might presently serve multiple users with a high-performance 14-inch disk drive, 400M bytes of storage and 25- to 30-msec average access time.

In the same space as the 14-inch drive, several Model 201s can furnish the same, if not greater, storage capacity. Overlapping seek operations would reduce access times. Although this configuration requires an intelligent controller board with special algorithms capable of storing data for quick access, the performance advantages outweigh the increase in hardware complexity.

The overall cost and power dissipation of multiple 201 drives would be comparable to that of the high-performance 14-inch unit. Moreover, a failure in one drive would not jeopardize the entire database, as might happen were the 14-inch drive to fail.

A half-height, high-capacity Winchester, such as the Model 201, can open up new application areas for single-user systems. The most obvious example is that of a portable computer aimed at scientific applications. Dropping in the half-height, 70M-byte Winchester in place of a half-height floppy allows a large amount of data to be stored for later processing. And if the hardware is upgraded to include a higher-performance processor, then high-level programming languages, the UNIX operating system and powerful number-crunching and data-processing capabilities can be integrated within a small, lightweight portable computer. □

David W. Basehore is manager of advanced development engineering and **Henry B. Hazebrouck** is a staff engineer at Priam Corp., San Jose, Calif. Previously, Basehore worked at Ampex Corp. on Winchester drives and at IBM Corp., where he specialized in disk-drive technology. He holds a B.S. in mechanical engineering from Penn State University and an M.S. in mechanical engineering from Syracuse University. Hazebrouck designed disk-drive actuators and magnetic tape transports at Ampex before he came to Priam. He holds a B.S. in mechanical engineering from Worcester Polytechnic Institute.

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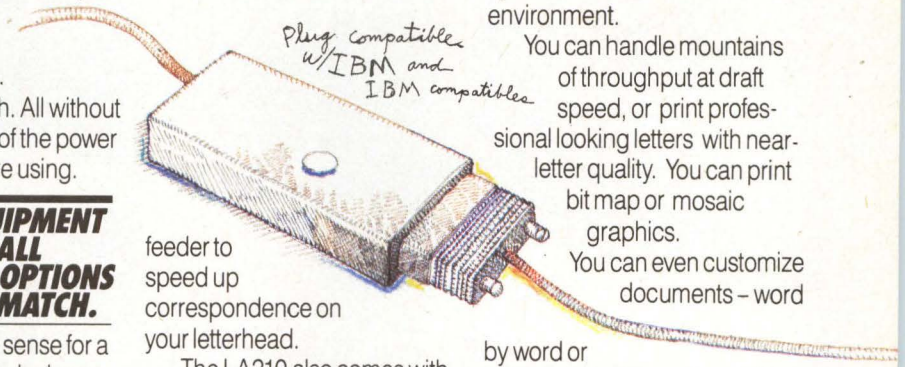

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SCSI BUS EASES DEVICE INTEGRATION

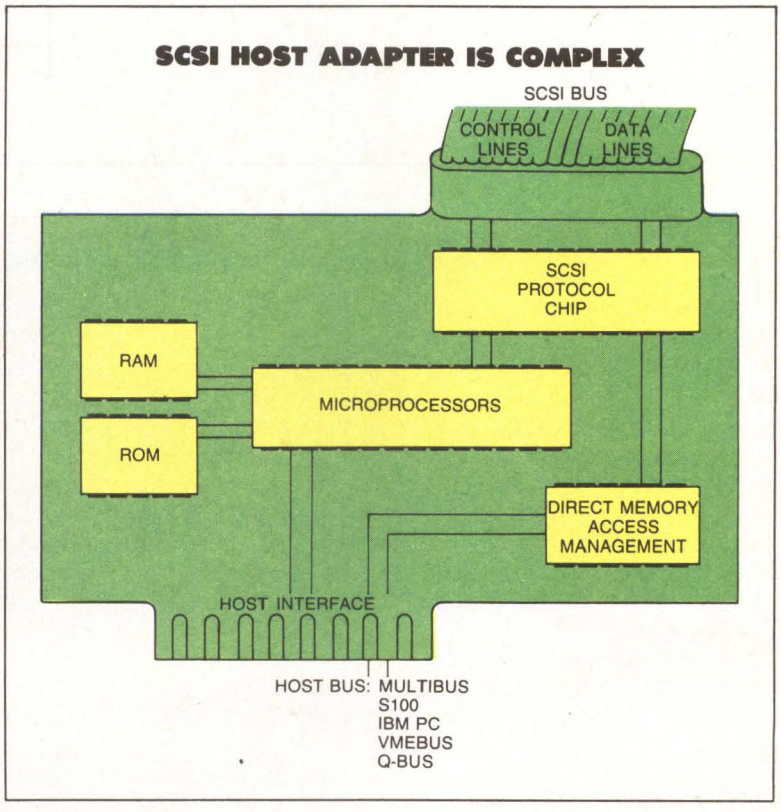
Serving as a subordinate interface bus and traffic cop, the Small Computer Systems Interface permits varied system and peripheral links

Carl Warren, Western Editor

The Small Computer Systems Interface (SCSI), unlike other interfaces, is a complete bus structure that is subordinate to the rest of the system architecture. As such, it provides system integrators with a wide range of integration opportunities and alternatives.

The SCSI specification "is one created by technicians, and that has caused a menu selection: a real short-order cook's nightmare," says Mike Kirby, vice president of marketing at Data Technology Corp., Santa Clara, Calif. "Which SCSI implementation do you choose? And when you've chosen, how do you know that you have the right one? In some cases, full arbitration isn't required, nor are many of the sophisticated commands. What may be needed is the more simple SASI."

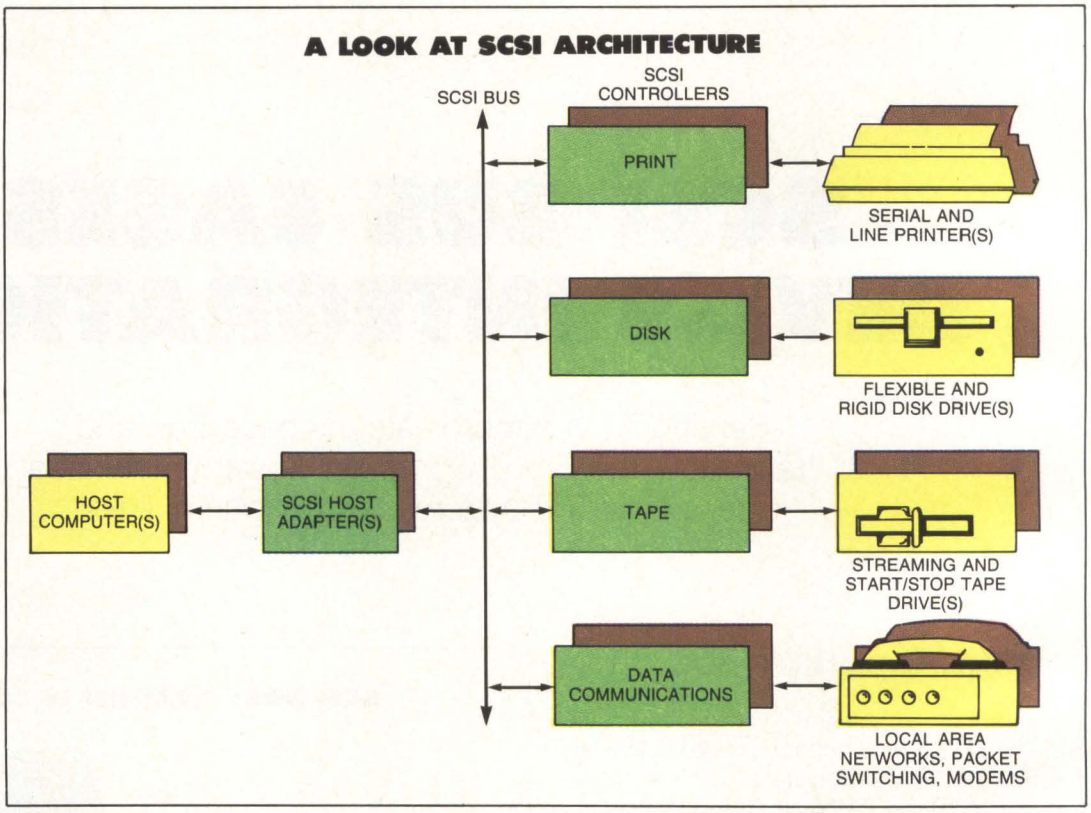
System architecture requirements and cost determine the integration alternatives. Interfacing requirements vary from application to application. Personal computers and smaller business systems typically require a "dumb" controller with just enough electronics to match the device-level electronics on the storage device. As system capability and performance increase, intelligent interface bus designs, such as the Shugart Associates System Interface (SASI) and SCSI, become more important to the system integrator. (See "An historical note: A standard is born," Page 124.)



An SMS/OMTI implementation of SCSI *combines microprocessor, cache memory, ROM firmware and a host adapter, that matches the controller to virtually any system bus configuration.*

System integrators can benefit from SCSI in the more complex system architectures. Unlike single-user systems requiring only low levels of intelligence such as that provided by SASI, these architectures call for an interface bus that permits the addition of mass storage, optical storage, local area networks (LANs), printers, plotters, modems and other devices. Additionally,

The SCSI system architecture *is hierarchical by design. Thus one or more host computers can be attached to the SCSI bus via host adapters, and a number of peripherals such as storage devices, printers and modems can also be hung onto the bus with appropriate controllers. Additionally, a gateway to a local area network can be attached to the bus as well.*



An historical note: A standard is born

Joseph V. Jaworski
Peripheral Concepts Inc.

Keeping pace with the rapid growth of Winchester disk capacity is the standardization of generic input/output (I/O) buses such as the Shugart Associates System Interface (SASI). The continued advancements in storage technology, particularly in higher transfer rates, continues to fuel the success of SASI and the formal effort toward standardization known as the Small Computer Systems Interface (SCSI).

SASI got its start in 1979 as a way to solve the interface problems associated with then-emerging 8-inch Winchesters. Working closely with Data Technology Corp., Santa Clara, Calif., Shugart developed a general-purpose interface which was based on IBM Corp.'s I/O channel architecture. What made this "new" interface exciting was that it could accept host adapters, thus allowing the easy adaptation of Shugart's SA-1000 8-inch Winchester to different makes of microcomputers regardless of the system bus structure. The extended version of SASI is known as SCSI.

As SASI was implemented by a variety of manufacturers and became a de facto standard, users asked for formal standardization. In 1981, at the urging of NCR Corp., Dayton, Ohio, Shugart took SASI to the American National Standards Institute (ANSI) for consideration. The American National Standards Committee (ANSC) X3T9.2 was assigned the task of developing a refined document for its parent committee, X3T9.

The ANSI committee didn't want to use a company name like Shugart in a standards specification. Thus was born the name Small Computer Systems Interface.

Moreover, the committee outlined a number of enhancements to the original SASI specification. These enhancements, however, created differences between SASI and the proposed SCSI standard. Specifically, SASI is implemented as a single-host

SCSI provides an easy method of eliminating cost-consuming interfacing tasks by providing a rich set of commands and a defined bus structure. Because system integration can take longer than product development, the use of SCSI can lessen the time to market. Besides these benefits, SCSI offers a number of other advantages, including service to multiple hosts as well as devices, and full arbitration and message-passing. The latter eludes bus contention problems while maximizing use of system architecture.

Avoiding rocks and shoals

An intelligent interface helps integrators avoid the rocks and shoals of integration. But it can be costly in terms of performance. Because SCSI is intelligent, command latencies must be included in the performance calculation. Therefore, SCSI will be much slower than an interface directly under the control of the host CPU. On the other hand, controlling the input/output (I/O) with the CPU makes the processor unavailable for other tasks; SCSI relieves the CPU of these slow I/O functions. In addition, SCSI provides special command and hardware bus arbitration functions, such as disconnect/reconnect, thus allowing many devices to communicate with a host or multiple hosts and devices. That makes it beneficial for powerful multitasking and multiuser business systems.

The SCSI industry is still young and developing and manufacturing sources are limited. Finding more than one source for interfaces if you're interface bus with no arbitration. SCSI is for multiple hosts and supports bus arbitration plus disconnect/reconnect for multiple devices. Additionally, the SCSI specification includes commands for printers, optical disks, tape drives and CPU-to-CPU transfers.

The ANSC X359.2 committee has been working closely with the European Computer Manufacturers' Association (ECMA) to encourage the use of SCSI. The ECMA committee expects adoption of SCSI in 1985. Finally, the International Standards Organization (ISO) committee TC-97 has also adopted SCSI as a working document, allowing their SC-13 committee to begin work towards an ISO standard.

The adoption of the SCSI specification by these standards organizations doesn't guarantee product success. It does, however, provide the potential manufacturer with a common set of guidelines from which to work.

Joseph V. Jaworski is president of Peripheral Concepts Inc.

Who's putting SCSI into action

Chip sets	Controllers	Subsystems	Systems	Smart peripherals	
				Disks	Tape
Adaptec	Adaptec	Emulex	Data General	Amcodyne	Archive
Advanced Micro Devices	Adaptive Data Systems	Innovative Data Technology	Datapoint	A.I.M.	Cipher Data
Data Technology	Data Technology	NCR	Digital Equipment	Atari	Kennedy
Emulex	Data Processing Technology	Sysgen	Intel	Cogito	Lancore
Intel	Emulex	Xebec	NCR	Cynthia Peripherals	Northern Telecom
National Semiconductor	Konan		Perkin-Elmer	Control Data	Rosscomp
NCR	NCR		Point 4 Data	Fujitsu America	Tandberg
Shugart	Priam		Sperry	Iomega	Wangtek
SMS/OMTI	Science & Communications		Texas Instruments	Megavault	
Western Digital	Shugart			Northern Telecom	
Xebec	SMS/OMTI			Priam	
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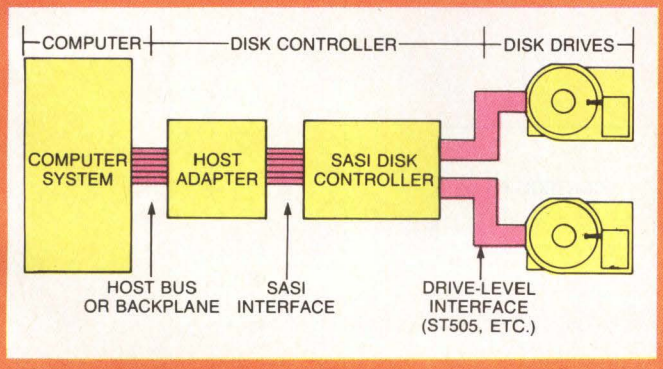


A typical SASI interface *configuration consists of a host system with adapter, controller and devices. This is still the most common SASI implementation and established the methodology for interfacing devices with differing host systems.*

going to use SCSI can be a problem. Because of that, says I. Dal Allan, ENDL Consulting, Saratoga, Calif., there is a clear need for a multifunction SCSI controller. With it, says Allan, who is chairman of the American National Standards Institute (ANSI) X3T9.3 interface committee, many attributes can be emulated to ensure multiple sources for SCSI controllers and adapters. To meet this need, Priam Corp., San Jose, Calif., has a series of SCSI controllers that employ a compatibility mode. By using dual in-line package (dip) switches, users can tailor the controllers to match one of three SASI controllers available from Data Technology, SMS/OMTI and Xebec.

Allan explains that the multipurpose capability limits the liability of the system integrator. "Since the industry is at the early stages of intelligent interfaces, the system integrator needs a method of building towards greater capability. Emulation of other controllers and functions is a relatively inexpensive way of solving the problem," he says.

'The answer to where to put the cache isn't clear...'

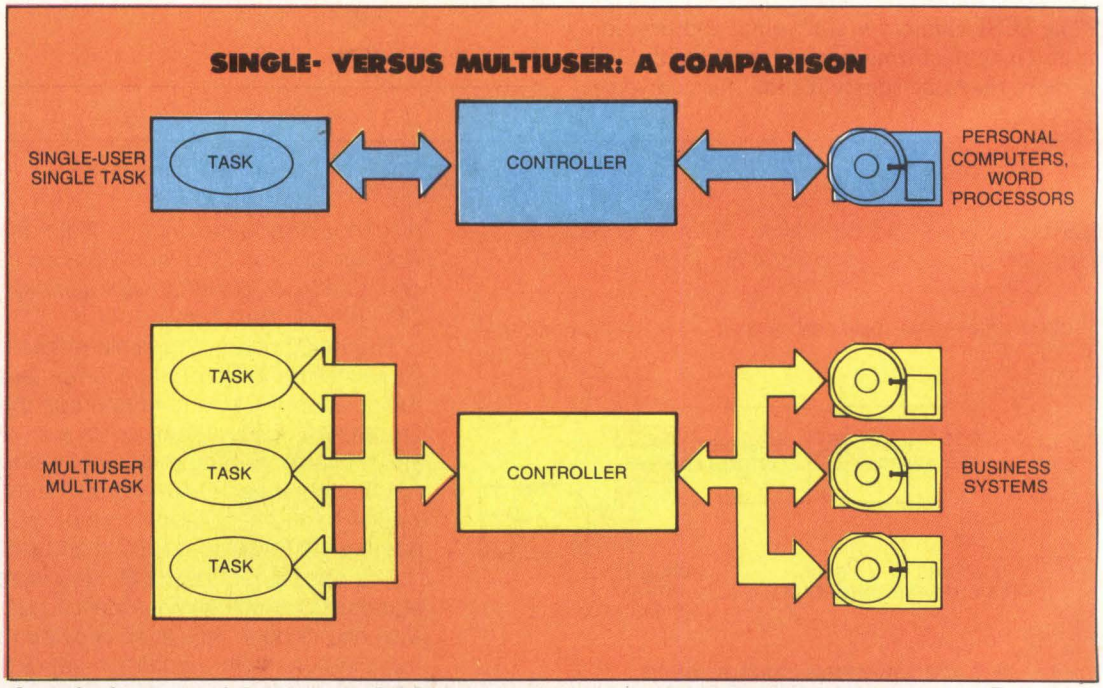
Multiple devices share the bus

The purpose of SCSI is to join mismatched devices electrically so that signals from one can be translated and used by the other. But SCSI does more than act as an electronic translator. This interface defines a complete bus system whereby definite electrical paths and communication protocols are clearly determined. Thus, like any bus or backplane, other devices can be added to take advantage of the distribution of signals and information.

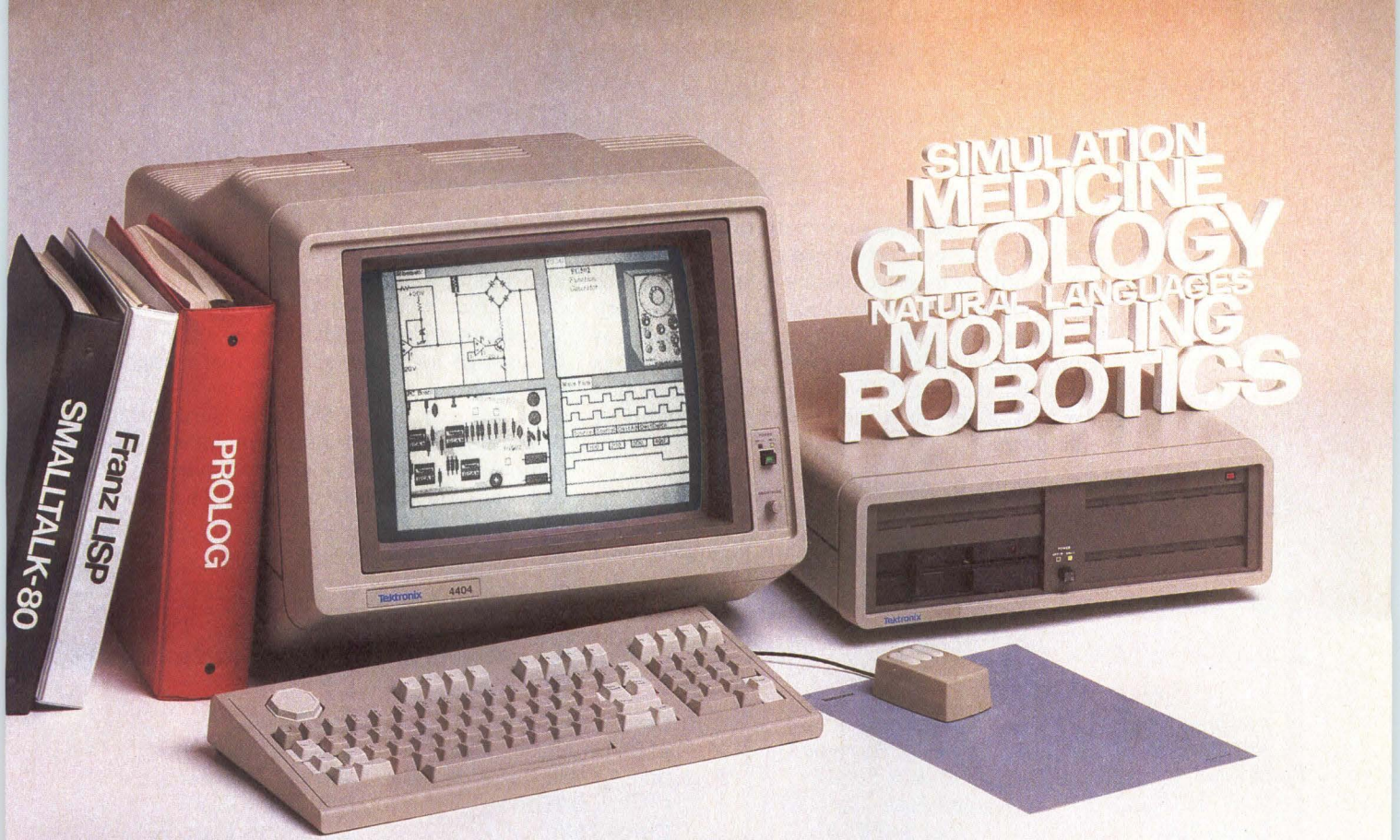
It is because SCSI is a full-fledged bus that many industry observers consider it an important step forward in system architectures. "The SCSI bus methodology greatly enhances a system integrator's ability to build systems," says SCSI forum chairman Joseph Molina. "The use of a bus-oriented design with arbitration and communication protocols will greatly simplify most integration tasks," he says.

An SCSI controller can support as many as eight peripherals. The ability to turn the bus over to an initiator to send a message to a target becomes important as the number of devices grows on the SCSI controller or within the total system architecture.

In operation, the initiator requests use of the bus; if it is available, the initiator passes a message to a target (e.g., another host, storage device or printer), then disconnects from the bus. The return message, such as an electrical handshake to indicate that the message got to the



A main feature of Adaptec's SCSI *is its ability to support multiple hosts and devices and thus multiple tasks. In a typical single-user environment, the relationship is one-to-one; as tasks are added, so are the number of disk accesses threatening a major I/O bottleneck. SCSI allows multiple tasks to address any of several storage devices. I/O channel bottlenecks are avoided by arbitrating bus data transfers with disconnect/reconnect capability within the SCSI bus controller.*



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CIRCLE NO. 69 ON INQUIRY CARD

other end, uses the same path to acknowledge receipt. The connect device typically holds the bus until the message passing is finished. Device priorities can be established, however. This priority arrangement determines which device has precedence and can take control of the bus. This is all handled via the bus arbitration scheme that is part of the microcode in the SCSI controller hardware.

Hierarchy by design

One of the noticeable attributes of SCSI is the attention to system architecture hierarchies, says Larry Boucher, president of Adaptec, Inc., Milpitas, Calif. "A controller, or interface, isn't a lonely item. Rather, it is something that is a part of a larger whole, or system. The SCSI bus specification clearly reflects how system architectures go together—and, for that matter, are extended."

To this end, the SCSI bus is hierarchical by design. System integrators can attach a host computer or multiple host computers to the SCSI bus via the host adapters. The adapters tailor the host bus to match the electrical and software characteristics of SCSI.

Representative list of manufacturers

Adaptec Inc.
580 Cottonwood Drive
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Circle 700

Adaptive Data Systems Inc.
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Pomona, Calif. 91768
(714) 594-5858
Circle 701

Advanced Micro Devices Inc.
901 Thompson Place
P.O. Box 3453
Sunnyvale, Calif. 94086
(408) 732-2400
Circle 702

Amcodyne Inc.
1301 South Sunset Street
Longmont, Colo. 90501
(303) 772-2601
Circle 703

Applied Information Memories
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(408) 263-9321
Circle 704

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San Jose, Calif. 95150
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Circle 706

Cipher Data Products Inc.
9815 Carroll Canyon Road
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San Diego, Calif. 92138
(619) 693-7284
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Because SCSI is for multiple-device environments, techniques that speed the transfer of data can be implemented in a cost-effective and system-efficient manner. For example, RAM buffers can be placed in the SCSI controller to allow the rapid collection and transference of data between devices using direct-memory-access (DMA) methods. Moreover, algorithms for error correction and data location quickly can be embedded in the system to make maximum use of the RAM cache buffers.

Implementing cache systems and using high-level system algorithms, however, add to system overhead. Cost is determined by how much memory is added and where it's located in the system architecture. According to Richard Barrett, president of Adaptive Data Systems Inc., Pomona, Calif., adding RAM cache to the controller or host adapter can boost costs as much as 40 percent, due to the additional expenses of added memory and logic. The cost also is determined by whether the cache is used in a multi-host system with many controllers and adapters.

System integrators can save money by using existing RAM in the host system. But that reduces the amount of available system memory

involved in SCSI implementation

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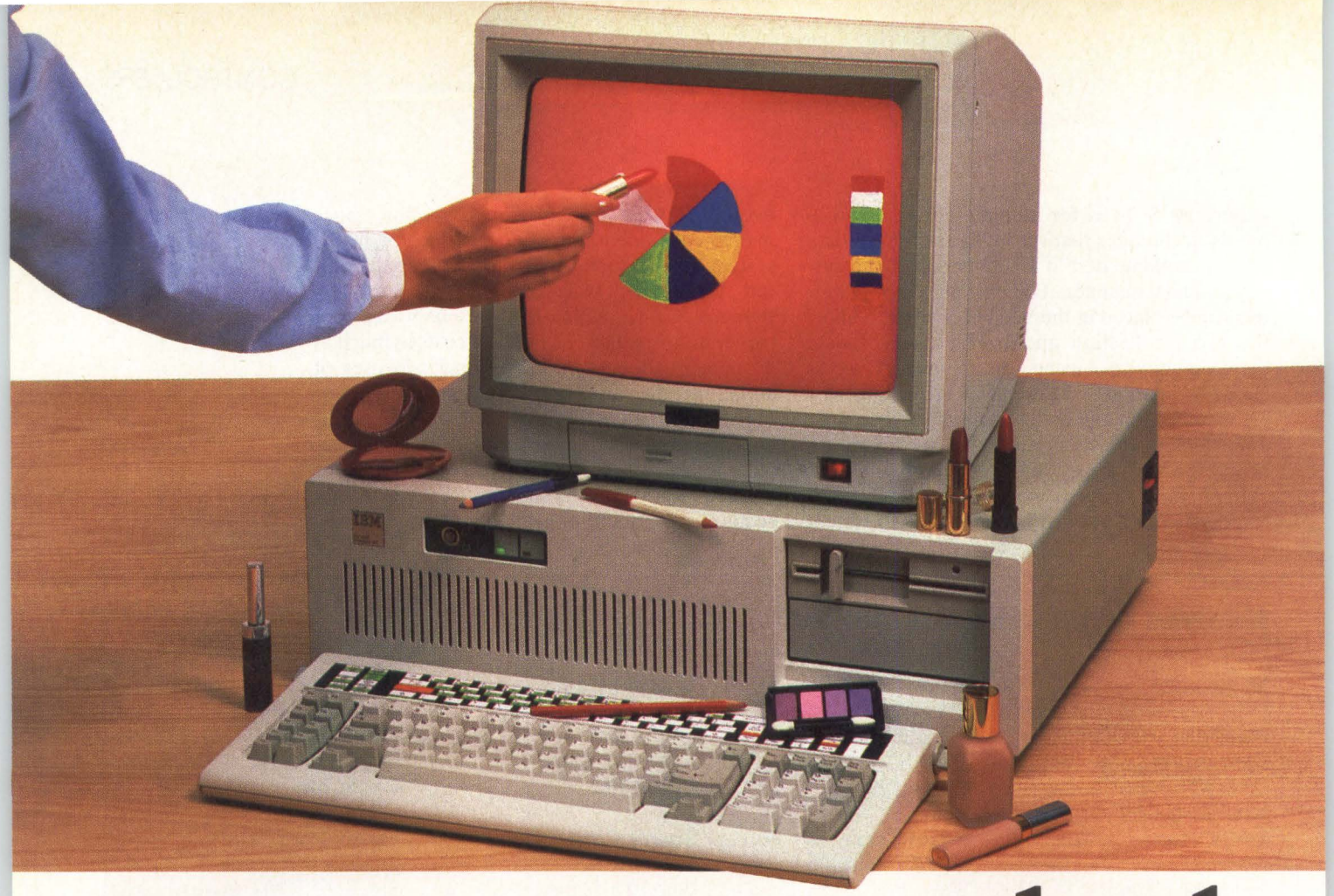

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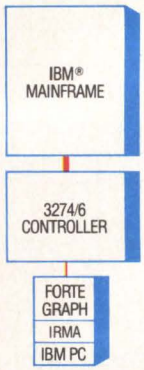

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CIRCLE NO. 70 ON INQUIRY CARD

and ties up an I/O channel when any transfers are made to or from the cache. Additionally, in multiple-host architectures, the system integrator must choose one host in which to implement the cache, since it is too expensive to implement in all hosts. "The answer to where to put the cache isn't clear," says Barrett. "Basically, it depends on the needs of the overall system architecture and not just adding RAM for a frivolous reason."

One method of maximizing system gains with SCSI, suggested by Daniel Loski, product line manager for SMS/OMTI, Campbell, Calif., provides a complex implementation of SCSI that employs controlling firmware in ROM, the host adapter and microprocessor control with cache memory. This strategy takes advantage of SCSI's ability to be matched to a foreign host bus via the adapter, but handles the cache buffering as well.

Chip sets speed design

Almost coincidental with the growing acceptance of the SCSI interface bus is the availability of very large-scale integration (VLSI) chip sets that handle the SCSI-defined protocols. Don Redman, Xebec's vice president of engineering, notes that low-cost VLSI eliminates 90 percent of the design work required for creating an SCSI controller or host adapter. He says that means controller manufacturers and system integrators can get products to market much quicker. He says upgrading SCSI by adding the various commands can be accomplished by changing the microcode of the protocol chip or, in some cases, the firmware on the SCSI controller.

Software lacking

Redman sees problems in SCSI software. He notes that currently no software exists to take advantage of the command structure of SCSI, and he sees no help on the horizon. According to him, the problem is similar to that with LANs. He explains that, like a LAN, SCSI implementations also have a transport and presentation layer, and software must take this into account. "That's where the problems lie, and consequently will cause the majority of SCSI implementations, at least initially, to be single-host with multiple targets," says Redman.

His assertion is based on the fact that most operating systems are I/O-bound and tend to rely on specific ports or addresses. Currently no operating system exists that uses the intelligence built into interfaces such as SCSI. Moreover, most mechanical devices are inefficient and represent high system overheads in moving data. Thus, a mismatch in performance occurs.

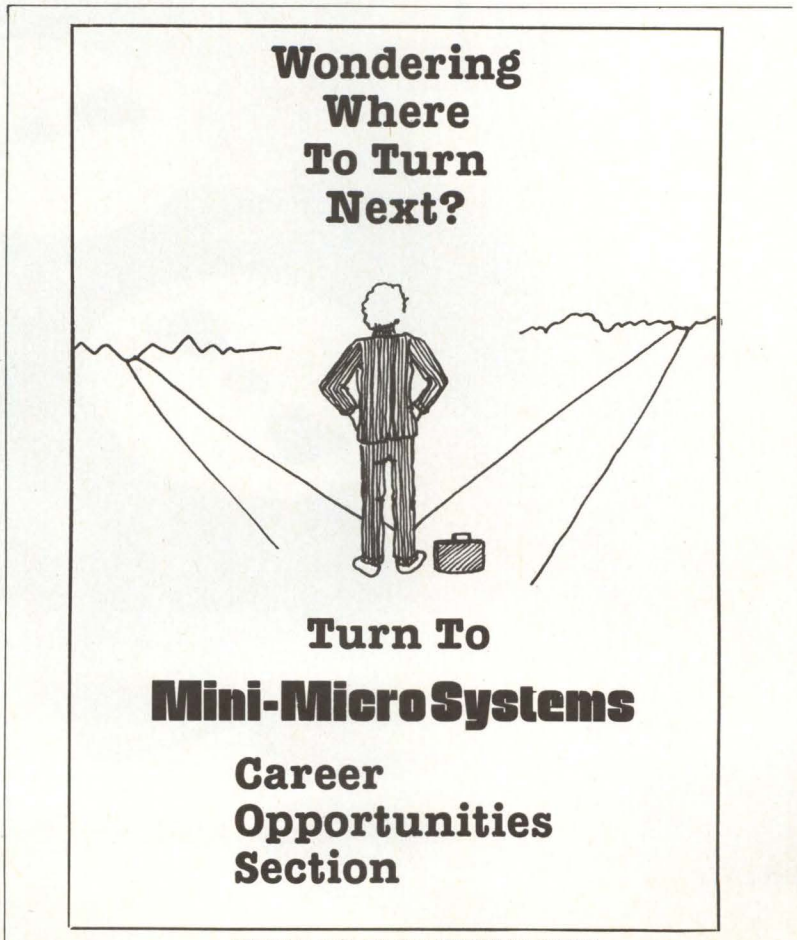
Most companies supporting SCSI believe the problems can be overcome. "Each application conjures up new needs," says Dal Allan. "Nothing is by the numbers. That may be the beauty of SCSI, since it does allow tailoring."

Command set a key element

Among the commands that make SCSI rich in features are those that allow the formatting of storage devices and that provide the ability to read and write to and from peripherals and to set special file marks for locating data either on storage devices or LANs. Additionally, provisions are made for directing output to various hard-copy attachments or storage devices and for allowing the copying of data from one machine to another or the sending of data to other hosts.

Currently, the bulk of intelligent controllers are still in the single-user SASI class. Most of the SCSI manufacturers have yet to release their products. What can be expected by mid-year are numerous announcements of peripheral devices sporting SCSI interfaces. □

Interest Quotient (Circle One)
High 825 Medium 826 Low 827



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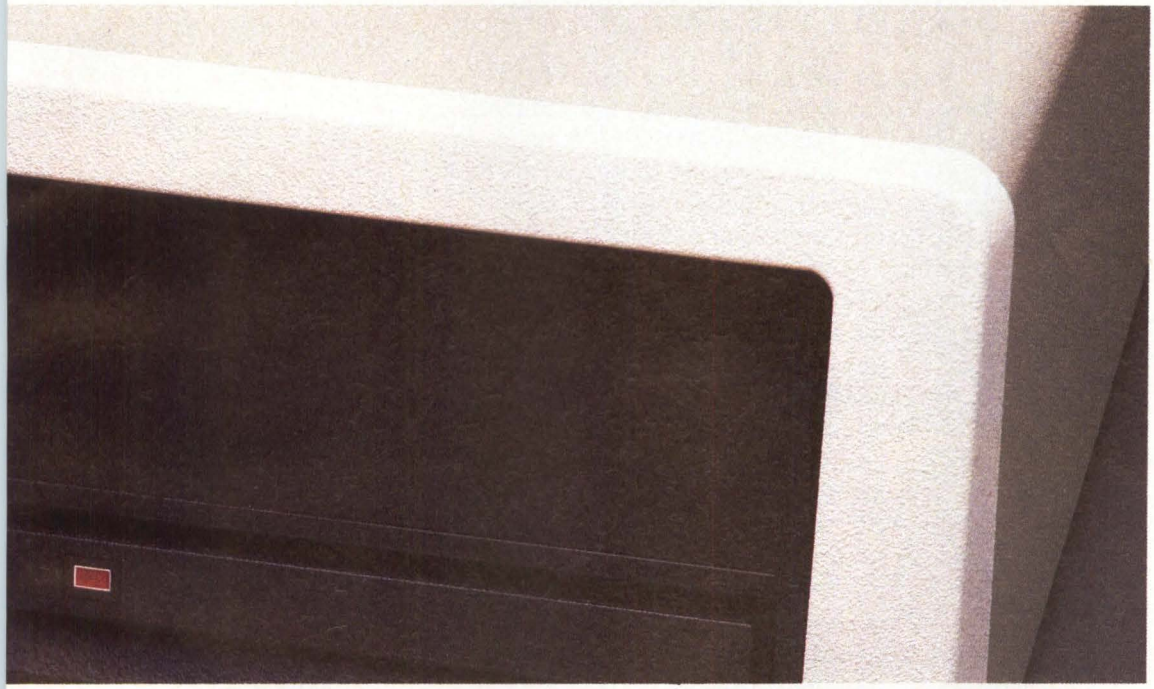

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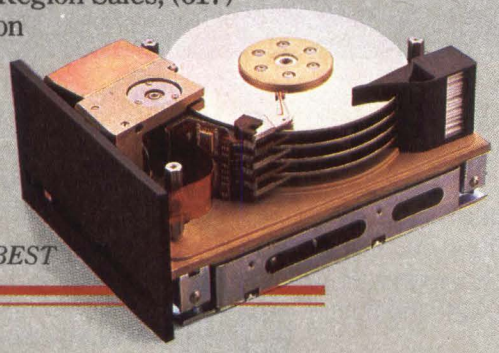


VERTEX

QUIETLY BUILDING THE BEST

CIRCLE NO. 73 ON INQUIRY CARD

VARIED DRIVE INTERFACES MYSTIFY INTEGRATORS

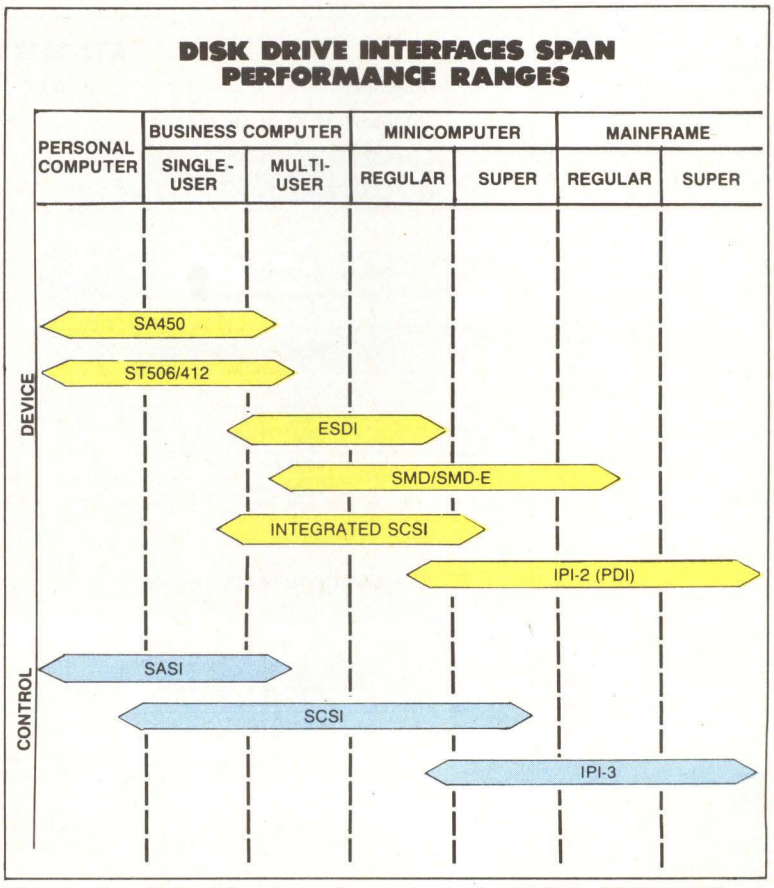
Confusion exists in the disk and tape drive interface market as emerging products begin to replace older ones. If you're using ST506/412, SA1000, SMD or QIC-02, it's time to take a close look at ESDI, SCSI, IPI or QIC-36

I. Dal Allan, ENDL Inc.

New disk and tape drive interfaces usually evolve out of extensions made to existing interfaces, with modifications geared to new requirements. However, the cost of introducing a new interface can be enormous. The expense is not limited to hardware, but extends throughout the whole system—from software to customer engineering. But the most significant, immediate requirement, as well as one of the most expensive, is the need for new controllers.

Established interfaces provide a controller infrastructure that can attach to many host buses, without having to add or modify the software drivers already in place. It takes several years for such an infrastructure to evolve. Longevity of an interface directly relates to the ability of controller and peripheral manufacturers to continually extend the interface's application to new products.

On small disk drives, the most recent device interface is the Enhanced Small Device Interface (ESDI) for high-performance 5¼-inch rigid disk drives. ESDI's roots can be traced as far back as the original SA800 floppy disk interface from Shugart Corp., Sunnyvale, Calif. The SA800 spawned the SA400, which changed into the SA450 when double-sided recording was introduced. The SA450 is the most popular 5¼-inch floppy interface and has been adopted by the new generation of 3½-inch floppy disks.



The major disk drive interfaces *include SA450, ST506/412, ESDI, SMD, SASI, SCSI and IPI.*

The ST506 interface is the de facto standard for low-performance Winchester disk drives. Seagate Technology (at that time Shugart Technology) first introduced the ST506 on a 5¼-inch Winchester as a hybrid of the SA1000 Winchester and the SA450 floppy disk interfaces. Seagate subsequently improved performance with its ST412 by buffering the step counts. ST506 is now available on 3½-inch Winchester disk drives.

ESDI extends the ST506/412 interface. The data rate limitation of 5M bits per second (bps) on the ST506/412 is adequate for low-performance, low-capacity, 5¼-inch products, but is inadequate for 5¼-inch disks with capacities and performance comparable to those of high-performance 8-inch Winchesters.

ESDI has step and serial modes of operation on disk, plus a tape mode. ESDI most closely resembles ST506/412 in the electrical cable, connectors and line names. Onboard logic (Fig. 1) bears little resemblance.

Putting the data separator on the drive—instead of on the controller—so that non-return-to-zero (NRZ) data can be used between controller and device is the key difference between ESDI and previous 5¼-inch interfaces. Instead of one signal intermixing both clock and data pulses, as with modified frequency modulation (MFM), ESDI uses a 50-percent duty-cyle, clock signal. This means that NRZ data bits can be complete bit cells in terms of time. Unlike ST506/412, the drive—not the controller—provides the reference clock.

Because NRZ transfers are less susceptible to jitter and noise than are MFM transfers, all large-diameter, high-performance OEM Winchesters use NRZ data. In addition to adding NRZ clocking to the data cable, ESDI replicates on the data cable rotational information from the control cable so that each drive's position can be monitored radially. This capability increases performance in multiple-disk configurations.

ESDI added two ways to replace the ST506/412 missing clock sector scheme, (i.e., a missing clock pulse means that a sector has been located): sector pulses and address marks on both the control and data cables.

There are two ways to position an actuator: step mode and serial-command mode. The latter is the preferred method when using an ESDI interface. Serial-command mode goes beyond

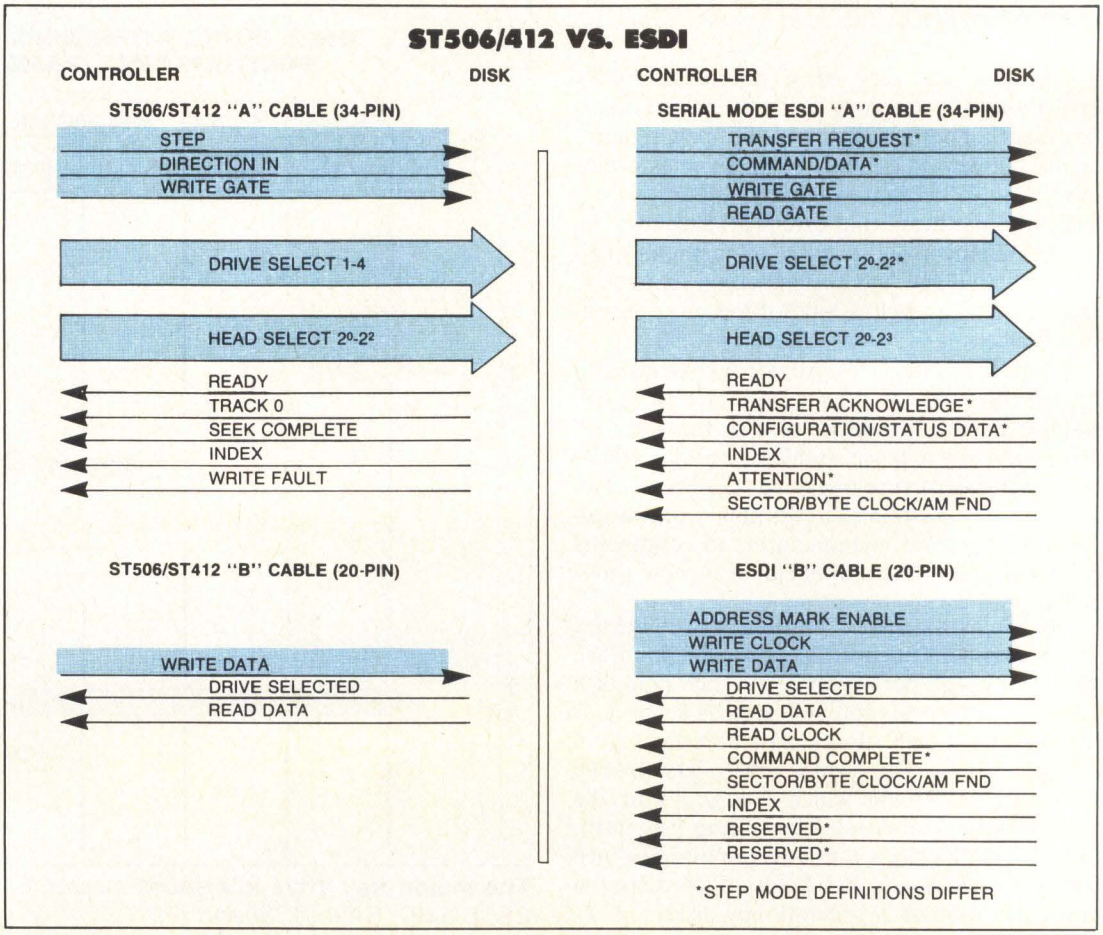


Fig. 1. The ESDI interface *extends the capabilities of the ST506/412 interface.*

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the step-mode ability to allow seeking directly by cylinder address. Serial commands are also available to enable the transfer of parameter, drive configuration, status and diagnostics information. This capability means that ESDI controllers can reconfigure automatically to handle different drives.

SMD hangs on, but for how long?

The over-5¼-inch disk drive interface market is more confusing than the 5¼-inch and smaller market. The SA800 was the first floppy interface, and became the SA850 on double-sided diskettes. The SA850 grew into the SA1000 interface for Shugart's 8-inch Winchesters. The popularity of SA800/850/1000 interfaces is waning because the product growth of disks that use them is waning.

The Storage Module Drive (SMD) interface incorporates the data separator and is the only interface that is appropriate for disk drives from 5¼ inches through 14 inches. This unusual situation exists even though SMD has always been considered an expensive, difficult interface to implement. SMD is the de facto standard on high-performance Winchesters, and only recently became available on high-capacity 5¼-inch disks.

Originally introduced by Control Data Corp. (CDC), Minneapolis, Minn., for a removable pack disk drive, the SMD specifies a 1.2M-byte-per-second transfer rate and 20,160 bytes per track. Manufacturers have consistently improved the SMD interface and the latest version permits a 3M-byte-per-second transfer rate and 50,400 bytes per track.

Two distinct, yet derivative, interfaces were introduced to provide low-cost alternatives to the SMD interface. The first was the SA4000, used on low-capacity 14-inch drives, and the second was the Rigid Disk Interface (RDI), used for 8-inch drives. Neither met with great commercial success, due in large part to competition from 5¼-inch products.

The HSMD (Fujitsu Ltd.) and SMD-E (CDC) are enhanced versions of SMD that provide more diagnostic and error-reporting capabilities. They have improved SMD's longevity, but SMD cannot support emerging disk-drive technology for long. Drives with transfer rates of 3M bytes per second will be available this year, and faster drives will be available next year. The Intelligent Peripheral Interface (IPI) will gradually replace the SMD interface, largely because the IPI can accommodate higher transfer rates.

SASI/SCSI incorporate intelligence

In the late 1970s, a number of drive manufacturers introduced intelligent interfaces to facilitate OEM integration. Shugart subcontracted the development of the Shugart Associates Systems Interface (SASI) and made the specifications freely available. SASI became the preferred interface for OEMs that wanted to attach SA1000 and ST506 disks which had been difficult to integrate — largely because they did not include data separation in the drive.

A large SASI aftermarket developed when independent controller houses started providing it as a vehicle for attaching floppy disks, Winchesters and ¼-inch tape cartridge drives. The changes and differences that began to appear led to an industry effort to standardize. The result is the Small Computer Systems Interface (SCSI). SCSI extends SASI's capability by providing more functionality and continues to isolate OEMs from changes in drive technology.

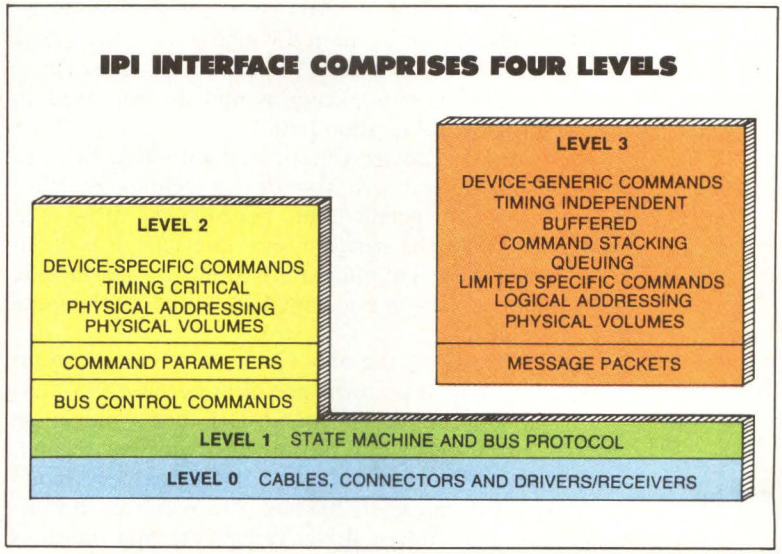

Fig. 2. The IPI interface *is defined in four levels. Levels 0 and 1 make up the physical interface. The physical interface plus one of the two command sets define either an IPI-2 (level 2) or IPI-3 (level 3) interface.*

IPI addresses performance requirements

Manufacturers producing high-end drives recognize the performance limitations imposed by the SMD interface. This resulted in the development of the IPI, which provides two types of command sets to meet two diverse market needs.

IPI is defined in levels (Fig.2). Level 0 refers to the mechanical and electrical characteristics of connectors, cables, drivers and receivers. Level 1 represents the state machine, the bus protocol and control and status byte information. Levels 0 and 1 constitute the physical interface.

Level 2 refers to device-specific commands that provide timing-critical operations. Level 3 refers to intelligent commands which provide buffered operation and device management. The physical interface plus one of the two command sets defines either an IPI-2 (level 2) or IPI-3 (level 3) interface.

IPI targets applications where there is a large

installed base of SMD or equivalent products. Thus, it offers a path for migration. This differs from SASI and SCSI, which are predominantly used in new applications and do not need to provide a migration path.

IPI-3 is device-generic and not unlike SCSI in isolating software from device technology. IPI-2 is device-specific, but, because the IPI-2 and IPI-3 use the same physical interface, it is possible for system integrators to mix device-specific and device-generic implementations on the same cable.

The IPI is the only viable device interface for future high-performance disks because the latest announced version of SMD-E has a maximum data transfer rate of only 3M bytes per second. The IPI extends this to 10M bytes per second over distances to 200 feet. Over shorter distances, RS485-class driver/receiver testing indicates that 22M bytes per second over a 50-foot cable is achievable.

The physical interface of the IPI is based on a state machine with five lines for control, one "attention" line and two bus bytes plus parity (Fig. 3). A 50-pin cable with shield incorporates a total of 24 lines. There is a high level of noise immunity between the cable conductors, because every signal has a corresponding ground which protects it from interfering with another signal.

The two bus bytes operate differently for control and data-transfer operations. When transferring data, the two buses operate in parallel to provide double-byte transfers. Thus the interface achieves an effective data rate of 10M bytes per second at 200 feet with only a 5MHz repetition rate in the drivers and receivers. This compares with a repetition rate of 24 MHz on the fastest SMD-E. As new driver and receiver families are introduced, the IPI transfer rate will increase accordingly.

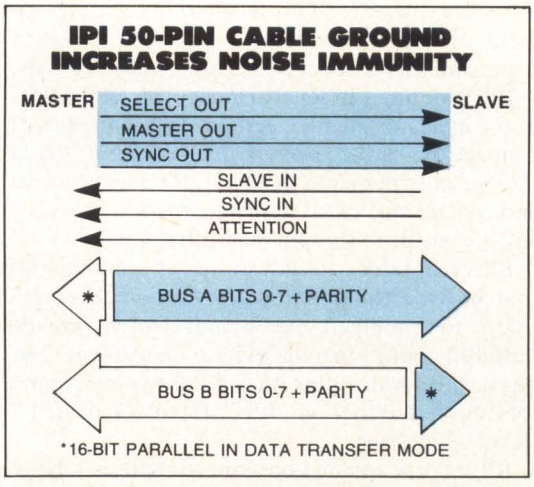

Fig. 3. The physical interface of the IPI *is based on a state machine with five lines for control, one attention line and two bus bytes plus parity.*

The buses are unidirectional when used for control, with bus A running out from the controller and bus B running in from the peripheral. There are no turnaround delays, in contrast to bidirectional buses. Recognizing control and responding with status can take less than one μsec. The most significant factor in turnaround time is not the interface but the length of the cable.

With most disk interfaces, it is necessary for the controller to manage the gaps between fields on a disk. This requires the controller to recognize sync-byte detection schemes and to provide the write-splice adjustments necessary on disks built by different manufacturers. With IPI-2, gap management is the responsibility of the drive, so that the idiosyncrasies of a particular drive are masked from the controller. Because turnaround time and gap management directly affect the size of disk gaps, IPI-2 allows smaller disk gaps than are presently in use, thus increasing usable data storage.

Disk drive manufacturers usually provide a flaw map of media defects in their own specific format. IPI-2 offers a major advantage in that it establishes an agreed-upon definition for the flaw map. With IPI-2, the manufacturer is required to provide a flaw map that can be read by a controller supporting the IPI-2 interface. This provides an added degree of compatibility between IPI-2-based disk drives.

The IPI-2 is a new interface, and thus will require a high level of technological development. A number of disk manufacturers are participating in a chip development program, the goal of which is to produce silicon chips that will facilitate implementation of IPI-2. When the chip prices get low enough, it will be possible to transfer IPI-2 from large Winchesters down to many disk drives of different sizes and capacities. If this occurs, controller and system manufacturers can develop product lines that can grow and expand without having to make major hardware changes every few years.

A host system capable of supporting both command sets can intermix IPI-2 and IPI-3 peripherals on the same daisy-chain cable. This would ease the burden of migrating from device-specific I/O with existing software to intelligent I/O with new general-purpose software.

Any interface that lowers the cost of software maintenance and development is a major boon for OEMs. IPI-3 controllers will eliminate the need for hosts to handle error recovery, error correction, buffering, defect management, etc. IPI-3 also offers queueing, chaining, multiplexing large data transfers, and dual-port and multiport management. All these functions reduce the software I/O burden in complex system configurations.

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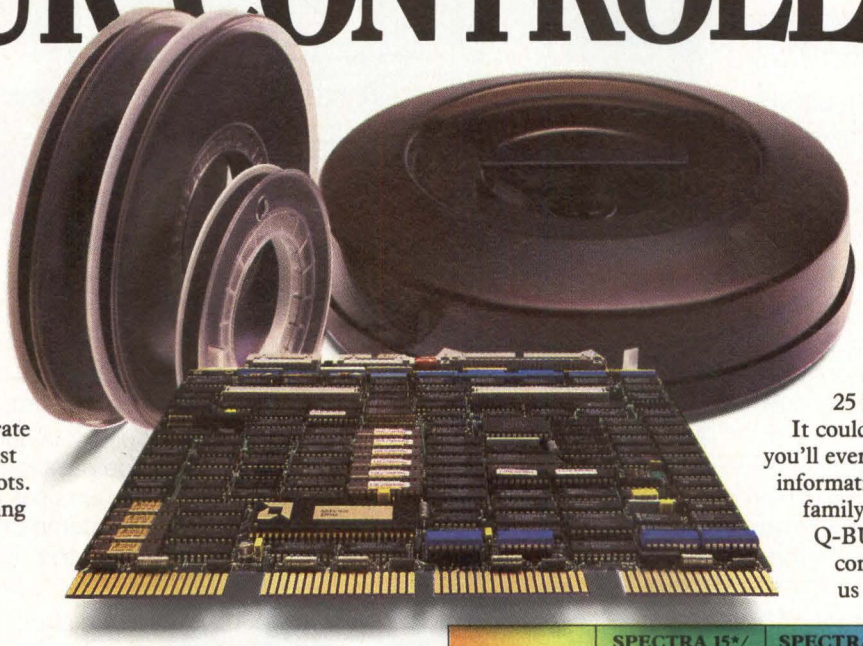

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Disk Emulation	RM02/05, RM80, RP06 (2 drives)	RM02/05, RM80, RP06 (4 drives)	RK06/07 (4 drives)
Tape Emulation	TS11 (4 drives)	TS11 (4 drives)	TS11, TM11 (4, 8 drives)
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Configurable On-Line	Yes	Yes	No
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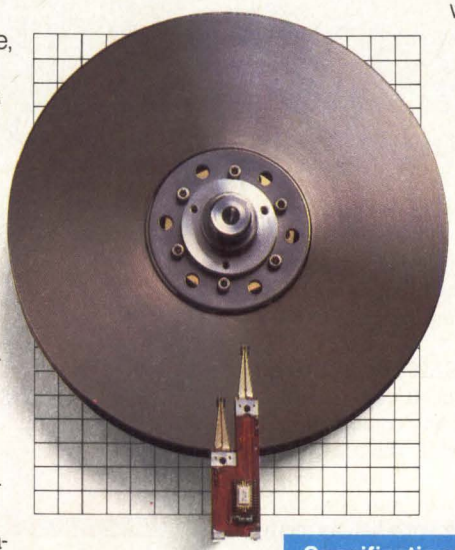

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Storage capacity, removable cartridge	26.7 megabytes	35.1 megabytes	———
Positioning time, average	32 milliseconds	32 milliseconds	15 milliseconds
Interface	SMD/LMD	SMD/LMD	ESMD
Transfer rate	1209 kilobytes/sec	1209 kilobytes/sec	1859 kilobytes/sec
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IPI-3 commands are transferred as message packets and are not interpreted until they reach the controller memory. Thus it will be possible to replace the IPI physical interface with one of different technology, yet not change the IPI-3 software.

The same is not true of IPI-2 because it uses the physical interface for timing-critical operations. Commands are not transferred separately, but are an extension of the bus controls that manage the interface. Parameters associated with the command are detailed in content, fixed in format and limited in number.

IPI-3 message packets are self-defining and require extensive parsing of the packet. Although this flexibility allows much room for future growth and expansion, it requires a large initial investment in microcode to interpret commands and generate responses. IPI-3 is designed for the software programmers who need to know only the generic characteristics of peripherals, and who want to provide commands in a language not unlike that used by a high-level compiler. The parsing requirements of IPI-3 commands are similar to those during the compile phase of any high-level language.

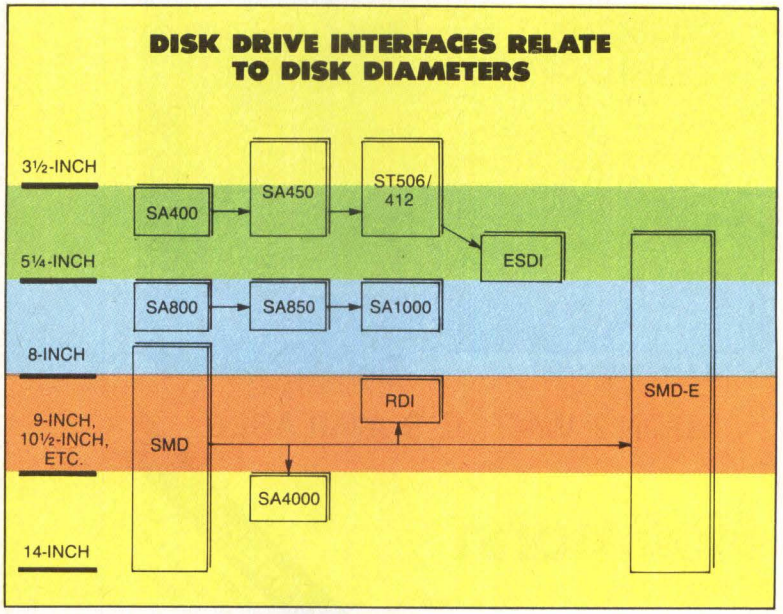
The need for controllers external to the host bus will define the market for standalone controllers with an IPI-3 interface. IPI-3 controllers will not be cheap, but they will offer a new high in throughput by providing performance that maximizes system bandwidth. This will be especially noticeable in configurations where there are several IPI-3 controllers, each with multiple devices attached.

All three recent interfaces—ESDI, SCSI and IPI—were defined by industry prior to their introduction. The cost of introduction and the difficulty of OEM evaluation make it advantageous for vendors to agree in advance upon an interface. An OEM can then establish multiple sources at the evaluation stage. Product success will depend more on quality, performance and other capabilities rather than the ability to "hook it up."

Tape drive interfaces are less confusing

There is less confusion about interfaces in the tape drive market than in the disk drive market. For example, the Pertec interface has been the de facto standard for ½-inch, reel-to-reel tape drives for many years.

When manufacturers introduced ¼-inch tape cartridge drives, each company incorporated a different interface. As a result, ¼-inch tape drives encountered a significant delay in market acceptance. The formulation of QIC-02 as the de facto standard interface led to an explosion in the demand for ¼-inch tape cartridge drives.



Disk drive interfaces *are usually associated with diameters, but some—such as the SMD and enhanced SMD—span a variety of disk sizes.*

The industry subsequently agreed on the QIC-36 de facto standard interface because it provided better cost/performance for controller houses.

Once ¼-inch tape cartridge drives become available with the SCSI interface, QIC-02 will probably fall in popularity because SCSI allows the same physical cable to connect both disks and tapes. The IPI can share disk and tape drives, too, but it is an unlikely interface for ¼-inch tape cartridge drives because its cost/performance characteristics are more suited to high-performance, large-computer installations. Small-to-medium-scale installations most commonly use ¼-inch tape drives. Future ½-inch tape drives, however, will include the IPI-3 command set. (Cipher Data Products Inc. has announced an IPI-3 ½-inch tape streamer.)

The demand for independent controllers at the host bus interface will create a demand for tape drives with IPI-2. Controller manufacturers have a vested interest in encouraging industry to use an interface that allows the combination of disk and tape drives. Controller houses can maximize their value-added input by integrating backup and restore functions between disks and tapes attached on the same cable.

Currently, a high-performance controller for disk and tape requires an SMD interface and a Pertec interface. A single IPI-2 interface supporting disk and tape will reduce board costs by eliminating one of the two interfaces.

The battle lines are drawn

The availability of SCSI in silicon is beginning to have a significant impact upon device interfaces. When it is possible to integrate SCSI within a

peripheral at the same cost as a device interface, will the market swing away from device interfaces? Will integrated SCSI become a "device" interface on low-to-medium-performance peripherals? If available at the same price as ESDI and SMD interfaces, SCSI could prove more popular than either, because it is easier to integrate. It is less likely that this will happen with high-performance peripherals because SCSI is not as effective as high-end interfaces in configurations that include more than one disk drive per subsystem.

The adoption of IPI-2 on lower performance devices would have many ramifications. Compatibility between all device interfaces would mean that a single interface could attach disk and tape drives of any size and capacity. If that happens, the major impact would be on ESDI and SMD.

SCSI and SMD more immediately threaten ESDI as a standard for disk and tape drives. A significant number of the systems that could incorporate the ESDI interface will use SCSI. LSI chips available now make it feasible to implement SCSI on the disk and tape drives.

ESDI advantages are limited primarily to integrators who implement only 5¼-inch products because it does not offer a migration path to higher capacity products in the 8-inch or larger form factors. At this time, the only 5¼-inch drive with an 8-inch drive interface is the SMD Dart from Applied Information Memories (AIM). If AIM is successful in marketing the drives, other manufacturers will follow suit and adapt SMD to the 5¼-inch form factor.

ESDI thus faces a challenge from the past (SMD), a challenge from the present (SCSI), and a challenge from the future (IPI-2). SMD offers a bridge between 5¼-inch and 8-inch disks; SCSI offers intelligence; and IPI-2 promises a new era of interface compatibility. □

I. Dal Allan is the founder of ENDL Inc., Saratoga, Calif., an independent organization specializing in marketing and engineering consultation on interface issues. He is also publisher of the *ENDL Letter*, a monthly newsletter on interfaces. He has been involved with computer systems and mass storage architecture for over 15 years as an employee of IBM Corp., Sperry Corp. and Priam Corp. He is vice chairman of the American National Standards Committee X3T9.3 for peripheral interfaces.

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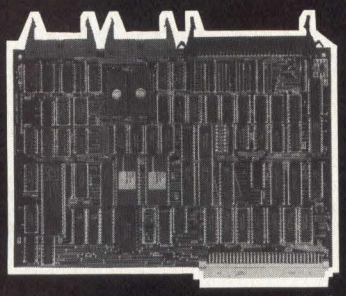

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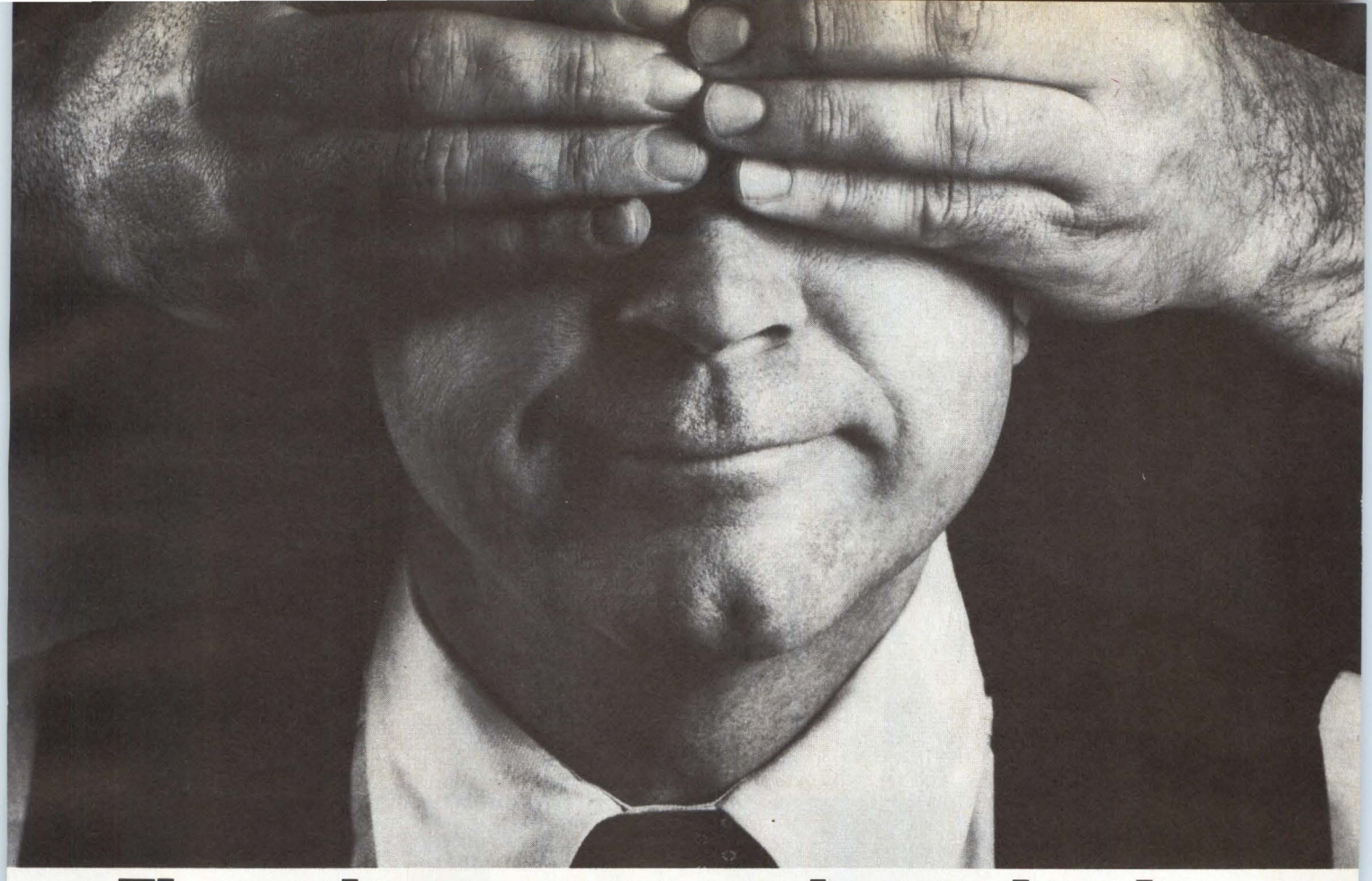

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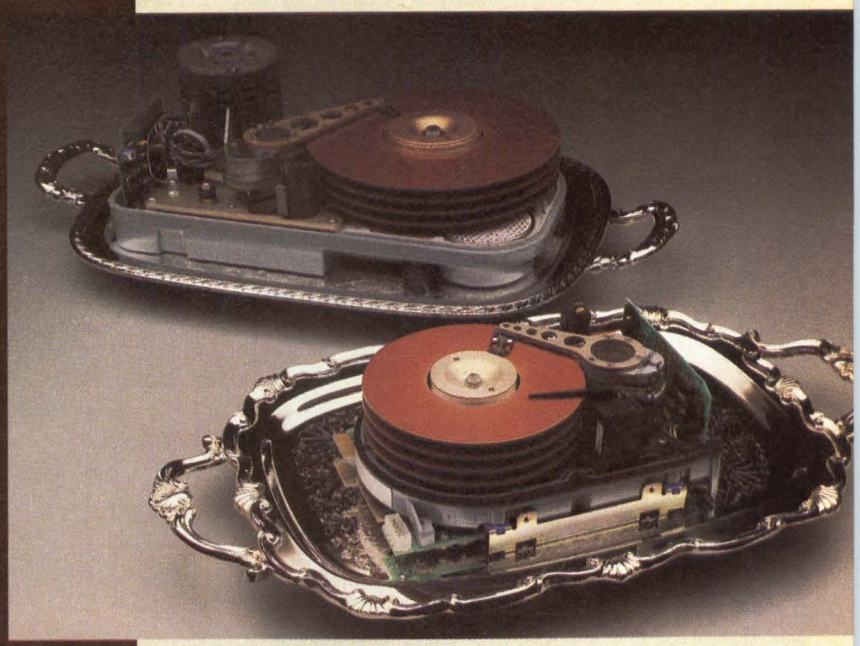

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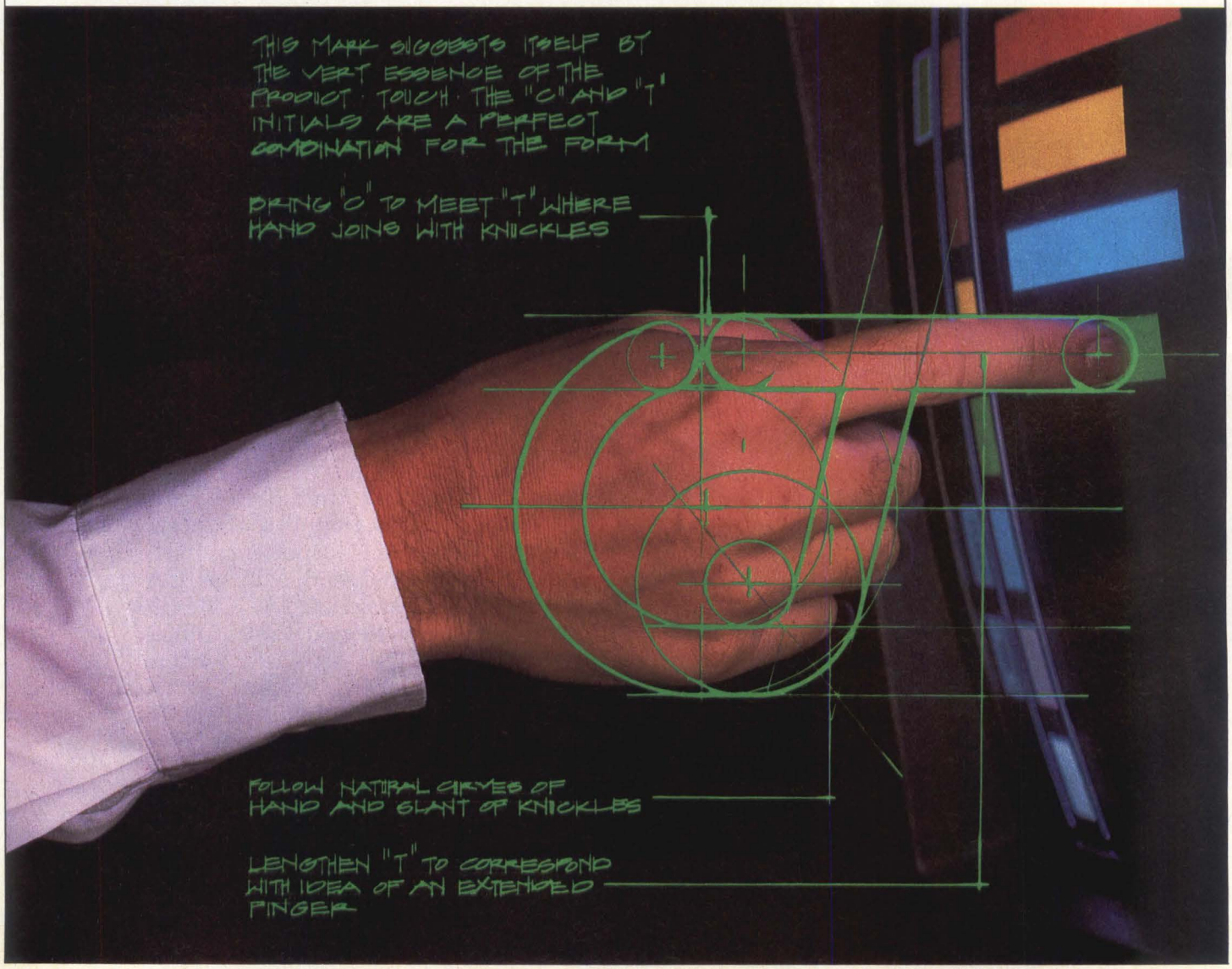


UNIX EMERGES AS A UNIVERSAL TOOL KIT

With UNIX shells appearing atop proprietary kernels, UNIX itself looks less like an operating system and more like a programming environment

Michael Tucker, Associate Editor

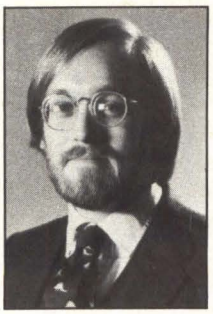
The drive to make UNIX the minicomputer industry's single operating system seems stalled, but Ma Bell's favorite child might still become the standard programming environment. Market analysts and computer system integrators suggest that UNIX will become a kind of "lingua franca"—a universal language providing users with a common software tool kit adaptable to a wide spectrum of machines. They point out that several leading minicomputer manufacturers have chosen to offer UNIX shells—some licensed from AT&T Information Systems—running concurrently with their proprietary operating systems, avoiding the commercial and technical drawbacks of going with a native (dominant) UNIX alone.

Moreover, software developers claim to have overcome the system degradation that marred the first UNIX implementations. OEMs can now purchase coresident UNIX-like environments that approach the performance of native UNIX systems.

Even its strong advocates seem resigned to UNIX's becoming a guest in many houses rather than the overall owner. "Frankly, I don't see UNIX so much as an operating system as an operating environment," says Peter Marvit, manager of laboratory services for the market research firm of Yates Ventures, Los Altos, Calif. "In fact, I think the term 'operating system' is becoming obsolete. I know that could get me lynched by some people, but what happens in three years when the specific operating system of

Illustration by Michael Cobb

Rising from the ashes *of a nearly extinct effort to be the minicomputer industry's only operating system, UNIX may become instead a standard programming environment. Market analysts and computer system developers are suggesting that UNIX will be the computer world's universal language.*



"I think the term 'operating system' is becoming obsolete," *says Peter Marvit, manager of laboratory services for the Yates Ventures market research company.*

any one machine becomes much less important than communications between machines? [When communications become] in fact, more important than even the characteristics of individual hardware?"

Marvit continues, "When that happens, I'll want to be able to sit down at my terminal or my phone and access information easily, from one resource to another, without operating systems getting in my way."

Analysts debate UNIX as tool box

Many market analysts seem reticent about UNIX's chances of becoming the prevailing, native operating system. They are, however, more enthusiastic about it as a programmer's basic tool kit that every hardware vendor would offer so that buyers could rapidly transfer programs—and the trained personnel that engenders—from one machine to another.

"UNIX is definitely not becoming *the* industry standard," says Damian Rinaldi, manager of the software and systems information program for research company International Data Corp., Framingham, Mass. "Rather, it is becoming *an* industry standard. In fact, there really hasn't been a commercial demand for it. There doesn't seem to be a lot of people knocking down any vendor's door for UNIX-based systems."

Even Brian Boyle, managing analyst of software for market research company Gnostic Concepts Inc., San Mateo, Calif., praises the operating system with faint damns. "I'm afraid UNIX is a bit like what Winston Churchill said about democracy. It's a very bad form of operating system, but the others are so much worse. I think it is probably going to be the industry standard, but by default...for the same reason that certain bars in New York get popular because everybody goes there. It's a trendy product."

He notes that most buyers are interested in UNIX's shell (its user interface) rather than its kernel. "There are good technical reasons for going with UNIX, but unfortunately those aren't the reasons people are buying it...most people see it as an appliance. In the majority of smaller systems sales where the buyer is usually an end user—and some 60 percent of UNIX sales were in that range last year—people aren't buying UNIX but rather what's on top of UNIX: utilities, commands, software tools."

As a result, he says, "UNIX as a guest operating environment is one of the places we see a growth market. Harris is doing it, IBM is doing it, Apollo is doing it...they're all running UNIX on top of native operating systems. In some ways, UNIX has become almost...a universal bridge between systems, allowing the relatively easy migration of software and programmers from one machine to another."

Marvit agrees. "Look at it from the programmer's point of view. You sit down at a terminal and it looks like UNIX to you. You don't care that it's actually a virtual machine and there's another operating system under it. Computers are, after all, nothing more than different levels of abstractions. If the top happens to be UNIX, and the middle level some native operating

Software humanizes UNIX

Do your customers long for a UNIX that doesn't drive their non-programming staff stark, raving mad?

Recently, .MENU, an online database operation provided by International Software Database Corp., ran a search of its listings for user-friendly interfaces currently on the market for system integrators wishing to make UNIX a wee bit less terrifying. Its findings include:

- **Softshell** from Logical Software Inc. Softshell is a full-screen interface to UNIX with which users enter commands through the screen or line by line. This interface will gently and progressively ease the uninitiated user into UNIX with helpful advice and kindly prompts at appropriate moments. Available for all Bell Labs' UNIX-based systems.
- **The Menu System** from Softest Inc. The Menu System is a user-friendly interface to UNIX that can provide customized menus for individuals or groups. English is the user language. Available for Digital Equipment Corp.'s PDP-11, DEC's VAX, Intel Corp.'s Intel 8086, and Motorola Inc.'s Motorola 68000.
- **MIMIX:SHELL** from Touchstone Software Corp. MIMIX:SHELL provides UNIX users with an operating environment that blends MS-DOS and UNIX capabilities into one interface. Designed particularly for naive users, MIMIX:SHELL has a menu-driven simplicity. Available for Bell Labs' UNIX-based machines.
- **Office Menu Tool Ver-1.0** from Unisource Software Corp. This system allows the user to construct a menu system as a UNIX interface. Menus can be constructed for various levels of user expertise, each with a help screen and unique descriptions. Available for IBM PC/XT and most compatibles.

For more information about .MENU, contact The International Software Database Corp., 1520 S. College Ave., Fort Collins, Colo. 80524.

Technical Bulletin
No. 2 in a series.

QNX™

SUBJECT: Engineering a LAN for Maximum Flexibility.

Quantum Software Systems Ltd. proudly announces QNX 2.0 — the Ultimate Distributed Network Operating System. QNX 2.0 is now available for the IBM-PC, IBM-AT, PC compatibles, DEC Rainbow and TANDY 2000. If you have been waiting for a Real-time Multi-tasking Multi-user Operating system with fourth generation LAN support, then QNX 2.0 can offer you today what the competition can't even begin to promise for the future.

QNX 2.0 integrates the Local Area Network architecture right into the heart of the operating system, at the fundamental level of intertask communication allowing tasks to communicate transparently with other tasks across the whole network. This means that any task (program/application) may access ANY serial port, ANY printer or ANY disk on the network. There are no artificial restricitons. Every PC with a disk is a potential file server. PCs without disks will automatically BOOT over the network.

QNX on the IBM-PC AT:

QNX is the only Multi-tasking Multi-user Operating system available for the AT. It is available in both networked and single machine configurations. At about 2.5 times faster than the QNX 8088 PC based systems, and 10 times faster than other multi-tasking operating systems on the same processor, QNX is the ideal program development environment.

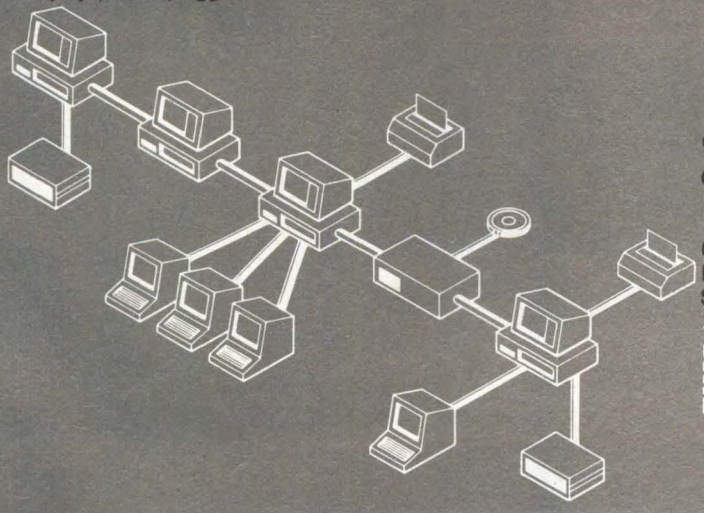
O/S	Computer	Processor	Measured time
QNX ™	IBM-PC AT	80286	480 usec
XENIX ™	Intel-286	80286	4,930 usec

File Security:

Designed with extensive file security features, QNX 2.0 provides login protection with network wide file permission checking based on 255 groups of 255 users. In addition, each PC user may control network access to devices attached locally to their machine.

Distributed Processing:

The QNX LAN supports distributed processing as well as distributed devices. Tasks may be executed on remote stations as easily as they may be executed on the local work station. This allows pure processing elements (PCs without keyboards or displays) to be plugged into the network to be used as an un-committed processing resource. This is ideal for real-time, process control, data acquisition and data communication applications.



Global Communications:

QNX supports a full implementation of X.25 allowing connection to public networks such as Telenet and Datapac. This allows you to link geographically separate LANs together providing true global area networking.

Cost Effective Growth and Flexible Solutions:

QNX is affordable, and will work with the PCs you use today and those you will use tomorrow. You may mix and match different brand PCs on the same QNX network with absolute ease. Multi-user expansion may be accomplished by adding terminals to PCs or PCs to the network. You can start your multi-user application on a single PC with 1 to 10 attached terminals. Once your single processor starts to show signs of degradation, add another PC and connect terminals to the new processor. If the disk becomes the major bottleneck, you may add hard disks to other attached PCs to distribute the processing. Applications which are very CPU intensive may wish to limit a single user to each processor and expand the system with low cost diskless PCs used as work stations. QNX does offer a truly cost effective and flexible solution to your applications needs.

Portability:

QNX 2.0 is portable. The operating system is independant of the physical local area network. It is available in a form suitable for porting to other 8088/8086/80186/80286 computers in the consumer, educational and industrial market place. QNX is ROMable and can operate in as little as 128Kb RAM.

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PC-DOS version 2.1 can run as a task under the QNX 1.2 or 2.0 operating systems. QNX will also allow transparent access to the DOS file system partition and floppies.

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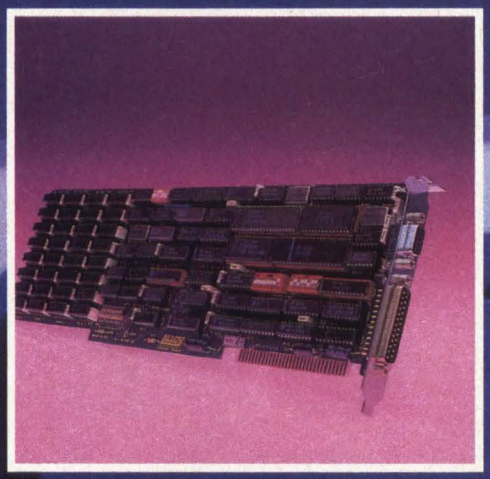

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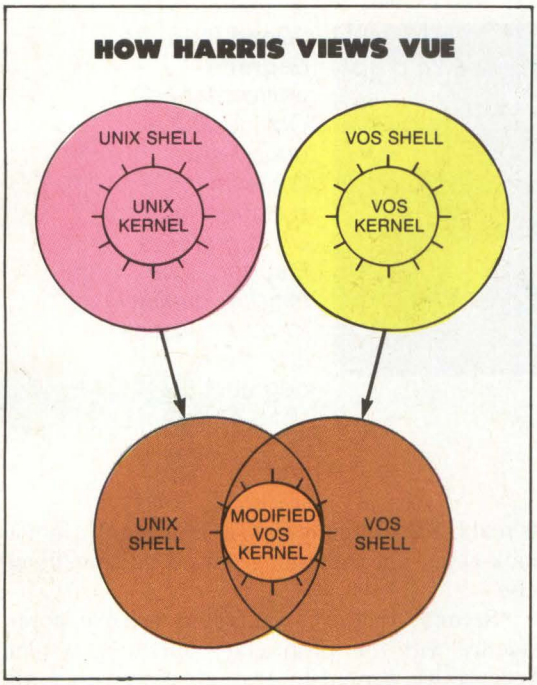


Harris Corp. envisions VUE *as the blending of UNIX and VOS. VUE is a System V environment with Berkeley enhancements over a modified Harris proprietary VOS kernel, and aside a VOS shell.*

system, the bottom level is still chips and bits."

Performance is key issue

The one thing that could make hash of such rosy predictions of the operating system's future as a common language is UNIX implementations' terrible reputation. In the rush to make every machine on the market UNIX-compatible, vendors brought out UNIX emulations that, in certain cases, degraded overall system performance by as much as 50 percent.

"Coresident operating systems were the first response of the mini vendors," notes Laura Stuart, director of small systems research for the Yankee Group, Boston. "Typically, the performance of the coresident system was less than that of either UNIX or the proprietary system alone. The first company I know of that successfully put UNIX on top of a native operating system was Apollo, and now their AUX concurrent system is roughly equivalent in performance to native UNIX...but not everyone's been that successful. Let's just say that coresident operating environments are something that many vendors would very much like to do."

Still, developers are confident they can overcome the difficulty of grafting UNIX onto proprietary operating systems. Two common approaches to the problem have been either to run UNIX as an application on the proprietary system or to modify the proprietary kernel so that it supports a UNIX shell and UNIX capabilities in addition to the native shell.

Software developers have made significant progress in overcoming the problems of running UNIX as an application—particularly below the multiuser level. For example, Whitesmiths Ltd., Concord, Mass., offers Co-Idris, a UNIX-compatible environment that runs as an MS-DOS job on the IBM Corp. PC/XT. Co-Idris provides over 100 utilities, C and Pascal compilers, and the ability to switch between the guest and native operating systems without rebooting.

The president of Whitesmiths, P.J. Plauger, has been associated with UNIX since its beginnings. He bristles at any suggestion that making UNIX an MS-DOS application program somehow tarnishes the operating system. "Does it degrade performance? Obviously it does. The missing qualifier is in the degree. The question should be, 'Does it degrade performance intolerably to run UNIX on top of something else?' I think the answer is no, and that's shown in that we have grown-ups who earn good money doing just exactly that with Co-Idris."

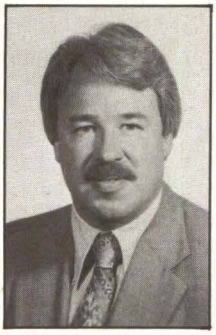
Vendors prefer coresidence

For minicomputer vendors, the coresident approach is the clear favorite—partly because of technical considerations ("After all," says one software specialist who prefers not to be named, "there's not that much to it. So you're making a few of your calls look like UNIX calls. So what?") and partly because it least resembles the disastrous UNIX implentations of the early days.

Charles River Data Systems Inc., Natick, Mass., for example, stresses the distinction between imitating UNIX and "implementing" it as a genuine user interface. The company markets a UNIX product known as UN/System V over its own UNOS operating system. Designed specifically for the company's Universe 68 machines (though, technically, capable of running on almost any 32-bit minicomputer), UN/System V uses licensed AT&T code to make the already-UNIX-like UNOS indistinguishable from UNIX System V with Berkeley Version 4.2 enhancements. In fact, Charles River offers three shells: Bourne, C and proprietary.

Asked if UN/System V degraded computer performance, Jim Isaak, director of product marketing for Charles River, replies, "No. There is no degradation because there is no emulation. This is an implementation of what amounts to a native system."

Isaak is also chairman of the IEEE P1003

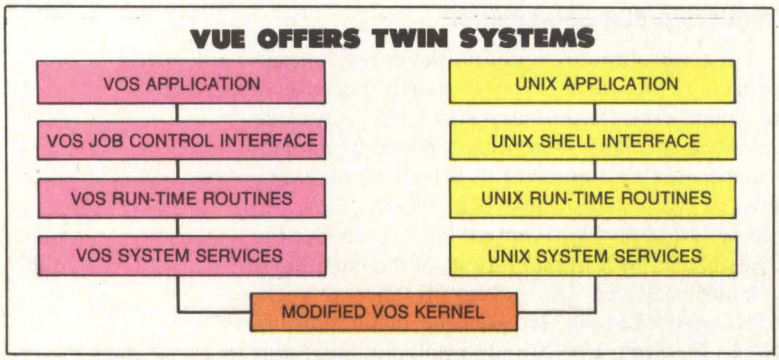


"UNIX as a guest *operating environment is one of the places we see a growth market," says Dr. Brian Boyle of Gnostic Concepts Inc. "In some ways, UNIX has become almost a universal bridge between systems."*

Operating Systems Committee and a member of the /usr/group standards committee. Speaking in those roles, he says, "Much of what people call UNIX isn't. They're actually talking about the shell, the tools and so on...The /usr/group committee focuses on that. You don't define a UNIX standard by trying to standardize the kernel, which is perhaps best left to the creative genius of programmers, but rather by standardizing the shell a user actually sees."

Vendors play the UNIX shell game

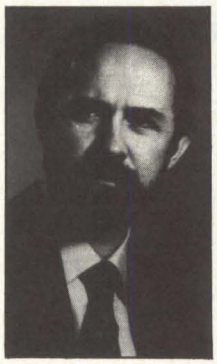
Other minicomputer vendors who are already marketing or have announced at least one UNIX product running atop or beside a native operating system include Digital Equipment Corp., Prime Computer Inc., Harris Corp., Apollo Computer Inc., Stratus Computer Inc. and several others. IBM may have endorsed the approach, at least on the microcomputer level, with its IBM PC/IX, which runs a UNIX implementation from Interactive Systems Corp., in addition to native MS-DOS. But IBM remains silent on anything related to UNIX, and a company spokesman says only, "UNIX is an operating system that is offered and supported on selected IBM products."



VUE is meant to be an "unapologetic" offering *of both UNIX and the Harris proprietary system. The two shells are highly compatible—files may be exchanged freely, and users can switch from one environment to the other without logging off.*

The Harris implementation is designed to bring UNIX to the company's superminicomputers. Offically titled "VUE" (VOS/UNIX environment), it is a System V environment with Berkeley enhancements over a Harris proprietary virtual operating system (VOS) kernel, alongside a VOS shell. The two shells are highly compatible—files may be exchanged freely and users can switch from one environment to the other without logging off—and so Harris' customers have access to both VOS' real-time capacity and UNIX-based software.

Harris also stresses the difference between implementation and emulation. "There are two key points I want to make," says Charles Maule, director of product marketing, computer systems division, Fort Lauderdale, Fla. "First, that VUE



"Does it degrade performance? *Obviously it does," says Whitesmiths president and UNIX guru P.J. Plauger. "The missing qualifier to your question is in the degree."*

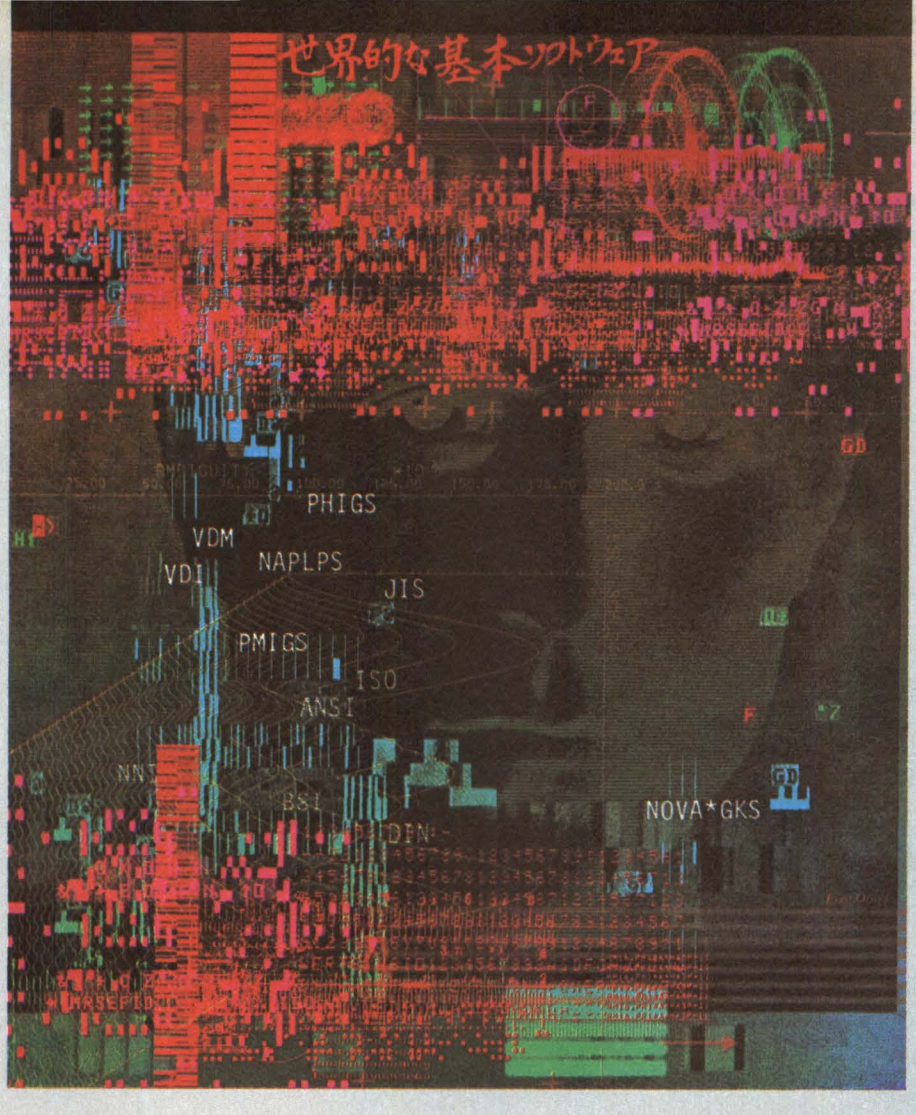
is real UNIX; it really is AT&T System V...not a look-alike, not something ported on something else.

"Second, that we wanted to achieve coresidence with our proprietary operating system because we wanted to give our customers both UNIX and VOS. We wanted to break down the wall between the two operating systems. The reason we did it was to make certain we didn't have an apologetic offering in either area."

Harris is attempting to bring VUE to a very broad range of engineering, scientific, aerospace, computer-aided design/computer-aided manufacturing (CAD/CAM), office automation and other markets where Harris superminicomputers might function as the link between workstations and mainframes. It might be an omen of UNIX's eventual fate that the company is also using the "multiuser" system to enter the single-user market. VUE was officially introduced less than a month before the announcement of new Harris engineering workstations, the Station 10 and the Station 20, which have native UNIX operating systems.

Apollo, of Chelmsford, Mass., introduced its minicomputer UNIX product, AUX, in 1983 to run with the Apollo proprietary system, AEGIS, over a modified proprietary kernel, now titled Domain. Apollo's early entry into the UNIX shell arena is reflected in AUX's System III-like environment. The company has announced plans to extend and upgrade it. "In our next major software release," says Mark Hatch, AUX product manager, "we'll be providing two more shells, a System V and a Berkeley 4.2. The user will be able to choose between four separate shells. And, we have complete command transparency. You can pipe utilities between environments in pretty much any combination you'd like.

"Why is it advantageous to have all four



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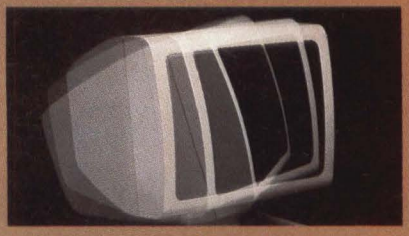

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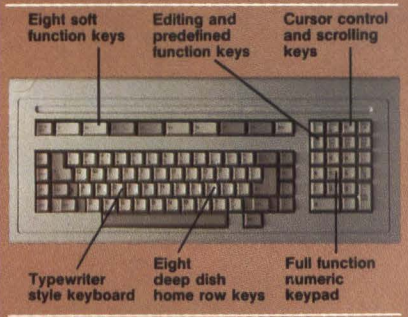

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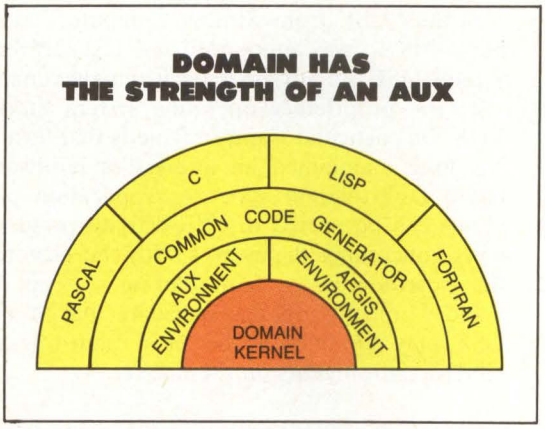
environments? It's well-known that UNIX variants have not proved strictly compatible. By offering as many UNIXes as we can, we increase the chances of our providing users with the environment with which they feel the most comfortable or from which they're porting software."

New players lay bets

Prime, Natick, Mass., which had been hanging back in the UNIX market, got into the fray with what may be accurately called a vengeance. The company recently brought in some very tough out-of-town software muscle, Human Computing Resources of Toronto, to help develop a UNIX environment to run over the PRIMOS operating system on Prime's 32-bit and larger machines.

The new UNIX/PRIMOS is expected to be on the market sometime early this year. As of press time, Prime had not made an offical announcement of the product and so declines to reveal the new environment's cost or even its name. The company does, however, reveal that UNIX/PRIMOS will be a System V environment, licensed from AT&T, with Berkeley enhancements. It will support both the C and Bourne shells and over 160 UNIX commands.



AUX, Apollo Computer's *minicomputer UNIX product, runs with the Apollo proprietary system, AEGIS, over a modified proprietary kernel titled Domain. The company has announced plans to extend and upgrade AUX.*

"I think Prime sees UNIX as an operating system interface standard," says Ross Summers, Prime product manager for UNIX. "In fact, I think that's what will be important about UNIX —that it will be an interface standard."

UNIX rivals thrive

UNIX has competition.

Less than a year ago, the conventional wisdom held that UNIX would drive every other operating system out of the multiuser minicomputer market.

Conventional wisdom was dead wrong.

Non-UNIX operating systems are doing just fine, thank you very much. Their growing numbers include:

- The Pick System from Pick Systems, Irvine, Calif. Brainchild of the colorful Dr. Richard Pick, the Pick System continues to interest the business community. It is multiuser, multitasking, extremely user-friendly and unsurpassed for database management applications.
- OASIS from Phase One Systems Inc., Oakland, Calif. Now available in both 8- and 16-bit versions, OASIS is multiuser, multitasking and supported by a large selection of application programs. OASIS is reportedly a favorite of small engineering and professional concerns.
- S1 from MultiSolutions Inc. of Lawrenceville, N.J. Supporters of this modular operating system say it makes UNIX look like a dinosaur.
- PolyFORTH from Forth Inc., Hermosa Beach, Calif. Written in FORTH, this operating system has been known to inspire almost fanatic loyalty in its users. PolyFORTH is multiuser and multitasking, and it may be the best real-time application development environment on the market.
- MICROBOL from MICROBOL Inc., Altamonte Springs, Fla. Its creators call MICROBOL a "master operating system" and say it is the step between traditional operating systems and expert systems. It is multitasking and multiuser. Most MICROBOL programs need not be compiled because file-handling, language-programming and disk-operation functions are integrated.
- MS-DOS from Microsoft Corp., Bellevue, Wash. Despite MS-DOS' continued dominance of the microcomputer market, many analysts expected it to fade away after Microsoft introduced XENIX. Actually, MS-DOS has continued to thrive and gain ever-more-faithful adherents. Microsoft has, in fact, recently announced that MS-DOS will evolve to meet the requirements of the workstation market—multitasking, networking, file sharing and so on.

Also, less than a year ago, the conventional wisdom held that if any of these operating systems were to survive, they would have to become application programs running on top of UNIX. In fact, if UNIX does become a common programming environment, things may go the other way around entirely.

Stratus USF from Stratus Computer, Marlboro, Mass., was announced just last October. Stratus USF is a System V environment running over the proprietary operating system Stratus VOS. Its particular claim to fame is that Stratus has long maintained an interest in hardware-based fault-tolerant systems. Application programs can be ported to USF without programmers concerning themselves with the esoterica that software-based, fault-tolerant systems demand. Company officials speculate that Stratus USF may be one of the most fault-tolerant UNIX environments on the market.

And still other vendors are hinting they have UNIX shells in mind for the near future. Sandra Humphrey, UNIX product marketing manager for Modular Computer Systems Inc. (MODCOMP), Fort Lauderdale, Fla., notes, "MODCOMP is certainly working on something. Our customers are interested in UNIX, but they don't want to give up the real-time capacity of our proprietary operating systems. It's a high-priority project for us."

AT&T's feelings on UNIX as a coresident operating environment are understandably mixed. Larry Crume, department head for

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UNIX systems and planning at AT&T Bell Labs, Murray Hill, N.J., says, "I think coresident UNIX is neither good nor bad. On small machines, I think you're better off going with UNIX as a native system...but in the minicomputer range, and certainly in the supermini range, it gets a bit fuzzy. I think you can go either way.

"For minicomputer companies, I think it's a very positive way to provide UNIX to existing customers. It's very attractive, if you want to provide UNIX to your embedded users."

As for UNIX's future as a standard tool kit, Crume says, "I believe UNIX as a native operating system will always be with us...though it is true that UNIX provides far more than an operating system. It provides an operating environment...and a consistent environment."

Native UNIX finds champions

Native UNIX has its defenders outside of AT&T as well (see "An opposing view: Why Perkin-Elmer feels that UNIX will stand alone," Page 160). Several minicomputer vendors—notably Gould Inc. and Perkin-Elmer Corp.—offer UNIX only as a native operating system.

operating system vendors

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An opposing view: Why Perkin-Elmer feels UNIX will stand alone

C.J. Morris, Perkin-Elmer Corp.

While some companies in the marketplace feel that UNIX is becoming a subset of a proprietary operating system, Perkin-Elmer Corp., Oceanport, N.J., does not. The reasons are myriad, and our customers substantiate this view. Most proprietary operating systems fit in a specific niche that the vendor is filling. Many are aimed at "real-time" and others at "business," even though the vendor refers to the system as general-purpose. UNIX is a great operating system for applications that include software development and on-line interactive processing.

We decided to implement a pure UNIX port—called XELOS—because it offered significant advantages. It is substantially easier to port the unique UNIX features directly to hardware, and this tends to run faster than a port placed on top of a proprietary operating system. The pure port of UNIX can optimize the attributes of the hardware instead of working through another operating system.

The advantages of buying a system from a vendor with pure UNIX is that, should users need to move to different hardware, they can do that without making major changes to the application or worrying about the vehicle it sits atop. Some of our new customers who have required increased power have ported their applications without hardship because their previous vendors used a generic UNIX port.

Perkin-Elmer's proprietary operating system, OS/32, is oriented to real-time applications with a high degree of data communications, IBM networking and a powerful database manager. Our OS/32 customers have told us that they want the proprietary operating system for their production environment but are serious about using a UNIX system that provides the same languages for software development. UNIX is currently the system of choice at a great many research labs and universities. The result is a growing pool of programmers that are conversant with UNIX. We intend to continue to develop and maintain both OS/32 and XELOS.

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"A lot of minicomputer companies see UNIX as a competitor," says Robert Gintz, manager of UNIX product marketing for Gould, Fort Lauderdale, Fla., "But we don't. Essentially, we see it as an addition. It's something we can offer as well as our own proprietary systems. Customers can have the computer with the best native operating system for their unique purposes."

AT&T's Crume suspects that the discussion of rival operating systems, with or without UNIX, may be a waste of time. "Some people get a bit angry when I raise the point," he says, "but the whole industry's short of programmers. Well, maybe we could all pick up a little staff, if we pulled some programmers off writing all those new operating systems and put them to writing application software."

But whatever UNIX becomes, native operating system or programmer's standard tool kit, its future is probably best described by Whitesmiths' Plauger. "Way back at the start of all this," he says, "when we were writing UNIX, I used to tell people that it was not the answer, but it was the bottom half of the answer, and that's even more true today. UNIX will always be with us in some form. The concepts it introduced are just too important to be ignored." □

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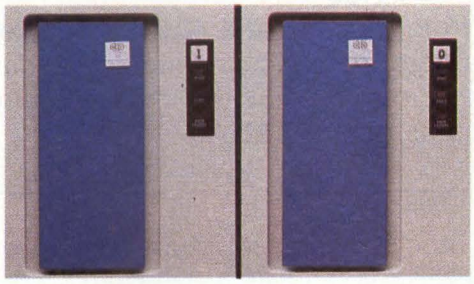

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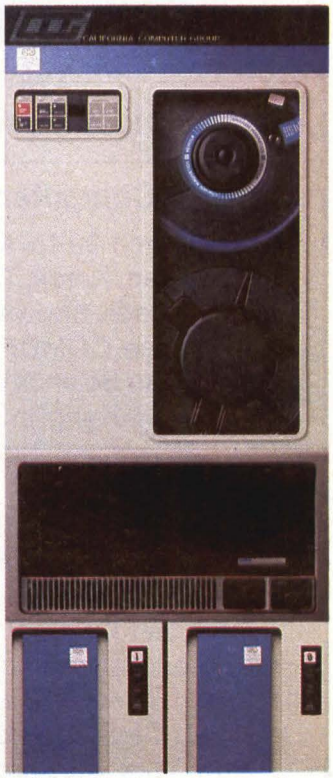

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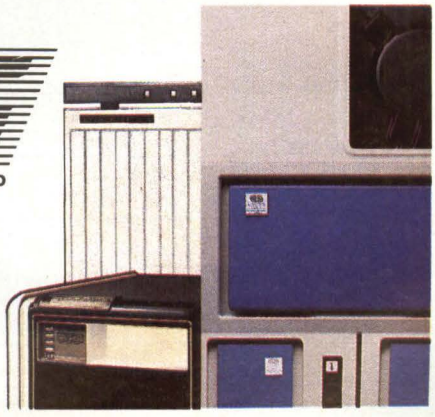

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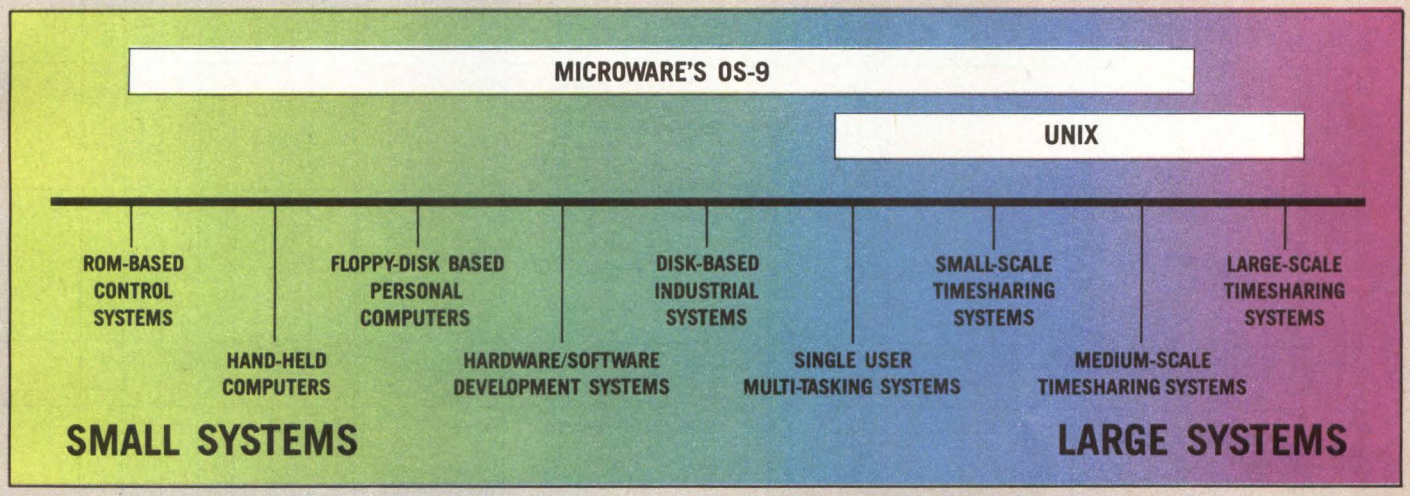

Is complicated software and expensive hardware keeping you back from Unix? Look into OS-9, the operating system from Microware that gives 68000 systems a Unix-style environment with much less overhead and complexity.

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Microware's C compiler technology is another OS-9 advantage. The compiler produces extremely fast, compact, and ROMable code. You can easily develop and port system or application software back and forth to standard Unix systems. Cross-compiler versions for VAX and PDP-11 make coordinated Unix/OS-9 software development a pleasure.

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Key OS-9 Features At A Glance

- Compact (16K) ROMable executive written in assembly language
- User "shell" and complete utility set written in C
- C-source code level compatibility with Unix
- Full Multitasking/multiuser capabilities
- Modular design - extremely easy to adapt, modify, or expand
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- Rugged "crash-proof" file structure with record locking
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SUPPLIER	OPERATING SYSTEM	μP	MINIMUM MEMORY (BYTES)	LANGUAGES SUPPORTED	PRICE	GENERAL OVERLAYS	DEVELOPMENT	REAL-TIME	NETWORK SUPPORT	MULTIUSER	MULTITASKING	MULTIPROCESSING
ALCYON	REGULUS	68000	128k	ASSEMBLER, BASIC, C, COBOL, DIBOL, FORTRAN-77, PASCAL	$2000	•	•	•	•	•	•	
APPLIED INTELLIGENCE	PC/NOS	8086/8	256k		$250 FRONT-END; $650 BACK-END	•			•	•		•
APPLIED SYSTEMS	O/S	8086/8, 68000	16k-32k	ASSEMBLER, BASIC, COBOL, FORTRAN	—	•	•		•	•	•	•
BOSTON SYSTEMS OFFICE	UMD	8048/51, 8080/5, 8086/8, F8, 6800/2/5/9, 1802/5, 6502, F8, 68000, Z8000, OTHERS	64k	ASSEMBLER, PASCAL	—		•			•		
CENTRAL DATA	XENIX	Z8001	256k	ASSEMBLER, BASIC, COBOL	$1500	•	•		•	•	•	
CHARLES RIVER DATA SYSTEMS	UNOS	68000	256k	ASSEMBLER, BASIC, C, FORTRAN, PASCAL	$3000	•	•	•	•	•	•	
COMPUPRO	CONCURRENT DOS 8-16	8085, 8086/8, 80286	256k	ADA, ALGOL, ASSEMBLER, BASIC, C, COBOL, LISP, FORTH, FORTRAN, MODULA-2, PASCAL, PILOT, PL/I, PL/M, SNOBAL	$400	•	•		•	•	•	•
COMPUPRO	CP/M 8-16	8085/8088	128k	LANGUAGES COMPATIBLE WITH CP/M-80 OR CP/M-86	$450	•	•					
COMPUPRO	MP/M 8-16	8085/8088	194k	LANGUAGES COMPATIBLE WITH CP/M-80 OR CP/M-86	$1000	•	•			•	•	
CONVERGENT TECHNOLOGY	CTOS	8086, 80186	256k	ASSEMBLER, BASIC, C, COBOL, FORTRAN-77, PASCAL	—	•	•	•	•	•	•	•
CREATIVE SOLUTIONS	MULTI-FORTH	68000	64k	FORTH	$895	•	•	•			•	•
DESTEK GROUP	DES RT	MICRO-VAX, MV 4000, MV 8000, Z8000, 32016, 68020, 8086/8, 80186/8, 80286	192k	BASIC, C, PASCAL	$500	•	•	•	•	•	•	•
DESTEK GROUP	OS/RT	MICRO-VAX, MV 4000, MV 8000, Z8000, 32016, 68020, 8086/8, 80186/8, OTHERS	8k	ASSEMBLER, C, PASCAL	$10,000	•		•	•	•	•	•

MEMORY MANAGEMENT						PERIPHERAL MANAGEMENT													FILE MANAGEMENT							COMMENTS
						DEVICES SUPPORTED									FEATURES											
OVERLAYS	SWAPPING	CHAINING	SEGMENTATION	STATIC RELOCATION	DYNAMIC RELOCATION	CRT	CHARACTER PRINTER	LINE PRINTER	FLOPPY DISK	HARD DISK	CARTRIDGE DISK	MODEM	MAG TAPE	PAPER TAPE	INTERRUPTS	I/O MULTIBUFFERING	SPOOLING	DMA	NAMED FILES	SEQUENTIAL	CONTIGUOUS	RANDOM	INDEXED SEQUENTIAL	MULTILEVEL DIRECTORY	PASSWORD SECURITY	
•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	SYSTEM CALLS COMPATIBLE WITH UNIX VERSIONS 6, 7 AND SYSTEM III. SUPPORTS REAL-TIME TASKS. PRICE SHOWN IS FOR END USER.
						•	•	•	•	•	•	•	•		•	•	•								•	RUNS WITH MS-DOS, PC-DOS, CP/M AND CP/M-86, TURNING THE OS INTO MESSAGE-BASED, MULTIUSER LAN OS. ADDS LISTED ATTRIBUTES TO BASE OS CAPABILITIES.
•						•	•	•	•	•		•			•			•	•	•		•			•	PRICE DEPENDS ON CONFIGURATION.
•			•	•		•	•	•	•		•	•	•	•	•	•	•	•	•			•			•	REQUIRES 512k-BYTE DISK STORAGE. CALL VENDOR FOR PRICING.
	•					•	•	•	•	•	•				•	•	•	•	•	•		•	•	•	•	XENIX, A TRADEMARK OF MICROSOFT CORP, NEEDS A 10M-BYTE HARD DISK.
	•		•		•	•	•	•	•	•	•				•	•	•	•	•	•	•	•	•	•	•	UNIX COMPATIBLE; HAS REAL-TIME EXTENSIONS.
•		•		•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•		•	INCLUDES PC-DOS 1.1 SUPPORT, GSX SUPPORT AND MODEM SOFTWARE. SUPPORTS ARCNET PROTOCOL UNDER DR/NET FOR NETWORKING.
•		•		•	•	•	•	•	•	•	•	•		•	•		•	•	•	•	•	•	•			RUNS 8- AND 16-BIT APPLICATIONS SIMULTANEOUSLY ON SYSTEM 816's DUAL-PROCESSOR ARCHITECTURE.
•				•	•	•	•	•	•	•		•	•		•	•	•	•	•			•			•	RUNS 8- AND 16-BIT APPLICATIONS SIMULTANEOUSLY IN MULTIUSER ENVIRONMENT ON SYSTEM 816's DUAL-PROCESSOR ARCHITECTURE.
•		•		•		•	•	•	•	•		•	•		•	•	•	•	•	•	•	•	•	•	•	COMES WITH MODELS AWS, NGEN AND IWS HARDWARE. DISTRIBUTED OS SUPPORTS WORKSTATIONS VIA LOCAL-AREA NETWORK.
•					•	•	•	•	•	•		•			•				•				•	•		APPLE MACINTOSH VERSION, MACFORTH, $149.
	•		•			•		•	•	•		•	•		•		•		•	•			•	•	•	REAL-TIME UNIX-LIKE OS WITH MINICOMPUTER-LIKE RESOURCE-MANAGEMENT AND FILE SYSTEM. USER-FRIENDLY COMMAND LINE INTERPRETER AND FULL DEVELOPMENT FEATURES.
			•			•			•	•		•	•		•				•	•			•	•	•	REAL-TIME CAPABILITIES ORIENTED EXECUTIVE, ROM- OR DISK-BASED, THAT CAN BE USED AS THE KERNEL FOR A FULL UNIX-LIKE OS.

OPERATING SYSTEMS DIRECTORY

GENERAL INFORMATION						AREAS OF USE			GENERAL FEATURES			
SUPPLIER	OPERATING SYSTEM	μP	MINIMUM MEMORY (BYTES)	LANGUAGES SUPPORTED	PRICE	GENERAL OVERLAYS	DEVELOPMENT	REAL-TIME	NETWORK SUPPORT	MULTIUSER	MULTITASKING	MULTIPROCESSING
DESTEK GROUP	PORTX	Z80, Z8000, 32016, 68020, 8086/8, 80186/8, 80286	8k	ASSEMBLER, C, PASCAL	$1000			•		•	•	•
DIGITAL EQUIPMENT	RSX-11M	LSI-11	48k	ASSEMBLER, BASIC, COBOL, FORTRAN	$5000	•	•	•	•	•	•	
DIGITAL EQUIPMENT	RT-11	LSI-11	24k	ASSEMBLER, APL, BASIC, FOCAL, FORTRAN	$700-$1090	•	•	•	•		•	
DIGITAL EQUIPMENT	MICROPOWER/ PASCAL	LSI-11	8k	ASSEMBLER, PASCAL	$4000	•		•	•	•	•	
DIGITAL RESEARCH	CONCURRENT DOS	8086/8, 80186	256k	ASSEMBLER, APL, BASIC, C, COBOL, FORTRAN, PASCAL, OTHERS	—	•	•	•	•	•	•	•
DIGITAL RESEARCH	CONCURRENT PC-DOS	8086/8, 80186	256k	ASSEMBLER, APL, BASIC, C, COBOL, FORTRAN, PASCAL, OTHERS	$295	•	•	•	•	•	•	•
DIGITAL RESEARCH	CP/M PLUS	8080/5, Z80	48k	ASSEMBLER, APL, BASIC, C, COBOL, FORTRAN, PASCAL, OTHERS	—	•	•					
DIGITAL RESEARCH	CP/M-80 VER. 2.2	8080/5, Z80	32k	ASSEMBLER, APL, BASIC, C, COBOL, FORTRAN, PASCAL, OTHERS	—	•	•					
DIGITAL RESEARCH	CP/M-86	8086/8, 80186	64k	ASSEMBLER, APL, BASIC, C, COBOL, FORTRAN, PASCAL, OTHERS	$60	•	•					
DIGITAL RESEARCH	MP/M	8080/5, Z80	48k	ASSEMBLER, APL, BASIC, C, COBOL, FORTRAN, PASCAL, OTHERS	—	•	•		•	•	•	•
ELECTRONIC INFORMATION SYSTEMS	EIS-110	8086/8	20k	C	—		•	•			•	
EYRING RESEARCH	PDOS	68000, 9900, 9905	32k	ASSEMBLER, BASIC, C, FORTH, FORTRAN, PASCAL	$1150	•	•	•		•	•	
FORTH	FORTH	8080/5, 8086/8, 6809, 68000, 1802/5, LSI-11	64k	ASSEMBLER FORTH	$600-$3200	•	•	•		•	•	•
GOULD AMI	PERSONAL CP/M	S83 (Z80)	64k	ASSEMBLER, BASIC, C, PASCAL, PLM	—	•	•	•	•			
HEMENWAY	MSP/68000	68000	24k	ASSEMBLER, BASIC, PLM	—	•	•	•			•	

MEMORY MANAGEMENT						PERIPHERAL MANAGEMENT												FILE MANAGEMENT							COMMENTS
						DEVICES SUPPORTED									FEATURES										
OVERLAYS	SWAPPING	CHAINING	SEGMENTATION	STATIC RELOCATION	DYNAMIC RELOCATION	CRT	CHARACTER PRINTER	LINE PRINTER	FLOPPY DISK	HARD DISK	CARTRIDGE DISK	MODEM	MAG TAPE	PAPER TAPE	INTERRUPTS	I/O MULTIBUFFERING	SPOOLING	DMA	NAMED FILES	SEQUENTIAL	CONTIGUOUS	RANDOM	INDEXED SEQUENTIAL	MULTILEVEL DIRECTORY	PASSWORD SECURITY	
			•												•											ROM-BASED EXECUTIVE.
			•			•	•	•	•	•		•		•	•		•	•	•	•	•	•	•	•	•	
•		•	•	•	•	•	•	•	•		•	•		•	•		•	•	•	•		•				
			•	•		•	•	•	•	•		•			•	•		•	•	•	•	•					EXECUTE ONLY LICENSE, $30 (100).
		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	PC/XT WITH 512k RECOMMENDED. RUNS CP/M-86 AND PC-DOS APPLICATIONS CONCURRENTLY.
		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	PC/XT WITH 512k RECOMMENDED. RUNS CP/M-86 AND PC-DOS APPLICATIONS CONCURRENTLY. RETAIL VERSION OF CONCURRENT DOS.
		•			•	•	•	•	•	•	•	•	•	•	•		•		•	•	•	•	•			•	•	CP/M-80 VERSION 3.0; OFFERS RAM MEMORY BANK SWAPPING FOR >64k TOTAL MEMORY.
		•			•	•	•	•	•	•	•	•	•	•	•		•		•	•	•	•	•			•	•	MOST WIDELY USED 8-BIT OS CURRENTLY ON THE MARKET.
		•	•	•		•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•			•	•	
		•		•		•	•	•	•	•	•	•	•	•				•	•	•	•	•	•					
		•				•	•	•		•	•				•	•												FOR REAL-TIME TASK USE INCLUDING CONTROL SYSTEMS AND COMMUNICATIONS SUPPORT.
		•		•		•	•	•	•	•	•	•	•		•		•	•	•	•	•	•	•		•		
•						•	•	•	•	•					•	•		•	•	•	•	•	•					OPTIMIZED FOR HIGH-PERFORMANCE REAL-TIME APPLICATIONS WITH INTERACTIVE ON-LINE DEVELOPMENT AIDS AND DATABASE SUPPORT.
•	•					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			AVAILABLE ON-CHIP WITH CPU AND MEMORY INTERFACE LOGIC AS THE S83 PROCESSOR. PERSONAL CP/M COMBINES FEATURES FROM CP/M-80 VERSIONS 2.2 AND 3.0 (CP/M PLUS).
		•			•	•	•	•	•	•		•			•	•	•	•	•	•	•	•					CONFIGURATIONS INCLUDE DISK- AND ROM-BASED VERSIONS. IN USE IN INSTRUMENT AND PROCESS-CONTROL SYSTEMS.

OPERATING SYSTEMS DIRECTORY

GENERAL INFORMATION						AREAS OF USE			GENERAL FEATURES			
SUPPLIER	OPERATING SYSTEM	μP	MINIMUM MEMORY (BYTES)	LANGUAGES SUPPORTED	PRICE	GENERAL OVERLAYS	DEVELOPMENT	REAL-TIME	NETWORK SUPPORT	MULTIUSER	MULTITASKING	MULTIPROCESSING
HEMENWAY	OS/ENGINE-68000	68000	8k	ASSEMBLER, BASIC, PLM	—			•			•	
HEWLETT-PACKARD	RTE-A	A600+	128k	ASSEMBLER, BASIC, FORTRAN-77, PASCAL	$2000		•	•	•	•	•	
HUMAN COMPUTING RESOURCES	UNITY: MC68000	68000	512k	ASSEMBLER, C, FORTRAN-77, PASCAL	—	•	•		•	•	•	•
HUMAN COMPUTING RESOURCES	UNITY: NS32016	NS32016	512k	ASSEMBLER, C, FORTRAN-77, PASCAL	—	•	•		•	•	•	•
HUNTER & READY	VRTX KERNEL	Z80, Z8002, 1750A, 68000, 68008, 68010, 8086/8, 80186/8	4k		$5275	•		•			•	•
HUNTER & READY	VRTX/OS	8086/8, 80186/8, 68000, 68008, 68010	52k	ASSEMBLER, C, PASCAL, PLM	$9975	•		•			•	•
HUNTER & READY	VRTX/Z8002	Z8002	4k	ASSEMBLER, C, PASCAL	—	•		•			•	•
HUNTER & READY	VRTX/1750A	MIL-STD 1750A	4k	ASSEMBLER, JOVIAL	—	•		•			•	•
HUNTER & READY	VRTX/68000	68000, 68008, 68010, 68020	4k-80k	C, PASCAL	—	•		•			•	•
HUNTER & READY	VRTX/80	Z80	4k	ASSEMBLER, C, PASCAL	—	•		•			•	•
HUNTER & READY	VRTX/86	8086/8, 80186/8, 80286	4k-80k	ASSEMBLER, C, PASCAL, PLM	—	•		•			•	•
IBM	PC/IX	8086/8	256k	ASSEMBLER, C	$900	•	•				•	
INDUSTRIAL PROGRAMMING	MTOS-68	6800	3k	ASSEMBLER	$4000			•			•	
INDUSTRIAL PROGRAMMING	MTOS-68K	68000	6k-11k	ASSEMBLER, C, PASCAL	$11,000			•			•	•
INDUSTRIAL PROGRAMMING	MTOS-68KF	68000	16k	ASSEMBLER, C, PASCAL	$1500			•			•	•
INDUSTRIAL PROGRAMMING	MTOS-68KFG	68000	16k	ASSEMBLER, C, PASCAL	$12,000			•			•	•
INDUSTRIAL PROGRAMMING	MTOS-80MP	8080/5	8k	ASSEMBLER, PL/M	$6000			•			•	•
INDUSTRIAL PROGRAMMING	MTOS-80/85	8080/5	3k	ASSEMBLER, PL/M	$4500			•			•	

MEMORY MANAGEMENT						PERIPHERAL MANAGEMENT												FILE MANAGEMENT							COMMENTS
						DEVICES SUPPORTED									FEATURES										
OVERLAYS	SWAPPING	CHAINING	SEGMENTATION	STATIC RELOCATION	DYNAMIC RELOCATION	CRT	CHARACTER PRINTER	LINE PRINTER	FLOPPY DISK	HARD DISK	CARTRIDGE DISK	MODEM	MAG TAPE	PAPER TAPE	INTERRUPTS	I/O MULTIBUFFERING	SPOOLING	DMA	NAMED FILES	SEQUENTIAL	CONTIGUOUS	RANDOM	INDEXED SEQUENTIAL	MULTILEVEL DIRECTORY	PASSWORD SECURITY	
						•	•	•							•			•							SILICON-BASED MSP/68000 NUCLEUS AND REAL-TIME DEBUGGER. MAY USE MSP/68000 FILE-MANAGEMENT COMPONENT.
•	•		•			•	•	•	•	•	•	•	•		•	•	•	•	•					•	•	PASSWORD/SECURITY AND SPOOLING ARE OPTIONS. SUPPORTS 128M BYTES OF VIRTUAL MEMORY. RUNS ON MODELS 6, 26 AND MICRO/26.
	•					•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	DERIVED FROM AT&T SYSTEM V. AVAILABLE TO OEMs ONLY.
					•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	SUPPORTS MEMORY PAGING. BASED ON BERKELEY 4.1 BSD UNIX. AVAILABLE TO OEMs ONLY.
						•									•											
						•	•	•	•	•	•		•		•	•		•	•	•	•	•		•		
						•	•								•	•										
						•	•		•	•	•		•		•	•		•	•	•	•	•		•		
						•	•								•	•										
						•	•		•	•	•		•		•	•		•	•	•	•	•		•		OPTIONAL FMX COMPONENT SUPPORTS A PC-DOS-COMPATIBLE FILE SYSTEM EXTENSIBLE FOR REAL-TIME APPLICATIONS.
	•					•	•	•	•	•		•			•	•	•	•	•	•		•	•	•	•	BASED ON INTERACTIVE SYSTEMS CORP IS/3, A SYSTEM III-BASED UNIX.
															•											HAS PRIORITY SCHEDULING, UNLIMITED TASKS, TASK COORDINATION AND INTERRUPT PROCESSING.
			•			•	•	•	•	•					•	•		•	•	•	•	•	•	•		ALLOWS 32 MEMORY POOLS VIA DYNAMIC MEMORY ALLOCATION. SUPPORTS 16 CPUs.
			•			•		•	•						•			•	•	•	•	•	•	•		FIRMWARE VERSION OF MTOS-68k.
			•			•		•	•						•				•	•	•	•	•	•		FIRMWARE GENERATOR VERSION OF MTOS-68k.
			•			•			•						•			•	•	•	•	•				HANDLES EIGHT CPUs. HAS DYNAMIC MEMORY ALLOCATION.
						•		•	•						•											OFFERS PRIORITY SCHEDULING AND I/O DRIVERS.

OPERATING SYSTEMS DIRECTORY

GENERAL INFORMATION						AREAS OF USE			GENERAL FEATURES			
SUPPLIER	OPERATING SYSTEM	μP	MINIMUM MEMORY (BYTES)	LANGUAGES SUPPORTED	PRICE	GENERAL OVERLAYS	DEVELOPMENT	REAL-TIME	NETWORK SUPPORT	MULTIUSER	MULTITASKING	MULTIPROCESSING
INDUSTRIAL PROGRAMMING	MTOS-86MP	8086/8	10.5k	ASSEMBLER, C, PL/M	$11,000			•			•	•
INDUSTRIAL PROGRAMMING	MTOS-86/PC	8086/8	9k	ASSEMBLER, C, PL/M	$495		•	•			•	
INDUSTRIAL PROGRAMMING	MTOS-86 RESOURCE REPORTER	8086/8	9k		$11,000			•				
INDUSTRIAL PROGRAMMING	MTOS-86UP	8086/8	9k	ASSEMBLER, C, PL/M	$7000			•			•	
INFOSPHERE	SPHERE	LSI-11, Z80, 6809, 68000, 8086/8	16k	SPHERE	$500		•	•			•	
INTEL	iRMX 51	8031AH, 80C31, 8032, 8044, 8051AH, 80C51, 8052, 8751H	2.2k	ASM 51, PL/M 51	$3000			•	•		•	•
INTEL	iRMX 86	8086/8, 80186/8, 80286	13.5k-40.5k	ASSEMBLER, BASIC, C, FORTRAN, PASCAL, PL/M	$6000		•	•	•	•	•	•
LANTECH SYSTEMS	μNETix	8086/8	256k	ASSEMBLER, C	$130	•	•				•	
MARK WILLIAMS	COHERENT	LSI-11, Z8000, 68000, 8086/8	256k	ASSEMBLER, C	$500 FOR IBM PC	•	•	•		•	•	•
MICROSOFT	MS-DOS 2.0	8086/8, 80186/8, 80286	48k	ASSEMBLER, BASIC, C, COBOL, FORTRAN, PASCAL	—	•	•					
MICROSOFT	MS-DOS 3.0	8086/8, 80186/8, 80286	64k	ASSEMBLER, BASIC, C, COBOL, FORTRAN, PASCAL	—	•	•		•			
MICROSOFT	MSX-DOS	Z80	64k	BASIC	—	•						
MICROSOFT	XENIX	Z8000, 68000, 8086/8, 80186/8, 80286	512k	ASSEMBLER, BASIC, C, COBOL, FORTRAN, PASCAL	—	•	•		•	•	•	•
MICROWARE SYSTEMS	OS-9	6809, 68000	64k	BASIC, C, COBOL, PASCAL	$250	•	•	•		•	•	•
MOTOROLA	RMS09	6809	8k	ASSEMBLER, MPL	$2700			•			•	
MOTOROLA	RMS68K	68000	32k	ASSEMBLER, PASCAL	$490			•	•		•	
MOTOROLA	SYSTEM V/68	68000	384k	ASSEMBLER, BASIC, C	$1695	•	•			•	•	
MOTOROLA	VERSADOS	68000	384k	ASSEMBLER, C, FORTRAN, PASCAL	$2000-$2345	•	•	•	•	•	•	•

MEMORY MANAGEMENT						PERIPHERAL MANAGEMENT													FILE MANAGEMENT							COMMENTS
						DEVICES SUPPORTED									FEATURES											
OVERLAYS	SWAPPING	CHAINING	SEGMENTATION	STATIC RELOCATION	DYNAMIC RELOCATION	CRT	CHARACTER PRINTER	LINE PRINTER	FLOPPY DISK	HARD DISK	CARTRIDGE DISK	MODEM	MAG TAPE	PAPER TAPE	INTERRUPTS	I/O MULTIBUFFERING	SPOOLING	DMA	NAMED FILES	SEQUENTIAL	CONTIGUOUS	RANDOM	INDEXED SEQUENTIAL	MULTILEVEL DIRECTORY	PASSWORD SECURITY	
•			•			•	•	•	•						•			•	•	•	•	•		•		HANDLES 255 CPUs ON MULTIBUS. HAS DYNAMIC MEMORY ALLOCATION.
•			•			•	•	•	•						•			•	•	•	•	•		•		IBM PC VERSION OF MTOS-86.
																										DEBUGGING TOOL CAPTURES STATUS OF TASKS, SERVICES AND DEVICES.
•			•			•	•	•	•	•					•				•	•	•	•		•		HANDLES 2048 TASKS. ALLOWS 32 DYNAMICALLY ALLOCATED MEMORY POOLS.
						•	•		•	•	•	•			•	•		•		•	•	•				INTEGRATED ROM-BASED DEVELOPMENT SYSTEM FOR EMBEDDED REAL-TIME APPLICATIONS.
				•											•			•								TRANSPARENT SUPPORT FOR DISTRIBUTED BITBUS MICROCONTROLLER SYSTEMS.
•		•	•	•		•	•	•	•	•	•	•			•	•		•	•	•	•	•		•	•	SUPPORTS BUBBLE MEMORY, 8087, 80286 NUMERIC DATA-PROCESSOR EXTENSIONS, 80130 OS EXTENSIONS AND PSCOPE DEBUGGER.
				•	•	•	•	•	•						•	•	•	•	•	•				•		PRICE INCLUDES μNETix STAND ALONE, ONE WINDOW. MOST IBM PC/XT ADD-ONS SUPPORTED.
	•	•	•		•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	UNIX-COMPATIBLE SYSTEM. PRICE VARIES WITH HARDWARE. IBM PC PRICE INCLUDES C COMPILER.
	•	•	•			•	•	•	•	•		•			•	•		•	•	•		•		•		
•	•	•	•			•	•	•	•	•		•			•	•		•	•	•		•		•	•	ALL THE FEATURES OF MS-DOS 2.0 WITH THE ADDITION OF NETWORKING HOOKS.
						•	•	•	•	•								•	•	•		•				
	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		•	•	UNIX SYSTEM III WITH ENHANCEMENTS. AVAILABLE FROM OEMs.
						•	•	•	•	•		•							•	•		•		•	•	
				•		•	•								•											
		•	•			•	•	•				•			•		•	•								
	•		•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•		•		•	•	UNIX SYSTEM V IMPLEMENTATION.
		•	•	•		•	•	•	•	•	•	•	•		•		•	•		•	•	•	•	•	•	USED IN VERSAMODULE SBC OR CUSTOM-DESIGNED HARDWARE USING 68000.

OPERATING SYSTEMS DIRECTORY

GENERAL INFORMATION						AREAS OF USE			GENERAL FEATURES			
SUPPLIER	OPERATING SYSTEM	μP	MINIMUM MEMORY (BYTES)	LANGUAGES SUPPORTED	PRICE	GENERAL OVERLAYS	DEVELOPMENT	REAL-TIME	NETWORK SUPPORT	MULTIUSER	MULTITASKING	MULTIPROCESSING
MULTI SOLUTIONS	S1	Z80, 68000, 68010, 8080/5, 8086/8	3k	BASIC, C, COBOL, FORTRAN, PASCAL	$250-$950	•	•	•	•	•	•	•
NATIONAL SEMICONDUCTOR	GENIX	32016	512k	ASSEMBLER, C, PASCAL	—	•	•		•	•	•	
NATIONAL SEMICONDUCTOR	STARPLEX II	Z80A	NA	ASSEMBLER, BASIC, FORTRAN, PASCAL AND OTHERS	—	•	•				•	•
PHASE ONE SYSTEMS	OASIS-8	Z80	56k	ASSEMBLER, BASIC, COBOL	$850	•	•	•		•	•	
PHASE ONE SYSTEMS	OASIS-16	68000, 8086/8	256k	ASSEMBLER, BASIC, C, COBOL	$1495	•	•	•		•	•	
NV PHILIPS	DRM SYSTEM	68000, 68010	40k-50k	C	$15,000			•	•	•	•	•
RCA MICRO-SYSTEMS	MICRODISK OP SYS	1805	60k	BASIC, PASCAL, PL/M	$300	•	•					
RTCS/ REAL-TIME COMPUTER SCIENCE	PC/iRMX	8088	256k	C, FORTRAN, PASCAL, PL/M	$995		•	•		•	•	
RYAN-McFARLAND	RM/COS	9900/5, 68000	128k	COBOL	$1700	•			•	•	•	
S&H COMPUTER SYSTEMS	PRO/TSX-PLUS	DEC PROFESSIONAL 350 (LSI-11/23)	128k	BASIC, C, COBOL, DBL, DIBOL, FORTRAN-77, MACRO-11, PASCAL	$900	•	•		•	•	•	•
S&H COMPUTER SYSTEMS	TSX-PLUS	DEC PROFESSIONAL 300 SERIES (LSI-11/23), ALL MICRO-PDP-11S	128k	BASIC, C, COBOL, DBL, DIBOL, FORTRAN-77, MACRO-11, PASCAL	$2000	•	•	•	•	•	•	•
SGS-ATES	SUNIX	Z8002	512k	ASSEMBLER, BASIC, C, COBOL, PASCAL	—	•	•		•	•	•	
SANTA CRUZ OPERATION	XENIX	Z8000, 68000, 8086/8, 80286	512k	C	$1595	•	•		•	•	•	
SMOKE SIGNAL	OS9	6809	64k	ASSEMBLER, BASIC, C, COBOL, PASCAL	$200-$500	•	•	•		•	•	
SMOKE SIGNAL	OS9/68k	68000, 68008, 68010	128k	ASSEMBLER, BASIC, C, COBOL, PASCAL	$200-$500	•	•	•		•	•	
SMOKE SIGNAL	REGULUS	68000, 68008, 68010	256k	ASSEMBLER, BASIC, C, COBOL, FORTRAN, PASCAL	$995	•	•	•		•	•	

MEMORY MANAGEMENT						PERIPHERAL MANAGEMENT													FILE MANAGEMENT							
						DEVICES SUPPORTED									FEATURES										
OVERLAYS	SWAPPING	CHAINING	SEGMENTATION	STATIC RELOCATION	DYNAMIC RELOCATION	CRT	CHARACTER PRINTER	LINE PRINTER	FLOPPY DISK	HARD DISK	CARTRIDGE DISK	MODEM	MAG TAPE	PAPER TAPE	INTERRUPTS	I/O MULTIBUFFERING	SPOOLING	DMA	NAMED FILES	SEQUENTIAL	CONTIGUOUS	RANDOM	INDEXED SEQUENTIAL	MULTILEVEL DIRECTORY	PASSWORD SECURITY	COMMENTS
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	PROVIDES MEMORY PAGING, ALL VERSIONS COMPATIBLE, EXTENSIVE UTILITIES; EITHER MENU OR COMMAND DRIVEN. IBM PC VERSION, $495.
	•	•	•	•		•	•	•		•		•			•	•	•	•	•			•		•	•	DEMAND-PAGED UNIX SYSTEM REQUIRES 20M-BYTE DISK.
•		•				•	•	•	•	•		•			•		•	•	•	•		•		•		RUNS ON STARPLEX II DEVELOPMENT SYSTEM. PRICE DEPENDS ON CONFIGURATION.
•			•			•	•	•	•	•		•	•		•	•	•	•	•	•	•	•	•		•	
•			•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	
			•	•		•	•	•	•	•		•	•		•	•			•	•		•		•		UNIX COMPATIBLE.
•						•	•	•	•			•			•	•		•	•	•						RUNS ON MS2000 WITH 3½-IN. DISK DRIVES.
•			•	•		•	•		•	•					•	•	•	•	•	•	•	•		•	•	OS IS A PRECONFIGURED VERSION OF INTEL'S RMX-86 OS FOR THE IBM PC/XT AND COMPATIBLES.
		•	•	•	•	•	•	•	•	•	•	•	•		•	•		•	•	•	•	•	•	•	•	SUPPORTS 3780/2780 COMMUNICATIONS. COBOL COMPILER, $1250.
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	ADAPTIVE SCHEDULING ALGORITHM MINIMIZES TERMINAL RESPONSE. RT-11 COMPATIBLE, IT SUPPORTS UP TO 4M BYTES OF MEMORY. VIRTUAL DEBUGGER HAS SYMBOLIC INSTRUCTION DECODING AND DATA-WATCH POINT.
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	ADAPTIVE SCHEDULING ALGORITHM MINIMIZES TERMINAL RESPONSE. RT-11 COMPATIBLE, IT SUPPORTS UP TO 4M BYTES OF MEMORY. VIRTUAL DEBUGGER HAS SYMBOLIC INSTRUCTION DECODING AND DATA-WATCH POINT.
•	•	•	•	•		•	•	•	•	•		•	•		•	•	•	•	•	•		•		•	•	UNIX SYSTEM.
	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•			•	•	•	•	MICROSOFT XENIX SECOND SOURCE.
•					•	•	•	•	•	•		•	•		•	•	•	•	•	•	•	•		•	•	
•						•	•	•	•	•		•	•		•	•	•	•	•	•	•	•		•	•	
•	•	•	•		•										•	•	•	•	•	•	•	•	•	•	•	

OPERATING SYSTEMS DIRECTORY

GENERAL INFORMATION						AREAS OF USE			GENERAL FEATURES			
SUPPLIER	OPERATING SYSTEM	μP	MINIMUM MEMORY (BYTES)	LANGUAGES SUPPORTED	PRICE	GENERAL OVERLAYS	DEVELOPMENT	REAL-TIME	NETWORK SUPPORT	MULTIUSER	MULTITASKING	MULTIPROCESSING
SOFTECH MICROSYSTEMS	p-SYSTEM	LSI-11, Z80, 6502, 6809, 68000, 8080, 8086/8, 9900	64k	ASSEMBLER, BASIC, FORTRAN-77, PASCAL	$250	•	•				•	
SOFTWARE COMPONENTS	pSOS-68K	68000	4k	NA	$3000	•		•		•	•	•
SOFTWARE DYNAMICS	SDOS	6809	56k	ASSEMBLER, BASIC	$782	•	•		•	•	•	
SYSTEMS & SOFTWARE	REX-80/80	8080/5, Z80	2.5k	ASSEMBLER, C, PL/M	$2750		•	•			•	•
SYSTEMS & SOFTWARE	REX-80/86	8086, 80186	4k	C, PL/M-86	$3750		•	•			•	•
TECHNICAL SYSTEMS CONSULTANTS	FLEX	6800/9	20k	ASSEMBLER, BASIC, C, FORTRAN, PASCAL	$250	•	•			•	•	
TECHNICAL SYSTEMS CONSULTANTS	UNIFLEX	6809, 68000, 68010	512k	ASSEMBLER, BASIC, C, COBOL, FORTRAN, PASCAL	—	•	•			•	•	•
TELESOFT	ROS	68000, 8086	320k-576k	ADA, ASSEMBLER	—	•	•					
UNISOFT SYSTEMS	UNIPLUS+	68000, 80286	256k	ADA, BASIC, COBOL, FORTRAN, PASCAL	$750-$1500	•	•		•	•	•	
US SOFTWARE	MTK	Z80, 6502, 6800/9, 68000, 8085, 8086	1k	NA	$250		•	•			•	
UTC/MOSTEK	M/OS-80	Z80	64k	LANGUAGES COMPATIBLE WITH CP/M	$325-$495	•	•	•			•	
VENTURCOM	VENIX	LSI-11, 8086/8, 80186, 80286	128k	BASIC, C, FORTRAN-77, PASCAL	$900-$5250	•	•	•	•	•	•	•
VOLITION	MOS	Z80, 68000, 8080, 8086/8	60k-64k	ASSEMBLER, MODULA-2, PASCAL	$595	•	•				•	
WHITESMITHS	CO-IDRIS	LSI-11, 68000, 68010, 8086/8, 80186, 80286	128k	ASSEMBLER, C, PASCAL	$695 FOR IBM PC WITH C AND PASCAL	•	•	•	•	•	•	
WINTEK	UCSD PASCAL	6800	56k	ASSEMBLER	$675	•	•					
WINTEK	WIZRD	6800	32k	ASSEMBLER, BASIC, C	$495	•	•	•			•	

MEMORY MANAGEMENT						PERIPHERAL MANAGEMENT													FILE MANAGEMENT							
						DEVICES SUPPORTED									FEATURES										
OVERLAYS	SWAPPING	CHAINING	SEGMENTATION	STATIC RELOCATION	DYNAMIC RELOCATION	CRT	CHARACTER PRINTER	LINE PRINTER	FLOPPY DISK	HARD DISK	CARTRIDGE DISK	MODEM	MAG TAPE	PAPER TAPE	INTERRUPTS	I/O MULTIBUFFERING	SPOOLING	DMA	NAMED FILES	SEQUENTIAL	CONTIGUOUS	RANDOM	INDEXED SEQUENTIAL	MULTILEVEL DIRECTORY	PASSWORD SECURITY	COMMENTS
	•				•	•	•	•	•	•	•	•			•				•	•	•	•	•			
						•	•		•	•					•	•	•	•	•		•	•		•		AVAILABLE ON FLOPPY OR IN PROM. PRICE IS FOR 5-COPY LICENSE. UNLIMITED LICENSE IS $12,000.
		•				•	•	•	•	•	•				•	•		•	•	•	•	•	•		•	PRICE INCLUDES BASIC COMPILER AND EDITOR.
			•	•		•	•	•	•						•	•			•	•		•				RUNS ON SINGLE-BOARD COMPUTERS.
			•		•	•	•	•	•						•	•										
•	•	•	•		•	•	•	•	•	•	•	•	•		•	•		•	•	•	•	•				AVAILABLE FOR VARIOUS HARDWARE SYSTEMS.
•	•					•	•	•	•	•					•		•	•	•	•	•	•	•	•	•	MODELED AFTER UNIX BUT WRITTEN IN ASSEMBLY LANGUAGE. KERNEL AND DRIVERS FOR 68000 VERSION RESIDE IN 45k.
•		•				•	•	•	•	•		•		•	•		•	•	•	•		•				PRICE DEPENDS ON CONFIGURATION.
	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		•		UNIX WITH BERKELEY ENHANCEMENTS. PRICES ARE FOR SINGLE-USER AND MULTIUSER VERSIONS, RESPECTIVELY.
																										MULTITASKING KERNEL USES AS LITTLE AS 100 BYTES OF MEMORY.
•		•	•			•	•	•	•	•	•	•	•	•			•	•	•	•		•			•	
•	•		•		•	•	•	•	•	•		•			•	•	•		•					•	•	UNIX, WITH BERKELEY ENHANCEMENTS AND REAL-TIME EXTENSIONS, RUNS ON IBM PC/COMPATIBLES.
•		•				•	•	•	•			•			•			•	•	•	•	•				PASCAL-LIKE p-CODE SYSTEM. PRICE INCLUDES LANGUAGE COMPILERS, SCREEN EDITOR AND UTILITIES.
	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•		•		•	•	SOURCE UNIX V7, SYSTEM III AND V COMPATIBLE. FILE SYSTEM IS V6 COMPATIBLE. SUPPORTS ALL V6 SYSTEM CALLS EXCEPT PTRACE.
•	•			•	•	•	•	•	•			•							•	•	•	•				RUNS ON SPRINT 68.
						•	•	•	•						•	•	•		•			•				

IS YOUR PRESENT DISK DRIVE SUPPLIER GIVING YOU ANYTHING TO LOOK FORWARD TO?

Our 5¼" drive gives you more capacity in less space, for less money.

Let's hope so.

Because your systems depend on disk drives. So it's important to have a disk drive supplier you can depend on.

And that's where NEC comes in.

At NEC, we're always driving ahead.

With newer drives. Drives with more storage capacity. More reliability. Drives that keep pace with the latest technology.

How do we do it?

With more experience. We've been designing disk drives a long time. Way back in 1959, we were one of the first to develop magnetic recording devices.

Plus, we've got plenty of other resources. We're an $8 billion company. And that means we're in this business for the long run.

We just doubled the capacity of our 5¼" half-height drives.

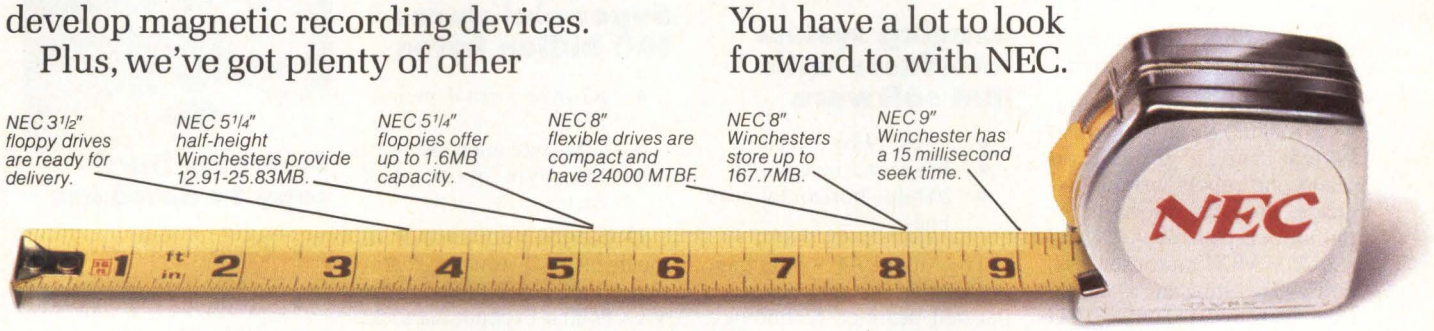
No one thought we could improve on our 5¼" Winchester half-heights. But we did. We doubled our efforts. And we ended up doubling the tracks on our 5¼". The result?

You guessed it. 25.83MB instead of just 12.91MB.

If you need other disk drives, we also make a new 3½" floppy, 8" Winchesters and floppies, and 9" Winchesters. And you can be sure there will be more.

Drive into the future with NEC.

You have a lot to look forward to with NEC.



To find out more just call 1-800-343-4418. (In Massachusetts call 617-264-8635.) Or fill out the coupon below.

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Please send me more information on:

Floppy Drives
- ☐ 3½"
- ☐ 5¼" half-height
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- ☐ 8"
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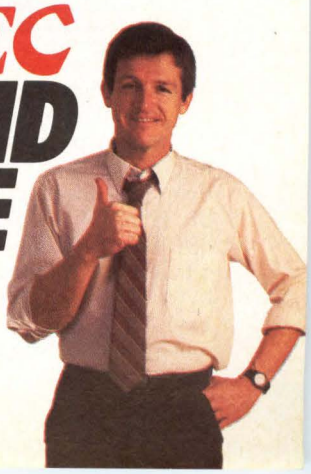
NEC AND ME

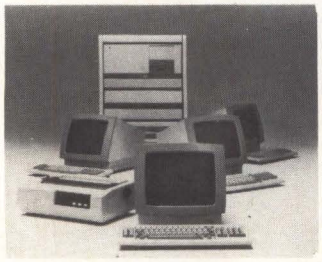


CIRCLE NO. 91 ON INQUIRY CARD

NEW PRODUCTS

SYSTEMS

Eileen Milauskas, Assistant Editor



Multiuser systems support Pick OS

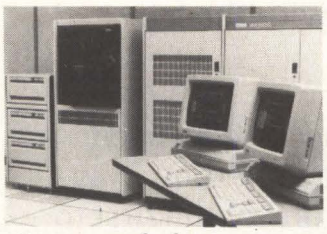
- 68000 CPU
- Dual-bus architecture
- Supports 4 to 40 users

The Pick operating system, with a database management system and a procedural query and report-writing language, provides the basis for the models 680/100 APX and 680/200 APX multiuser systems. Operating at 10 MHz, the systems' 68000 CPU achieves zero wait states. The dual-bus architecture—Multibus and the Intel Local Bus Extension (iLBX)—sends data between the CPU and memory at 19M bytes per second. Intelligent I/O controllers, standard on the 680/200 APX, incorporate an 8088-2 microprocessor with 64K bytes of RAM and 32K bytes of EPROM memory. The 680/100 APX supports four to 16 users and comes with 512K bytes of RAM, one 500K-byte floppy disk drive and as much as 92M bytes of Winchester disk storage. Supporting as many as 40 users, the 680/200 APX provides 512K bytes to 2M bytes of RAM and as much as 336M bytes of hard disk storage. Model 680/100 APX, $17,000-$30,000; model 680/200 APX, $35,000. **CIE Systems,** 2515 McCabe Way, P.O. Box 16579, Irvine, Calif. 92713-6579, (714) 660-1800. **Circle No 300**

Imaging system interfaces with IBM software

- 15 by 19 by 5 inches
- 30-second image scan
- 200-dpi horizontal scan line

The Model 700 word image processing system, based on flat-bed scanner technology, works with proprietary software to capture and process images. It interfaces with IBM PC word-processing and database-management software to create documents that integrate images, text and numbers. Operating as a front-end peripheral with the IBM PC/XT or PC-AT, the system consists of the Model 210 graphic scanner, the Model 111 imaging interface, software and cables. Scanning is initiated from the personal computer and takes less than 30 seconds. Selectable halftone patterns and three contrast levels provide for continuous tone scanning and imaging. Horizontal resolution is 200 dpi; vertical resolution is selectable at 200, 150 or 100 lpi. Weighing 21 pounds, the unit measures 15 inches by 19 inches by 5 inches. $4,000. **Datacopy Corp.,** 1215 Terra Bella Ave., Mountain View, Calif. 94043, (415) 965-7900. **Circle No. 301**



Supermini stores 160 billion bytes

- 4G-byte virtual memory
- 12M-byte main memory
- 16K-byte write-back cache

Delivering performance as much as 4.2 times greater than the VAX-11/780, the VAX 8600 is expandable to 32 million bytes of main memory and 160 billion bytes of online storage. Supporting 512 communication lines directly, the system runs under the VMS operating system and utilizes emitter-coupled logic (ECL). The processor includes an 8-byte look-ahead instruction buffer and a 16K-byte write-back memory cache. The instruction set consists of 16 32-bit registers, 304 basic operations, 32 priority interrupt levels and nine addressing modes. Virtual memory address space is 4G bytes. An entry-level system includes the CPU; integrated floating-point accelerator; 12M bytes of main memory; an integrated controller and adapters for 104 asynchronous communications lines, synchronous lines and line printer ports; HSC50 mass storage server and star coupler; a 456M-byte RA81 disk drive; TA78 magnetic tape transport; and console terminal. Prices start at $576,000. **Digital Equipment Corp.,** 146 Main St., Maynard, Mass. 01754, (617) 897-5111. **Circle No. 302**

Converts hard copy to database

- Scans, vectorizes documents
- Reduces vectors to primitives
- Divides drawings into layers

Model 4991S1 Graphics Input Workstation transforms existing maps and engineering drawings into CAD database files. After scanning, interactive graphics structuring software executes n-point registration and arc/-line/text/symbol replacement operations. Other editing capabilities include eliminating smudges, adding detail or dimension information and layering drawings for separate storage, display and manipulation. Host interfacing software supports IBM's CADAM, Computervision's CADDS 4X and Tektronix's PLOT 10 TekniCAD. $150,000. **Tektronix Inc.,** P.O. Box 500, Beaverton, Ore. 97077, (503) 644-0161. **Circle No 303**

FIVE AGAINST ONE

It Hardly Seems Fair

*F*ive against one is just as unfair in a business environment as it is on a basketball court. IBC's Multi-Star I,™ five user business computer—priced as low as a single user personal computer with all of the attributes of a true multi-user system has the full court advantage.

The Multi-Star isn't just another single user personal computer that can be "Networked" to pretend you have multi-user capabilities. It is a true multi-user business system like the high priced multi-user minicomputers of old. And, a low cost "Dumb" CRT terminal is all that you need for each user.

Sophisticated multi-user software with big system features such as record locking, user accounting, privilege levels, and system security provide capabilities well beyond those available on any personal computer.

There are hundreds of multi-user business accounting software applications available right now as well as word processing, spread sheet, and data base software.

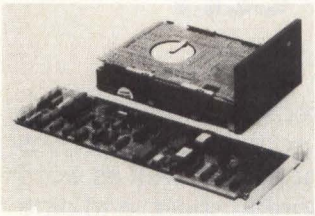
The Multi-Star I is the smallest member of the IBC multi-user family. Software compatible systems with up to 16 users and 167 megabytes of hard disk storage are also available.

IBC has been manufacturing high-performance, multi-user microcomputers since 1979. Their reputation has been built on quality, performance, and reliability. To find out more about the multi-user business systems that is priced like a single user personal computer, please call or write:

IBC

Integrated Business Computers
21621 Nordhoff Street
Chatsworth, CA 91311
(818) 882-9007
Telex No. 215349

CIRCLE NO. 92 ON INQUIRY CARD



Winchester drive upgrades PC to XT

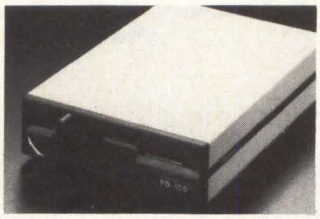
- 5M-bps data transfer rate
- 85-msec average access time
- 10M-byte storage capacity

Equipped with a controller, utility software and a half-height, 5¼-inch Winchester disk drive, the DiskSystem increases the capability of an IBM PC or PC compatible to that of an IBM/XT when using DOS 2.0. Storing 10M bytes, the drive transfers data at 5M bps. Track-to-track access time is 18 msecs; average access time is 85 msecs. With a faceplate, the drive fits a standard 5¼-inch slot. $1,095. **I2 Interface Inc.,** 21101 Osborne St., Canoga Park, Calif. 91304, (818) 341-7914. **Circle No 304**

Disk drive employs DC drive motor

- 164K-byte storage capacity
- 48-tpi track density
- 5,536-bpi recording density

Storing 164K bytes and compatible with Apple microcomputers, the 5¼-inch FD-100 minifloppy disk drive utilizes a direct DC drive motor to reduce noise. The



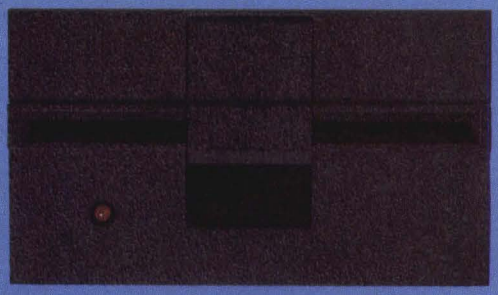
single-sided, double-density drive employs Group Code Recording (GCR). Track density is 48 tpi and recording density is 5,536 bpi. Track-to-track access time is six msecs; data transfer rate is 250K bytes per second. The Track-O-sensor feature prevents disk damage by reducing friction inside the mechanism. The FD-100 is only 46mm thick and weighs 4.29 pounds. $90, quantity 100. **Multitech Industrial Corp.,** 9FL. 266, Sung Chiang Road, Taipei 104, Taiwan, Republic of China, (02) 551-1101.

Circle No 305

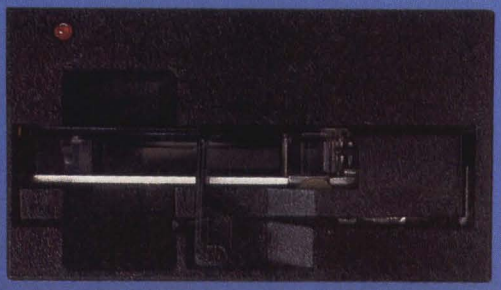
3½-inch drives suit HP computers

- 485-msec average access time
- 500K-bps data transfer rate
- Double-sided, double-density

Providing mass storage options for HP personal computers are three double-sided, double-density, 3½-inch microfloppy disk drives. The single-drive 9122S, offers 710K bytes of formatted storage capacity; the dual-drive 9122D, stores 1.4M bytes and comes as standard equipment on the HP Touchscreen Personal Computer. The 9114A, a portable, battery-powered 3½-inch disk drive, holds 710K bytes and transfers data between the Portable and the Touchscreen Personal Com-



THE END OF THE SECONDARY STORAGE SPECTRUM EVERYONE FORGOT ABOUT WAS THE MIDDLE.

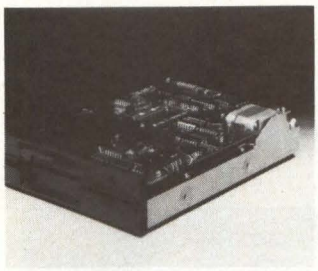


puter. All three models read, write and format in a single-sided format. Average access time is 485 msecs; the average data transfer rate for the three drives is 500K bps. $795, model 9114A; $965, model 9122S; $1,270, model 9122D. **Hewlett-Packard Co.,** 3000 Hanover St., Palo Alto, Calif. 94304. **Circle No 306**

Half-height drive operates at two speeds

- 96-tpi track density
- 500K-, 250K-bps data transfer rates
- Brushless direct-drive motor

Giving systems designers the benefit of two standard formats in one package, the



YD-380-1714 5¼-inch disk drive's dual-speed feature allows operation with either the current standard format for 5¼-inch media or the new high-capacity 5¼-inch media. The drive reads and writes on either the standard 1M-byte, double-density, double-track format or the new high-capacity 1.6M-byte unformatted/1.2M-byte formatted disk. Data transfer rates are 500K and 250K bps; track density is 96 tpi. As many as four drives can be daisy chained. A read and write head design, steel belt head positioning and a brushless direct-drive motor provide a 12,000-POH mean time between failures (MTBF). $200, OEM quantities. **C. Itoh Electronics Inc.,** 5301 Beethoven St., Los Angeles, Calif. 90066, (213) 306-6700.

Circle No 307

Disk drive features closed-loop servo

- 20M-byte storage capacity
- 9,036 bpi
- 85-msec average access time

Simplifying system upgrades by utilizing the ST506/412 interface, the model 724 5¼-inch half-height Winchester disk drive features a

closed-loop servo positioning system. With a track density of 720 tpi, the drive stores 20M bytes. With a recording density of 9,036 bpi, the drive achieves an 85-msec average access time and a 5M-bps transfer rate. The printed circuit board includes four LSI devices and two 8-bit microprocessors. The read/write head is positioned with a stepper motor/band actuator system. $500, OEM quantities. **Shugart Corp.,** 475 Oakmead Pkwy.Sunnyvale, Calif. 94086 (408) 733-0100. **Circle No 308**

It wasn't long ago that when you wanted to back up a 5¼" Winchester, you only had two choices: floppies or QIC-compatible ¼" tape.

Well, now there's a third choice: Cipher's FloppyTape.™ It gives you the best of both worlds — without the drawbacks of either.

Economical like a floppy.

FloppyTape is the perfect secondary storage device for low-cost systems. It offers a substantially lower cost-per-megabyte than floppies. Yet the actual cost of the drive is only slightly more.

What's more, FloppyTape uses a standard floppy interface. And it works perfectly with most regular floppy controllers. So you can share your system's existing floppy controller.

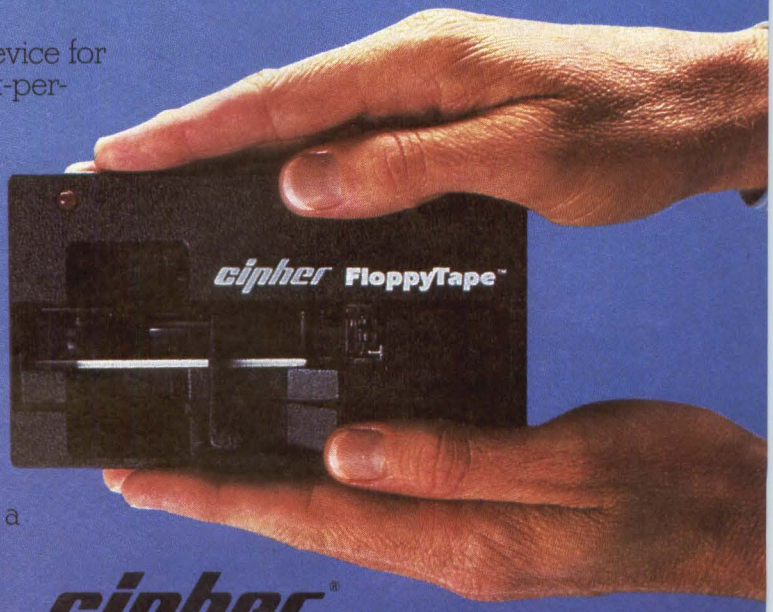
High capacity like a streamer.

Using a standard ¼" tape cartridge, FloppyTape gives you up to 32 megabytes of storage.

It eliminates the problems of handling a large number of floppy disks.

And FloppyTape is priced well below QIC-compatible ¼" streamers. With QIC, you also need a new host adapter or controller. But you don't with FloppyTape.

If the part of the secondary storage spectrum that's best for your system is the middle, call 800-982-8808. Or write Cipher Data Products, P.O. Box 85509, San Diego, CA 92138.



cipher® data products, inc.

WE PUT THE BEST IDEAS INTO STORAGE.

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CIRCLE NO. 93 ON INQUIRY CARD

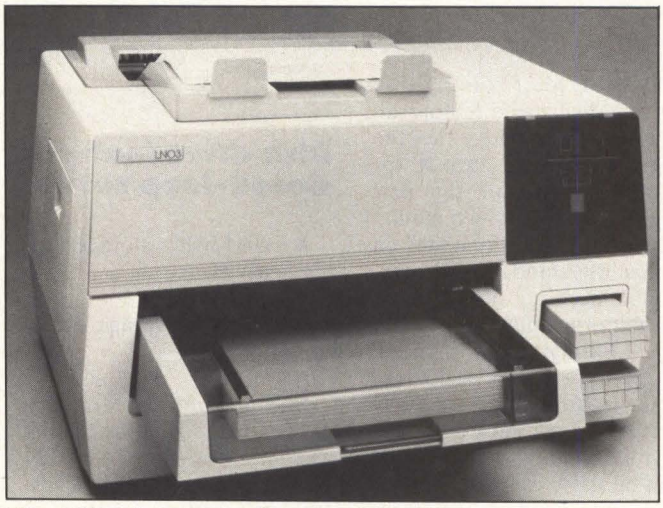
Desktop laser printer produces 300-dpi resolution

- Prints eight ppm
- 150-dpi business graphics
- 16 resident fonts

Working with both single- and multiuser systems, the low-cost LN03 desktop laser printer combines the features of a line printer, a dot-matrix printer and a daisywheel. Printing 8 ppm or 333 cps, the unit is 10 times faster than conventional printers. It generates 300-dpi resolution in text mode, twice that of average dot-matrix printers, and 150-dpi resolution for business graphics.

The printer's input cassette and output tray can each hold up to 250 sheets of standard letter-size paper. This is 2½ times the input capacity of most laser printers and 12 times the capacity of most output systems. The unit prints on standard 8½-by-11-inch paper, European Standard A4 paper, 16- to 24-pound paper and tranparencies.

Sixteen resident fonts permit two modes; the vertically aligned portrait mode, with as many as 120 cpl (characters per line) and the horizontal landscape mode, with a maximum of 150 cpl. Optional fonts are available in precoded ROM cartridges or in host media that are downline-loadable to 128K-byte RAM cartridges offering 24 fonts per page.



The LN03 hardcopy laser printer *for personal computers and multiuser systems prints eight ppm, a rate ten times faster than conventional printers.*

Accommodating a monthly print volume of 3,500 pages, the non-impact printer requires access from only two sides for maintenance. Replaceable components, international control panel symbols and explanatory flip cards mounted on the printer are provided.

Driven by an onboard controller, the laser printer is furnished with a serial interface with a selectable baud rate to 19.2K. It is compatible with applications written for the proprietary LQP02 letter-quality printer, the LA100 printer and the LN01 laser printer. $4,195. **Digital Equipment Corp.,** 146 Main St., Maynard, Mass. 01754, (617) 897-5111. **Circle No 309**

Electrostatic plotters produce 508 dpi

- .25-ips to .1-ips plot speed
- 24-, 36- and 44-inch plot widths
- Sensor capabilities

The 9800 series of electrostatic plotters operates at 508 dpi. Plot speed for the 24-inch model is 0.25 ips; for the 36-inch model, .15 ips and for the 44-inch model, 0.1 ips.

Sensor capabilities monitor paper, toner and concentrate levels; concentrate adjustment control is automatic. A built-in paper media cutter and self-diagnostics are standard. An optional Graphware 2400 dedicated element-processor which accepts Virtual Device Metafile graphics data for raster-image generation is optional. The plotters and Graphware can be interfaced to superminicomputers and mainframes. $44,485, 24-inch model; $61,875, 36-inch model; $79,875, 44-inch model. **Benson Inc.,** 2690 Orchard Park Way, P.O. Box 32059, San Jose, Calif. 95152-2059, (408) 945-1000.

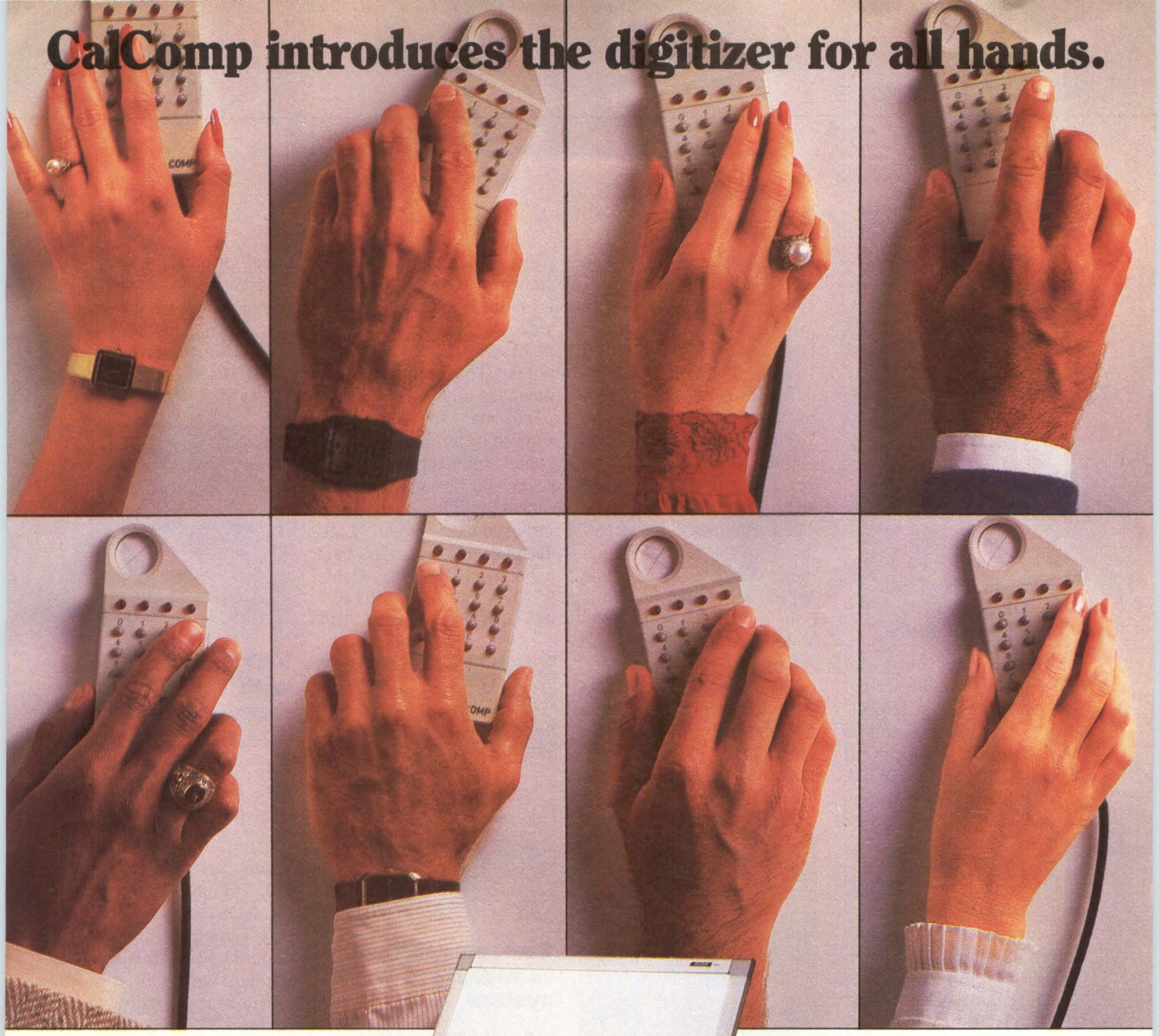
Circle No 310

Multimode printer offers software compatibility

- 37½ cps in letter-quality mode
- 75 cps in near-letter-quality mode
- 180 or 150 cps in data-processing mode

Compatible with Anadex, Epson and DEC escape codes, the model 7035 multimode printer stores as much as 43 letter-quality fonts online. The printer operates at 37½ cps in letter-quality, 75 cps in near-letter-quality and 180 or 150 cps in data-processing mode. It supports 32 ASCII code-selectable line-drawing graphics characters in the 150-cps and 180-cps speeds. In the graphics mode, buffer capacity is 4.7K bytes standard, expandable to 12.7K bytes in 2K-byte increments. Dot-addressable graphics produce 72-by-72 and 144-by-144 bit-mapped dpi. Courier and Trend word processing fonts and eight international character sets are standard. Standard features include bar-code capability, compressed pitch at 10, 12, 13.3, 15 and 17.1 cpi; horizontal and vertical tabs from one to 255 positions; vertical line spacing; front and bottom paper feed; adjustable tractor feed from three to 15½ inches and Centronics parallel and RS232C serial interfaces. $1,695. **Qantex Printer Products, North Atlantic Industries Inc.,** 60 Plant Ave., Hauppage, N.Y. 11788, (516) 582-6060 or (800) 645-5292. **Circle No 311**

CalComp introduces the digitizer for all hands.



At CalComp, we believe a digitizer should be easy to use. For everyone. In every application.

As a result, our new 9100 features a special ergonomic design ideal for both left- and right-handed operation. The cursor's slim body promotes accurate cross hair placement, even at severe operating angles. And the signal cable exits the cursor behind your hand, away from the work area.

To keep all hands happy, we've concealed the 9100 digitizer's control electronics in the frame. And table edges are smooth so they'll never snag clothing. We've also included a handy accessory tray to keep digitizing tools in easy reach and a pen/cursor holder that can be mounted anywhere on the 9100's uniquely constructed frame.

The new 9100 digitizer.

Ergonomics even extend to accurate operation of the unit. Here, human engineering combines with the patented electromagnetic technology to deliver ±.005″ accuracy with a resolution of 1000 lines/inch. Performance is verified with automated testing, detailed in an accuracy certification printout and brochure shipped with every unit.

CalComp innovation puts new digitizing productivity in your hands. The new 9100 digitizer is available in a range of table sizes, with 4- and 16-push-button cursors, pens, and a wide choice of options. For details call toll-free 1-800-CALCOMP, ext. 156. Or write CalComp, 2411 W. La Palma Ave., P.O. Box 3250, Anaheim, CA 92803.

CALCOMP 25 1959 1984

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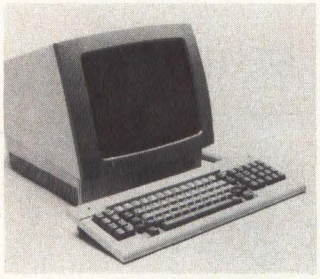
CIRCLE NO. 94 ON INQUIRY CARD

TERMINALS



Display terminal emulates IBM 3101

- 14-inch screen
- 25 lines of 80 or 132 characters
- DEC VT100, HP 2622A emulation

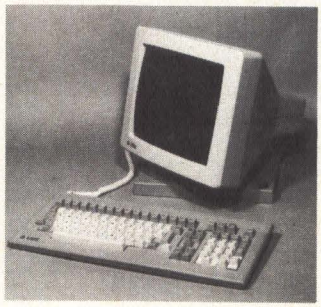
Meeting data entry requirements in multiuser environments, the CIE-7100 display terminal emulates the Digital Equipment Corp. VT100 and HP2622A terminals and terminals recommended as multiuser add-ons to the IBM PC-AT. Replacing the IBM 3101 display terminal, the CIE-7100 can be used as a data entry device with the proprietary family of multiuser UNIX- or Pick-based computers. The terminal works with the IBM ASCII protocol converter as well. Features include a 14-inch, non-glare screen that displays 25 lines of 80 or 132 characters and a bidirectional RS232C port. **CIE Systems Inc.,** 2505 McCabe Way, Irvine, Calif. 92715, (714) 660-1421.

Circle No 312

Terminals emulate Tektronix 4010, 4014

- 665-by-288-pixel resolution
- 4,096-by-4,096 addressing
- 14-inch, 132-column display

The Freedom 240 Graphics/ANSI Video Display Terminal and the Freedom 210 Graphics/ASCII Video Display Terminal both offer 14-inch, 132-column alphanumeric displays with 665-by-288-pixel resolution and 4,096-by-4,096 addressability. Both emulate the Tektronix Inc. 4010 and 4014 graphics terminals. The Freedom 240 is compatible with the Digital Equipment Corp. VT220 and VT100 terminals; the Freedom 210 emulates the TeleVideo Systems Inc. 950 and ADM 31 terminals. $1,395, model 240; $1,295, model 210. **Liberty Electronics,** 625 Third St., San Francisco, Calif. 94107, (415) 543-7000. **Circle No 313**



Terminal emulates ASCII terminals

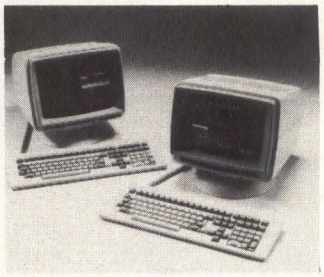
- 14-inch, 132-column display
- 32 function keys
- One page of screen memory

Compatible with the Wyse Technology 50, TeleVideo Systems Inc. models 925 and 910, Lear Siegler Inc. models ADM 3A and 5 and the ADDS Viewpoint, the Link 25 provides 32 programmable function keys and non-volatile storage capability. Its 14-inch screen displays 132 columns. One page of screen memory is standard. Reduced intensity is non-embedded; reverse video, underline, blink and blank are embedded attributes. The unit offers a green or amber screen and performs full editing, smooth or jump scroll, horizontal split screen, screen saver and business graphics functions. The keyboard is DIN-standard. $599. **Link Technologies Inc.,** 2260 Paragon Drive, San Jose, Calif. 95131, (408) 943-0142/-0143. **Circle No 314**

Converts IBM PC to multiuser system

- 20 function keys
- 25-line display
- IBM PC character set

Converting IBM Corp. PC/XT,-AT or other compatibles into a timesharing, multitasking and multiuser computer system, the KT-7/PC data display terminal offers a 256 IBM PC character set including graphics characters. Features include a green, nonglare, 12-inch screen with a 25-line scrollable and directly addressable display; an attribute-selectable user line; a low-profile IBM PC keyboard with three adjustable heights and a tilt-and-swivel monitor; a bidirectional printer port and 20 programmable function keys stored in non-volatile memory. $895. **Kimtron Corp.,** 2225-I Martin Ave., Santa Clara, Calif. 95050, (408) 727-1510. **Circle No 315**



VDT compatible with TeleVideo terminals

- 16 function keys
- 424 bytes of memory
- Bidirectional printer port

Compatible with TeleVideo System Inc.'s 925, 950, 912 and 920 terminals, the ADM 12plus video display terminal offers a detached, low-profile DIN standard keyboard with 16 function keys, shiftable to perform 32 programmable, non-volatile functions. A variable-format display memory provides two 80-column-by-24-line standard pages, an 80-column-by-48-line-long page or a 158-column-by-24-line-wide page. Editing capabilities include variable-speed smooth, vertical and horizontal scrolling and five video attributes: underlining, reverse video, reduced intensity, blinking and blanking. The baud rate on the bidirectional printer port is independently set. **Lear Siegler Inc.,** Data Products Division, 901 E. Ball Road, Anaheim, Calif. 92805, (714) 778-3500.

Circle No 316

Not long ago, *PC* Magazine called MDBS III "The most complete and flexible data base management system available for microcomputers." That's a powerful statement. But then, MDBS III is an amazingly powerful software package. So powerful, in fact, that it lets you build mainframe-quality application systems on your micro or mini. MDBS III is not for beginners. It's for application developers with large data bases or complex data interrelationships who want to define data base structures in the most natural way—without resorting to redundancy or artificial constructs. It's for professionals who can appreciate its extensive data security and integrity features, transaction logging, ad hoc query and report writing capability and its ability to serve multiple simultaneous users. And if you want the power and the glory that only the world's most advanced data management system can provide, MDBS III is for you. For information on MDBS III and our professional consulting services, write or call Micro Data Base Systems, Inc., MDBS/Application Development Products, 85 West Algonquin Road, Suite 400, Arlington Heights, IL 60005. (800) 323-3629, or (312) 981-9200. **MDBS III. ABSOLUTE POWER.**

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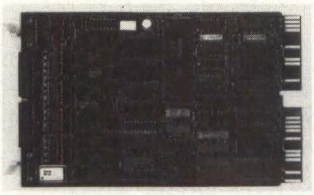
CIRCLE NO. 95 ON INQUIRY CARD



Multiplexer works with DEC LSI-11

- Eight or 16 asynchronous serial lines
- DEC DH11 software compatible
- Programmable data rates to 38.4K bps

Achieving a 38.4K-bps data rate, the Model 309 8- or 16-channel asynchronous multiplexer uses an EIA RS232C or CCITT V.24 interface to link the DEC LSI-11 Q-bus to multiple local or remote terminals and peripherals. Packaged on a single dual-height Q-bus module, Model 309 is compatible with all DEC DH11 software and with Q-bus extended 22-bit addressing and four-level vector interrupt structures. The 192-character FIFO receiver buffer and the on-board DMA controller reduces CPU overhead. The receiver-buffer fill level required to generate a receiver interrupt is software programmable. The transmitter buffer areas can hold 64K bytes of data and can be relocated over the address space. The board operates in half-duplex or full-duplex mode and measures 5.2 inches by 8.9 inches. $995, 8-bit model; $1,595, 16-bit model. **Grant Technology Systems Corp.,** 11 Summer St., Chelmsford, Mass. 01824, (617) 256-8881.

Circle No 317

Modem operates at 2,400 bps

- Smartmodem 1200 compatibility
- Stores six 37-digit numbers
- Links to dial-up, dedicated lines

The autodial/auto-answer MT224AD modem conforms to the CCITT V.22 bis standard at 2,400 bps and to the Bell 212A and 103/113 standards at 1,200 and 300 bps. By utilizing the Hayes Smartmodem 1200 command, the modem becomes compatible with most microcomputer communications software. It stores six 37-digit telephone numbers in battery-backed memory and detects busy or dial tones. Additional commands allow the unit to redial a busy number until it connects, or to link to alternate numbers. The modem operates in synchronous or asynchronous modes and connects to dial-up or dedicated telephone lines. Features include 10 status LEDs, analog, digital and remote digital loopback test modes and free online time for CompuServe, NewsNet, The Source and other information retrieval services. $949. **Multi-Tech Systems Inc.,** 82 Second Ave. S.E., New Brighton, Minn. 55112. (612) 631-3550.

Circle No 318

Interface unit links IBM 3270, non-IBM hosts

- Supports 7- or 8-bit ASCII modes
- 110 bps to 19.2K bps
- VT100, ADM-3A emulation

Allowing IBM 3270 terminal users to toggle between IBM and non-IBM host sessions, the Matchmaker 2000 interface unit makes minicomputers, personal computers, microcomputers, PBXes, public packet-switching networks, information and electronic mail services accessible to 3270 users. It resides between an IBM 3178, 3179, 3180, 3278 or 3279 terminal and the IBM 3274 or 3276 cluster controller. In 3270 mode it is transparent; an RS232C cable links the unit directly, or via modem, to the ASCII device. It supports 7- or 8-bit ASCII character modes to allow interfacing at 110 bps to 19.2K bps. The unit furnishes VT100 and ADM-3A terminal emulation for ASCII compatibility. Weighing three pounds, the unit measures 6½ inches by 9½ inches by 1½ inches. $695. **Manufacturing Technologies Inc.,** System Division, 6481 Global Drive, Cypress, Calif. 90630, (714) 220-1004.

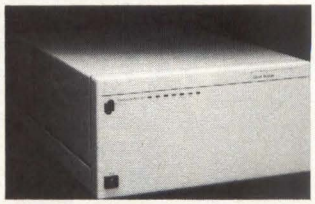
Circle No 319

Modem offers triple compatibility

- 300 or 1,200 bps
- Originate, answer modes
- 20-number directory

The DialNet3000 Model 3012T+ autodialing modem provides three-way compatibility—Bell 212A or Racal Vadic 3400 at 1,200 bps or Bell 103 at 300 bps—in both originate and answer mode. The unit automatically sets for compatibility with a calling modem and automatically sets speed and compatibility mode to match when dialing the remote modem. It operates under either computer or terminal control and the autodialer supports pulse and tone dialing. Numbers within the 20-number directory can be linked so that the modem dials alternate numbers in a specified sequence. $795, standalone unit; $745, card module. **Micom Systems Inc.,** 20151 Nordhoff St., Chatsworth, Calif. 91311, (213) 998-8844.

Circle No 320



Bridge boosts data-transfer rates

- 1,000-packet-per-second transfers
- Interconnects broadband channels
- Transparent packet routing

Increasing data transfer rates between networks by more than 600 percent over the previous version, the Net/One Local Bridge provides store and forward interconnection of multiple Net/One networks in the same geographic location. The bridge functions as a packet-switching node between Ethernet/IEEE 802 baseband, fiber-optic baseband and broadband systems and executes virtual circuit and datagram packet transfers at 1,000 packets per second. It supports downloading of software configuration information by a single network management console (NMC) into network interface units (NIUs) throughout the internet. Sixteen local bridges can be supported on an internet. Transparent and dynamic packet routing provide automatic adaptation to topology changes. $9,850. **Ungermann-Bass Inc.,** 2560 Mission College Blvd., Santa Clara, Calif. 95050, (408) 496-0111.

Circle No 321

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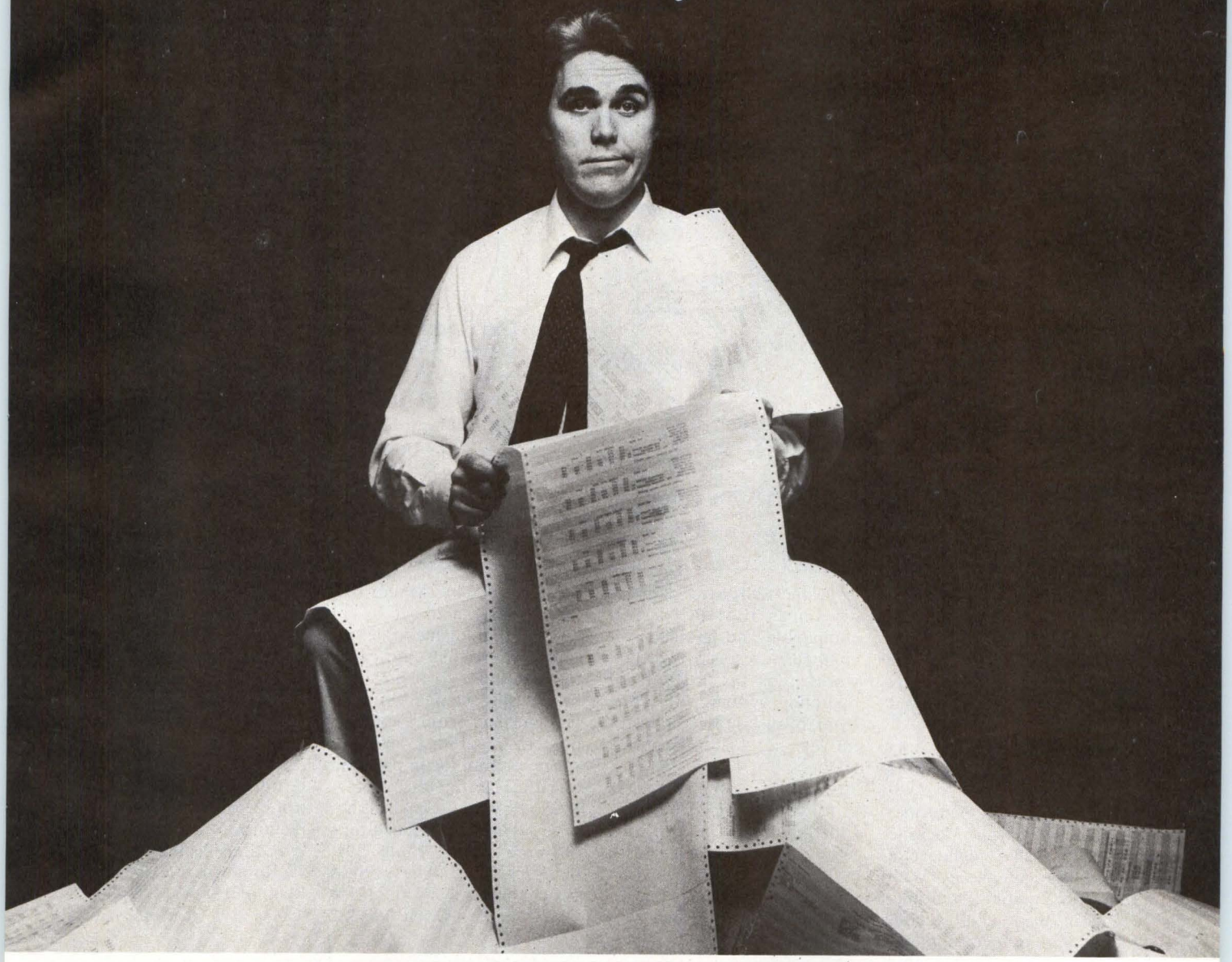

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Mini-Micro Systems
The leading magazine for computer professionals in the value-added market who integrate, configure and implement mini-micro computers and computer-based systems.

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PC Products
The product review and evaluation magazine for the business users of IBM PC's and compatible computers.

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CIRCLE NO. 96 ON INQUIRY CARD

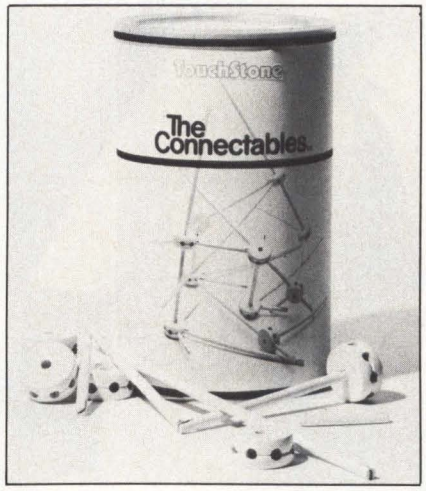
Software creates networks for three operating systems

- Exchanges electronic mail
- Transmits data at 19.2K baud
- Supports Bell, Hayes modems

With Connectables Network software, previously isolated computers, including IBM Corp. PCs and compatibles, UNIX-based systems and the Apple Computer Inc. Macintosh, can share information. Structured as three packages—PCworks for IBM PCs, UniHost for UNIX- and XENIX-based computers and MacLine for the Macintosh computer—the software enables the computers to exchange electronic mail, transfer files or use the disk or printer attached to the UNIX system to print reports and backup files.

Used alone, the PCworks software connects the IBM PC and compatibles to various computers and information services; the MacLine software similarly connects a Macintosh computer. With MacLine's graphics terminal emulator, the Macintosh doubles as an interface to graphics applications implemented on other computers. Both packages can be used to dial up and access an information system that supports an ANSI, TTY or Digital Equipment Corp. VT100 or VT52 terminal. PCworks transmits data at 9,600 baud; MacLine transmits at 19.2K baud.

Both software packages support Bell 103 and 212A modems and the Hayes Microcomputer Products Smartmodem 1200 with auto-dial support. In addition, MacLine supports the Apple modem 300/1200 with autodial support. PCworks and MacLine require an RS232C cable and 128K bytes of memory on an IBM PC or PC-compatible and a Macintosh computer, respectively. PCworks runs on a DOS 2.0 operating system with 280K bytes of disk storage and requires an asynchronous adapter.



The Connectables software *builds a network out of the IBM PC, the Apple Macintosh and UNIX-based systems.*

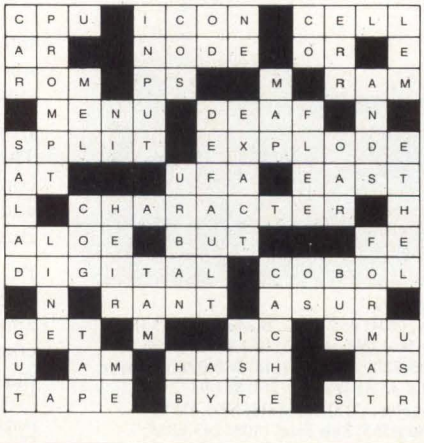
Acting as a command server for the PCworks and MacLine packages, UniHost software enables the UNIX system to respond to file-transfer, mail and remote printing requests from connected PC or Macintosh workstations and act as an interface among the three systems. UniHost supports 9,600-baud transmission speeds and standard dial-in modems and requires 30K to 60K bytes of disk memory space, a serial log-in port and an RS232C interface cable. $195, PCworks or MacLine; $295, UniHost. **Touchstone Software Corp.,** Suite 207, 909 Electric Ave., Seal Beach, Calif. 90740, (213) 598-7746. **Circle No 322**

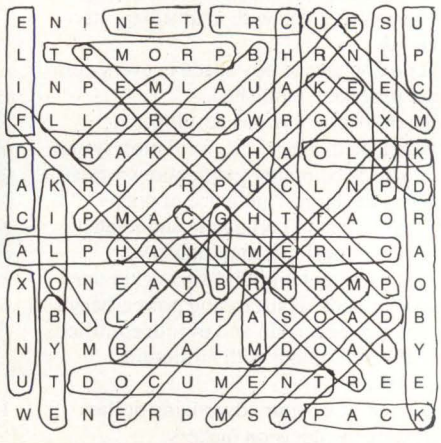
Software transfers VAX data

- Audit trail capability
- Error detection/correction
- Access control

Providing information access and transfer in a controlled environment, The VAX: Information Server transfers data between DEC VAX minicomputers and various personal computers. It runs as an application on the VAX VMS operating system, Releases 3.0 and above. Communicating over asynchronous lines, it supports ASCII terminal emulation and embeds in the application programs, making the personal computer a front-end processor. The software suits IBM PC and PC compatibles running PC-DOS; DEC Rainbows running MS-DOS and CP/M-86; and Lee Data personal computers running MS-DOS operating systems. Features include access control, error detection and correction and audit trail capability. $12,000. **Linkware Corp.,** 77 Rumford Ave., Waltham, Mass. 02154, (617) 894-9330. **Circle No 323**

ANSWERS TO JANUARY'S PUZZLES





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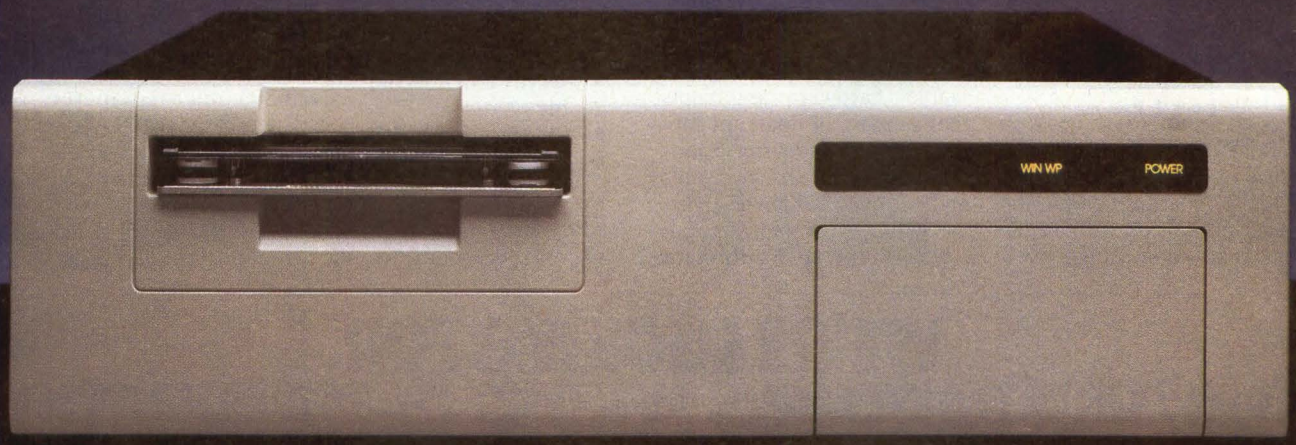

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For starters, Cyclone's 5¼" Winchester packs formatted capacities from 36 up to 120 megabytes.

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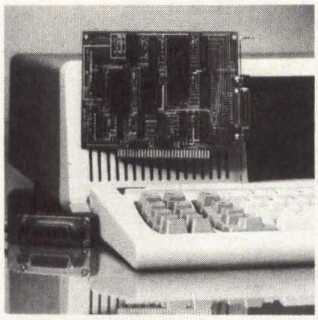
CIRCLE NO. 97 ON INQUIRY CARD

SUBASSEMBLIES

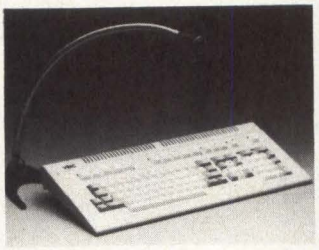


IEEE-488 interface has software package

- IBM/XT, -AT, PC compatible
- 14 maskable interrupts
- 8K-by-8 EPROM

The PC-488 IEEE-488 interface for the IBM/XT, -AT, PC and compatible computers comes packaged with software that allows high-level languages to support instrumentation, printing and plotting applications. The software allows standard word processing and spreadsheet programs to interface with IEEE-488 peripherals. Application programs or compilers can use the 640K-byte memory space; an 8K-by-8 EPROM is standard. Three programmable DMA modes, single, demand, or burst, are supported. Independent of DOS, command and data transfer routines provide transportability to other operating systems. The memory-mapped interface furnishes programmable hardware interrupts that support 14 interrupt conditions at six interrupt priority levels. The unit transmits and receives 64K-byte arrays at 300K bytes per second. $395. **Capital Equipment Corp.,** 10 Evergreen Ave., Burlington, Mass. 01803, (617) 273-1818.

Circle No 324



Keyboard recognizes voice commands

- IBM PC-, XT-compatible
- 8K bytes of ROM
- 16K bytes of static RAM

The IntroVoice III intelligent voice/keyboard for the IBM PC or /XT recognizes words or short phrases and allows voice and keyboard data input concurrently. Operating independent of the operating system in recognition mode, the keyboard allows an unlimited vocabulary size in subsets of 100 with the utility software written in PC-DOS and operable with MS-DOS. The Utility Program creates, edits, trains and tests a vocabulary and activates recognition. A correction feature enables on-line editing of text. Hardware includes a 16-channel audio spectrum analyzer, an 8-MHz 6803 microcomputer, 16K bytes of static RAM and 8K bytes of ROM. $1,495. **The Voice Connection,** Suite C, 17835 Skypark Circle, Irvine, Calif. 92714, (714) 261-2366.

Circle No 325

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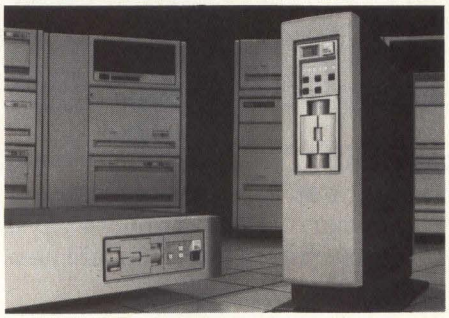
- VAX 11/725
- VAX 11/730
- VAX 11/750
- VAX 11/782



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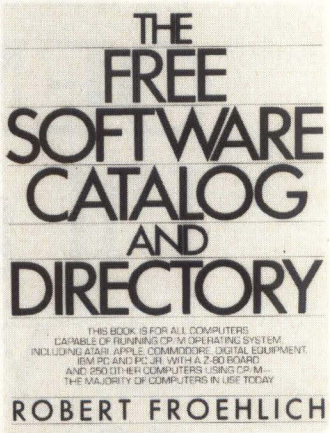
Data sheet describes D/A converter

A four-page data sheet describing ILC Data Device Corp.'s DDC-1250 12-bit, 35-nsec hybrid digital-to-analog converter contains features, applications and specifications of the product. The data sheet covers block-diagram descriptions, dynamic characteristics and glitch, input coding, analog output ranges and external operational amplifier. The text also describes offset trim, output compliance, layout precautions, and power supply decoupling. Illustrations include a full-size photo, a block diagram and five figures highlighting key features. **ILC Data Device Corp.,** 105 Wilbur Place, Bohemia, N.Y 11716, (516) 567-5600. **Circle No 326**

Guide explains voice, data applications

The T1 "Voice/Data Applications Guide" discusses how to make the most efficient use of a T1 facility. The literature provides an introduction and also outlines voice and data applications over T1 facilities such as PBX tie-lines, off-premises extensions, drop and insert networks, synchronous and asynchronous data, Bell DDS Data Port, CAD/CAM and video teleconferencing. The guide details T1 network requirements and highlights the company's T1 voice/data multiplexer, D/I MUX. **Coastcom,** 2312 Stanwell Drive, Concord, Calif. 94520. (415) 825-7500.
Circle No 327

Directory focuses on free software



The *Free Software Catalog and Directory* concentrates on free software libraries such as the CP/M Users Group (CPMUG) and the Special Interest Group for Microcomputers (SIG/M). The resource includes games, business programs, educational software, word processing, time-saving utilities and automation and productivity-enhancing programs. The text offers descriptions of over 5,000 program files and explains where to get free software from over 2,000 sources and how to use, alter and transfer free software. $9.95. **Crown Publishers Inc.,** One Park Ave., New York, N.Y. 10016, (212) 532-9200. **Circle No 328**

Catalog details Multibus products

A short-form catalog, describing over 75 Multibus products from single-board computers to multitasking systems, relates the products to application areas and computer systems. The catalog covers 8085-, 8086- and 80186-based boards and the new ZX-186/30 single-board computer that accomodates 1M byte of dual-ported RAM. Descriptions of floppy, floppy/Winchester, serial I/O, serial communications and parallel I/O controller boards are included. **Zendex Corp.,** 6700 Sierra Lane, Dublin, Calif. 94578.
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4-7 **FOSE Software '85 Conference and Exposition,** Washington, D.C. Convention Center, sponsored by National Trade Productions Inc. Contact: Jill Nieman Boesch, National Trade Productions, Suite 400, 2111 Eisenhower Ave., Alexandria, Va. 22314, (800) 638-8510 or (703) 683-8500.

4-7 **Interface '85 Thirteenth Annual Conference and Exposition,** Georgia World Congress Center, Atlanta, presented by The Interface Group Inc. Contact: Peter B. Young or Linda M. Yogel, The Interface Group Inc., 300 First Ave., Needham, Mass. 02194, (617) 449-6600.

6-8 **DEXPO Europe '85,** Olympia 2, London, organized by Expoconsul International Inc. Contact: Expoconsul International Inc., 55 Princeton-Hightstown Road, Princeton Junction, N.J. 08550, (609) 799-1661.

6-8 **Integrated Services Digital Networks Conference,** Bally's Park Place Casino Hotel, Atlantic City, N.J., organized by Information Gatekeepers Inc. Contact: Michael O'Bryant, Information Gatekeepers Inc., 214 Harvard Ave., Boston, Mass. 02134, (617) 232-3111.

11-13 **Exploding the UNIX Myth,** Orlando, Fla., sponsored by Gartner Group Inc. Contact: Lynn M. Bentley, Marketing Manager, Gartner Group Inc., P.O. Box 10212, 72 Cummings Point Road, Stamford, Conn. 06904, (203) 964-0096.

11-15 **XENIX Operating System Workshop,** Chelmsford, Mass., presented by Intel Corp. Contact: Rhonda Carney, Intel Corp., Customer Training, 27 Industrial Ave., Chelmsford, Mass. 10824-3688, (617) 256-1374.

12-14 **SEMICON/Europa '85,** Zurich, Switzerland, sponsored by Semiconductor Equipment and Materials Institute (SEMI). Contact: Pamela Merritt, SEMI, Suite 212, 625 Ellis St., Mountain View, Calif. 94043, (415) 964-5111.

13-14 **Eleventh Annual Computer Fair,** University of Washington, Seattle, sponsored by University of Washington Academic Computing Center. Contact: Thomas Bennett, Ph.D, University of Washington Academic Computing Center, 3737 Brooklyn Ave. N.E., Seattle, Wash. 98105, (206) 543-5728.

18-20 **COMTEL '85,** Infomart, Dallas, sponsored by International Computer and Telecommunications Conference. Contact: Serena Bryan, COMTEL, Suite 600, 13740 Midway Road, Dallas, Texas 75244, (214) 458-7011.

20-22 **CAD/CAM Seminar,** Inn of Westchester, White Plains, N.Y., sponsored by Frost & Sullivan Inc. Contact: Frost & Sullivan Inc.., 106 Fulton St., New York, N.Y. 10038, (212) 233-1080.

20-22 **Independent DEC Users Society (IDUS) '85 Conference,** Killington Conference Center, Killington, Vt., sponsored by IDUS. Contact: Sheila Hopkins, IDUS, Suite 4, 3657 Post Road, Warwick, R.I. 02886, (401) 738-4430.

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20-22 **International Spectrum Conference,** New Orleans, sponsored by International Database Management Association (IDBMA). Contact: IDBMA, 9740 Appaloosa Road, San Diego, Calif. 92131, (619) 578-3152.

25-27 **Third Annual Conference on Optical Storage of Documents and Images,** The Shoreham Hotel, Washington, D.C., sponsored by Technology Opportunity Conference (TOC). Contact: Judy P. Hanson, TOC Coordinator, TOC, P.O. Box 14817, San Francisco, Calif. 94114-0817, (415) 626-1133.

25-28 **IEEE Infocom '85,** Washington, sponsored by the Technical Committees for Computer Communications of the Societies. Contact: Tom Stack, Program Chairman, IEEE Infocom '85, P.O. Box 639, Silver Spring, Md. 20901, (301) 589-8142.

26-28 **European Information Technology and Office Automation Exhibition (INFO),** Olympia, London, sponsored by B.E.D Exhibitions Ltd. Contact: Sandra Paul, British Information Services, 845 Third Ave., New York, N.Y. 10022, (212) 752-8400.

26-28 **COMDEX-in-Japan,** Harumi Exhibition Center, Tokyo, produced by The Interface Group Inc. Contact: Peter B. Young (U.S.A.) or T. Shinohara (Japan), The Interface Group Inc., 300 First Ave., Needham, Mass. 02194, (617) 449-6600 or (800) 325-3330; in Japan: Kashiwabara Bldg. 2F, 1-3-3, Kyobashi, Chuo-Ku, Tokyo 104, Japan, 03-271-0246.

27-30 **PBC Show '85/Infotech '85,** Hong Kong Exhibition Centre, organized by Hong Kong Exhibition Services Ltd. Contact: Overseas Exhibition Services Ltd., 11 Manchester Square, London, W1M 5AB, England, 01-486-1951.

28-29 **Minnesota Joint Computer Conference (MJCC),** Radisson South Hotel, Bloomington, Minn., sponsored by the Association of Systems Management (ASM), the Association of Computing Machines (ACM) and the Data Processing Management Association (DPMA). Contact: Mick Williams, c/o Standard Iron, 4990 N. County Road 18, New Hope, Minn. 55428, (612) 533-1110.

31-(3) **SOFTCON,** Georgia World Congress Center, Atlanta, sponsored by Northeast Expositions. Contact: Northeast Expositions, 822 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000.

APRIL

2-4 **1985 IEEE Microprocessor Forum: "Pathways to Design Productivity,"** Bally Park Place Casino Hotel, Atlantic City, N.J., sponsored by the Philadelphia Electric Co. Contact: Gerald W. Gordon, Philadelphia Electric Co., 2301 Market St., N3-1, Philadelphia, Pa. 19101, (215) 841-4676.

2-4 **UNIX Systems Exposition '85,** Palais des Congres, Paris, organized by Network Events Ltd. Contact: Network Events Ltd., Printers Mews, Market Hill, Buckingham, MK18 1JX, England, (0280) 815226.

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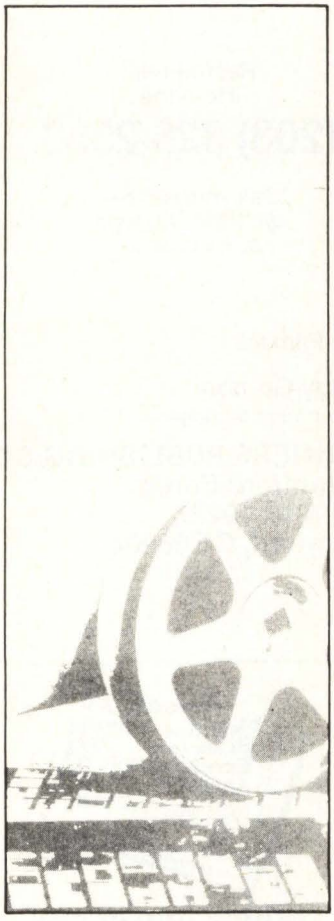

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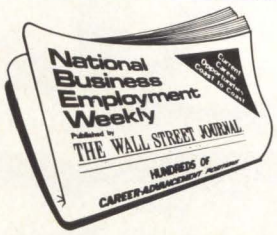

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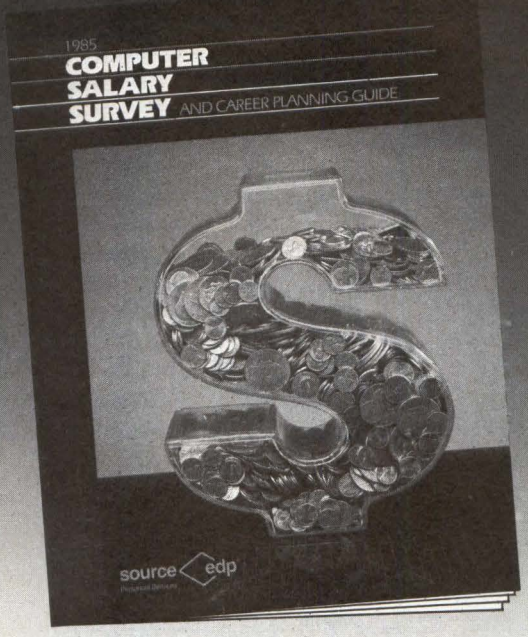

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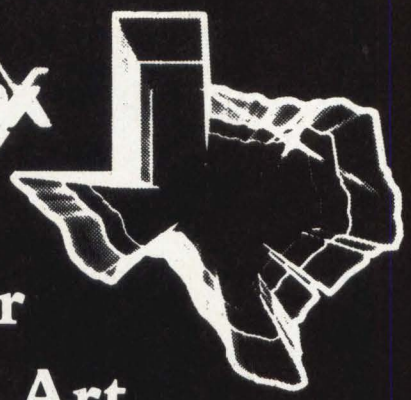

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2-85

BATCH FILES SOLVE INTEGRATION TASKS

Carl Warren, Western Editor

The IBM Corp. PC operating system, PC-DOS, or its complementary operating system, MS-DOS from Microsoft Corp., Bellevue, Wash., can be used as a powerful front-end for solving many integration tasks. Both versions employ a command language that provides considerable system control. For example, to simplify task location and management, employ the PATH-setting function in the AUTOEXEC.BAT file that DOS looks for when the machine turns on. Proceed as follows to locate applications virtually anywhere on the hard disk:

```
PATH C:\tools;C:21;C:tools\
    master;C:\tools\utilities;
```

This line tells DOS to first look in the directory called Tools, then Directory 21, back to Tools and its subdirectory master, and back again to Tools and the subdirectory utilities. Besides calling applications directly, you can invoke other batch files that, in turn, search other directories and subdirectories and even switch directories for storing information.

To make the batch process even more efficient, consulting software engineer Robert Anton Byers, La Crescenta, Calif., recommends invoking Ashton-Tate's dBase III along with a menu command file. According to Byers, the powerful database manager package serves as an excellent "shell" around the operating system and applications. The newest dBase III release, Version 1.1, no longer requires the distribution disk to be inserted into the main floppy drive; it can reside on the hard disk, thus providing full turnkey operation. Byers says that, when using Version 1.1, dBase command file should display a menu of application choices, and employ the CASE statement to determine selection:

```
DO CASE
CASE = "1"
RUN "WS"
...
```

The key is the "Run" verb. This causes dBase to look for the named application—in this case Micropro International Corp.'s WordStar—and then run it. Once you're finished running the application, an automatic return to the dBase environment is executed, thus allowing another choice to be made. dBase stores all the information and keeps track of the proper pointers to allow a return to dBase. Byers says that, besides allowing the direct call to an application, files in sub-directories can be called by specifying the DOS PATH using proper syntax (\parent directory\subdirectory\ application) or by establishing the PATH routes at bootup. Byers does warn, however, that dBase is sensitive to the length of the directory name, which shouldn't exceed seven characters.

If you're planning on adding a hard disk to a portable computer such as Compaq Computer Corp.'s portable, consider providing a parking mechanism for the read/write heads. Consulting engineer Richard Steincross, of RMS Laboratories, Long Beach, Calif., offers a simple solution for system integrators using Western Digital Corp.'s Model WD1002-WX2 controller for the PC and compatibles. Steincross recommends using the WX2 utility that Western Digital Corp. supplies with the board for moving the heads back to a safe zone. The utility accepts parameter commands that direct disk drive operation. An example of the parameters to pass are:

```
WX2, Blocks:17, Cyl:306, Heads:4 idc
Step:0, c:0, Seek, Step:0, c:305, Seek, Quit
```

This parameter file tells the WX2 utility that 17 data blocks exist, the drive has 306 cylinders with four read/write heads, the drive should make zero steps and the identifier for the C drive is 0. The final parameter settings direct the controller to move the head to cylinder 305 and stop. The park mechanism is invoked by installing a batch file called PARK.BAT, which is used to call the parameter file and, if desired, a message file that displays: "The hard disk can now be transported." Steincross admits that the method isn't necessarily elegant, but it does help avoid damage to the drive.

Some notebook jottings: If you're having trouble reading data on a floppy disk, don't be too quick to blame the drive. The problem might lie with the spindle hole protector found on some disks. The adhesive holding the rigid protector on the disk sometimes melts as the temperature in the drive goes up, depositing a gooey substance on the clamping mechanism fingers. This condition results in mis-clamping of disks, which can cause read and write errors. The solution is simple: Use a cold-degreasing compound spray.

If you're wondering how to make Micropro's WordStar word-processing software work on an IBM PC or similar machine with a serial printer, install WordStar for the parallel printer driver. Then, use the MODE function in DOS to set the line printer (LPT1) to equal the desired serial communication port COM1 or COM2. The DOS command MODE LPT1:=COM1: does the job, but don't forget to use the mode function to set the proper baud rates, parity and handshake. □

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See p. 207-208 for Mini-Micro Marketplace

MARKET TRACK

Sharon Hassell
Assistant Editor

Market-standard title eludes UNIX

The market for all UNIX-based computers will grow from 79,000 units shipped in 1984 to 264,200 in 1988, according to a study by International Resource Development Inc. (IRD), Norwalk, Conn. However, while the number of units shipped will more than triple by 1988, UNIX will become a standard operating system only in the supermicrocomputer arena, rather than become a mass-market standard, the study says. Supermicrocomputers will account for 90 percent of all UNIX-based units shipped in 1988.

The study blames UNIX's limited mass-market expansion on a number of factors, including the wide use of Microsoft Corp.'s MS-DOS operating system and MS-DOS-based applications software. According to IRD, MS-DOS is so prevalent in today's personal computer market that converting to a UNIX operating system "does not make sense."

Even with supermicrocomputers, the study says, many users will avoid UNIX-based products in favor of those using MS-DOS with networking enhancements—DOS 3.1 for example—and mainframe vendors will give greater prominence and marketing support to their own proprietary operating systems.

A widely established local area network (LAN) protocol such as Ethernet, or a protocol from IBM Corp.'s PC Network, could be the major roadblock in UNIX's growth as a multiuser operating system. The study claims it is often less expensive to link computers to LANs than it is to tie personal computers to a supermicrocomputer host that runs UNIX. Although multiuser systems can support a larger number of users at a lower cost-per-user than a LAN, this only applies to a comparison of their original purchase prices.

And, according to IRD, there exists more than 3 million IBM PCs and compatibles, and they aren't wearing out. Therefore, the cost of buying a file server or of converting a personal computer into a file server added to a LAN might be cheaper than buying a new multiuser system, even if the systems were to use the personal computers as terminals, according to the study. An additional advantage is that LAN users wouldn't need to buy or learn new software.

The study also says that the incorporation of UNIX features, such as its file directory system, into non-UNIX systems is an obstacle to its acceptance as a standard. The study adds that the UNIX operating system is no more or no less portable than is MS-DOS.

Supermicrocomputers dominate UNIX shipments

	1984	1986	1988
Mainframes	300	700	1,200
Standalone personal computers	1,700	4,000	10,000
Superminicomputers	5,000	8,000	13,000
Supermicrocomputers	72,000	160,000	240,000
Total	79,000	172,700	264,200

SOURCE: INTERNATIONAL RESOURCE DEVELOPMENT INC.

The total market for UNIX-based computers *will increase threefold from 1984 to 1988. Supermicrocomputers will account for more than 90 percent of all UNIX-based units shipped in 1988.*

PCB market to reach $13 billion by 1993

Once a borrower of methods and machinery from photography, metal finishing and laminating, the printed circuit board (PCB) industry is developing a technology all its own. As a result, the PCB industry will boost shipments tenfold from 1983 to 1993 to reach $13.7 billion, according to a recent study by Frost & Sullivan Inc., New York.

The study says new PCB machinery is being designed to produce the much denser patterns of conductive lines and insulation spaces required by microprocessors and other very large-scale-integrated (VLSI) semiconductor devices, while keeping waste to a minimum.

The increasing need for high-density applications will mean that the use of boards with multiple circuit layers will grow at a rate even faster than the PCB market as a whole, the study says. From 25 percent of total U.S. sales in 1983, multilayer boards will claim 41 percent of the market in 1993. Single-sided and flexible circuits will drop from 17 percent of the total market to 14 percent over the forecast decade.

Other highlights of the study include a discussion of the new materials being used to make PCBs. These include Teflon and ceramic substrates, and aqueous-based photosensitive materials, which can be disposed of economically in an environmentally acceptable manner. Higher-density input/output connections with surface attachments will also affect the PCB industry, according to the study. This method will do away with large mounting holes that take up valuable circuit space on PCBs.

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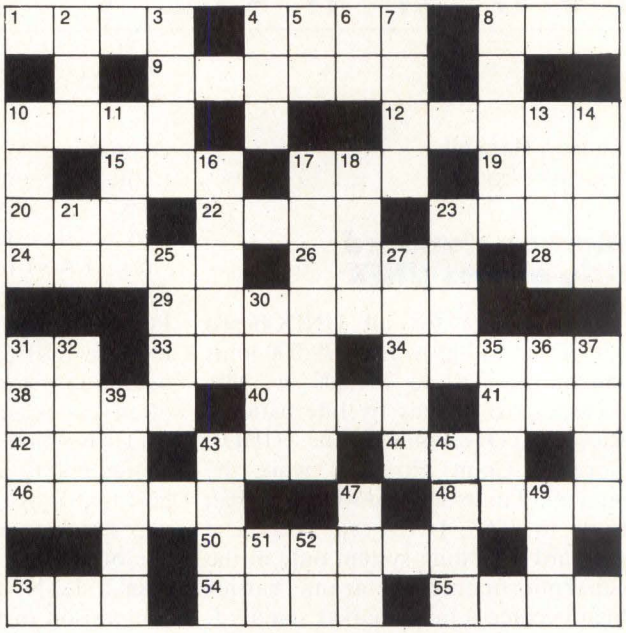
ARTFUL INTELLIGENCE

By John K. Young



A C R O S S

1 List of options
4 Combining form meaning "motion pictures"
8 Kind of chart
9 Movement, up or down, of text on screen
10 Cut and paste, e.g.
12 Kind of screen display
15 His name means "watchful"
17 Name for unknown person on legal papers
19 Small inflammation on eyelid
20 They are controlled by egos and superegos
22 What each new computer development causes
23 Triumphant look salesman may give to losing competitor
24 System of points satisfying given conditions
26 Device for measuring thickness of wire
28 Molybdenum (Chem.)
29 Plain product
31 Exist
33 Prepare final manuscript
34 Patterned on the model of
38 Information
40 Printed circuit board
41 The Computer _____
42 Statement
44 Wings at right angles
46 What technicians do to move wires through tight places
48 Thatch for native huts in Malaya
50 Pattern
53 When in doubt
54 Statement
55 Transfer to another section of storage

D O W N

2 Flattering opinion of oneself
3 Support group for new computer owners
4 _____ display
5 A port
6 It is not clear (Latin abbr.)
7 In addition
8 Sharp voltage change
10 Electronic _____
11 Storage medium
13 Entry in account
14 Computer novice
16 President of Syria
17 _____ data
18 Kind of command you can give advanced computers
21 Special FORTRAN function
23 Found on tree
25 Eye's pigmented, vascular layer
27 Forest open space
30 Calling for great accuracy
31 Calculates total of
32 This memory formerly called "core"
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39 Disc's concentric circles
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49 What some graphics tablets use
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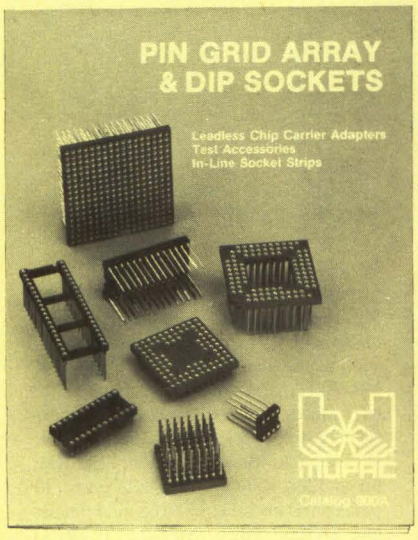

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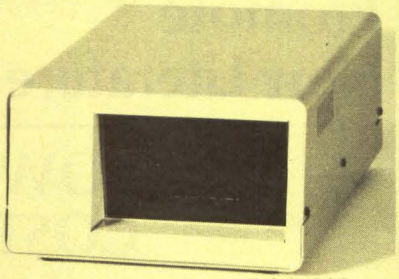

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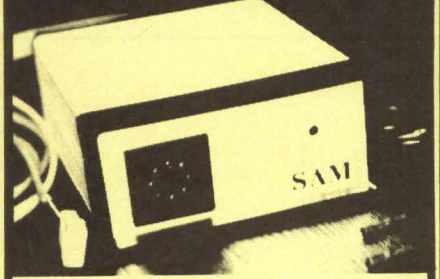

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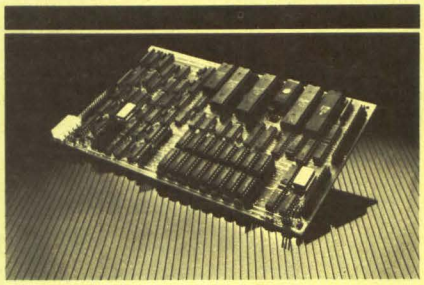

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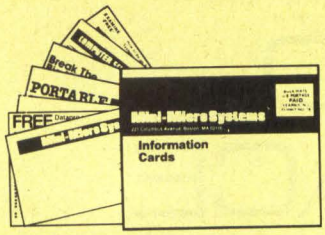


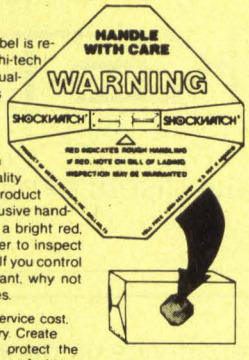
HIGH INQUIRIES
LOW COST

- Sell products and services directly
- Introduce new products
- Investigate new applications
- Develop new sales leads

MINI-MICRO SYSTEMS
DIRECT RESPONSE POSTCARDS

CIRCLE NO. 206 ON INQUIRY CARD

YOU KEEP THE QUALITY IN, WHEN YOU PUT A SHOCKWATCH ON!

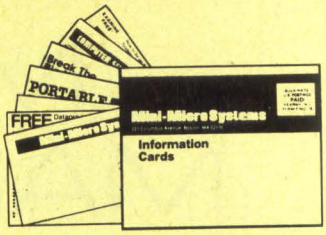


The Shockwatch® Label is revolutionizing the way hi-tech shippers control the quality of shipments. This inexpensive and precision impact device is the basis of a shipping system that controls the quality of handling after the product leaves your dock. Abusive handling turns this device a bright red, warning your customer to inspect for possible damage. If you control quality inside your plant, why not control it after it leaves.

- Reduce damage..service cost, returns, dead inventory. Create customer goodwill & protect the quality product you manufacture.

Call 1-800-527-9497 for application information & a list of our Fortune 500 customers.
MEDIA RECOVERY, INC.
1435 Round Table Drive, Dallas, Texas 75247

CIRCLE NO. 207 ON INQUIRY CARD



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MINI-MICRO SYSTEMS
DIRECT RESPONSE POSTCARDS

CIRCLE NO. 208 ON INQUIRY CARD

for Serious Software Developers

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80286, 8086/80186, 8096, 8080/8085, 8051, 8048, Z8002, Z80, Z8, NSC 800, 9900, 68000/08/10, 6809, 6800/01/02, 6805, 6301, 6305, 6500, G65SCXX, G65SC1XX, R65C00, R6500/1, and others.

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DEC VAX, PDP-11, DG MV-Series, DG Eclipse, Apollo, UNIX Systems, IBM PC, Data General/ONE, HP 150, DEC Rainbow and others.

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If you are a serious software developer, shopping for software development tools, call or write today for more information. **800-551-5554** in CA call **(408) 733-2919**

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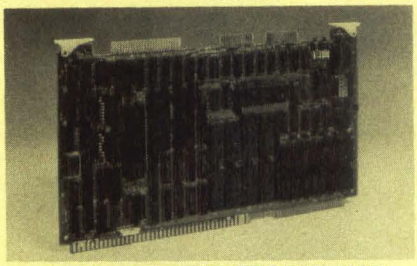
Promote New Literature at a LOW COST

If you've got catalogs or literature, distribute them at a low cost in the **MINI–MICRO MARKETPLACE.**

Call Norma Lindahl
(617)536-7780

CIRCLE NO. 210 ON INQUIRY CARD



10 MHz Z8000™ PERFORMANCE
In addition to 10 MHz, the NEW MBx8000 SBC features a single width SBX connector for adding standard expansion modules, such as the SBSxFDC Floppy Controller. MBx8000 maintains all the capabilities of its predecessor, the MB8000: Z8001/Z8002 CPU 4/6/10 MHz; 32K/128K/512K DRAM; up to 48K static RAM or EEPROM: up to 128K EPROM; 2 RS-232 ports; 40 parallel I/O lines; six 16-bit counter-timers; etc. Z8000™ Zilog. SINGLE BOARD SOLUTIONS, 7669 RAinbow Drive, Cupertino, CA 95104. (408) 253-0181

CIRCLE NO. 211 ON INQUIRY CARD

ORDER FORM

Advertise in the **MINI-MICRO MARKETPLACE**

Please run my advertisement in the following issues

EFFECTIVE JANUARY 1985

1x	3x	6x	12x	18x
$660	$595	$575	$560	$545

24x	48x
$525	$505

MATERIALS

1. Glossy photo with 50-75 words. We will typeset your ad at no charge.
2. Camera ready artwork.
3. Film negatives: right reading emulsion side down.

AD SIZE: $2\frac{1}{4}'' \times 3\frac{1}{16}''$

COMPANY

ADDRESS

CITY STATE ZIP

TELEPHONE

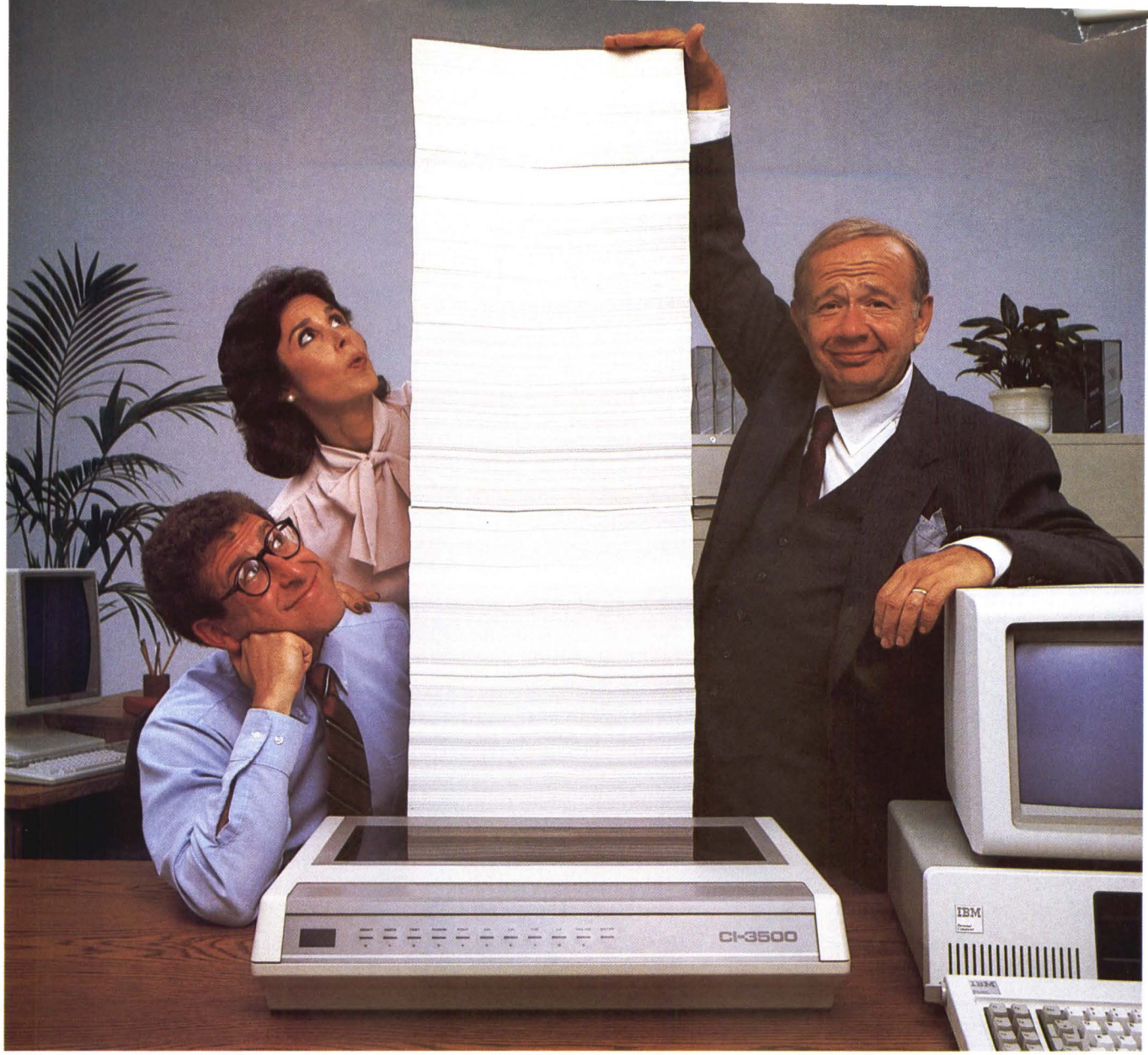
SIGNATURE

Space reservation by the first week of the month proceeding issue date.

☐ Materials enclosed ☐ Materials to come ☐ Please send information

Send to: Norma Lindahl, **MINI-MICRO SYSTEMS**
221 Columbus Ave.
Boston, MA 02116

15% Agency commission to accredited agencies. Please specify agency.



Never has an IBM®-compatible printer worked so fast for so few dollars.

With data processing printing at 350 CPS and a price tag of under $2,000, the CI-3500, Model 20 is the fastest IBM PC-compatible printer for the price.

Besides speed, the CI-3500, Model 20 delivers letter quality printing at a swift 87 CPS—more than twice the speed of most daisy wheel printers. And you also get the capability for high resolution graphics, up to 240 X 144 DPI.

The quiet, office friendly CI-3500, Model 20 is as flexible as it is fast and affordable. For instance, a convenient interface cartridge allows you to change your printer's personality simply by changing cartridges.

An operator changeable cartridge compatible with the IBM PC graphics printer is standard. Alternate cartridges compatible with other printers, such as DEC-LA100,® are also available.

A similar font cartridge accommodates multiple font and character sets, so you can avoid costly PROM installations.

The CI-3500, Model 20 Serial Printer from CIE Terminals. Never has an IBM-compatible printer worked this fast for so little. To find out more, just write or call CIE Terminals, 2505 McCabe Way, Irvine, Ca. 92714-6297. (714) 660-1421. Or call toll-free 1-800-624-2516.

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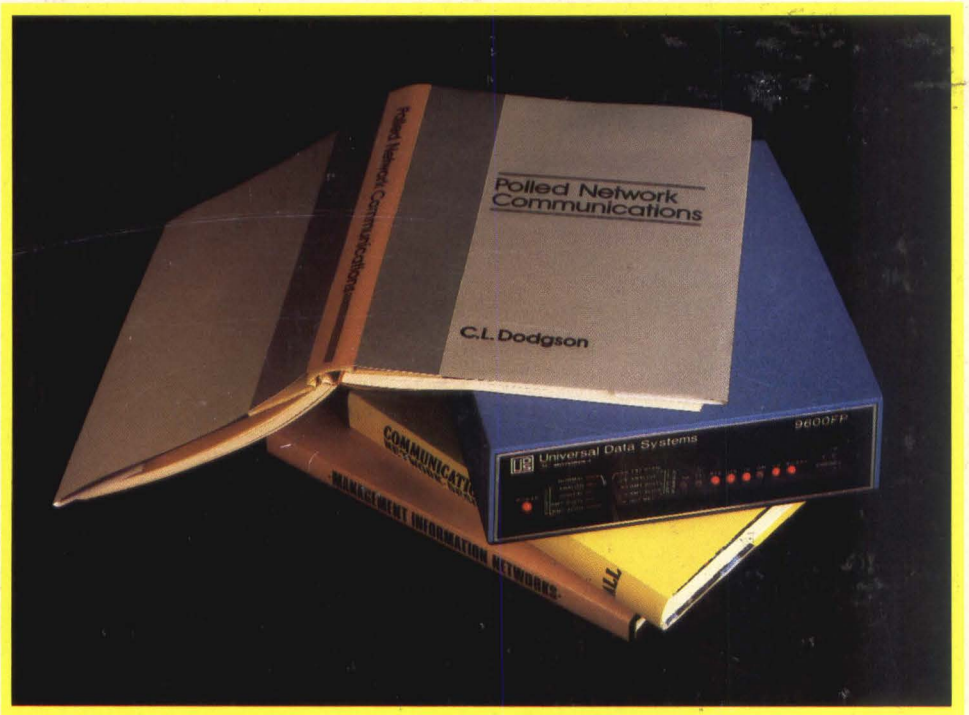
CIRCLE NO. 104 ON INQUIRY CARD

Quick Study!

New UDS 9600 bps Fastpoll Cuts On-line Training Time 33%



The new 9600 bps fastpoll modem from Universal Data Systems means extra throughput for your polled multipoint network! Until now the fastest on-line training time available anywhere has been 12 milliseconds. Since training time is non-productive time, UDS has increased system throughput by trimming the training cycle to 8 ms, producing a corresponding increase in overall system efficiency.

The device is suitable for operation over unconditioned four-wire leased lines in either fastpoll or conventional CCITT V.29 mode. Integral test features allow for system performance evaluation and fault isolation within the communications link.

The UDS design incorporates LSI and microprocessor technologies to achieve significant size and power consumption advantages. For detailed specifications, contact Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Phone 205/837-8100; Telex: 752602 UDS HTV.

$1995
Quantity One

Universal Data Systems

MOTOROLA INC.
Information Systems Group

Inquiry Hotline: 800/633-2252, Ext. 360.

UDS modems are offered nationally by leading distributors. Call the nearest UDS office for distributor listings in your area.
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CIRCLE NO. 105 ON INQUIRY CARD

Created by Dayner/Hall, Inc., Winter Park, Florida