JUNE 1987

Mini-Micro Systems®

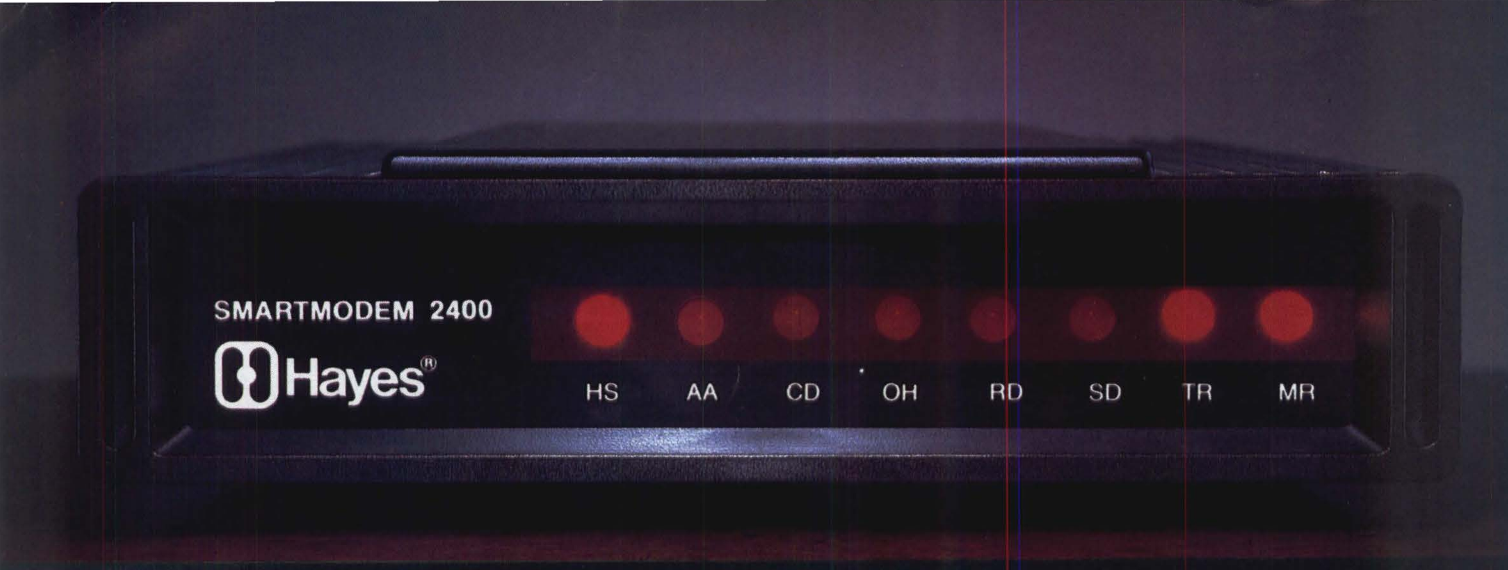
THE MAGAZINE FOR SYSTEMS INTEGRATION

A CAHNERS PUBLICATION

Altos paves reseller migration path with high-end 386 systems

SPECIAL REPORTS:
- Distributed DBMSes: Part II
- 16-bit minicomputers
- Uninterruptible power systems

Impact: IBM's PS/2



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Should you need further data to help you make up your mind, we offer this reassuring statistic: Year after year, more personal computer owners buy far more Hayes modems than any other kind.

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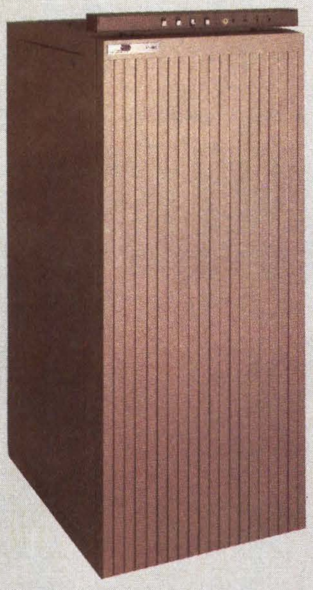
Concurrent Solutions



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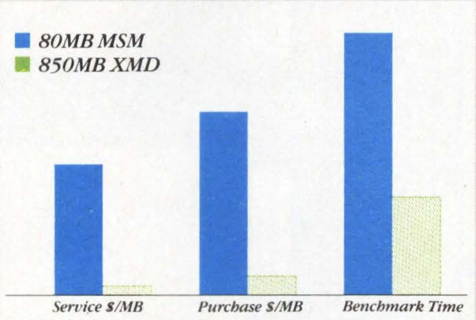

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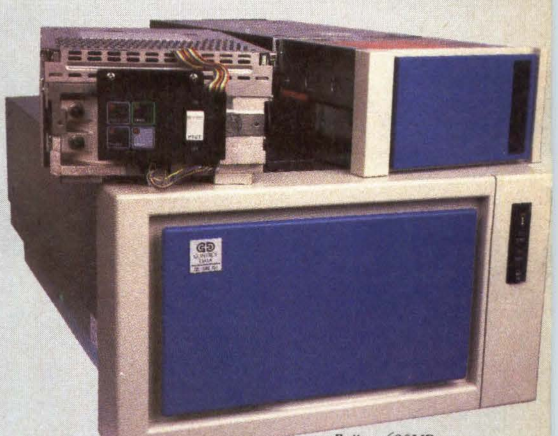

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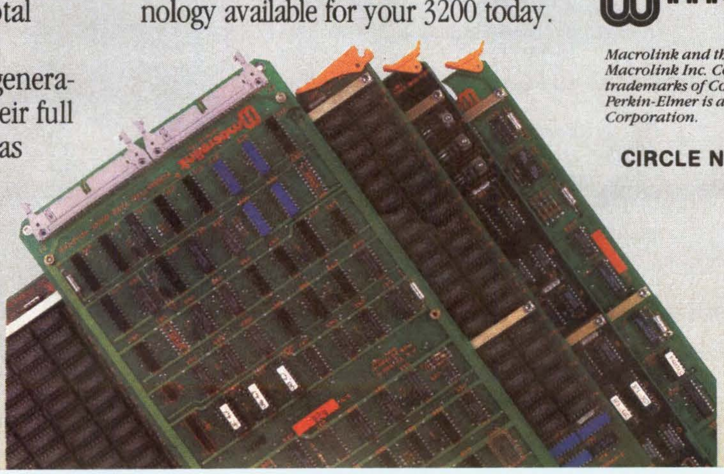
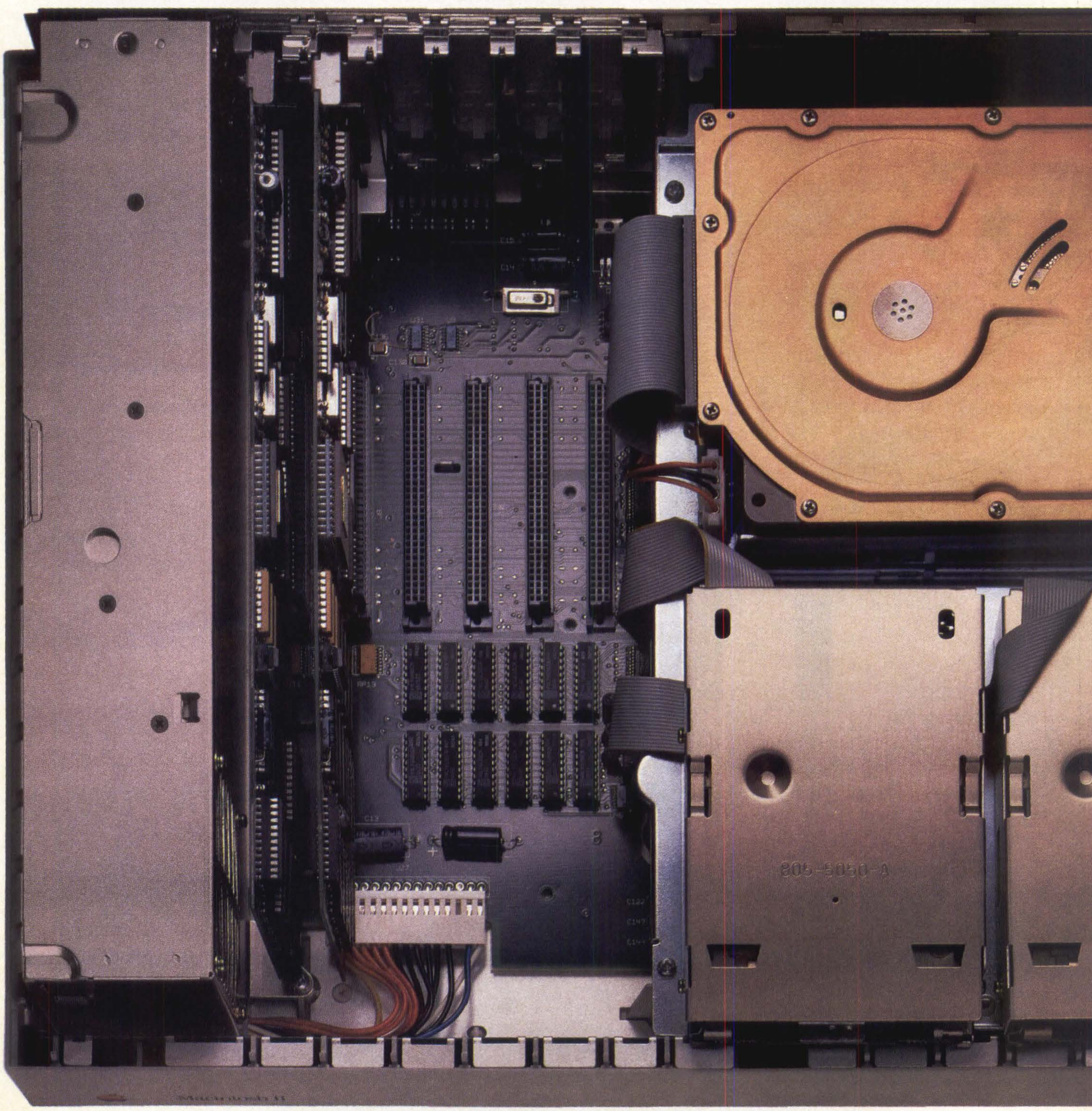


An open invitation to VARs.

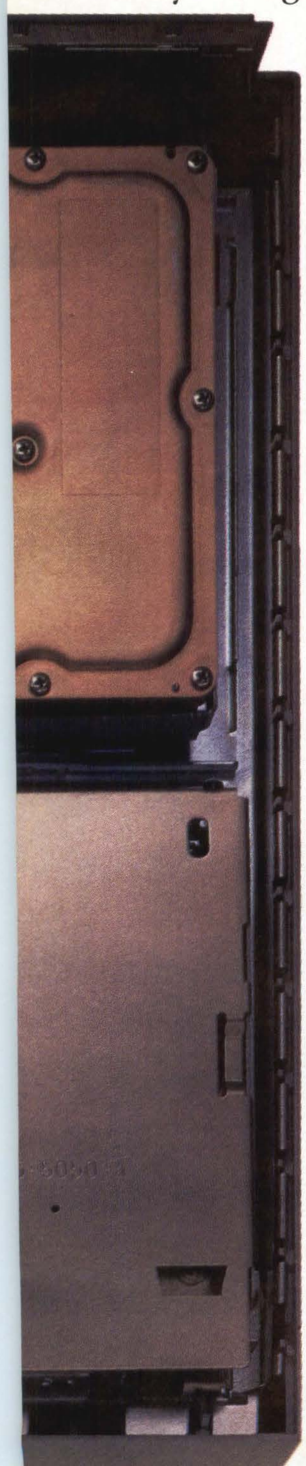


As a VAR, you undoubtedly find increased power very inviting.

Which is why Apple® keeps bringing you more powerful tools to help you build more sophisticated systems.

Our latest leaps in technology, the Macintosh™ SE and Macintosh II personal computers, are two prime examples.

They're designed to let you put together systems that offer more speed and graphics power. And are actually more affordable and easier to use.



Look at the SE, for instance. It comes with up to four megabytes of memory and an optional built-in 20-megabyte hard disk.

And you can add value easily, using its internal expansion slot, external SCSI port and two RS-232 serial ports.

The Macintosh II, on the other hand, offers a VAR even more. It's a full 32-bit machine, based on the new generation Motorola 68020 processor and 68881 math co-processor.

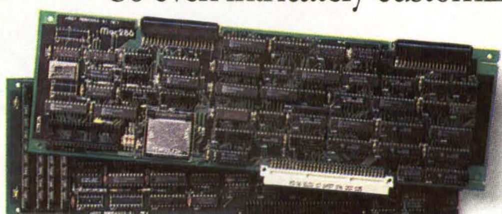
The latter of which can perform complex calculations up to 200 times as fast as conventional computers.

It comes with six internal expansion slots. Memory up to eight megabytes on the motherboard. And hard disk storage of 20, 40 or 80 megabytes.

But even better for your business as a value added reseller, the Macintosh II can be set up to run other operating systems. Like MS-DOS and AT&T UNIX.*

And because its slots are NuBus technology, they not only move information much faster–they have the good manners to "configure" themselves.

So even intricately customized systems are easy to assemble. With no DIP switches to set.



Build your own Macintosh II. Expansion cards let you add new power, such as the ability to run MS-DOS programs.

As for the options you can add, both the SE and II offer some formidable choices.

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CIRCLE NO. 4 ON INQUIRY CARD

Mini-Micro Systems

A CAHNERS PUBLICATION

VOL. XX NO. 6
JUNE 1987

PRODUCT SPOTLIGHT

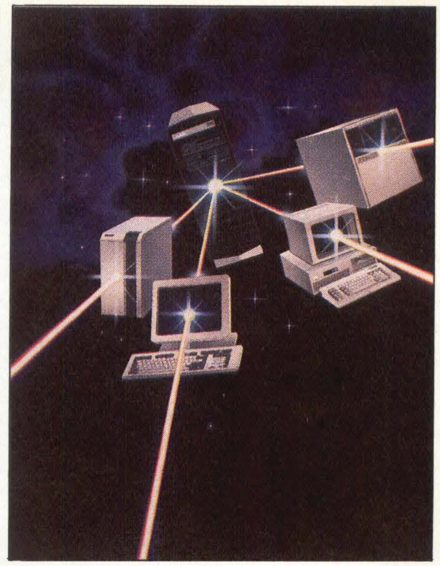
INTERPRETER

*DATELINE: USA

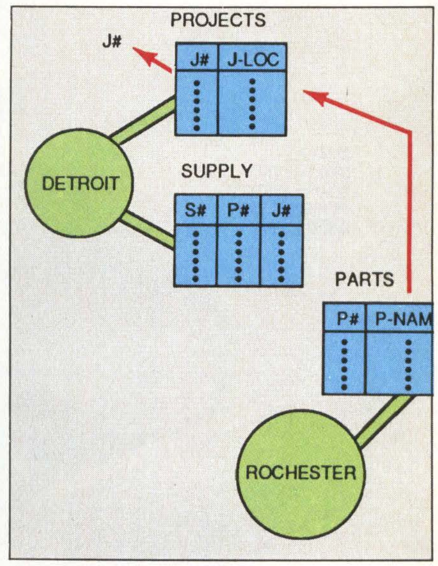
*Appearing in the European edition only

FEATURES

DEPARTMENTS



P. 25 .... Altos paves the way. Art design by Tranphere Inc. Courtesy of Altos Computer Systems



p. 61 .... Distributed DBMSes

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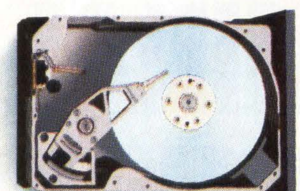

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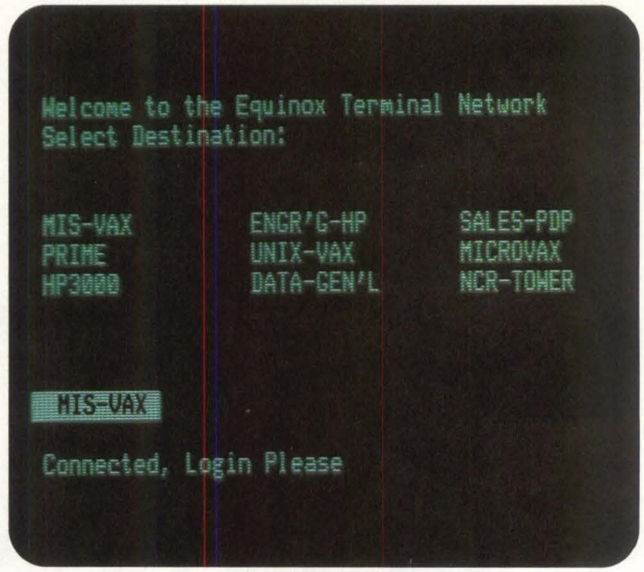

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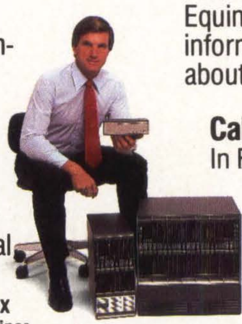

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EDITORIAL

IBM SQUEEZES THE COMPETITION

Prior to the April announcement of IBM Corp's new line of Personal System/2 microcomputers, the computer industry buzzed with conjecture about whether Big Blue would retain an open architecture or opt for a closed environment. Because it had lost market share to relatively inexpensive personal computer clones, IBM appeared poised to check competition by offering proprietary products. Such a marketing strategy, contended analysts, would probably impede a computer industry recovery. Instead, IBM's dramatically disclosed four new personal computers—models 30, 50, 60 and 80—are somewhat open units that will, most likely, rejuvenate the market. And, more important, with IBM's 1987-1988 PC marketing strategies fully disclosed, the industry can now plan and move forward with confidence.

A close look at the PS/2 line reveals both competitive restrictions and opportunities. The pricing is competitive, but not aggressive. The low- to midperformance models 30, 50 and 60 are available now, but the high-end model 80 doesn't arrive until 1988. Similarly, one of two new operating systems—PC-DOS 3.3—is here, but the multitasking Operating System/2 is scheduled for 1988. The models 30, 50 and 60 microprocessors run fast (8 MHz to 10 MHz), but model 80, with a 16-MHz microprocessor, won't be available until next year. Moreover, the PS/2 line's price/performance structure targets mid to large businesses, leaving the small-business arena unattended. Obviously, the PS/2 strategy leaves room for competition in the PC industry.

Overall, then, the competitive obstacles for IBM compatibles are non-trivial, but not impossible. Until model 80 arrives, personal computer vendors have nearly a year to generate competitive products. However, the degree of difficulty and the R&D stakes of competition have increased dramatically. For one barrier, some 80 percent of the chips in model 80 are IBM designed and manufactured. Cloners will have to invest huge sums of money in talent, time, and equipment to come up with equivalent units.

For another barrier, the new 16/32-bit bus—the Micro Channel—is not compatible with the PCXT/AT bus and will not accept add-on boards that work with those PCs.

For yet another barrier, IBM has introduced the Video Graphics Array (VGA). This combination of built-in graphics hardware and a graphics-based user interface wraps around Microsoft's Windows software. Buried in unique chips, VGA will provide the toughest challenge to copiers.

For still another barrier, the more complex OS/2 operating system software will contain IBM-specific extensions that will be difficult to analyze and exploit.

Despite all these barriers, though, IBM competitors still firmly believe that their opportunities abound. They point to the undefended low-end of the market, where cloners shine. They feel there's time-to-market to replicate the bus and graphics interfaces, no matter how difficult and costly. And they claim that PS/2 pricing and performance are not insurmountable.

Whatever the claims of IBM and its rivals, the competitiveness bodes well for the personal computer industry. In fact, in this year's first quarter, IBM, Apple, Compaq and Tandy sold personal computers at unit rates 30 percent to 80 percent over last year's period. Likewise, industry researchers predict that the U.S. personal computer sales growth will double in 1987 to 20 percent to 25 percent. And IBM's second generation of personal computers, along with those of its competitors, will surely propel the computer industry forward for the forseeable future.

George V. Kotelly

George V. Kotelly
Chief Editor

LETTERS

PRINTER UPDATE

To the editor:

Office Automation Systems Inc. was very pleased to be included in your article, "Boards, software enrich laser printers," which appeared in the April issue of *Mini-Micro Systems*. However, I would like to give you the correct information regarding our printers that were mentioned.

The LaserPro EXPRESS laser printer, with a suggested retail price of $1,895, is built with an engine manufactured by Tokyo Electric Co. (TEC).

The 805-R and 805-C laser printers are based upon either a Ricoh or Canon engine, and we have no intention of changing these manufacturers.

Christine Kopec
Marketing Communications Manager
Office Automation Systems Inc.
San Diego, Calif. 92111

PRICE CORRECTION

To the editor:

In the March issue, on Page 79, the price of Quadram's recently announced Quad386 XT coprocessor board was incorrectly listed at $595. The correct price is $1,495.

James Rush
Division Manager
Quadram
Norcross, Ga. 30093

DANG SLANG

To the editor:

I have been a regular reader of *Mini-Micro Systems* for some years now, and, although I find the content always interesting and relevant to my work, I am often irritated by the style and, above all, the vocabulary. Your article on MAP on Page 43 of the February issue was the last straw. ("Is MAP GM's revenge on us for not buying its cars? And nine other questions about Manufacturing Automation Protocols.")

Please, can you tell me what is a "boondoggle?" From the context it must be a *bad* thing. However, a "boon" should, on the contrary, be a *good* thing, should it not?

I am, in spite of my address, a native English speaker. I am widely read in contemporary American literature. I go to the cinema (movies to you). But I often have trouble guessing what your slang means. I can just about understand what "hang in there" means, for example.

I think that you journalists should bear in mind that many of your European readers have only limited command of the English language and be prepared to sacrifice a little of what you probably think is a snappy style, for the sake of clarity.

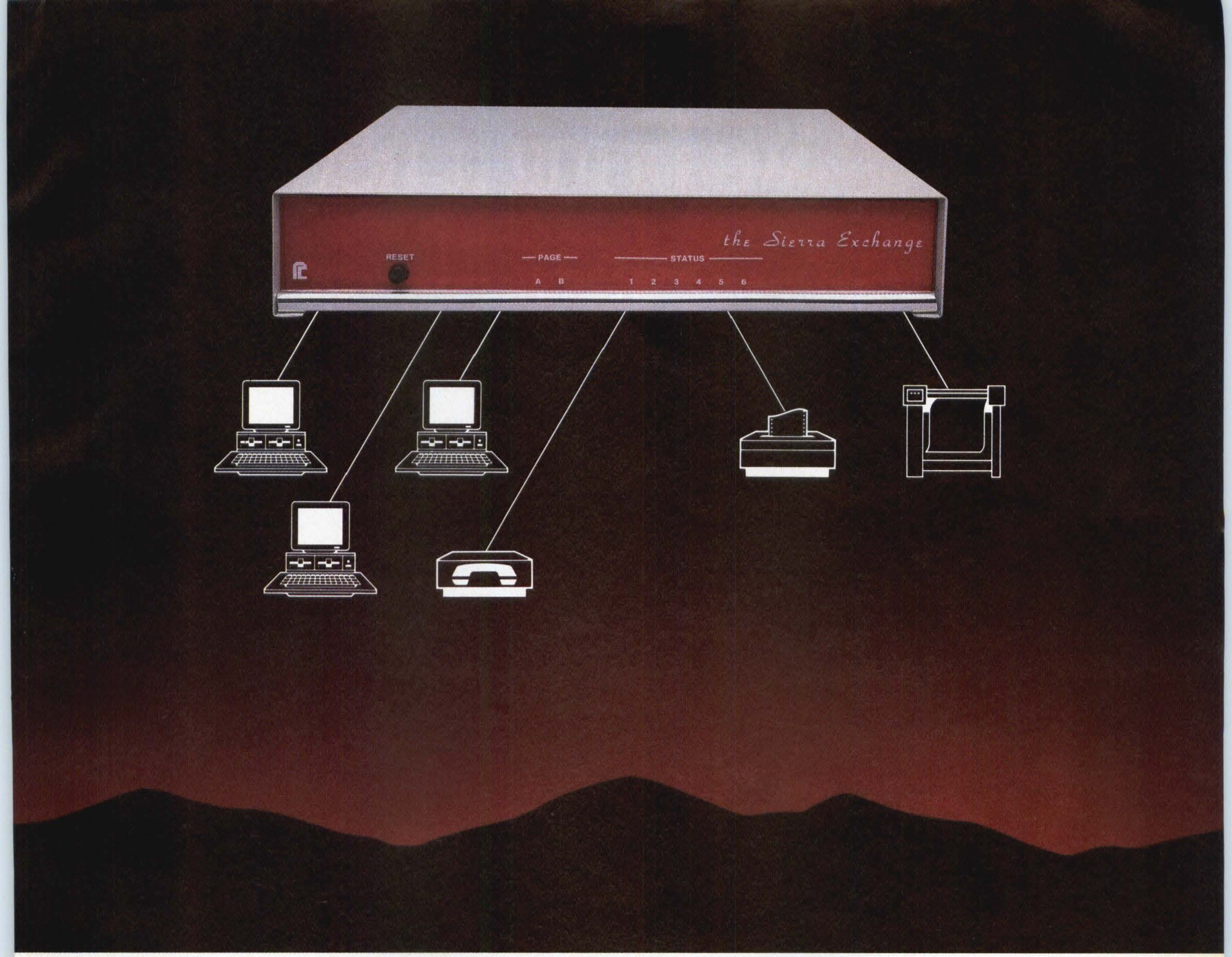
Solveig Albrand
Institut des Sciences Nucléaires
Université de Grenoble
Grenoble, France

Editor's response:

According to Webster's unabridged dictionary, American scoutmaster Robert H. Link coined the word "boondoggle" in 1925 to describe items made of leather or wicker by his youthful charges. Sadly, the word now means "an impractical or useless project, wasteful of time and money."

There is continuing debate on the larger question of using slang in prose. Those who don't like it consider it unseemly and churlish. Those who do, say good writing should "sound" like good talking. In other words, write the way people talk. And people use slang when they talk. Especially Americans.

If other readers have opinions on the subject, we'd like to hear them.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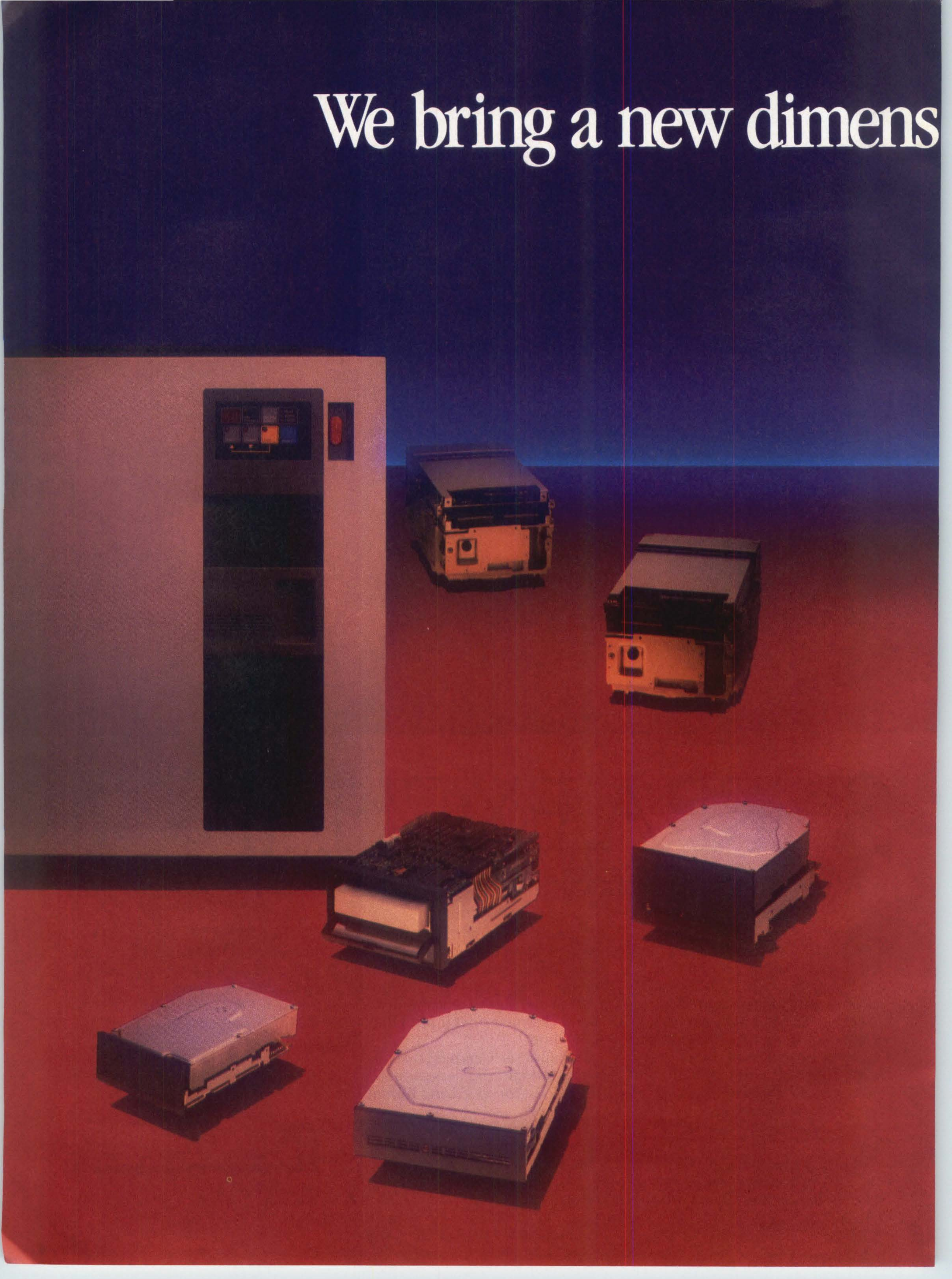
We bring a new dimens

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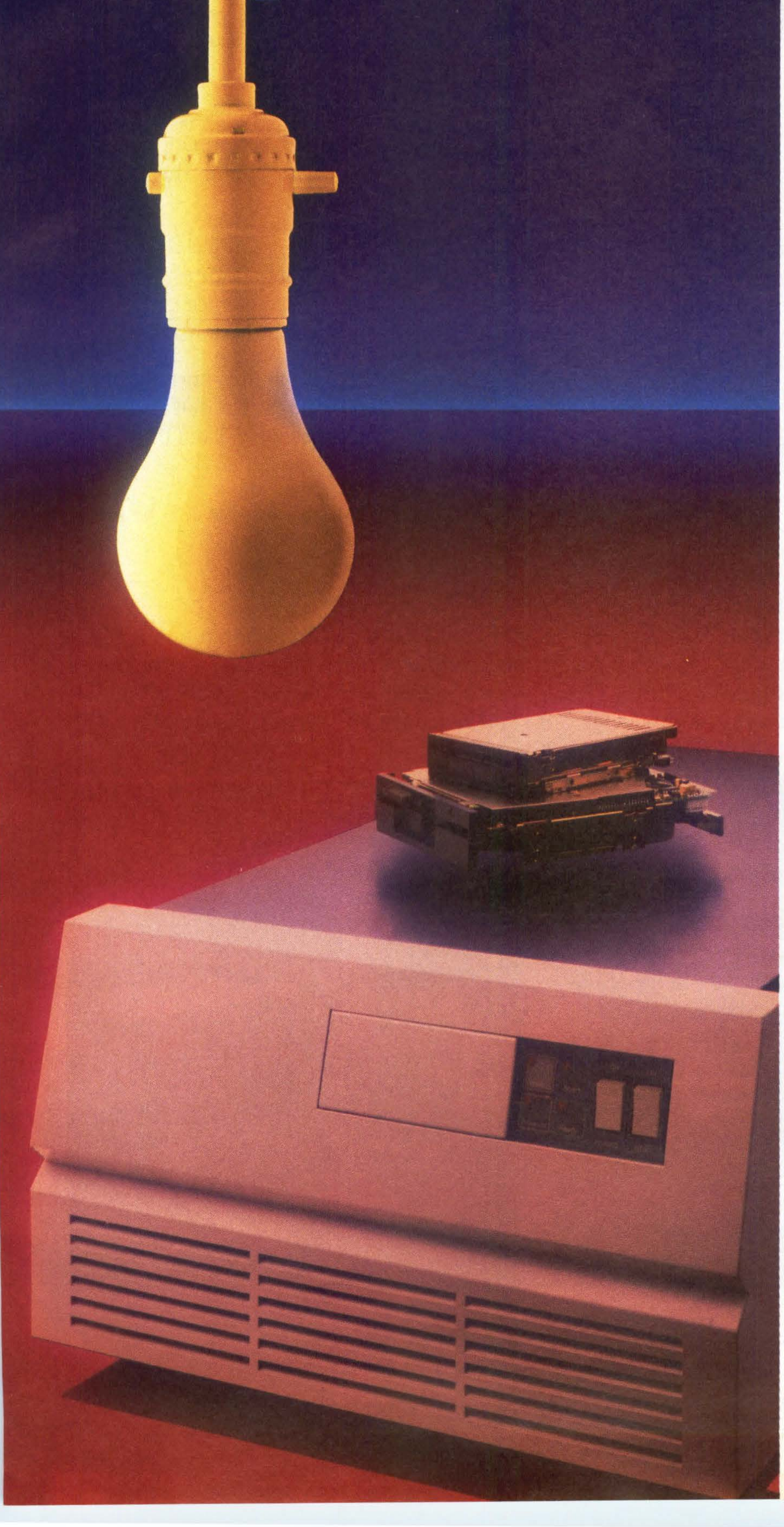

Our comprehensive line of data storage products outshines all the competition, thanks to two of Fujitsu's best ideas. Quality that is uncompromising. And reliability that is absolute.

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The LIPS 10 Plus laser image printing system continues to garner kudos wherever it runs, with its print quality, compatibility, 600,000 page life cycle and user-power features. Ten pages per minute of unparalleled first-class performance.

Our three-speed dot matrix Tri Printer/4000 is no slow poke either. In technology or speed. At top gun, it runs all day and night in data processing mode at 400 cps, as well as 87.5 cps for letter quality output. Not to mention higher graphics speeds for bar codes, forms and charts.

And the view doesn't stop here. C.Itoh's terminals are the perfect blend of price and performance and of quality and reliability. Pound for pound, there's none better. Nor more DEC-compatible.

Like our CIT224 terminal — completely VT220-compatible but with more desirable features, including a 14-inch screen, a 10 x 16 character cell, 11 set-up menus and 45 programmable key functions.

And the CIT101XL — to keep the fires burning in the VT100 market. Again, 100% compatible. But heavier on features than any alternative available. Even if DEC was still making its VT100.

C.Itoh's printers and terminals. You have to be pretty good to run with C.Itoh.

Good work, DEC.

For more information on C.Itoh's fast-running DEC-compatible peripherals, contact CIE Terminals, a C.Itoh company, 2505 McCabe Way, Irvine, CA 92714; or call (714) 660-1421 or our toll-free number (800) 624-2516.

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BREAKPOINTS

HP TECHNICAL COMPUTERS IN LINE FOR SPECTRUM RISC CHIP

By August, Hewlett-Packard Co. should be shipping its first systems using the VLSI version of the HP Spectrum reduced instruction set computer (RISC) architecture. The Palo Alto, Calif., company's new chip is in UNIX systems that fill out the HP 9000 line of technical computers. The entry-level Model 825S provides 8M bytes of memory and a 16-user license. It lists for $42,500. The high-end 850S supports up to 90 terminals. With 16M bytes of memory, a 32-user license and 10 I/O ports, the 850S will sell for about $200,000. HP also announced the RISC-based 950, which will become the top of its commercial HP 3000 family of minicomputers.—*Mike Seither*

TELEVIDEO COMES OUT WITH LINE OF 386 TECHNICAL WORKSTATIONS

Built-in Ethernet, TCP/IP and Remote File System (RFS) software, plus a combined UNIX/MS-DOS operating environment, are a few of the standard features TeleVideo Systems Inc. has designed into its newest Intel Corp. 80386 technical workstations. Priced from $8,000 to $13,000, the TeleSTAR workstations from the Sunnyvale, Calif., company also support X Windows—developed by researchers at MIT—for simultaneous display of multiple programs. The systems support eight I/O ports, two 32-bit slots and six IBM Corp. PC/AT-compatible 8- or 16-bit slots. They come with either 15- or 19-inch color and monochrome monitors and 40M-byte or 71M-byte disk drives.—*Mike Seither*

ON-LINE TRANSACTION PROCESSING GETS AN RDBMS

Sybase Inc., Berkeley, Calif., announces the first SQL relational database management system aimed exclusively at on-line transaction processing. In beta testing since October, the package includes a DataServer for handling data management chores and a window-based DataToolset for building and running applications on character terminals or bit-mapped workstations. It is available for Sun Microsystems Inc.'s UNIX workstations and Digital Equipment Corp. VAXes using VMS. The DataServer and DataToolset are priced from $15,000 to $150,000 for superminicomputers. Supermicrocomputer version prices range from $1,000 to $10,000. Sybase says that a version for Stratus Computer Inc.'s fault-tolerant systems should appear soon.—*Doug Pryor*

TEXAS INSTRUMENTS TIES 32 USERS WITH THE 386

The System 1300, scheduled in the fourth quarter from Texas Instruments, supports up to 32 users. According to the Dallas company, the 1300 is the first computer to use Intel Corp's. 80386 processor as the heart of a true multiuser system. The XENIX V.2 machine uses a 32-bit bus and provides 4M bytes of error-correcting code RAM (expandable to 15M bytes) and a 16K-byte

cache. The 1300 is available in two models: The $27,495 1325 furnishes 180M bytes of SCSI rigid disk storage with an average access time of less than 18 msec, while the $25,995 1350 goes to 360M bytes of mass storage. A 60M-byte cartridge tape backup is standard with both. TI will also offer a field upgrade kit—a CPU and memory—to turn a 16-user model 1100 into a 1300.
—*Doug Pryor*

MICROPOLIS READIES 180M-BYTE HALF-HEIGHT WINCHESTER

Micropolis Corp., Chatsworth, Calif., is planning a third-quarter announcement of a half-height, 5¼-inch, rigid disk drive with an unformatted capacity of 180M bytes and an average access time of less than 20 msec. That would pit Micropolis against Rodime Inc., and Control Data Corp., for drives of that class. Rodime already has announced a 170M-byte half-height product, and Control Data soon is expected to round out its Wren line with an equally expansive half-height Winchester.—*Mike Seither*

STRETCHING SOFTWARE THAT DOES IT BY THE NUMBERS

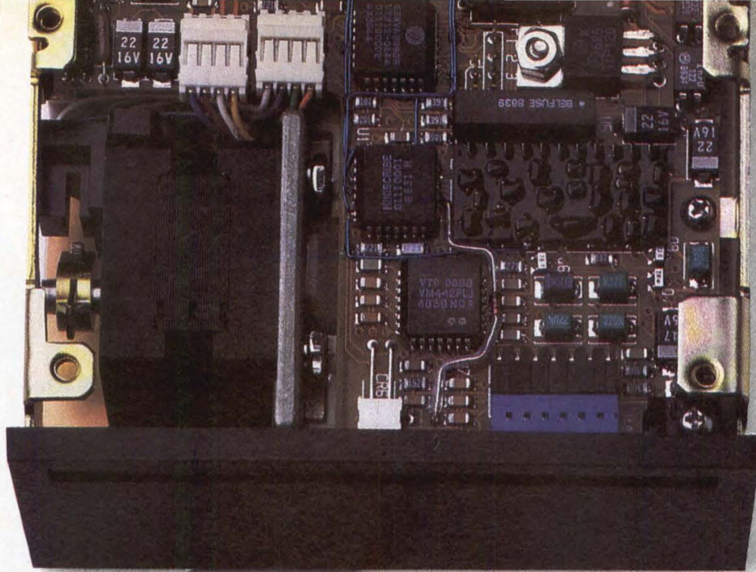
BBN Software Products Corp., Cambridge, Mass., has expanded its RS/1 statistical software to versions that run on Hewlett-Packard Co.'s 9000 Series 300 engineering workstations. Prices range from $3,900 for a single-user version to $9,900 for multiuser configurations. The company also plans a personal computer task force to explore the use of engineering-based statistics on MS-DOS and the more powerful OS/2 systems. BBN may expand its third-party development force beyond the present 10 percent of its overall business.
—*Tim Scannell*

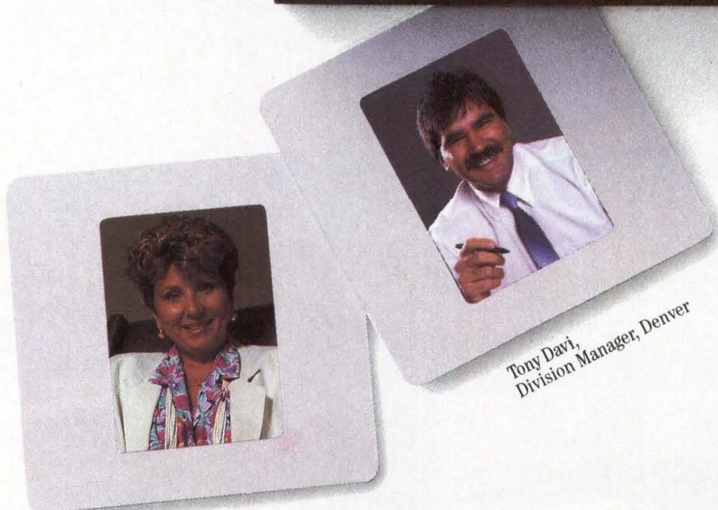
BENEFICIAL WAR LIKELY IN MICROCOMPUTER DBMS

Lotus Development Corp. has entered the microcomputer-based database management system arena, assuring competition that should benefit system integrators by driving down prices. Lotus/DBMS from the Cambridge, Mass., company goes directly against dBASE III from Ashton-Tate, currently the top DBMS package for microcomputers. Shipments start in the fourth quarter. Prices haven't been set. Lotus/DBMS—combined with its recently announced 10-year development pact with IBM Corp.—also should drive rival Microsoft Corp. into finally leaping into the DBMS fray, if for no other reason than to protect its relationship with IBM. The Lotus product is compatible with IBM's mainframe database system, DB2.—*Jim Donohue*

HP ADDS POSTSCRIPT TO LASERJET'S ARSENAL

With its industry-leading LaserJet printer under attack from Epson America Corp. and Okidata, Hewlett-Packard Co. has moved to broaden the appeal of the low-end product. The Palo Alto, Calif., company has endorsed Adobe Systems Inc.'s popular PostScript page description language for the LaserJet. Until now HP has backed only Imagen Corp.'s document desciption language, DDL. DDL





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Veronica Ellias,
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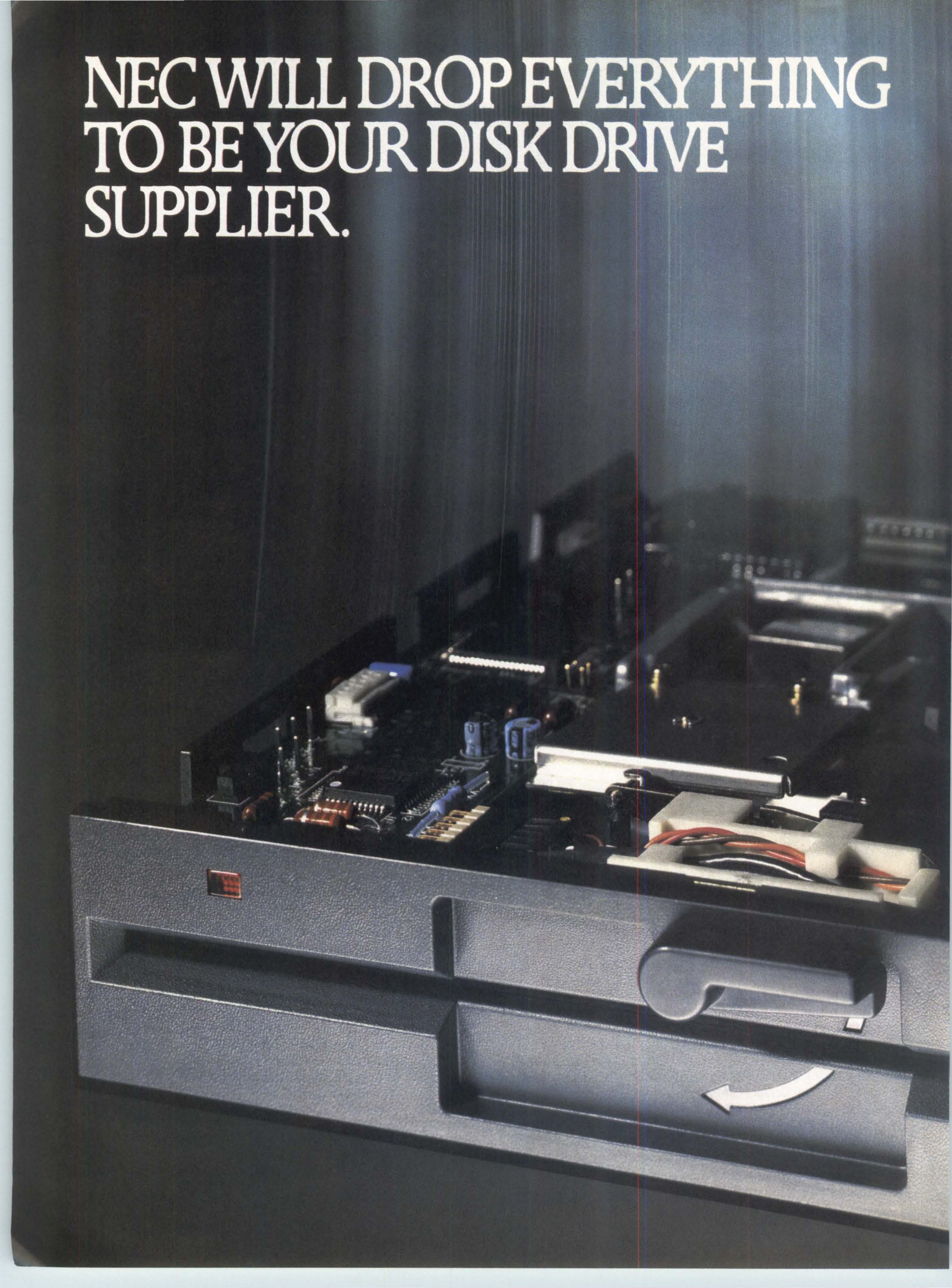
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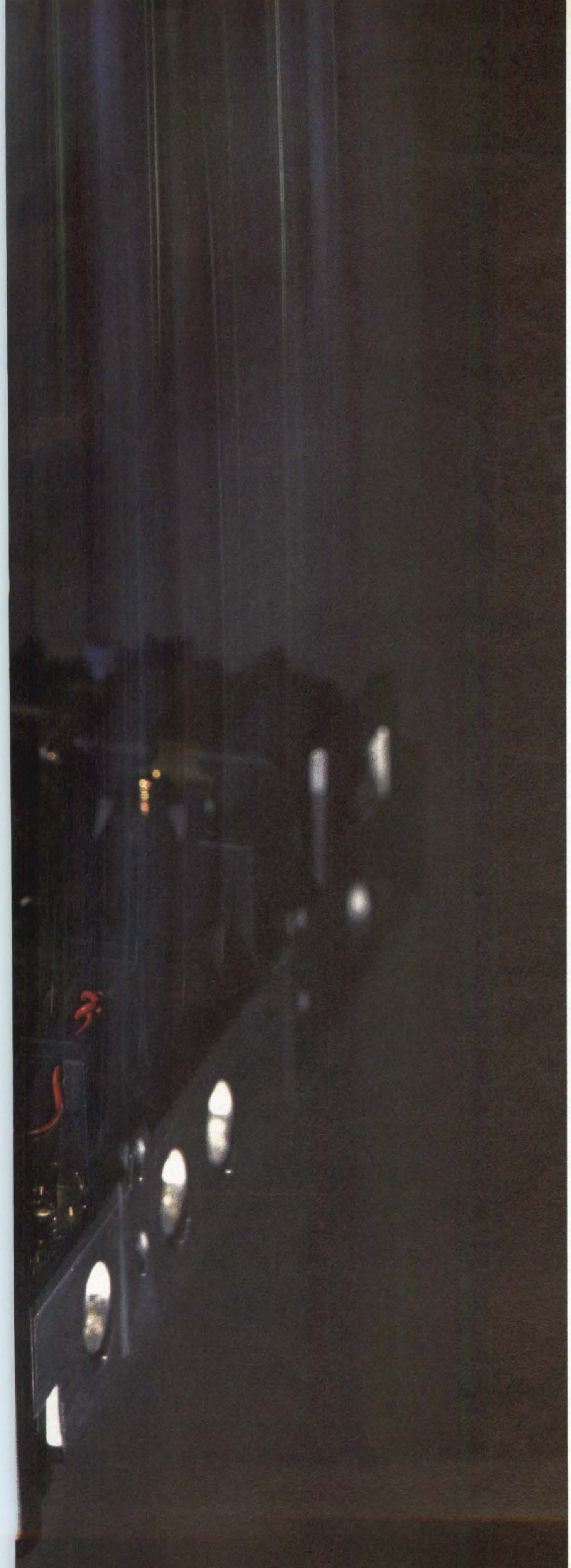

also has the backing of IBM Corp. and Apple Computer Inc. for their desktop publishing systems. HP says it is looking for other third-party vendors to write page description languages for the LaserJet.—*Jim Donohue*

MAXIMUM SHIPS IBM PC-COMPATIBLE OPTICAL DISK DRIVE

Maximum Storage Inc. has started shipping its APX-3000 Series of 5¼-inch optical disk drives for the "plug and play" IBM Corp. PC audience. The products store 244M bytes and are available in internal or external configurations. They are compatible with MS-DOS 2.0 through 3.2 with plans being made for DOS 3.3 compatibility in the near future. Single quantity pricing is $2,695. —*Megan Nields*

ADAPTEC WOOS DRIVE, CONTROLLER MAKERS WITH DATA SEPARATOR

Look for a mid-month announcement by Adaptec Inc., Milpitas, Calif., of a data separator for disk drives and controllers that the company claims operates at a guaranteed margin of 1 nsec. The new AIC-622 is priced from $11 to $28 in quantities of 1,000, depending on the data rate. The separator has an operating range of 10M bps to 33M bps and runs with most popular data encoding schemes, including RLL (run-length limited) 2.7, RLL 1.7 and modified frequency modulation (MFM). Volume shipments are expected later this summer.—*Mike Seither*

APOLLO SPREADS ARCHITECTURES WELCOME MAT

Although criticized last year for being too proprietary-minded, Apollo Computer Inc. of Chelmsford, Mass., is working hard to open its systems doors to other vendors. Recently, the company reaffirmed its support of such emerging standards as X Window (developed by MIT), IBM Corp.'s SNA and LU 6.2 and Ethernet. It also unveiled a series of 3-D graphics processors (DN570, 580, 590) with prices starting at $39,900 and network servers (DSP500) that are compatible with the industry-standard VMEbus and Multibus with prices starting at $47,900, all in the name of distributed computing.—*Tim Scannell*

SYMBOLICS USES SILICON ON CMOS CHIP

Symbolics Inc., Cambridge, Mass., known for its LISP machine architecture, is the first to employ silicon in a VLSI implementation of an entire LISP processor on a single CMOS chip. Based on an architecture optimized for VLSI, the chip's design allows it to be integrated with a small number of other chips—such as those for memory, I/O and bus interface—to make a single-board LISP machine. Programmers will be able to interface with either LISP or assembly code. Products could be available in the middle of next year. Symbolics is beginning to talk to OEMs about ways to license the chip and embed it into their systems.—*Wendy Rauch-Hinden*

AN AI MATCH SPARKS NEW BUSINESS VENTURE

Palladian Software Inc., Cambridge, Mass., has struck up a deal with Apollo Computer Inc. of Chelmsford, Mass., to offer an enhanced version of its financial software for Apollo workstations. This is the first time a general expert system will be available in the workstation market, according to Philip A. Cooper, chairman of Palladian. Both companies will work toward an AI-based engineering and business workstation for use throughout a corporation. —*Tim Scannell*

FINAL ESDI HEADS FOR ANSI COMMITTEE

The enhanced small device interface (ESDI)—in the making since 1983—is at last ready for ANSI approval. The final spec goes this month to the X3T9.3 committee for consideration. Formal blessing is expected in 1988, according to Dal Allan, chairman of the ESDI steering committee. ESDI is intended for 5¼-inch and 3½-inch disk drives and provides data transfer rates of up to 24M bps. The specification "grandfathers" previously implemented zero-to-15M-bps ESDI versions. Standardization should give the drive-level interface a lifespan of up to 10 years, according to Allan.—*Mike Seither*

COS STRESSES ROLE, DROPS FEES

Chided for having too many vendors and not enough users on its member roster, the Corporation for Open Systems, McLean, Va., has begun to aggressively present the organization as a promoter of standards; not a standards body. The campaign consists of all-day seminars and lectures, in conjunction with such groups as the National Bureau of Standards. COS also has dropped its rates for joining, which can be as high as $400,000 the first year and $200,000 each succeeding year for members like IBM Corp. Now, companies can affiliate for $500 per year, entitling them to a newsletter and access to a projected online database of standards activities.—*Tim Scannell*

SYSTEM INDUSTRIES UNVEILS HIGH-CAPACITY STORAGE SYSTEM

System Industries Inc., Milpitas, Calif., has announced a family of data storage solutions based the SI93 C-Series disk drive which boasts 1.1G bytes of unformatted capacity. The company claims the unit has the fastest average access time in current minicomputer envirionment—11 msec. Data is transfered at 2.46M bytes per second.—*Megan Nields*

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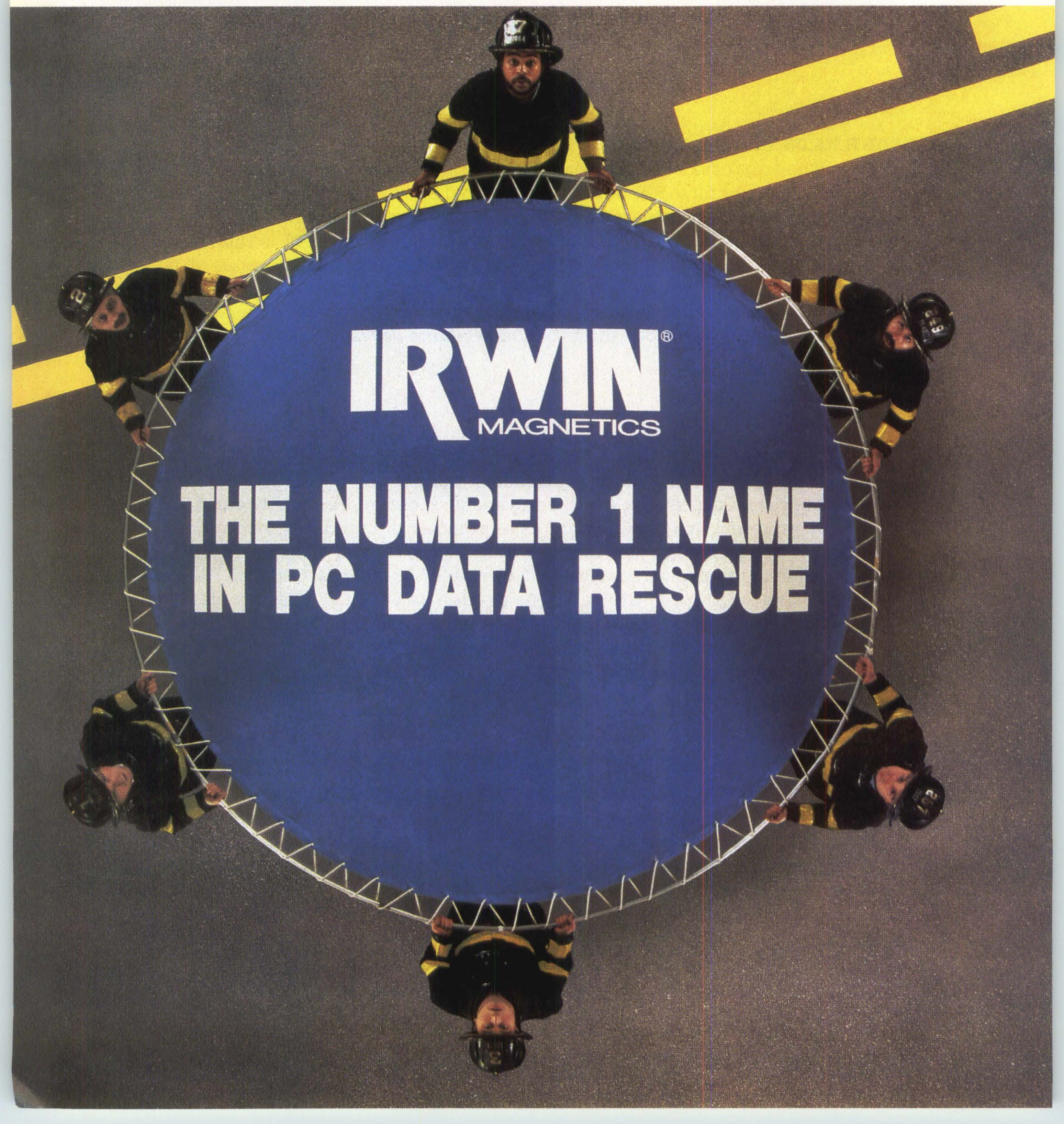

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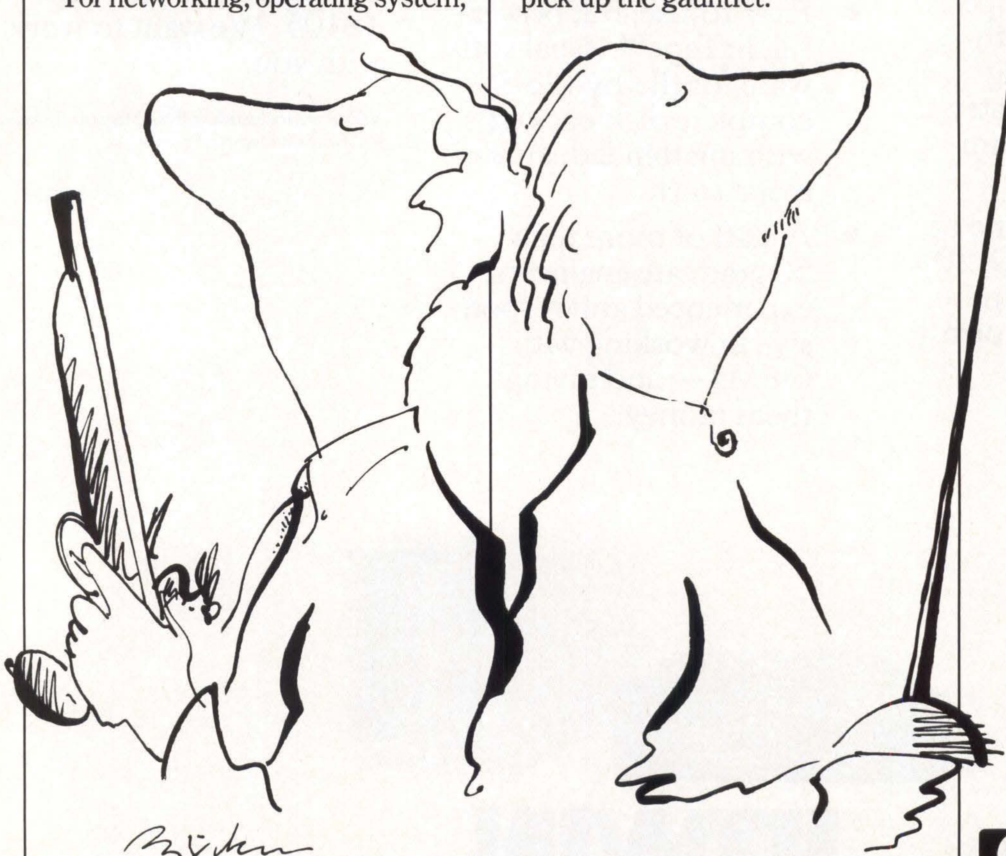

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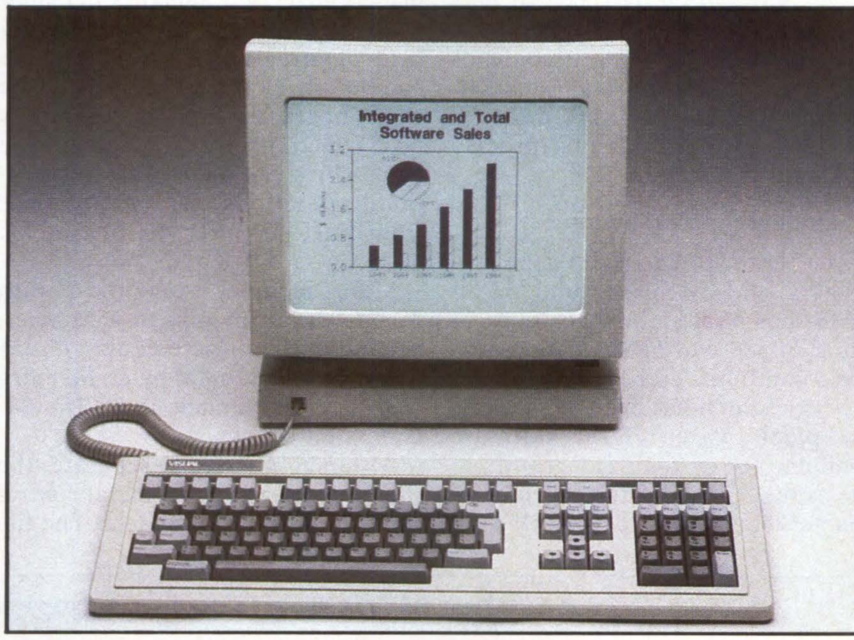
MINI-MICRO SYSTEMS PRODUCT SPOTLIGHT

COVER STORY

Altos paves reseller migration path with high-end 386 systems

Mike Seither, Senior Editor



Altos Computer Systems' *80386-based Series 2000 supports 45 to 60 users and most applications written for its earlier XENIX-based 80286 computers.*

Vendors of personal computers, technical workstations and network servers have been waxing enthusiastically about how Intel Corp.'s 80386 microprocessor will revolutionize their businesses. Meanwhile, makers of multiuser computer systems—except for a handful of announcements—have had little to say about their plans for 386-based products.

This month, however, Altos Computer Systems changes that with the introduction of its Series 2000, a floor-standing 80386 system that supports up to 64 users under the XENIX operating system. For the moment, the Series 2000 becomes the high end of the Altos line, boosting by at least 50 percent the number of users its systems can support. The new series joins the San Jose company's current family of 3086 computers, built around the 16-bit 80286 processor. Its 3068 systems, which use Motorola Inc.'s 32-bit MC68020 processors, are positioned as supermicrocomputers for about 30 users.

"More and more, Altos has found that it needs larger products," says analyst Chris Steitz of InfoCorp, the Cupertino, Calif., market research firm. "Thirty users has been a barrier, but [Series 2000] should get them over it comfortably."

Susan Purnell, a business computer analyst with Dataquest Inc., San Jose, observes: "As far as having a deliverable 80386 product for the UNIX-like multiuser market, Altos appears to be a leader. Now their resellers will be able to grow up and move into markets traditionally served by minicomputer vendors."

Although a force in the multiuser market, Altos is not alone in the 80386-based arena. This month, Fujitsu Microsystems of America Inc., San Jose, begins shipping a Pick Systems-based 386 multiuser product called the System 2200, model 50. It supports eight to 32 users and sells for $20,000 to $45,000, depending on configuration. Another company, Integrated Business Computers of Chatsworth, Calif., is shipping its Ensign 386:100. It supports from 16 to 100 users and can handle several operating systems, such as Theos 386, XENIX 386, and soon PC-MOS and Pick as well. An Ensign equipped with an 80M-byte Winchester, 1.2M-byte flexible disk drive, 60M-byte tape drive and 4M bytes of memory sells for about $19,000.

Altos is offering its Series 2000 in three models and at the following list prices:

- $25,990. System processor and chassis, 1.4M-byte flexible disk drive, 80M-byte Winchester disk drive with enhanced small device interface (ESDI), 60M-byte quarter-inch tape drive, 4M bytes of main memory and 20 serial ports.
- $29,990. Same processor, chassis, tape and flexible disk drive and main memory, 170M-byte ESDI Winchester and Multidrop. (Multidrop is an add-in board that uses a single coaxial cable to connect up to 64 serial devices to the chassis via Altos proprietary 1M-bit-per-second Worknet local area network.)
- $33,990. Same as the $29,990 version, but with for 8M bytes of

COVER STORY

main memory.

System integrators who buy in volume can expect normal discounts, but analysts who have looked at the pricing structure for the Altos systems say they are extremely competitive. That is chiefly because much of the design work was already done; although this is the first time Altos has used the 80386, the microprocessor has found a home in comfortable surroundings.

The Series 2000 has been in beta testing for a number of months and is now ready for the market, contends Jeff Bork, director of systems marketing at Altos. Distributors were expected to receive their first production units before June 1.

Channeled for distribution

The Series 2000 uses the same proprietary 20M-byte-per-second, 32-bit XMB bus that's the backbone of Altos' 80286 and 68020 floor-standing computers. Like those systems, the Series 2000 has eight slots in the backplane. Three of the slots are available for systems integrators to use as they please. Altos provides an adapter that allows off-the-shelf Multibus cards to attach to the XMB bus.

Altos uses the other five slots to configure the basic systems that go into the distribution channel. Those slots are occupied by the CPU, main memory and subsytems for file processing, communications and peripheral controllers.

The CPU features a 32K-byte data and instruction cache that allows the system to operate with no wait states more than 90 percent of the time, the company claims. An on-chip memory management unit supports demand-paged virtual memory. There are 2G bytes of virtual address space, that are handled in blocks of 4K bytes. The CPU board is also where Intel's 80387 math coprocessor roosts. The chip, which can be used for floating-point operations, became available from Intel just after the first of the year.

Main memory, organized into 32-bit words, can grow to 16M bytes, expandable in increments of 2M bytes, 4M bytes or 8M bytes. Memory transfers can be made in 8-, 16-, 24- and 32-bit chunks.

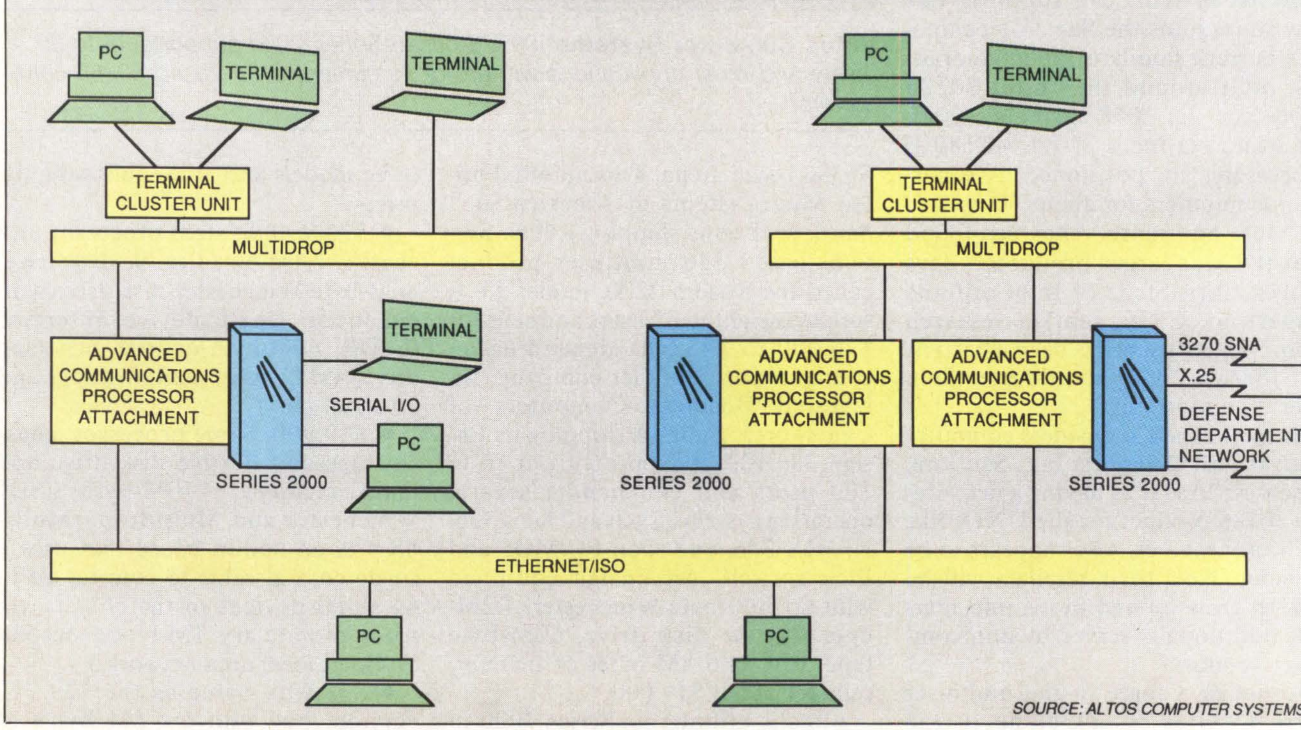
Although physically separate, the file-processing and peripheral-control subsystems work in tandem. The file processor has an 8086 processor for all mass-storage devices and is capable of overlapped seeks when more than one disk drive is in operation. The file processor also has a built-in Centronics-style parallel printer port. Meanwhile, the controller subsystem has independent controllers for the tape, flexible and rigid disk drives. Each communicates independently with the file processor, allowing concurrent transfer of data among all three.

Finally, there's the communications subsystem. Altos now provides two options for that slot. One is a board with 10 RS232 serial ports. Two ports can be programmed for synchronous communications, and another can be used for Altos' Worknet.

The second option is the Multidrop board, which supports up to 64 serial devices and Worknet. While the Series 2000 is designed for no more than about 60 active users, the system will support two Multidrop boards, allowing a total combination of 128 terminals, modems, printers and other serial devices to be hooked up.

The Series 2000 "was designed from day one to be modular enough

HOW ALTOS IS REACHING BEYOND ITSELF



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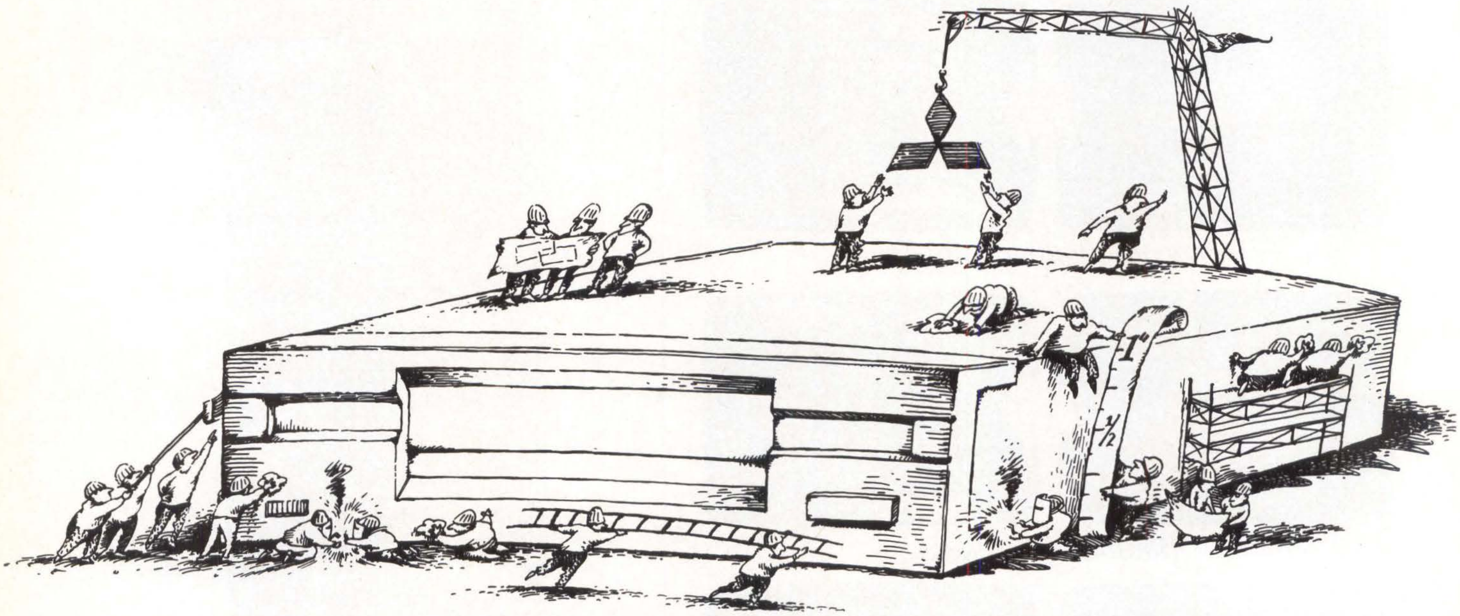

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MF355B	3½″	1.26″	1MB/2MB	+5V and +12V
MF353C	3½″	1″	1MB	+5V
MF355C	3½″	1″	1MB/2MB	+5V
MF501B	5¼″	1.61″	0.5MB	+5V and +12V
MF504B	5¼″	1.61″	.5MB/1MB/1.6MB	+5V and +12V
M2896	8″	2.25″	1.6MB	+5V and +24V

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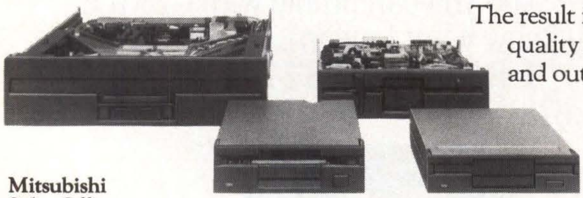

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to let us retrofit it with new technology, without having to throw away work we'd already done or leaving resellers to throw it away," says Altos' Bork.

Modularity to Altos means that all major components—drives and logic systems—can be removed by hand. The only exception is the power supply. Remote diagnostics can pinpoint which of the 13 field-replaceable subsystems is at fault. Admits Bork: "For the cost of these systems, frequent on-site service cannot be justified."

The big news for Altos' existing customers, however, is that they can swap out boards and upgrade to the 80386 system in the field. "In that respect, Altos may have a better story to tell than Digital Equipment Corp.," says Dataquest's Purnell. "Applications will run from the top to the bottom of the line, but you can also upgrade the technology in the existing chassis."

Programs written for earlier Intel-based Altos systems are expected to fall into three categories. A large number, perhaps 90 percent, will run on the 80386 without any modification, says Bork. That's because Altos, in its port of the XENIX System V operating system for the 386, has made it almost completely compatible with the 80286 version of XENIX. A few programs will have to be recompiled, and some may require what Altos officials call "unavoidable" changes in source code, but the task shouldn't be difficult, Bork claims. In fact, all the changes necessary to make previous code compliant with XENIX System V is contained in a four-page porting guide Altos has put together.

Highs and lows on the horizon

The Series 2000 is the first of a family of machines the company plans to market under the banner of the Altos 386. In the next nine to 12 months the Altos 386 family will be expanded at the high end and the low—there will be a Series 1000 and Series 3000, says Albert Leung, manager of systems product marketing at Altos. In the meantime, "Any existing floor-standing models in the field can be upgraded," he says. "Other products that it makes sense to upgrade will also get the 386."

Part of Altos' strategy is to continue moving toward industry standards. Right now the company supports XENIX on its Intel systems and UNIX System V on its Motorola systems. By the end of the year, it hopes to go to AT&T Co.'s UNIX System V Release 3 on all its systems.

And while Altos will continue to support its proprietary Worknet LAN, it plans to offer Ethernet on more of its systems in the future. At the moment, Altos offers Ethernet only on systems sold to large OEMs and the federal government, but not on those systems sold through distributors. A future product for the Altos 386 family, an advanced communications processor attachment, will provide that link to Ethernet (see Diagram). In order to bring IBM Corp. PCs and compatibles into its world of UNIX and XENIX, Altos is now evaluating a number of software products that allow DOS applications to run under UNIX.

What Altos might do down the road is indicated by its corporate activities and where it is putting its money. The company—which is expected to wrap up its fiscal year this month with about $140 million in revenues, $10 million more than last year—has always maintained about $50 million in cash and obviously has no qualms about spending.

Last year, for example, Altos bought a 25 percent share of Informix Software Inc., the Menlo Park, Calif., database company, and it's no secret Altos plans to use that equity position to beef its offerings in the database applications area. It also bought outright Communications Solutions Inc. of Cupertino, a supplier of SNA (Systems Network Architecture) software. Altos plans to use CSI's expertise to add IBM's LU 6.2 peer-to-peer communications protocol to its library of connectivity tools, which already include IBM's SNA and 3270 protocols and CCITT's X.25 standard. □

FACT FILE

Series 2000

Altos Computer Systems
2641 Orchard Parkway
San Jose, Calif. 95134
(408) 946-6700
Circle 473

**A floor-standing multiuser system running Intel Corp.'s 16-MHz 80386 processor.

**A 32K-byte cache allows the CPU to run 90 percent of time with no wait sates.

**Systems support 45 to 60 users, depending on configuration and applications.

**Runs under Altos' version of XENIX System V, the Microsoft Corp. UNIX-like operating system for the 80386.

DISK DRIVES

Maxtor's 3½-inch disk out front; rivals threaten lead

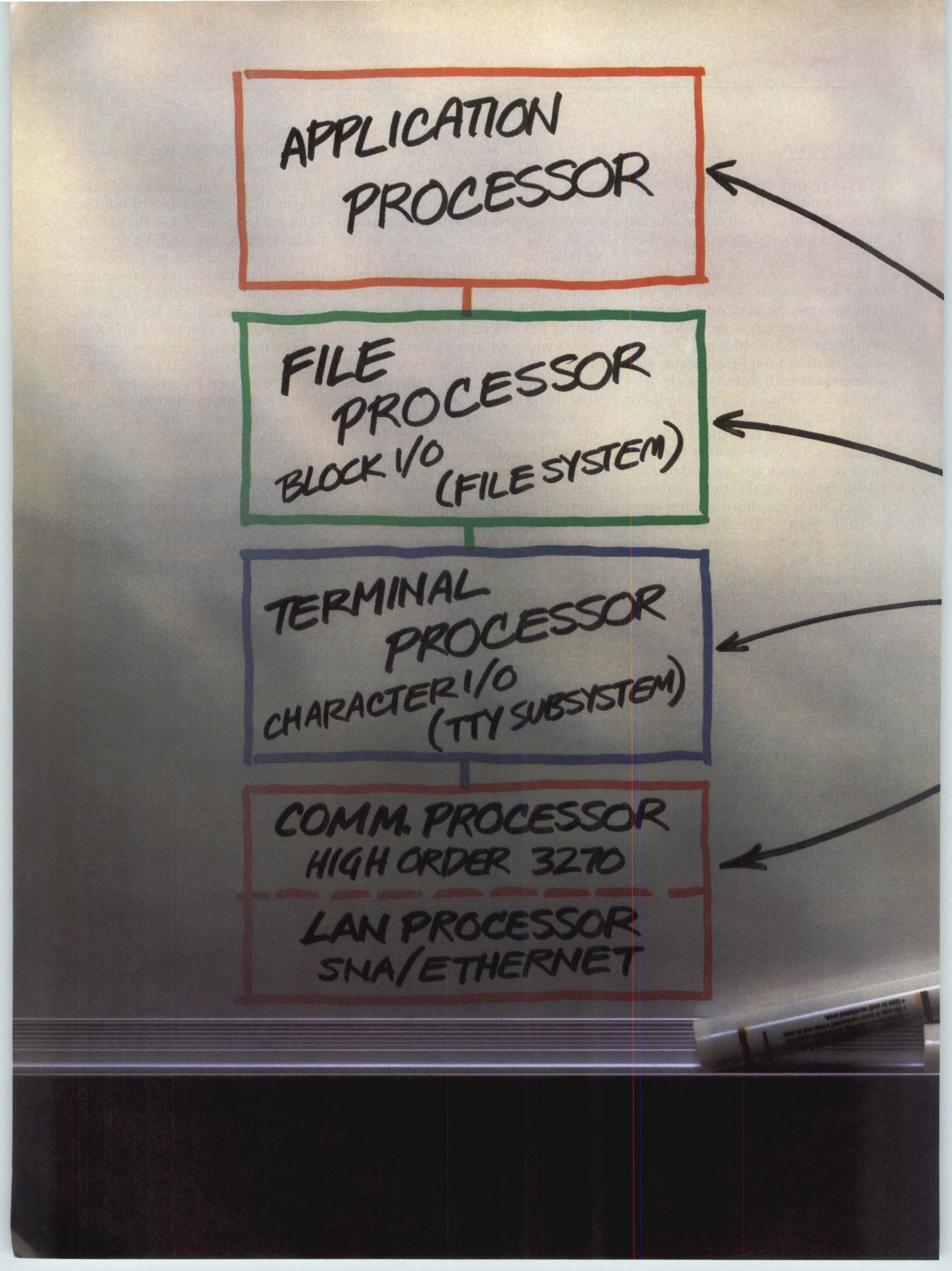
Mike Seither, Senior Editor

Maxtor Corp.'s long-rumored 3½-inch rigid disk drive—the company's first product in that form factor—is now a reality.

The San Jose manufacturer this month officially announced its LXT-170, a downsized Winchester with an unformatted capacity of 170M bytes and an average access time of less than 20 msec. Formatted, the drive comes in at 142M bytes. With this latest entry, Maxtor suddenly jumps ahead of the pack in what's turning out to be a fast-moving race for leadership on the 3½-inch Winchester track.

However, Maxtor's lead may be short-lived, say many analysts, as disk drive manufacturers position themselves for the inevitable transition by system integrators toward smaller mass-storage devices that consume less power.

In April, for example, Conner Peripherals Inc., also of San Jose, briefly captured the lead when it unveiled the CP3100, a drive with a formattted capacity of 100M bytes and an aver-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COMM. PROCESSOR
HIGH ORDER 3270
LAN PROCESSOR
SNA/ETHERNET

DISK DRIVES

age access time of less than 30 msec. Priam Corp., also of San Jose and one of Maxtor's chief competitors for high-end 5¼-inch disk drives, has also indicated its intention to manufacturer 3½-inch Winchesters. Although there has been no announcement yet, Priam's director of product marketing, John Hagerman, says that the company is aiming at a drive with a capacity in the area of 200M bytes.

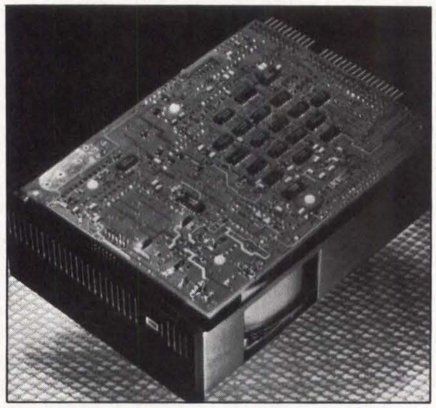
Micropolis Corp., Chatsworth, Calif., is also looking seriously at high-capacity 3½-inch technology, "from 100M bytes to 200M bytes," says Chett Baffa, senior vice president of sales and marketing. However, Baffa says that the market for Winchesters of that capacity can be served not only by 3½s but by half-height 5¼-inch disk drives as well. Those larger drives will find a home in tower-like systems, which do not have the space constraints imposed by desktop workstations.

Sizing up legitimacy

In view of IBM Corp.'s April announcement of Personal System/2, which uses 3½-inch flexible and rigid disk drives, many observers now believe the smaller form factor has been legitimized. And Maxtor, which has built a reputation for being first to the market with high-capacity drives, is apparently ready to capitalize on that acceptance. Industry analysts note that Maxtor has already shipped several thousand of its 380M-byte 5¼-inch Winchesters. Other vendors making drives of that class are, for the most part, still at the evaluation stage with OEMs and system integrators.

A GLANCE AT MAXTOR'S LXT-170

Unformatted capacity	170M bytes
Average seek time	<20 msec
Power requirement	18W
Disks	5
Heads	9
Latency	8.3 msec
Tracks per inch	1,360
Bits per inch	23,897
Interfaces	ESDI/SCSI
Dimensions (inches)	1.625×4.0×5.75
1987 OEM price	<$1,100



Maxtor's *first 3½-inch rigid disk drive, the LXT-170, first will be available with the ESDI and later with the SCSI interface.*

Maxtor marketing director Skip Kilsdonk says the company will charge OEMs less than $1,100 for the LXT-170, when the drive goes into production later this year. Kilsdonk adds that prices should fall to less than $1,000 during 1988. By comparison, Conner originally quoted a price of $995 for its 100M-byte drive.

Some analysts believe pricing for 3½-inch disk drives will be volatile for some time. Right now, early entrants with high-capacity devices should get better than average margins for their first shipments, says Phil Devin, who follows the mass-storage market for Dataquest Inc. of San Jose. "Based on the newness of the market, we expect to see instability in prices," says Devin. "Until manufacturing volumes get up, there is no indication that 3½-inch drives will be cheaper than 5¼s with comparable performance."

Maxtor will offer the LXT-170 with both the 10M-bit-per-second enhanced small device interface (ESDI) and an embedded asynchronous small computer systems interface (SCSI). The ESDI version is available now in evaluation quantities. Samples of the SCSI drives are expected to be ready for shipment after September, says Kilsdonk. Production units of both models are scheduled to begin 60 to 90 days after sample drives go out.

Dan Banerje, the product line manager for Maxtor's 3½-inch disk drives, says that the LXT-170 uses much of the same technology that's in the company's XT-8000E family of 5¼-inch Winchesters, which now offer 765M bytes of storage. With that technology, Maxtor pushed up capacity by increasing track and bit densities. The LXT-170 has 1,360 tracks per inch, about the same as the XT-8000E drives. The bit density, at 23,897 bits per inch, is about three-quarters that of the larger drives.

On the XT-8000E, seek times were reduced to about 18 msec by a reduction in the mass of the actuator and through the use of more efficient magnetic materials. The same design has migrated to the 3½-inch disk drives, according to Banerje.

The LXT-170 has five disks and nine read/write heads. One disk surface contains dedicated servo information. Banerje says that Maxtor may ultimately pack as many as eight platters into the 3½-inch head/disk assembly. If that comes to pass, Maxtor conceivably could produce a 380M-byte 3½-inch Winchester.

Whether Maxtor will reduce the number of platters and offer a 3½ with less than 170M bytes is still undecided. The company has, however, adopted that strategy with its XT-8000E line, paring its 765M bytes down to 400M bytes, with fewer disks.

"That's within the realm of technical feasibility," says Bob Katzive of Disk/Trend Inc., a Los Altos, Calif., research firm that tracks the disk drive business. "It seems like the logical thing for [Maxtor] to do." □

FACT FILE

LXT-170

Maxtor Corp.
211 River Oaks Parkway
San Jose, Calif. 95134
(408) 432-1700
Circle 473

**A 3½-inch Winchester with an unformatted capacity of 170M bytes.

**Average access time is less than 20 msec, with power consumption rated at 18W maximum.

**OEM pricing for 1987 deliveries to be less than $1,100, falling below $1,000 during 1988.

CIRCLE NO. 30 ON INQUIRY CARD →

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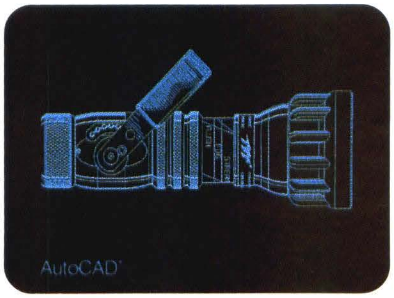

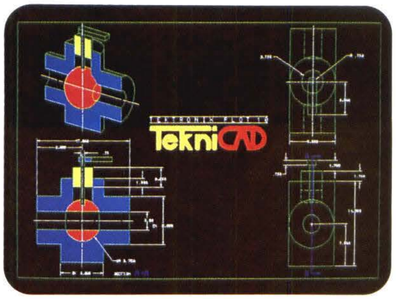

Graphics System Processor for ultra-fast throughput of your design applications. Add to that Tek's PC-05 or PC-07 terminal emulation software, and you're ready for stand-alone computing or access to a world of mainframe graphics.

To bring those applications to life, you can connect a Tek color ink-jet printer. And start producing high-resolution, vibrant hardcopy output on either paper or transparencies.

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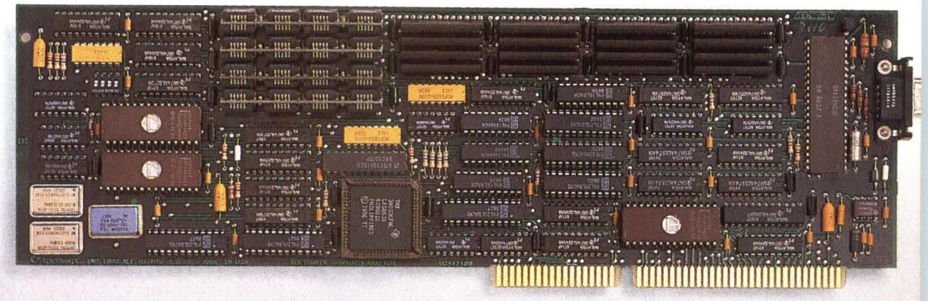

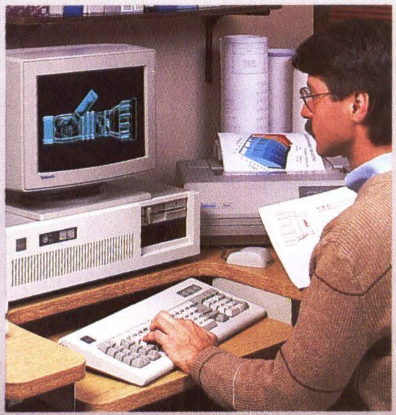

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Which means you can quickly access the power of Tek graphics—including 4107 segments, true zoom and pan, rubber-banding, definition of up to 64 viewports and more. You can use these highly productive features with a wide range of well-known designer software packages such as ISSCO's DISSPLA® and TELL-A-GRAF,® MCS's ANVIL-5000,™ SAS Institute Inc.'s SAS/GRAPH, Precision Visuals' DI-3000,® Swanson Analysis Systems' ANSYS® and McNeal-Schwendler's NASTRAN.

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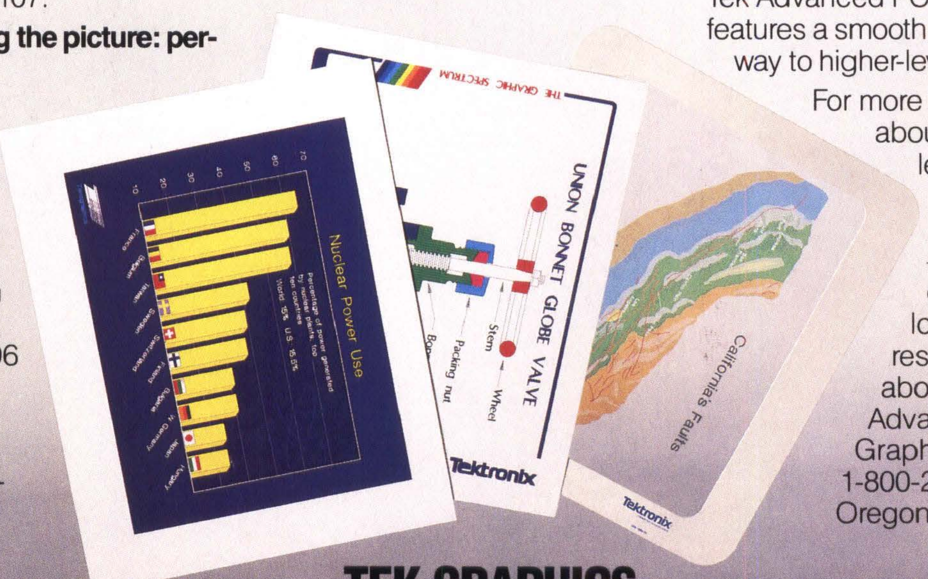

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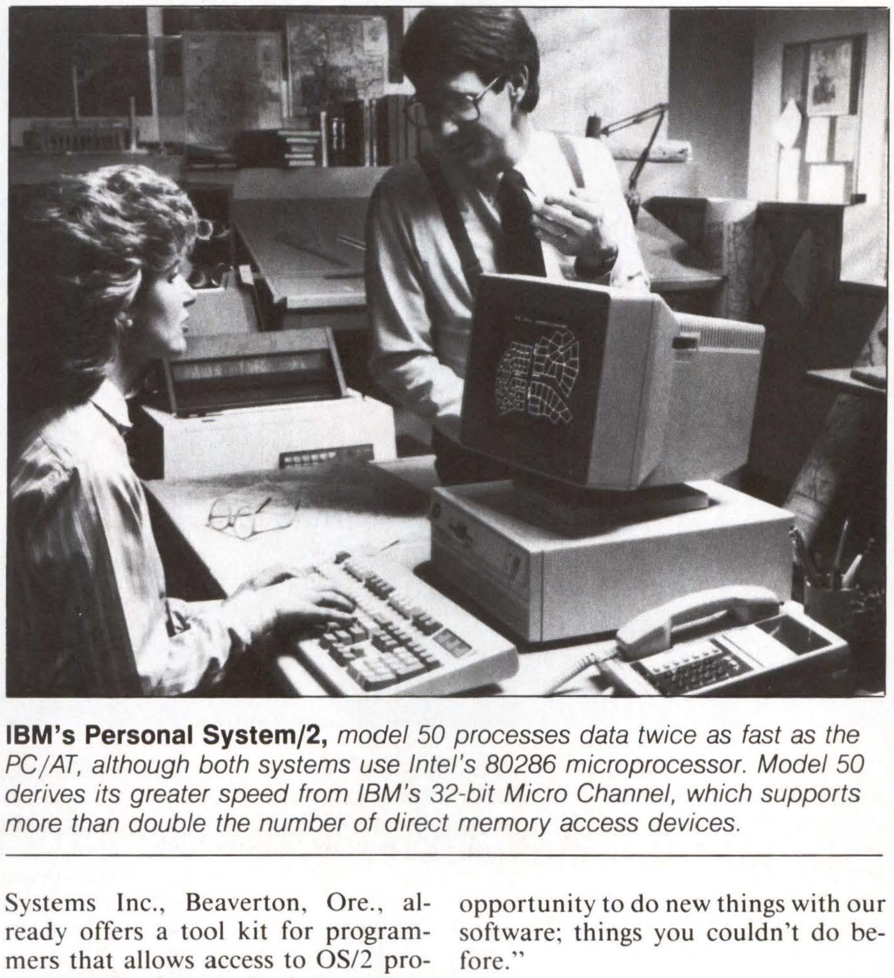
IBM PS/2 sparks new fires: vendors, integrators scramble

Tim Scannell, Senior Editor
and **Megan Nields,** Staff Editor



IBM's Personal System/2, *model 50 processes data twice as fast as the PC/AT, although both systems use Intel's 80286 microprocessor. Model 50 derives its greater speed from IBM's 32-bit Micro Channel, which supports more than double the number of direct memory access devices.*

Just how much of an impact will IBM Corp.'s Personal System/2 series of computers have on system resellers, value-added resellers and system integrators? As in the parable of the blind men trying to describe an elephant by individually examining its different parts, it depends on whom you ask.

Software developers are ecstatic that IBM seems to have opened a whole new market by unveiling microcomputers that will eventually be outfitted with an entirely new, graphics-oriented operating system, called OS/2. Programs written for IBM's MS-DOS machines can be easily ported to the PS/2—which consists of models 30, 50, 60 and 80 (see Chart), range in price from $1,695 to nearly $11,000, and are presently available with MS-DOS Version 3.3. These same programs, however, must be rewritten to take full advantage of the multiuser and multitasking functions of OS/2, which should be in the hands of developers sometime in the fourth quarter.

At least one firm, Graphic Software Systems Inc., Beaverton, Ore., already offers a tool kit for programmers that allows access to OS/2 protect mode for device-independent graphics development.

Given the breadth and scope of IBM's recently announced Personal System/2 microcomputers and OS/2 operating system software, Mini-Micro Systems *will cover their impact on system integrators, OEMs and VARs in a series of articles. This is the first in the series.*

"We really, really like the machine," says John A. Parsons, president of Micro-Integration Corp., a designer and developer of communications software and hardware based in Friendsville, Md. "It gives us the opportunity to do new things with our software; things you couldn't do before."

Modularity helps integrators

For Lotus Development Corp., Cambridge, Mass., the fact that three out of the four PS/2 machines have a built-in graphics capability—a 12,750-gate Video Graphics Array on the system board—fits in well with

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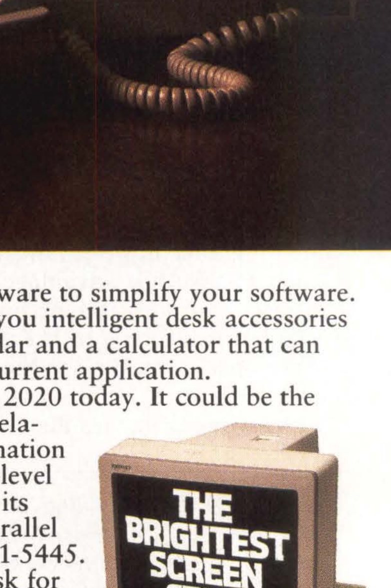

ADDS

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The person pictured above is a celebrity look-alike.
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CIRCLE NO. 21 ON INQUIRY CARD

the company's plans to expand its graphics software offerings and work more closely with third-party graphics software developers. In fact, just like the original IBM PC helped position Lotus as the spreadsheet standard-maker with its 1-2-3 product, the graphics capability of the PS/2 system could make Lotus a major force in the graphics marketplace, says director of marketing Tim Davenport. "The fact there is a major division, a major graphics group, within Lotus speaks for itself," he says.

System integrators should also like the product because it is highly modular. In fact, one communications hardware manufacturer noted that the whole system can be dismantled or upgraded with new components using a screwdriver.

Of course, while software developers have fallen over themselves in efforts to reintroduce old products that have been ported to the PS/2 (one even going as far to claim compatibility with the as-of-yet incomplete and unknown OS/2), board and add-in peripheral manufacturers are not as enthusiastic. The reason: Although earlier IBM PCs relied on an 8- or a 16-bit bus path for data transfers, all but one of the PS/2 systems incorporate the 32-bit "Micro Channel"—a bus that can support twice as many direct access memory devices and offers a faster data-transfer rate than the earlier PCs. For instance, while PS/2's model 50 uses the same Intel Corp. 80286 mircoprocessor as the PC/AT, it processes data at twice the speed. And, the Micro Channel is not compatible with current PC add-in boards. So, at least temporarily, it shuts out the clone manufacturers from marketing a "me-too" product against the PS/2.

IBM claims that details of the Micro Channel are readily available, although the company did not release any specifications until about a month after the splashy debut of the PS/2 held in both Miami and New York. Board manufacturers invited to attend the Miami two-hour briefing on the architecture engaged in a 15-minute shouting match with IBM spokesmen, when it became apparent no technical specifications were going to be released, says one source.

IBM may have delayed spilling the beans about its bit-moving structure to buy more time for the hardware to catch up with the yet-to-be-released

IBM'S PERSONAL SYSTEM/2 FAMILY: ACCENT ON POWER

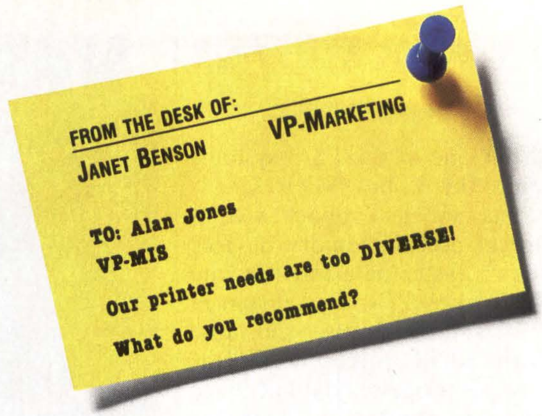
	Model 30	Model 50	Model 60	Model 80
Microprocessor	8086	80286	80286	80386
Potential system throughput[1]	2½ times PC/XT	2 times PC/AT	2 times PC/AT	3½ times PC/AT
Standard memory (bytes) Expandable to	640K	1M 7M	1M 15M	up to 2M 16M
Flexible disk size/capacity (inches/bytes)	3½/ 720K	3½/ 1.44M	3½/ 1.44M	3½/ 1.44M
Fixed disk capacity (bytes)[2] Additional options	20M	20M	44, 70M 44, 70, 115M	44, 70, 115M 44, 70, 115M
Maximum configuration (bytes)[3]	20M	20M	185M	230M
Expansion slots[4]	3	3	7	7
Operating system(s)	PC-DOS 3.3	PC-DOS 3.3, OS/2	PC-DOS 3.3, OS/2	PC-DOS 3.3, OS/2

[1]Based on the testing described in the IBM Personal System/2 Performance Guide. Your results may vary.

[2]Model 30 also comes in a flexible disk-based configuration.

[3]Models with the 44M-byte fixed disk are expandable to 88M bytes.

[4]Model 30 accepts most IBM PC and PC/XT option cards. Models 50, 60 and 80 accept new IBM Micro Channel option cards.



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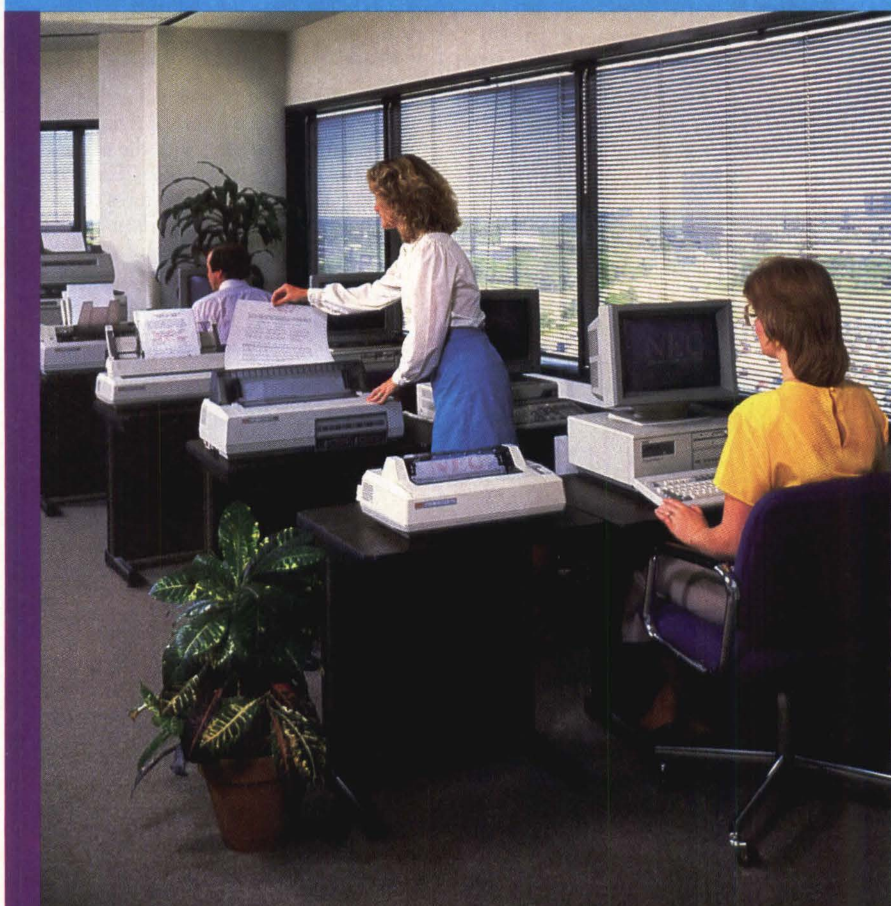

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CIRCLE NO. 29 ON INQUIRY CARD

IMPACT PS/2

OS/2 software. From a strategic standpoint, any kind of a delay or enforcement of patents concerning the Micro Channel can be seen as a way to discourage "premature cloning," maintains publisher Jeffrey Tarter in *Softletter,* a monthly newsletter.

Questions surround OS/2

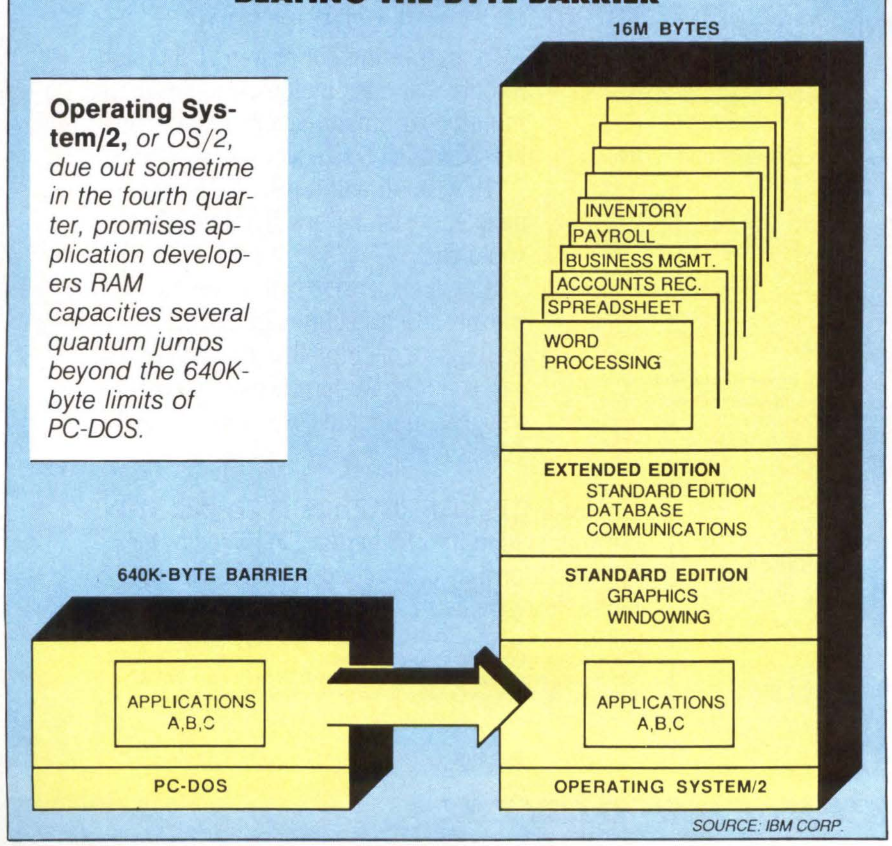
Many board manufacturers will undoubtedly adapt to IBM's Micro Channel standard. They will probably pay some kind of licensing fee, much like many software developers paid to incorporate IBM's basic input/output system so their software would run on IBM PCs. But a problem has yet to be solved centering on the OS/2 operating system.

As it stands, there seems to be two versions of the system software. One, actually two, is offered by IBM and incorporates a Systems Application Architecture (SAA). That's a common framework that allows programs to be written and used across IBM systems all the way up to the mainframe level. The other, being marketed by Microsoft Corp. of Redmond, Wash., under the same OS/2 moniker, will be available to OEM customers later this year.

At the moment, IBM seems to have the drop on Microsoft since its version seems to be more in tune with the PS/2's connectivity functions. In fact, at the systems' unveiling, IBM also announced a bevy of hardware and software products that allow the PS/2 to fit into local area network environments. Among them was a baseband version of its PC Network that targets the educational market and 3270 emulator adapters. These connectivity functions are part and parcel of the second version of OS/2 offered by IBM, called Extended OS/2.

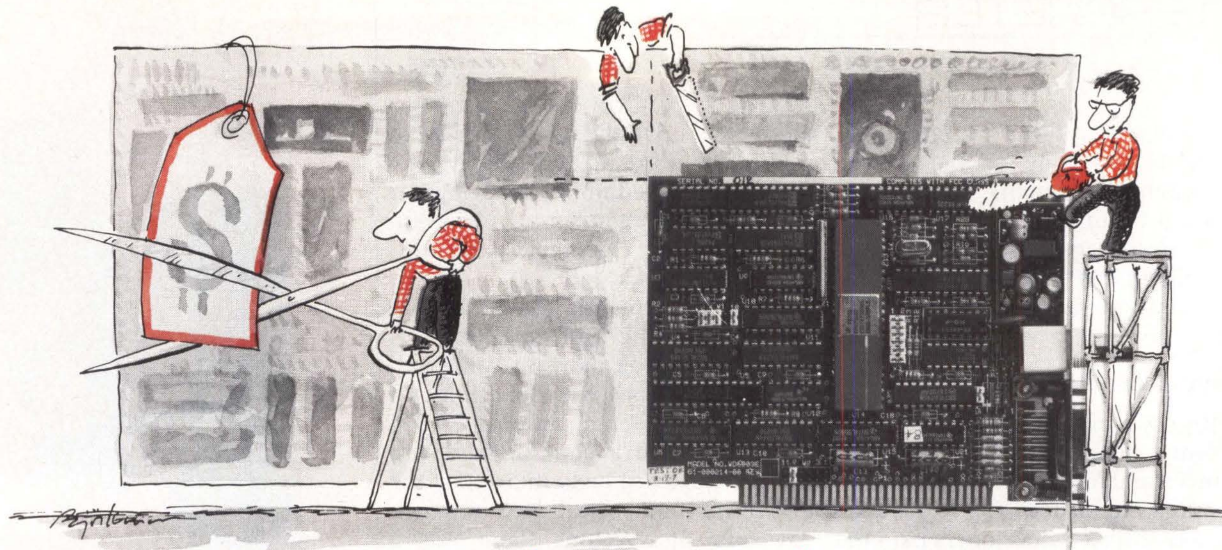
What's more, IBM may be trying to close the open concept of LANs by restricting access at the user end via its Extended OS/2, remarked Vincent Barrett, a market analyst for The Gar-

IBM's PC-DOS VS. OPERATING SYSTEM/2: BEATING THE BYTE BARRIER



Operating System/2, *or OS/2, due out sometime in the fourth quarter, promises application developers RAM capacities several quantum jumps beyond the 640K-byte limits of PC-DOS.*

SOURCE: IBM CORP.



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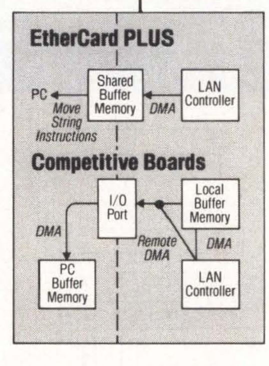

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WESTERN DIGITAL

tner Group Inc., Stamford, Conn., at a recent press briefing on token-ring networks. However, IBM is doing this to close access to its own systems world and not to the LAN market, which offers some new opportunities for developers who want to keep a foot in IBM's door.

Microsoft chairman and founder William Gates points out that, while IBM's OS/2 is not proprietary in terms of its graphics or operating system functions, it is locked into SAA. He added that Microsoft's OS/2 complies with SAA.

In terms of its connectivity, however, Microsoft will not have the networking aspects of its OS/2—embodied in a product called LAN Manager—available until the fourth quarter, says Steven Ballmer, vice president of operating system software.

Eyes on Microsoft

Robert C. Clark, vice president of marketing for The Seybold Group, an office automation consulting agency in Torrance, Calif., claims Microsoft has been "nebulous" in discussing the functions and strategy behind its LAN Manager, as well as unclear on its exact specifications. "Microsoft is well-known for making announcements before they have the products," he says.

Clark speculates that Microsoft may be trying to move toward some kind of a centralized file-server product that stresses performance. He is also not sure how such a product would be received or how it would affect the industry.

In any case, while IBM is marketing its OS/2 and PS/2 as connectivity systems, Microsoft seems to be trodding more familiar turf by referring to any PS/2 running under its OS/2 as "Windows" machines, capitalizing on the operating systems' graphics capabilities. Both Microsoft's and IBM's OS/2 versions include the Windows package, renamed Presentation Manager. However, Microsoft is betting heavily that present users of its Windows software environment—an estimated 850,000 units installed—will be likely candidates to jump on its bandwagon should a rift come between their view of OS/2 and IBM's.

Both IBM and Microsoft will charge about $325 for their respective OS/2 products, according to Microsoft's Ballmer. IBM's Extended OS/2 is priced at $795. At present, Microsoft has more than 120 ISVs (independent software vendors) committed to its Windows product, as well as more than 22 hardware companies like Digital Equipment Corp. and AT&T Co., relates Ballmer. "There is a strong, strong momentum behind the Windows product," he states.

Microsoft Chairman Gates stresses that, despite reports in the press, there is no strain in the relationship between IBM and his company. From a programming standpoint, both versions of the OS/2 operating system are similar, although IBM's contains a number of device drivers that are engineered for its particular products. He notes, however, that the IBM version does put more emphasis on connectivity with its SAA and built-in applications, since it includes a communications manager and a database manager in addition to the Windows-oriented Presentation Manager.

As a result, a mainframe user who has a full-blown SQL (structured query language) database on a network, may be attracted by IBM's Extended OS/2 because of its database conventions and advanced comunications functions, Gates says.

Role seen for third parties

Microsoft does not intend to develop an extended version of its OS/2 to mimic IBM's product. Stuff like that is best left up to third-party developers, who already do a good job, Gates says. But, Microsoft is not ruling out participating in any developmental projects that may crop up.

On the other hand, there's one thing that does concern Microsoft connectivity. The company's LAN Manager, says Gates, is the functional equivalent of Novell Corp.'s NetWare communications software. Novell's is the leading LAN system in the microcomputer area with an installed base of more than 22,700 systems, according to International Data Corp., Framingham, Mass.

Gates went on to say that any software or hardware developer, including Novell, who hopes to survive

We made it practical. OEMs made it Peripheral of the Year.

Two years ago, we asked OEMs to describe the perfect printer. "It would be fast and quiet" they told us, "and most of all, easy to use." Based on their suggestions, we built the 4/66 dot matrix printer. The printer named Peripheral of the Year at the international 1986 RITA Awards (Recognition of Information Technology Achievement Awards sponsored by the British Broadcasting Corporation and Computing Equipment Magazine).

Ease of use is what earned the 4/66 its RITA Award. It changes automatically from fanfold paper to single sheets, so you never have to re-thread paper onto a tractor feed. Plus, the 4/66 has automatic forms loading, a zero tear off feature, and it can handle paper sizes from 3″ to 17″ wide.

The 4/66 is also one of the fastest printers available. It produces three modes: 480 cps draft, 180 cps near letter quality, and 75 cps letter quality. And it is versatile. You get up to 20 optional type fonts, and seven colors.

Finally, the 4/66 is quiet. Its 18-needle print head sits in an anti-noise shield. It makes little more noise in an office than it does in this photograph.

To all the OEMs whose suggestions helped make the 4/66 Peripheral of the Year, we offer our special thanks. And to all the OEMs in the market for a dot matrix printer built especially to suit your needs, we offer encouragement to take a look at the Honeywell Bull 4/66.

For more information, contact Honeywell Bull Italia, Printers Division, 120 Howard St., Suite 800, San Francisco, CA 94106. Or, call us at 415-974-4340.

Honeywell Bull

Customers are more important than computers.

CIRCLE NO. 19 ON INQUIRY CARD

when OS/2 develops into a standard would do well to rewrite their configurations to comply with either version of OS/2—or at least provide some kind of bridge between their products and OS/2-type workstations. "Those (applications) that survive will be the ones that are written to take advantage of the graphics and multitasking of OS/2," Gates contends.

Indeed, Novell and others may not be too far behind in terms of developing products to comply with the PS/2 computer series. Seybold's Clark says IBM contacted Novell and a few other LAN manufacturers prior to the official debut of the PS/2 and offered some advance information to help get their products ready for market. Novell may already have a jump on the competition, because the latest NetWare version has been adapted to run on 80386 systems, notes Clark.

Other LAN manufacturers like AST Research Inc., Irvine, Calif.; 3Com Corp., Mountain View, Calif.; and Ungermann-Bass Corp., Santa Clara, Calif., will have to revamp their network operating systems to accommodate both IBM's and Microsoft's OS/2. No easy feat, considering OS/2 has more than 800 system calls and requires 400K to 500K bytes of memory, compared with MS-DOS, which has 89 system calls and runs in about 40K bytes of system memory.

However, since OS/2 will not be in users hands until 1988, every LAN manufacturer and integrator will have plenty of time to adapt, says Tom Roberts, manager of personal computer research at International Data Corp.

Bus raises some problems

At the moment, communications hardware vendors are running into a brick wall since delays in releasing specifications of the PS/2's Micro Channel have forced manufacturers and system integrators to speculate rather than to design products. Dealers of the new machines are also running into difficulty, because many have their sales firmly rooted in the personal computer market. "If they want to sell machines, they need to be able to understand the mainframe environment as well as the PC environment,"says Micro Integration's Parsons. "And that's something they have not done in the past very well."

There are also a number of competitors who feel that IBM and Microsoft may be putting too much stock in the connectivity prowess of the newborn operating system. "It's still too early to respond, but it will be interesting to see how [OS/2] manifests itself as multiuser and not just multitasking," says Leonard F. Halio, vice president of the Small Systems Product Group at Prime Computer Inc., Framingham, Mass. He admits that Prime will keep an eye on OS/2 developments, because the company just recently came out with a multiuser system, called the EXL 316, that is based on the same 80386 microprocessor used in IBM's model 80 PS/2 machine. It can run a variety of operating systems and application software under a UNIX environemnt.

In the end, it will be acceptance in the Fortune 500 market—a market that traditionally operates on three- to five-year purchase cycles—that makes or breaks the PS/2 systems. Seybold's Clark maintains it will be at least mid-1988 before developers can supply the market with an adequate number of application programs. A study recently conducted by the Newton-Evans Research Co., Ellicott City, Md., also showed that 28 percent of 50 Fortune 1000 executives interviewed indicated plans to purchase quantities of at least one model of the four PS/2 computers. However, 30 percent said the PS/2s will not affect their buying plans in the "foreseeable future."

"There are going to be people who decide from a cost standpoint it doesn't make sense to buy a new Personal System/2," says Micro-Integration's Parsons. "But, a lot of people who want to integrate their operating environment are going to choose the PS/2, because that is where IBM has said its machine is aimed." □

DATA COLLECTION

Bar code readers check out as 'most perplexing' automation tool

James F. Donohue, Managing Editor

Bar codes and their readers have long been touted as an effective way to count and control in the automated factory. But, many system integrators who build production lines around them are not happy with the results.

One is Mike Pouliot, a product marketing manager at McDonnell Douglas Corp.'s Information Systems Group, St. Louis. Pouliot wants to build systems in which products carrying bar-code identification move past a fixed-position scanner. But there are problems. These include difficulty in accurately and consistently lining up a product label with the scanner; smudged bar codes, which inhibit reading; and limits to the amount of data that can be carried by a single lined code.

Some of these problems can be overcome. For example, new laser scanners are available that "wrap" light beams around a moving product. Scanners like this have been pioneered at the grocery store checkout, where they effectively read labels on items of different shape and size. However, dirt and grease in harsh environments are still concerns, as is the amount of data that can be squeezed into any one code.

"It's not all that easy" to build such a system, Pouliot says. "Nobody has been able to do that efficaciously."

Bar-code equipment vendors like Larry Yost, vice president for operations at Allen-Bradley Co.'s Industrial Controls Group in Milwaukee, tend to agree. "Of all our problems, reading the bar code has been the most perplexing," Yost says.

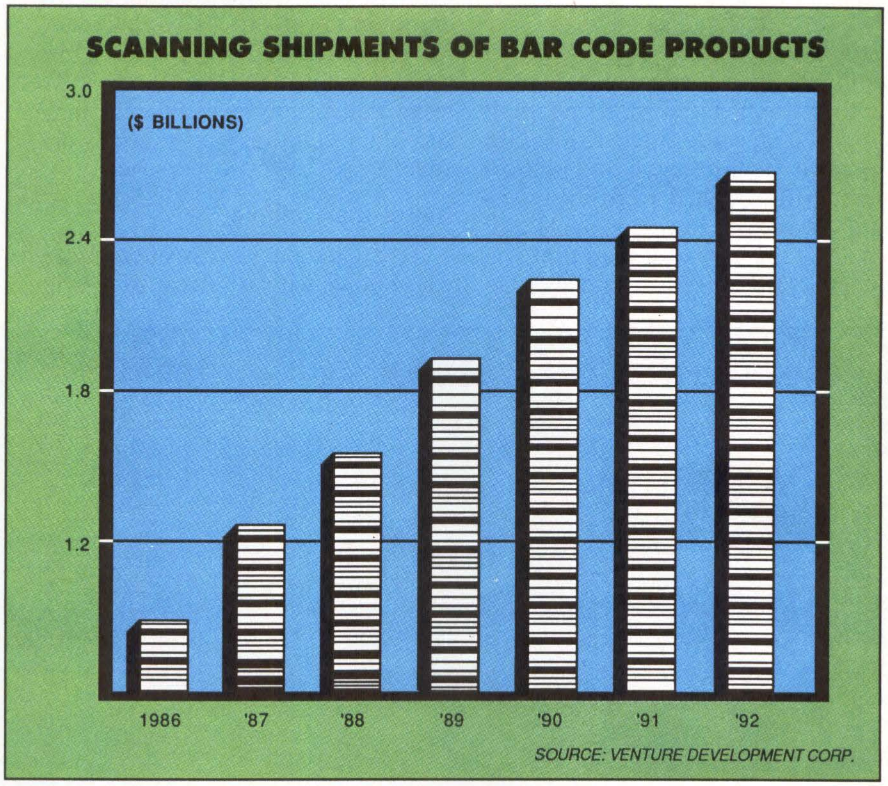
Yost's experience with bar-code readers comes from the effort of A-B's system integrator, the Industrial Automation Systems Division, to establish a highly automated "factory-in-a-factory" at its headquarters manufacturing plant in Milwaukee. In this operation, intended to showcase A-B's automation-control equipment, four workers attend 26 machines (doing assembly, subassembly, testing and packaging) making two sizes of contactors (controls for elec-

DATA COLLECTION

tric motors) in many variations.

Bar codes are major players in the operation, permitting A-B to build 675 variations of the two types of contactors, with little human intervention. The codes identify what variation of contactor is on the line and what each of the 26 production machines is to do to it. For example, the bar codes carry information that tells a machine's cam where to position tools (like a screw driver) for work on each variation.

However, A-B found itself going nuts trying to integrate a fixed-beam, incandescent bar-code reader—bought from an outside source—into the system. "Twenty-two machines might read the bar code, but the 23rd would not," explains Yost, bringing the whole production line to a stop. Partly in frustration, A-B went into the bar-code business itself, purchasing the bar-code line of Scope Inc.,



DATA COLLECTION

Reston, Va., in late 1985.

John Rothwell, supervisor of the "factory in a factory," says A-B solved its bar-code difficulties with improved technology and elbow grease. A-B switched from incandescent light to laser in the reader. Laser provides "the very best read that you can get," Rothwell says. And A-B became diligent in maintaining the machine that prints its bar-code labels.

"The bar code itself has to be very well printed," Rothwell says. "We clean that printer every day to make sure the resolution is as sharp as possible."

Better than people

If bar coding is so trouble-prone, why bother with it? Because, despite everything, it represents a reasonably good way to read data on the factory floor, says McDonnell Douglas' Pouliot. Certainly, he says, bar-code systems are a better way of reading data than assigning a worker to do it. "You can't afford to have people leave their bench and go over and interact with a terminal," he says. "They're not producing goods when they're doing that."

How industry bellies up to bar codes

Frost & Sullivan Inc. surveyed manufacturing plants and asked how they use bar-code readers. Here are the results. The numbers are the percent of respondents who say they employ bar code sytems in that application. Since most companies use bar codes for more than one application, the numbers total more than 100 percent.

Application	
Inventory management and control	47%
Work-in-progress monitoring and control	45
Shipping	41
Production counting	32
Data entry	30
Process control	24
Automated warehousing	20
Receiving	19
Document processing	17
Order processing	13
Sorting	11
Analytic systems testing	5
Automatic billing	3

DATA COLLECTION

To the three impediments to efficient reading of bar codes listed by McDonnell Douglas' Pouliot—orientation, smudging and limits on length—Maurice Klapfish, project director at Venture Development Corp., Natick, Mass., adds a fourth: the distance of the scanner from the bar code. "In many places," he says, "the distance is causing the problem. The places where there's contact reading—or very close to it—tend to have much less of a problem."

Alternatives good, but expensive

The limitations and maddening inconsistencies of bar-code systems have led users to look for something better. One candidate, especially in harsh environments like automobile assembly plants, is radio tracking. In this type of system, a radio transmitter activates and then reads data on a small radio frequency (RF) tag attached to a product moving down the assembly line.

Radio tracking is accurate, and the tags are programmable so they can be used over and over. But costs are high. The transmitter/readers cost about $10,000 each, and the tags run from $8 to $50 each. Programmable tags cost $50 to $150 each. On the other hand, a fixed-position, fixed-beam bar-code reader, about equivalent in operation to radio tracking, costs about $600. The tags cost pennies apiece.

Klapfish says the high cost will keep radio tracking out of all but very specialized applications. Most factories will stick with bar codes, he says, but they will look for "better equipment, particularly the labels." He urges users to print the bar code on labels and paste them on the product, and not to print the code directly on a product. "A lot of the problems are caused by printing right on the product," he says. "There's no question that the accuracy is there if bar coding is done right."

Supporting that view are system integrators like Gary Ambush of Charles Stark Draper Laboratories Inc., Cambridge, Mass. "We've had our bugs and our minor problems with it [a bar-code system]," he says, "but for the most part it's been very successful."

Like A-B, Ambush pays particular attention to the bar-code label. Noting that some bar codes "are very elaborate," Ambush points out that Draper designs its own bar-code labels and aims for simplicity. "We try to simplify things."

Details of whom and what

Where they operate successfully, bar-code systems get good reviews. At Xerox Corp.'s Electronics Division in El Segundo, Calif., for example, bar codes are read by light wands to compile production histories of printed circuit boards. And the General Motors Corp. Buick plant in Flint, Mich., uses the codes to keep inventory straight, assuring, for instance, that red seats are kept out of green automobile interiors, as industrial robots feed them onto the production line.

How to decipher a couple of codes

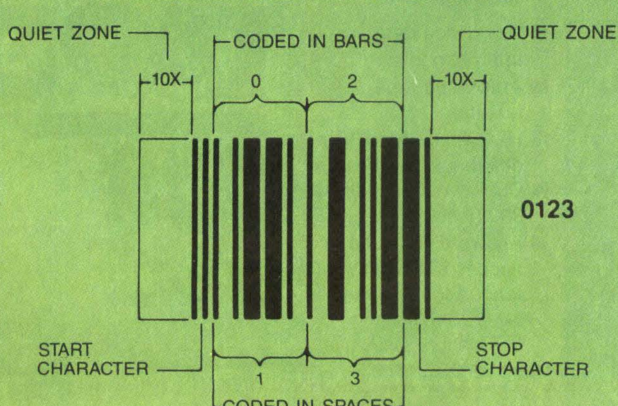
Code 39 (right), the most popular bar code, comprises consistently sized wide bars and narrow bars. The computer reads the wide bars as 1, the narrow bars as 0. Both black and white bars count.

In the sample, the computer reads the character 3 from two wide black bars, one wide white bar, three narrow black bars and three narrow white bars. The sequence is wide, narrow, wide, wide, narrow, narrow, narrow, narrow, narrow (101100000). The quiet zone at the start and finish of the code is 10 times the width of the narrow bar.

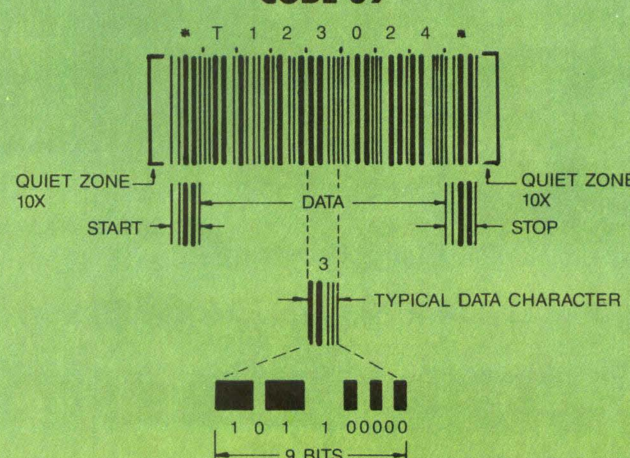
Code 39 is a product of Intermec Corp. Interleaved Two of Five by Computer Identics Corp., (left), the other code widely used in manufacturing, employs the same techniques, but in a different format.

(Code samples and explanations courtesy of Benjamin Nelson, industrial market relations, Markem Corp., Keene, N.H., a maker of bar-code label printers.

INTERLEAVED TWO OF FIVE



CODE 39



DATA COLLECTION

Sales of bar-code equipment (scanners, printers, label makers) are growing at a rapid clip, averaging a 30 percent annual rate, according to Frost & Sullivan Inc. The New York market research company estimates sales in 1990 will reach $2.3 billion, up from $750 million last year. Venture Development backs up these predictions, saying sales of bar-code equipment will reach $2.6 billion in 1992.

Seventeen companies presently sell bar-code reading equipment, according to Frost & Sullivan, with four of these accounting for 60 percent of total sales: Hewlett-Packard Co., Cupertino, Calif.; Intermec Corp., Lynnwood, Wash.; MSI Data Corp., Costa Mesa, Calif.; and Telxon Corp., Akron, Ohio. Other players include Accu-Sort Systems Inc., Telford, Pa.; Computer Identics Corp., Canton, Mass.; Skan-A-Matic Corp., Elbridge, N.Y.; Spectra-Physics Inc., Eugene, Ore.; and Symbol Technologies Inc., Bohemia, N.Y.

All bar-code equipment operates on the same basic principles. The bar code itself is a strip of alternating black and white verticle stripes of different widths arranged to represent letters, numbers and other symbols. Typically, it's painted on, pasted on or burned into whatever is being tracked—a box, an automobile transmission, a printed circuit board. The scanner is an illuminator—typically a laser, a light-emitting diode (LED) or an incandescent bulb—with a photodetector. The photodetector senses light reflected by the white stripes and generates voltages corresponding to the intensity of the light. The scanner or its controller digitizes this analog signal for entry into a computer.

With bar codes and their readers growing in popularity, users and their system integrators have begun pushing vendors toward a standardized language format that can be read by all. There are approximately 25 languages available today, but by far the most widely used is Intermec's Code 39, developed in 1974 and adopted in 1981 by the Department of Defense as the Logistical and Material Automated Recorder System. The Defense Department's 50,000 vendors use it. The U.S. General Services Administration and private-sector groups like the Automotive Industry Action Group also have adopted Code 39.

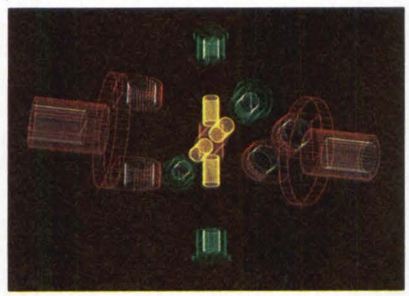
Next in popularity is Interleaved Two of Five, promoted by Computer Identics and used primarily for warehousing and distribution.

The Universal Product Code (UPC), adopted in 1974 by the National Association of Food Chains, is what's on that box of cereal, can of soup or sack of crackers that you buy at the supermarket and that gets "beeped" at the checkout counter. □

CAD/CAM

Excellence is standard for CAD/CAM data exchange

James F. Donohue
Managing Editor



The first three versions *of the Initial Graphics Exchange Specification could handle only 2-D and 3-D data, including 3-D wire models (left). But Version 4 handles solids model data as well. (Wireframe screen picture courtesy of VersaCAD Corp.; solids model, courtesy of Aries Technology Inc.)*

Every now and then the federal government does something that shakes your faith in its ineptitude. An example is the IGES/PDES committee. That's a largely voluntary eight-year effort spearheaded by the National Bureau of Standards to write translator protocols that permit engineers and designers to move computer aided design/manufacturing (CAD/CAM) data among disparate computer systems.

The NBS, from its headquarters in the Washington suburb of Gaithersburg, Md., coordinates the work of more than 600 representatives from more than 250 companies, universities and entire nations organized into 15 committees in the project. The NBS also keeps tabs on what's going on with graphics-exchange standards in Europe and Japan. The committee budget is of the shoestring variety, by federal standards: \$150,000 to \$175,000 a year. Most of the money comes from the Department of Defense, which is interested in using CAD/CAM in the design of military hardware.

So far this small army of talent has produced a top-notch first-pass specification, the Initial Graphics Exchange Specification (IGES), and is about to launch its powerful successor, the Product Data Exchange Specification (PDES).

Why should you care? Because IGES and PDES are critical elements in computer integrated manufacturing (CIM), a concept many system integrators expect to use to generate business. They are translators that permit you to take CAD/CAM data held in an IBM Corp. computer system, for example, and send it to the database of a Digital Equipment Corp. computer system.

IGES/PDES will make factory integration more likely by facilitating transfer of CAD/CAM data to various departments, even if they don't have the same brand of computers.

PDES, especially, has the potential to handle data more complete than anything found today even in many of the best engineering drawings. In theory at least, it will be able to support a product from design through the entire manufacturing/maintenance process, all on computer and without paper.

Not yet, but coming

Says Bradford Smith, head of the IGES/PDES committee, "PDES gives you such a complete representation of the product that the application program [to set up and run machines to manufacture the product] can proceed with no human input." But Smith cautions, "Remember, PDES has not been created quite yet. And application programs like that definitely have not been created yet. But they're coming along hand in hand."

"PDES will support the entire life cycle requirements of the part," Smith explains. IGES deals only with the geometry of a product. "But PDES will support a wide range of non-geometry data such as manufacturing features, tolerance specifications, material properties and surface finish specifications," Smith says.

Version 1 of PDES is due out late this year. Meanwhile, work on IGES continues. The IGES project began in 1979 at a meeting of users of CAD/CAM systems. The users complained about being unable to swap data among computer systems, and Boeing Co. and General Electric Co. came to the rescue by turning over to the public domain work they had been doing on the problem.

That prompted the NBS to combine grants of \$25,000 each from the Army, Navy, Air Force and the National Aeronautics and Space Administration to fund the IGES commitee. The first specification went before the American Society of Mechanical Engineers in May, 1980, for processing as a national standard. The approval

CAD/CAM

came in 1981.

By now, IGES has evolved through four versions into a mature specification capable of handling 2-D, 3-D and solids models. Smith says work has begun on IGES Version 5, which will add boundary representation (called B-rep by solids modelers), one of two popular methods for representing parts geometry in a computer database. Version 4 has only constructive solid geometry (CSG), the other popular method. Expect Version 5 sometime toward the end of 1988.

IGES is not universally cheered by users. It is memory hungry: an IGES file is "usually larger than a compressed raster data file," says Chester Fleszar, marketing specialist at Applicon, Burlington, Mass. And error rates run as high as 10 percent, according to Maciej Zgorzelski of GMI Engineering and Management Institute, Flint, Mich.

PDES comes out this year

The NBS will launch PDES this spring with a "straw man" version that will be circulated among committee members for comment. A second "straw man" may follow in the summer. If all goes well, the NBS will publish Version 1 in October or November.

Smith says not to expect the first implementations of PDES (one of which will be at the NBS in Gaithersburg) until late 1988. Commercial applications should start in 1990 in the very highest of high-tech companies, he says, and PDES will be in common use in 1992-93.

The NBS plans to present PDES to the International Standards Organization's Technical Committee 184/SC4 in Geneva as the U.S. position in the emerging international Standard for Exchange of Product Model Data (STEP), scheduled for publication in 1988.

Smith says the U.S. position is that the PDES specification will be assumed into the international standard. "We recognize that there is only room for one world standard in product data modeling," he says.

However, Smith notes that international committees sometimes can engage in "endless, very childish arguments about turf and domain. We don't have time to wait for a lot of little turf battles to be fought. If this happens, we may keep PDES as it is [for use in the United States and by anybody else who wants to use it] and allow STEP to be a subset. We look at it this way. If the international community cannot agree on something sensible, we're going forward anyway."

IGES and PDES are "neutral" specifications, meaning they are not biased toward any particular computer or CAD/CAM vendor. Smith says all vendors of CAD/CAM systems "with at least a 1 percent market share" now offer IGES compatibility as part of their package.

To have something IGES compatible, the vendor writes software to translate what's in his CAD/CAM database into something IGES can understand and send along to another computer. Of course, there must be software at the receiving end, as well, to translate the data into that system's database.

"This data exchange is not without some problems," Smith says. After all, there are two translations involved in every IGES exchange, and something is lost in almost any translation.

The greatest problems, Smith says, are in the completeness and accuracy of the translator software. "Even though the two CAD systems may have the same functionality, if the IGES entities have not been implemented in the software translators, you will not have complete data exchange."

(In the CAD/CAM world, an "entity" can be just about anything: the geometry of the part, the relationship of the various parts to the product, the product specifications.)

To help out, the NBS is working with big CAD/CAM users like Westinghouse Electric Corp. and Ford Motor Co. to prepare a test for the IGES translators. The procedures are expected to be in place by June. The Society of Automotive Engineers will supervise the tests.

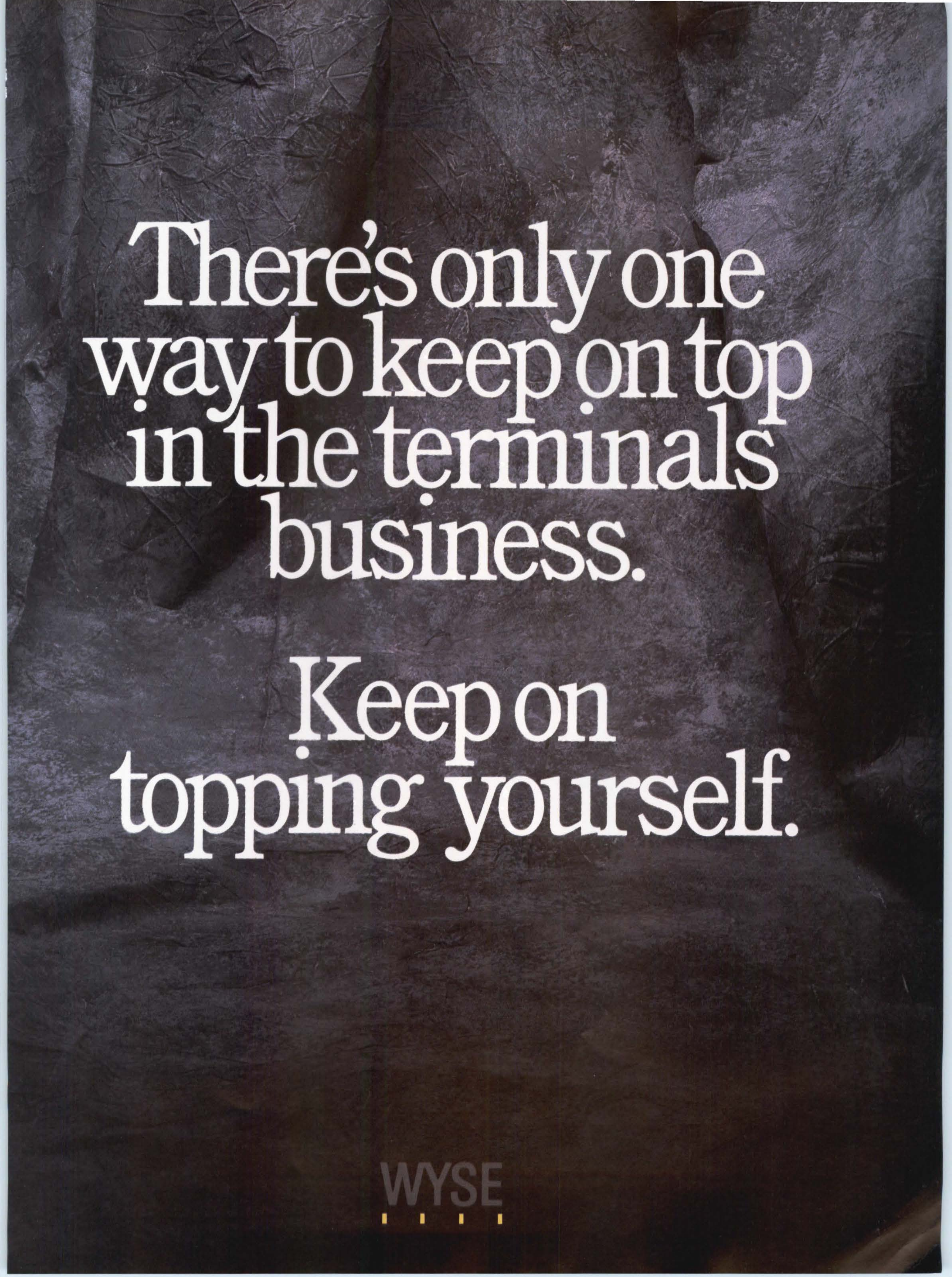
"This won't be a certification program," Smith says. "The SAE will test the translator, much as they test motor oils, and issue a letter stating that it has tested the product and that the product meets the claims of the vendor."

For more information about the tests, contact Bradford Smith at the National Bureau of Standards, Room A-353, Building 220, Gaithersburg, Md. 20899. The SAE is at 440 Commonwealth Drive, Warrendale, Pa. 15096. □

Whom to ask

For information on the latest version of the Initial Graphics Exchange Specification (IGES), write the National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22161.

If you'd like to get the IGES Newsletter, write Mrs. Gaylen R. Rinaudot, IGES Coordinator, National Bureau of Standards, Room A-353, Building 220, Gaithersburg, Md. 20899.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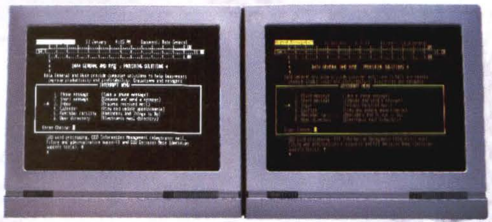
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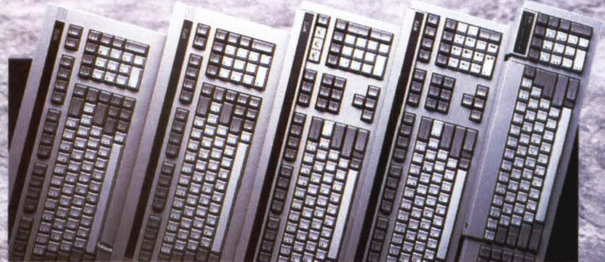
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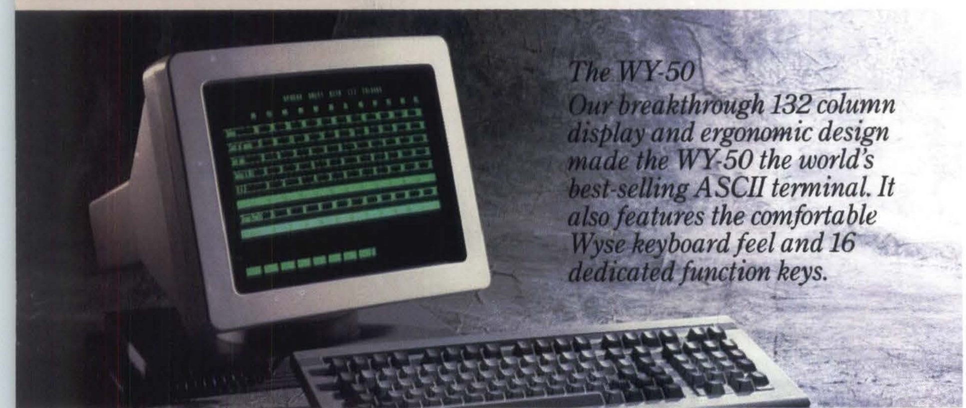
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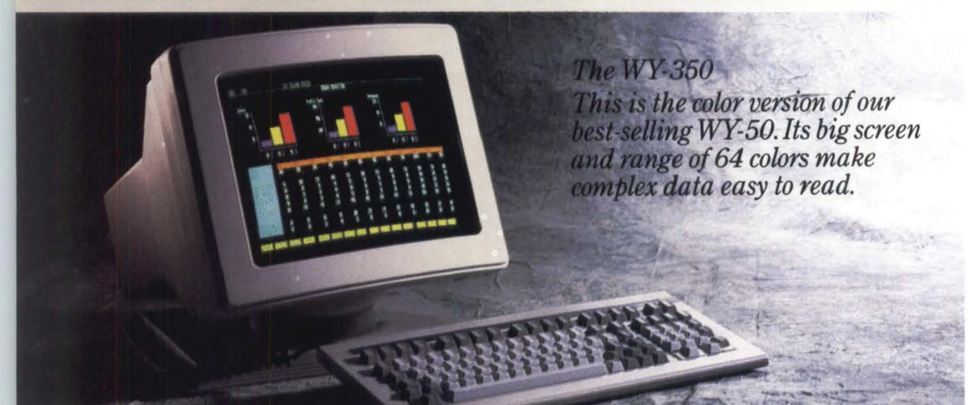
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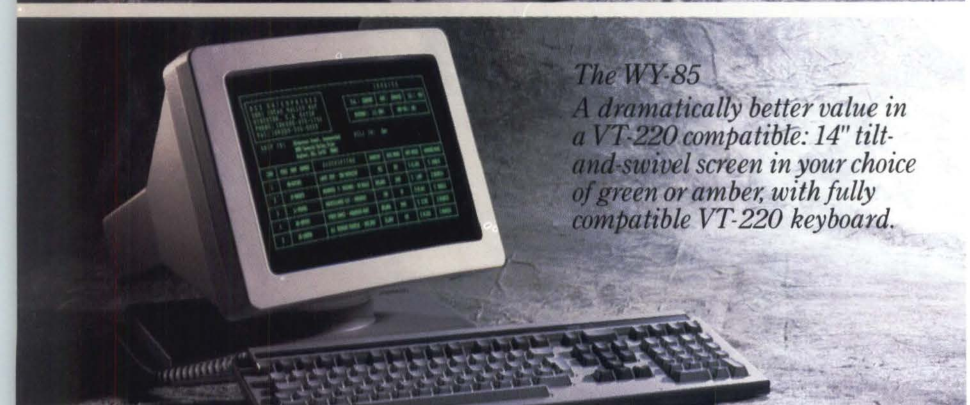
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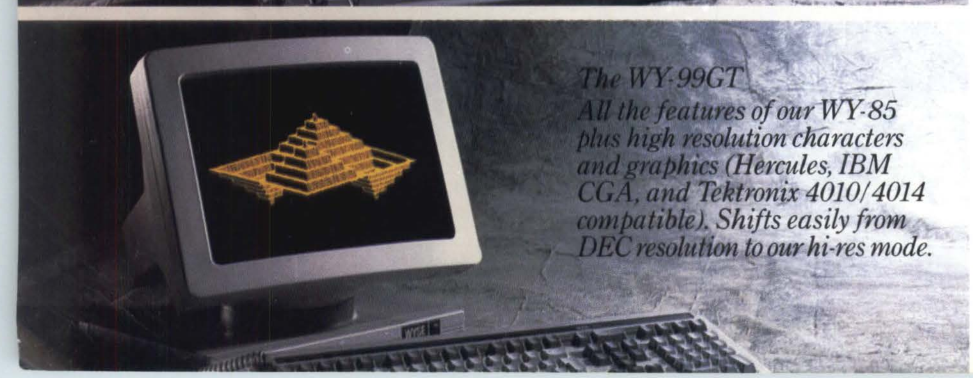
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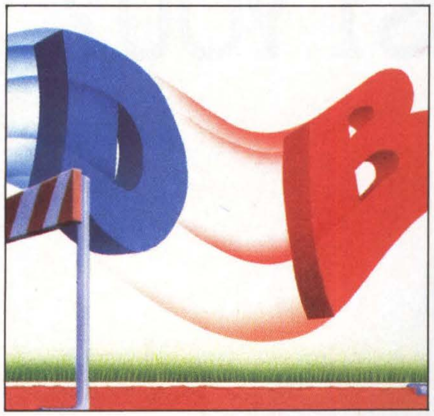
FEATURE HIGHLIGHTS



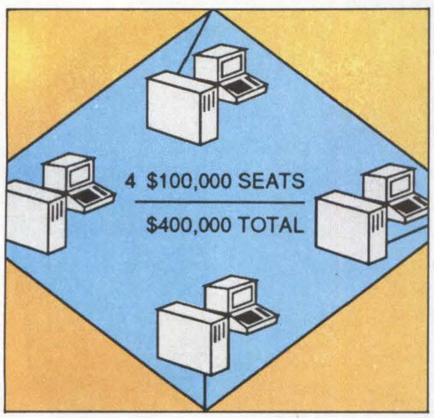
p. 61 . . . . Distributed DBMSes

DISTRIBUTED DATABASES CLEAR HURDLES 61

Successful implementations of distributed DBMSes surmount a number of technical problems. Among them, how to divvy up data and maintain consistency, how to fight high communications costs and how to handle data synchronization while avoiding deadly embraces. The second part of this two-part series examines what the major DBMS vendors offer VARs and system integrators to help them match products with applications.

A VANISHING BREED OF WORKHORSES 83

A minicomputer is only as good as its word, size that is. As basic system building blocks become more standardized on UNIX and MS-DOS and on a handful of 32-bit microprocessors, competition in the midrange—the traditional province of 16-bit minicomputers—is reshaping the job description of the OEM, system integrator, software house and distributer.



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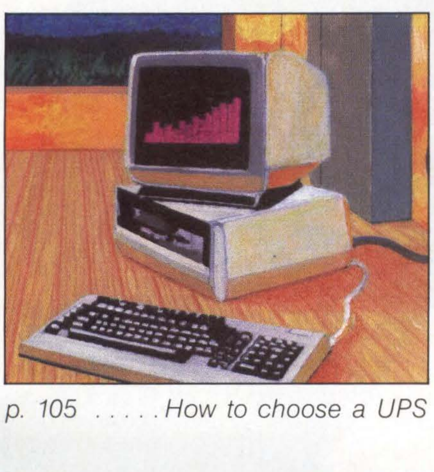
COMPUTE SERVERS CUT PROCESSING COST 93

As the demand for computer cycles in technical applications skyrockets, networked compute servers move in to bridge the performance gap between low-cost workstations and minisupercomputers. They offer about 10 times more power than general-purpose workstations and relieve individual stations of resource-hogging number-crunching chores.



p. 105 . . . . . How to choose a UPS

THE SAFE WAY TO FIGURE UPS SPECS. 105

Computer users, system integrators and equipment resellers face a rising tide of dirty, unreliable power. *Mini-Micro Systems'* survey of more than 50 vendors tells power-protection equipment specifiers how to combat this sea of troubles. A comprehensive guide to UPSes begins on Page 113.

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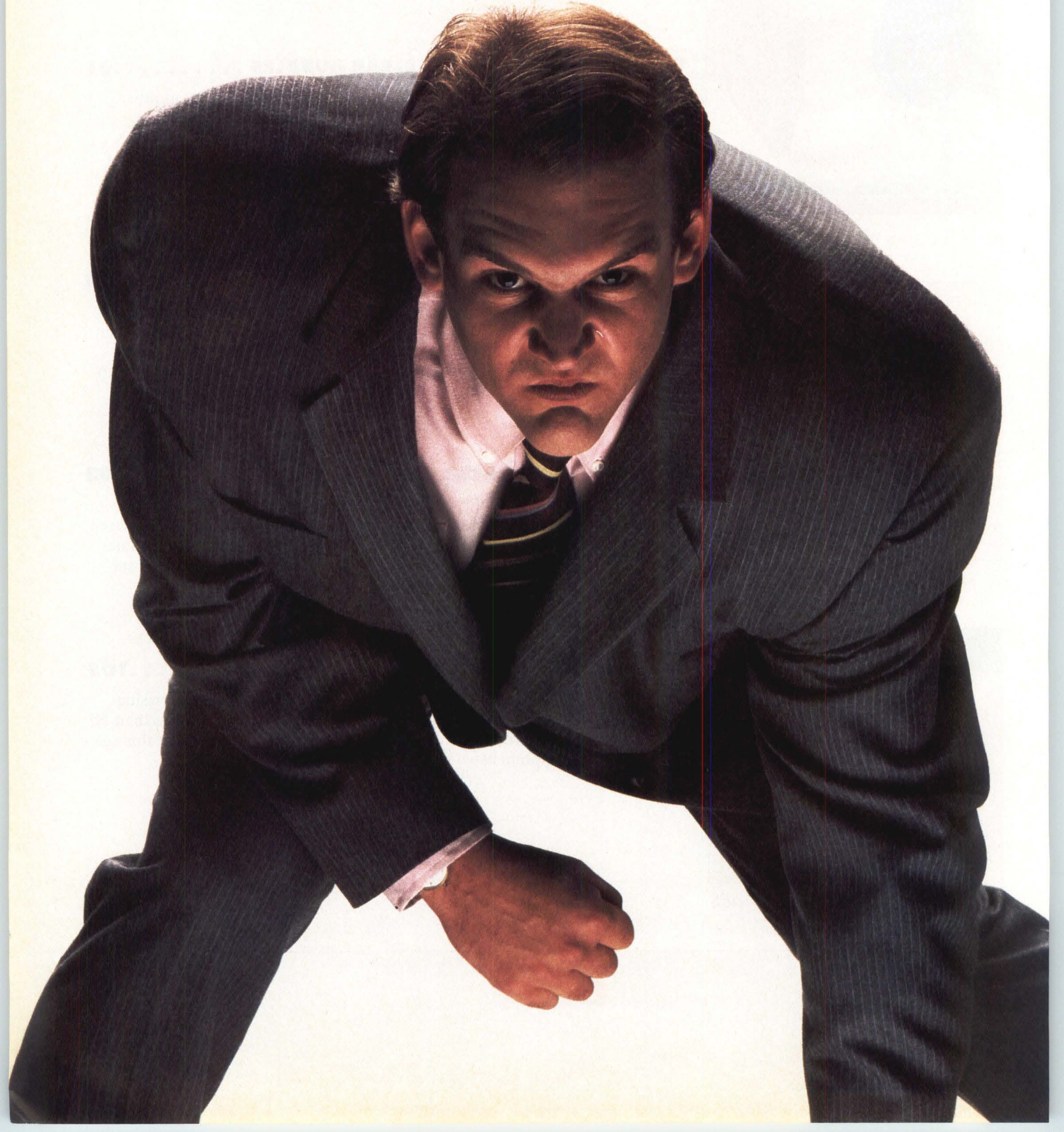

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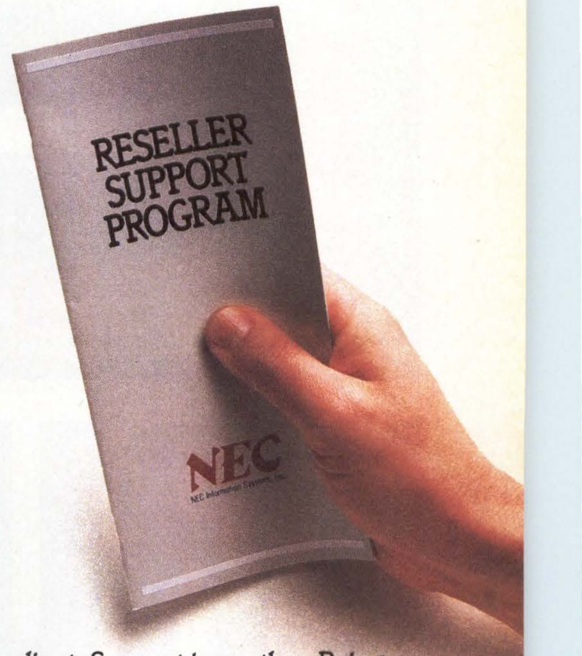

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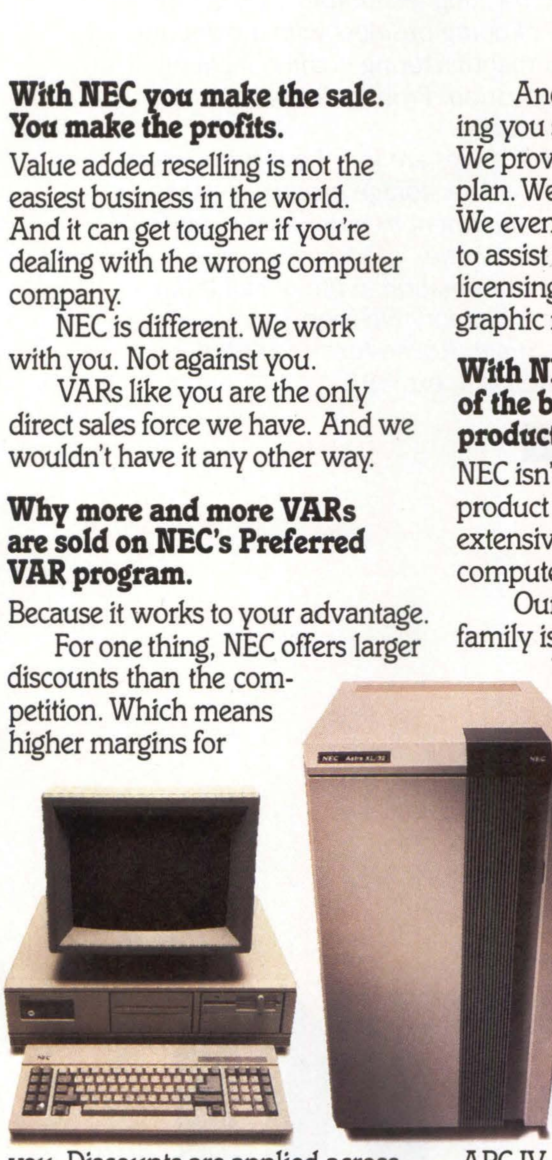

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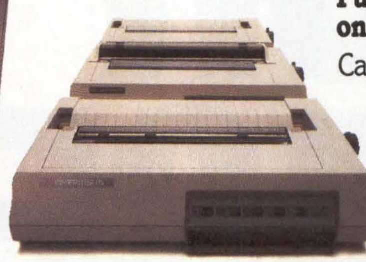

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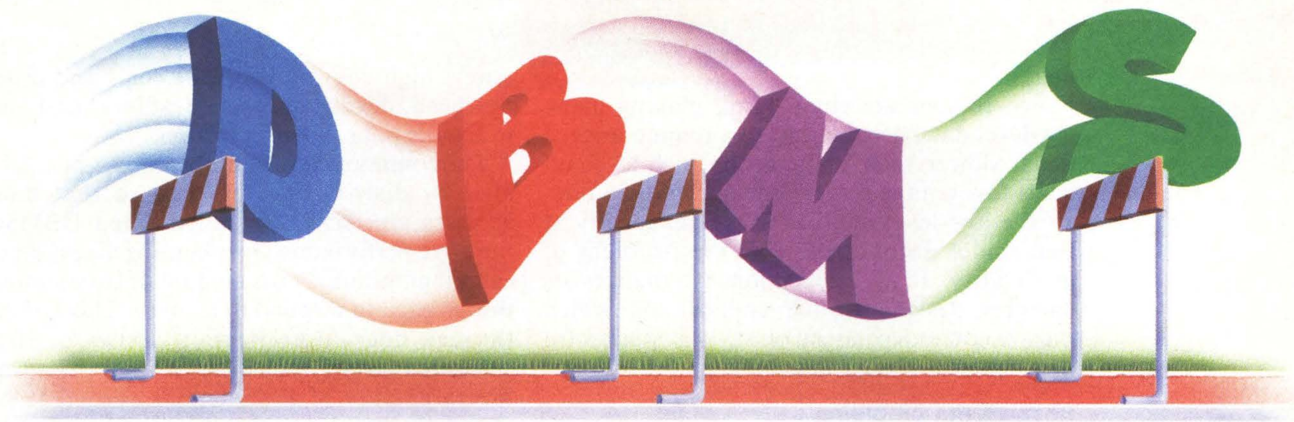

Illustration by Tom Szumowski.

DISTRIBUTED DATABASES CLEAR HURDLES

Distributed database management systems solve difficult problems, if the different types are matched to the right markets and applications

Wendy Rauch-Hindin
Special Features Editor

Within the last year, several software companies and computer manufacturers have introduced distributed database management systems (DBMSes), and other introductions are expected soon. With distributed DBMSes, a single coherent database can be partitioned across diverse, autonomous computers ranging from mainframes to microcomputers. And neither the user nor the application need know the location of data in order to make a request (MMS, May, Page 65).

The benefits of distributed DBMSes arise from their ability to reflect an organization's structure, reference data locally, improve response time and data availability and support disaster recovery. Even more important, they represent a significant new technology, because they provide a means for working in today's heterogeneous computing environments.

Despite these advantages, system integrators and value-added resellers should not look upon distributed DBMSes as ideal for all environments. For example, distributed DBMSes suit decision-support and revenue-generating systems rather than basic corporate applications.

This is the second of a two-part series on distributed database management systems. The first part appeared in the May issue of Mini-Micro Systems.

Also, distributed DBMSes have different architectures and features, depending on whether they are aimed at high-volume, on-line transaction environments; decision-support applications; or the factory floor. Because distributed DBMSes are complex, and because their performance, management and update capabilities are still in question, users are moving into the technology slowly.

For all these reasons, most distributed DBMS vendors have adopted a multiphased introduction strategy. The initial phases feature DBMSes that allow distributed queries. Systems that support updates over multiple nodes within a single transaction, and synchronization of replicated data, will come later (see Table).

Surprisingly, Tandem Computers Inc., the only vendor that has had a fully distributed DBMS in the field for some years, claims that distributed DBMSes may have been oversold and recommends against indiscriminate use of such systems. In a 1986 Tandem report on "Distributed Computer Systems—Four Case Studies," distributed DBMS designers Jim Gray and Mark Anderton state that: "Distributed DBMSes are essential in a local network (which is fast and reliable), but are inappropriate to a long-haul network. When using a long-haul network or when crossing administrative boundaries, we [Tandem] recommend using a requestor-server design in which an application makes high-level requests to servers at remote nodes to perform the desired functions at those nodes."

Two reasons are cited. First, making many low-level database requests to a remote node is much slower than making one high-level request to a remote server process that then does all the low-level database accesses locally at that node. Second, there is the problem of modularity. If an application externalizes its database design to other applications, which then become dependent on it, it is stuck with that database design forever.

Resolve the problems

The success of a distributed DBMS depends on the resolution of a number of technical and implementation considerations. Among them are how to distribute and maintain data consistency, high communications costs and other overhead, deadly embrace (deadlock) and how to handle data synchronization.

The communications problems can be alleviated by distributing the data so that most accesses are local. Also, distributed DBMSes improve performance by planning access strategies that minimize the amount of communication needed to respond to a query. This is done through query-optimization software. Such software chooses a data access path based on the cardinality of the relations needed to respond to the query, the distribution of attributes in the relations, the size of intermediate results generated during a multistage join, an estimation of the network traffic involved and disk access costs.

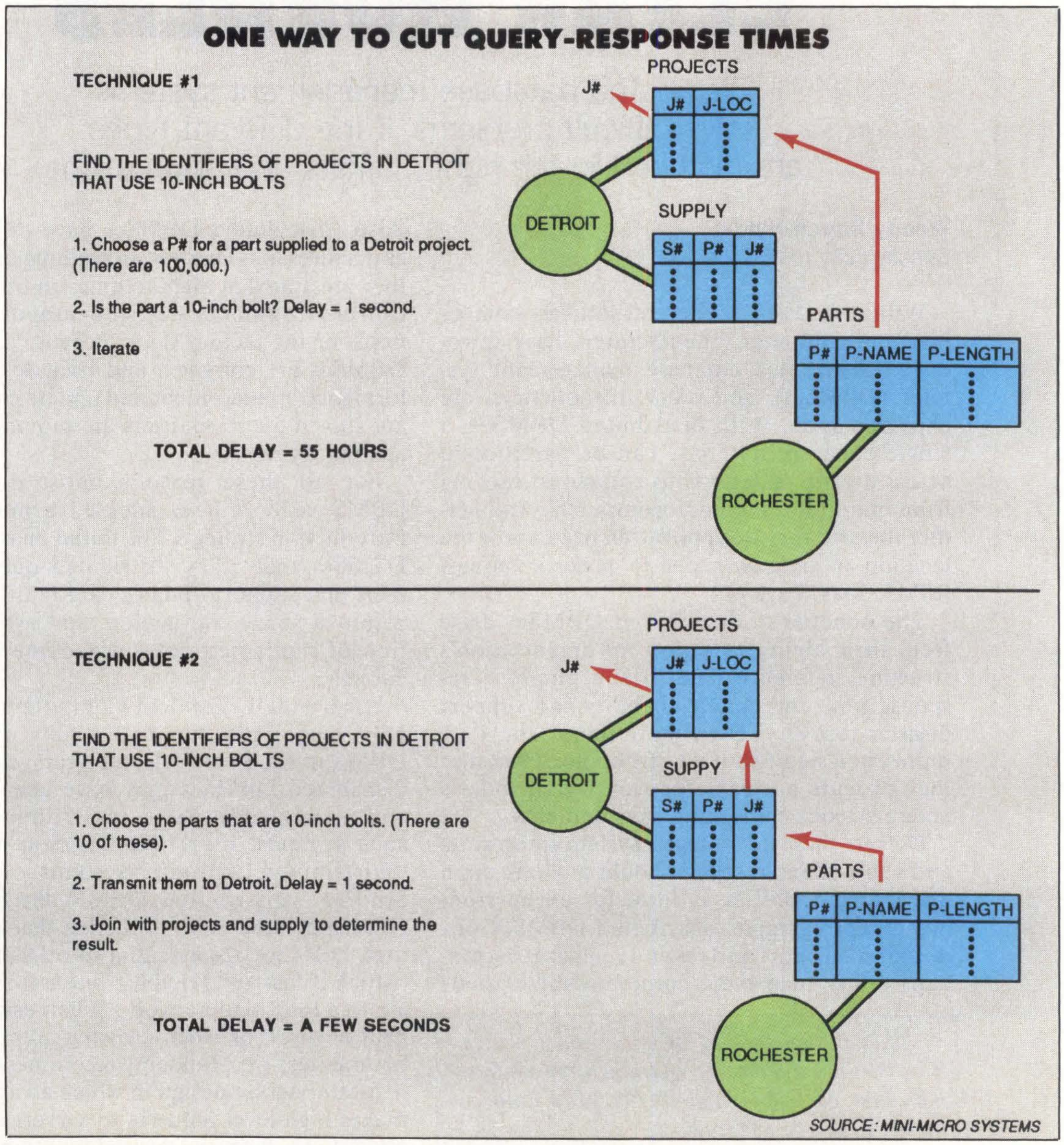

Fig. 1. Two distributed-query techniques *can be used to find the identifiers of projects in Detroit which use 10-inch bolts. The bottom technique is orders of magnitude faster than the top technique.*

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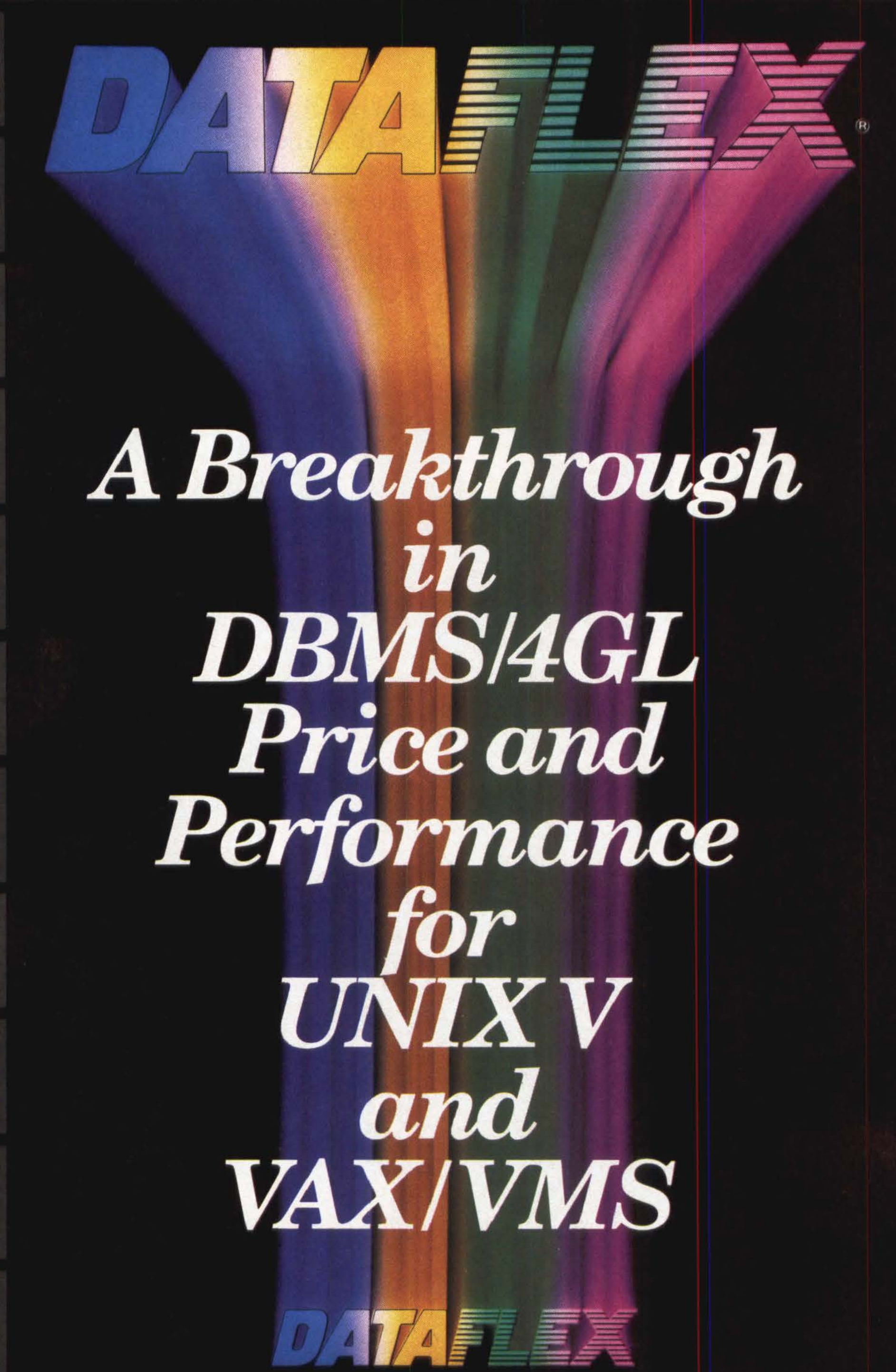
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Distributed DBMS' potential

Distributed database management systems (DBMSes) pose design, management and performance problems. However, they can be fast and efficient, if the data is distributed so that 90 percent of the accesses are local and do not cross administrative or application boundaries. This criteria can be used to help understand the distributed DBMS potential.

According to Robert Holland, chairman of Holland Systems Inc., an Ann Arbor, Mich., database consulting firm, commercial DBMS processing can be divided into three categories: baseline operations, revenue generation and decision support (see Diagram). Baseline operations encompass basic business functions and their associated databases such as accounting, finance and human resources.

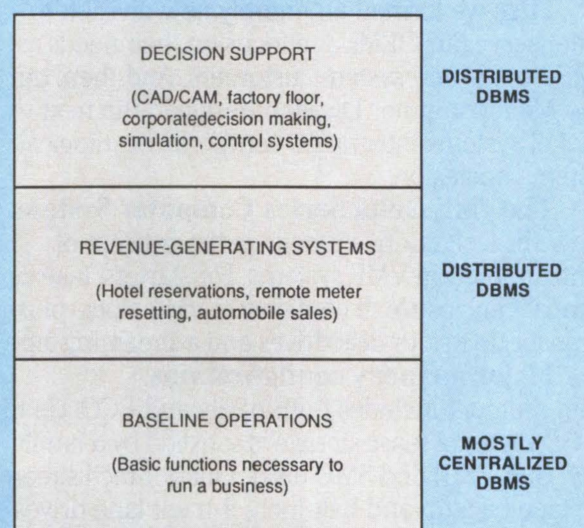
Baseline DBMSes that contain data used by many functions are the ones most suited to a centralized database, Holland says. Those which are used by only one or two functions are candidates for distribution. Synchronization is not generally a problem, because the DBMSes at this level tend to be updated periodically in batch mode and during specified, quiet, periods.

Databases associated with revenue-generating systems, or customer services, Holland explains, are frequently good candidates for distribution. They tend to require only data subsets, which are easily located on local computers. Examples are the Holiday Inns' call-ahead-for-reservations system, Pitney Bowes Inc.'s remote meter-resetting system and automobile dealerships.

Revenue-generating applications often require distributed synchronized updates. But this distributed data does not directly update the baseline-operation DBMSes. Instead, the data is uploaded for update during a baseline DBMS' regularly specified update period. Pitney Bowes, for example, runs revenue-generating distributed DBMSes on Tandem Computers Inc. machines and baseline DBMSes on IBM Corp. computers. The DBMS' languages communicate with one another for handoff procedures.

Decision-support applications that are candidates for distributed DBMSes include corporate decision making, factory-floor control, CAD/CAM and simulation. Decision-support distributed DBMSes may contain data from the other two general types, and users may manipulate and modify their data. But they may only replace data in the baseline databases by treating updates as normal input transactions.

Consequently, it is important for distributed DBMSes to have a database language that can communicate with the subject and corporate DBMSes at the lower levels. It is the distributed DBMSes at this level, along with compatible database languages and handoff-procedure utilities, that vendors are now starting to supply.



SOURCE: HOLLAND SYSTEMS INC.

In a hypothetical example, two different sequences of processing can be used to find the identifiers of projects in Detroit that use 10-inch bolts (Fig. 1). One is to search through all part numbers (say 100,000), transmitted from a parts table in Rochester, N.Y., to a projects table in Detroit to see which parts correspond to 10-inch bolts. The other is to transmit only the numbers for the various types (say 10) of 10-inch bolts, for joining with the projects and supply tables in Detroit. As the figure shows, the second technique is orders of magnitude faster than the first.

Deadly embrace, or deadlocks, can be detected in advance by building and analyzing a "wait-for" graph to look for loops. For example, a loop showing that process A is waiting for process B to get some data, while process B is waiting for process C, and process C is waiting for process A, indicates deadlock. Once detected, the deadlock can be broken by killing one deadlock victim, rolling back the transaction and allowing the others to proceed.

Synchronization poses problems

Distributed versions of this procedure can be implemented either by building a global "wait-for" graph out of the local ones or by sending a snoop process from site to site to examine and sort out all the local "wait-for" graphs to detect global deadlock. However, both approaches require the exchange of many messages and are deemed too expensive for commercial environments. Therefore, the most common approach

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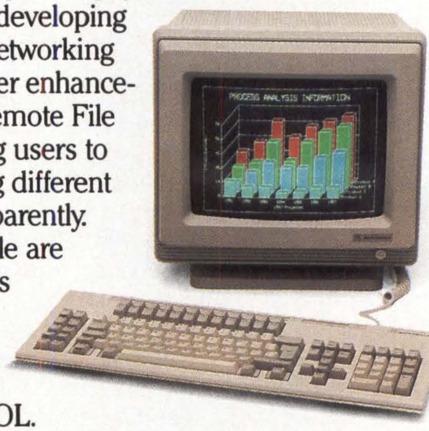

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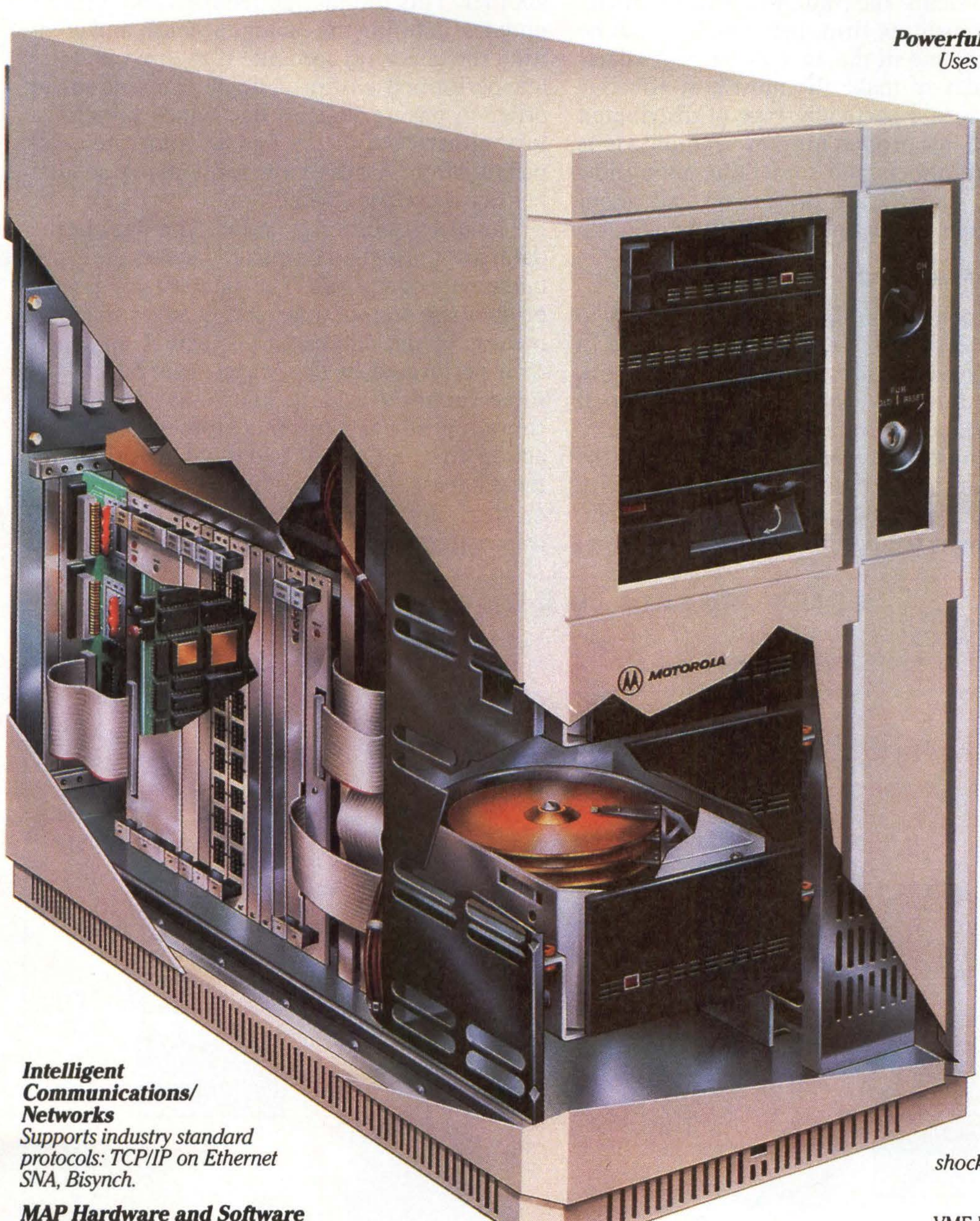

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to distributed DBMS deadlock is to implement the centralized DBMS deadlock-detection scheme at the local site, but detect and avoid global deadlock via timeouts.

Data synchronization poses, perhaps, the toughest distributed DBMS problem to resolve. It is one that Robert Holland, chairman of Holland Systems Inc., an Ann Arbor, Mich., database consulting firm, believes "will not be totally overcome in the next 15 years." Therefore, in order to make the most cost-effective match between a particular type of distributed DBMS and its proper market segment, it is necessary to understand something about how distributed updates are performed and about the communications that are involved.

Updates prove tough

The key concern in distributed updates is to keep the data at different sites synchronized in the face of multiple users and possible network or node failures. Synchronization means that replicated data at different sites must be identical. Users must be prevented from updating the same data at the same time and interfering with each other. In addition, data must be current, and consistent relationships between different items must be maintained. Satisfying these requirements gets expensive when a single transaction manipulates mutually dependent items that are located at different sites.

The classic example of a distributed transaction is the transfer of money from a savings account at one site to a checking account at another. This transaction requires two discrete updates: debiting the savings account and crediting the checking account. If the two updates are performed within a single transaction, in order to ensure that no one winds up with a loss, either both of the updates must be completed or the transaction must abort so that neither update is carried out.

The usual solution is to lock the data in the database until the complete transaction (both updates) is completed. The database keeps a log of database transactions and changes made to records in the database. The actual update is then performed in two stages, generally using some variant of what is known as a two-phase commit protocol. With this protocol, the transaction first updates the log and then updates the database. In the event of a computer failure or illegal update, the log is used to back out the transaction so it appears as if the transaction

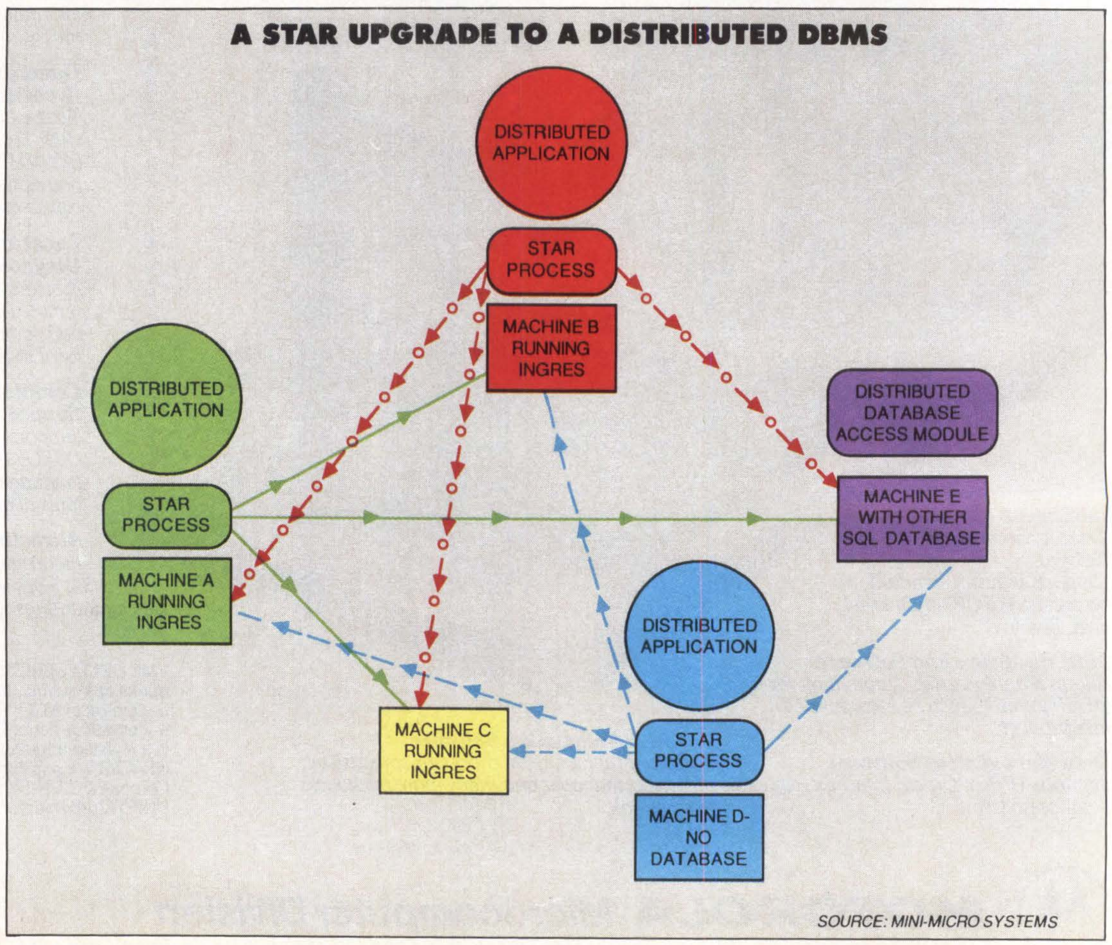

Fig. 2. In this Ingres configuration, *any machine can run a distributed application if it has a Star process, and if it is connected directly to the machine whose data it wants to access or update, as the lines connected to each Star process indicate.*

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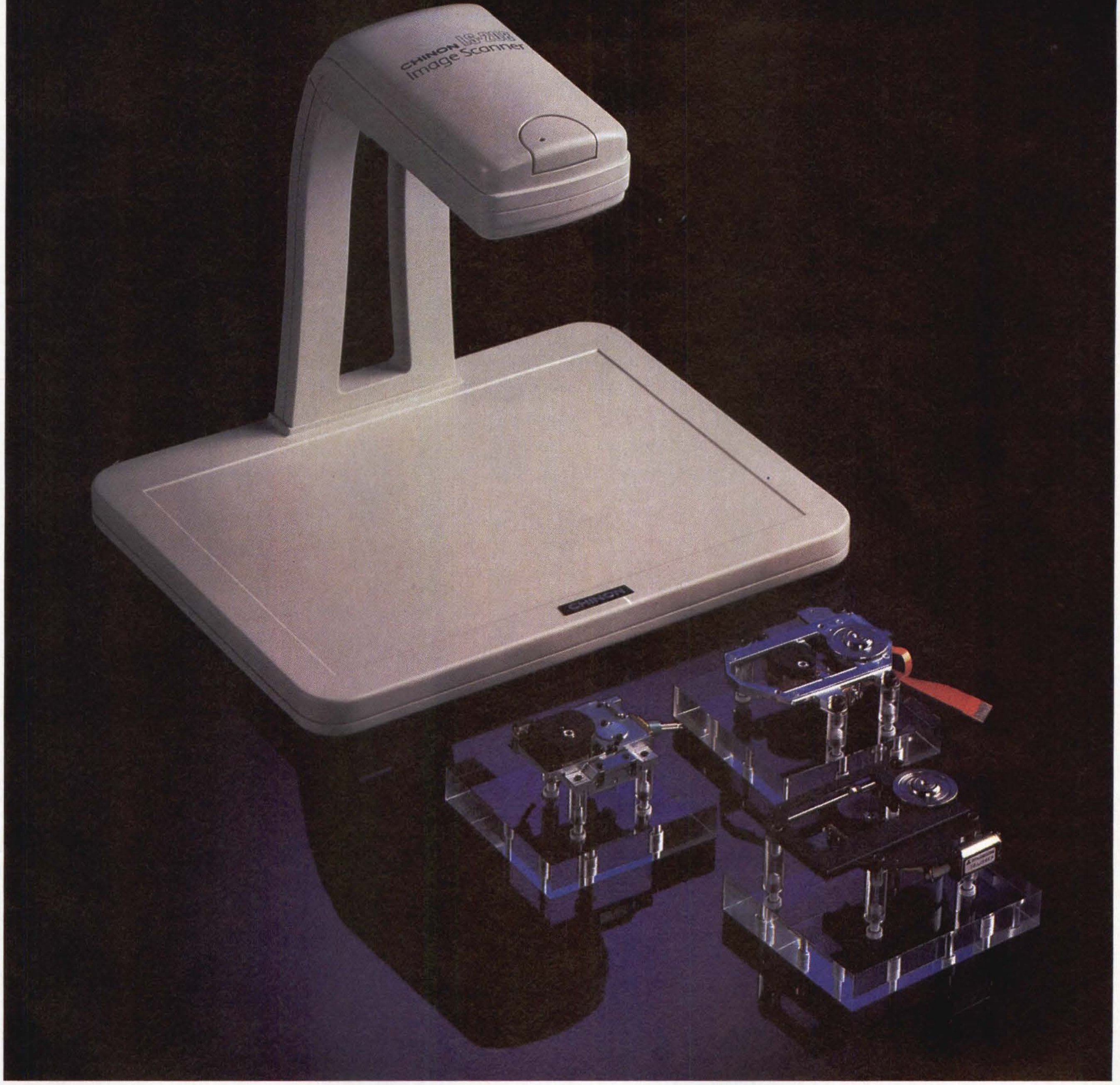

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never happened.

In a centralized database, all the information and control software pertaining to an update is in one memory. Failures cause all processing to stop, and locking and rolling back transactions are simple matters.

The problem in a distributed environment is that once a machine initiates an update it assumes the update will be done. It may be unaware that a remote machine failed before completing its work. Consequently, it may allow other transactions to read the now-inconsistent information.

Like centralized DBMSes, distributed DBMSes avoid this inconsistency by using a variant of the two-phase commit protocol. Unfortunately, in a distributed environment, the two-phased commit involves a lot of messages, overhead and communications traffic among lock managers, data items and updating of nodes.

For example, a node must obtain a lock mechanism from whatever node is acting as the lock manager for a particular data item. Data may be locked at several sites. And during both phases of the protocol, all the sites involved in the update exchange messages such as, "Are you ready to commit the transaction?" "Prepare to commit," "Yes I am," "No I am not," "Ready to commit," "Acknowledge the commit" and "Abort."

The exchange of so many messages provides coordination between sites and greater resistance to failure. But during the message exchange, the data being updated is locked at all nodes involved, and it remains locked until all the nodes have completed their processing and communications exchanges. Consequently, maintaining synchronized data is expensive, not only in terms of the communications required by the protocol but also in terms of reduced availability of the data being updated.

Fortunately, several possible solutions exist to solve this overhead problem. One is to decompose transactions that read and update multiple nodes into smaller, separate transactions so that they do not keep data locked for long. Another solution is to use a distributed DBMS that supports multiple synchronized updates within a single transaction, but only if they all occur at a single site. Several currently available distributed DBMSes support this capability.

Still another solution is to invent a new synchronization protocol that consumes less overhead. IBM Corp., for example, is working on a new transaction and recovery mechanism. However, any new protocol is for future use

Distributed DBMSes: the factory factor

Recognizing the factory floor's special requirements, Motorola Inc.'s Computer-X Inc. designed a factory-oriented distributed database management system (DBMS) for its cell-controller platform. Called cXDMS, the DBMS supports partitioning and replication of data, distributed queries and distributed updates. But all tables that participate in an update must reside in a single node.

The cXDMS differs from traditional DBMSes in that its primary design criterion was real-time performance. Furthermore, cXDMS contains several subtle features unique to factory-control needs.

For one, cXDMS has a user-selectable option that allows users to operate either in strict or lax data-consistency mode, depending on application needs. Second, because a factory-floor DBMS handles mostly numeric data, representing "null" values can be a problem. So cXDMS provides a bit map at the top of a row, which can be automatically or manually examined and distinguished from collected values.

Third, cXDMS does not provide much query optimization. There are three reasons for this. Factory communications generally occur across high-speed local networks, ad hoc queries are not performed very often, and a real-time environment cannot afford the processor time for much query optimization.

Fourth, to improve performance, cXDMS supports a programatic interface rather than structured query language, although SQL statements can be used in the program. Full interactive SQL will be provided later this year, because factory managers and engineers sometimes need plant status and analysis information. But it is not vitally important to a cell controller's applications, because, on the factory floor, most of its database users are other machines.

Other factory DBMS requirements that cXDMS supports include an "exception index" for fast retrieval, a low-level read-only mode to read locked data, an ability to handle unstructured data, and data replication with update facilities for reliability. The exception index is important for data that is retrieved only if some test fails or data fails to meet some criteria. The read-only mode for locked data is needed because high-priority, real-time users cannot wait for the data to become unlocked. Consistency is not always a practical consideration with data normally being updated 10 to 100 times a second. The ability to handle unstructured data is important because, while factory DBMS' data may not be there most of the time, when it is there it tends to be long and highly variable.

Most distributed DBMS vendors have adopted a multiphased introduction strategy.

because, regardless of the synchronization protocol adopted, every DBMS in the network must agree to it to ensure consistency.

For some market segments such as the airline industry, the military and the factory floor, updates are less of a consideration; either data-consistency requirements are not strict or other requirements are more important. For example, Computer Corp. of America (CCA), as part of its work on Shard (System For Highly Available Replicated Data), a distributed DBMS for the military, has identified data consistency vs. data availability as a fundamental tradeoff. Shard's solution for an application where the tradeoff favors availability at the expense of strict consistency is to relax the consistency requirements. In other words, a distributed DBMS can issue an update request to be processed later.

This scheme, which CCA calls a "reliable update propagation mechanism," will ensure that all updates eventually get to all copies of the data in question. However, the DBMS would not be required to perform all the updates in a single transaction at the same time. Consequently, the locking that occurs could be local to only one site and consume a short period of time relative to communication delays. This would make the data more available. However, to serve applications with different requirements, Shard will contain a "satisfy-everyone" feature that will allow users to choose the level of consistency and availability.

Someone else in your seat?

This update scheme has proponents in several industries. For example, airline reservation systems have huge DBMSes that allow people anywhere in the world to make reservations with several airlines for a specified seat on flights to a particular destination. However, to the busy airlines, high data availability is more important than data consistency.

Consequently, airlines have low consistency requirements. Whether centralized or distributed, airline agents issue updates to be handled on an "as-soon-as-convenient" basis. As a result, conflicting updates for the same seat may cross each other in transit, and both may, unfortunately, update the same seat in the database.

The military has also been attracted by distributed DBMSes from the beginning, because DBMSes have the potential to satisfy the military's requirement for data survivability and availability. The military's problem is that its command and control stations are widely scattered. If an attack should occur, it is likely that communication links will be fractured, and the network partitioned.

But command and control and intelligence applications will still need to function. Availability in this worst case takes precedence over other requirements, so Shard is designed to support data replication at all sites, in conjunction with a distributed-update capability via propagation of distributed updates.

Factories want distributed DBMSes, too. But factory floor operations need real-time performance. Real-time data management capabilities take precedence over strict data consistency, because most factory-floor database activities tend to be high-speed data acquisitions in a single node and, secondarily, data retrieval by machines.

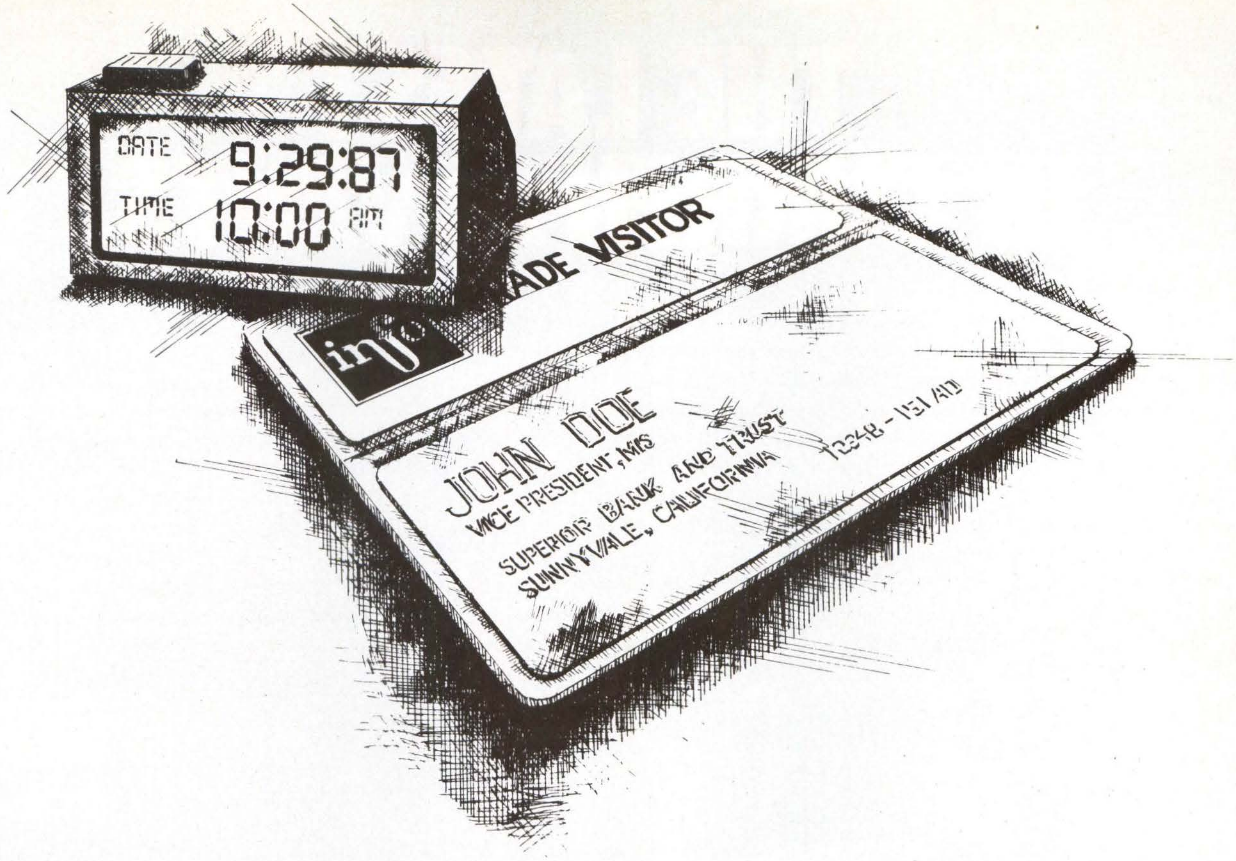
Strictly speaking, the data acquisition involves updates. However, these are mostly asynchronous updates that create additions to a database rather than change existing data. Unlike typical commercial data, in which debits and credits must always balance, factory data items tend to be much less interdependent. This data is generally sampled many times a second so that losing a row has little impact, and the notions of "simultaneity" (which are the basis for ordinary definitions of data consistency) have no meaning. Furthermore, in factory-floor applications, data collected at one node are frequently entirely independent of data collected at other nodes. Consequently, real-time performance can be preserved by performing updates in background mode or deferring them to slack periods (e.g., between shifts).

A picture of distributed technology's future in the factory can be gleaned from what appears to be the first fully distributed database designed for the factory floor. Called cXDMS, and designed by Computer-X Inc. (a Motorola Inc. subsidiary that manufactures cell controller platforms for system integrators and OEMs), it takes into account a number of special requirements for factory distributed data management systems.

Distributed systems spark controversy

All-in-all, performance and overhead costs make distributed DBMSes practical if, as much as possible, the DBMS avoids performing distributed updates. According to Holland, in a bank trying to run a normal 40 to 50 transactions per second (tps), processing across a switched DBMS network could degrade to a mere 2 to 3 tps, if multiple locations are accessed often. In a local network, throughput might degrade only to 10 to 25 tps under similar conditions.

Jim Gray, a software designer at Tandem's Encompass distributed DBMS group, agrees



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DISTRIBUTED DBMS PLAYERS AND PRODUCTS

Company	Product	Introduction date	Transparent access	Compatible with heterogeneous databases	Replication without synchronization	Distributed query	Distributed update—one site at a time	Distributed update within a single transaction	Fragmented tables	Replication with synchronization
Applied Data Research (ADR)	ADR/Dnet Release 2.0	March 1987	Y	N	NA	Y	Y	Y	Y	Y
Cincom Systems	unnamed	no date announced	Y	Y	NA	Y (no date announced)	N	N	Y (no date announced)	Y (no date announced)
Computer Corp. of America (CCA)	Shard	under contract	Y	N	NA	NA	Y	Y	NA	Y
	Adaplex	no date announced	Y	not initially	NA	Y	Y	Y	Y	Y
	Model 204	no date announced	Y	Y	NA	Y	Y	future release	future release	N
Computer-X Inc.	cXDMS	no date announced	Y	N	NA	Y	Y	N	N	Y
Cullinet Software	IDMS/Distributed	no date announced	N	Y	NA	Y (no date announced)	N	N	N	N
Digital Equipment	VAX Data Distributer	Jan. 1987	NA	N	Y	N	N	N	N	N
IBM	Starburst	experimental	Y	Y	NA	Y	Y	Y	horizontal partitioning	N
Information Builders	Focus/Distributed	1988	Y	Y	NA	Y	Y	Y	second release	N
Informix Software	Informix-Star	late 1987	Y	Y	NA	Y	Y	N	N	N
Oracle	SQL*Star	1986	Y	Y	NA	Y	Y	next release	Y	N
Relational Technology	Ingres/Star	June 1986	Y	Y	NA	Y	Y	fourth quarter 1987	third quarter 1988	N
Sybase	Sybase/Star Server	Jan. 1987	future release	N	NA	Y	Y	Y	N	Y
Tandem Computers	Encompass	1979	Y	N	NA	Y	Y	Y	Y	N
Unify	unnamed	late 1987	Y	Y	NA	fourth quarter 1987	fourth quarter 1987	fourth quarter 1987	fourth quarter 1987	N

with Holland but doesn't consider his statement as relevant as it first seems. Gray asserts that, "You decentralize data for organizational or geographic reasons. People submit transactions. And organizations and people have geographic locality of reference. So most transactions are local."

To illustrate his point, Gray refers to a recent set of J.C. Penney benchmarks. He claims that a Tandem credit-authorization system running against these benchmarks ran 120 tps per data center, only a fraction of which turned out to be distributed.

Applied Data Research Inc.'s (ADR) users have a different opinion says Tony Percy, director of product planning at ADR. ADR's new release of Dnet, its distributed DBMS, supports distributed queries and distributed updates within one transaction. However, the reality of the situation, says Percy, is that even though the distributed update capability is there, most users do not take advantage of it because of possible slow response time. Those who do use it tend to restrict updates to only a couple of nodes; and probably via a channel-to-channel connection.

More bang for the bit

The performance results achieved by many of today's fully distributed DBMSes don't re-

Data synchronization is perhaps the toughest distributed DBMS problem to resolve.

flect what could happen if these DBMSes were specifically designed for performance. "Many of today's distributed DBMSes are well-suited for decision support applications, but they need some fundamental changes in their architectures to adapt them for large, high-volume, on-line applications," says Stewart Schuster, vice president of marketing at Sybase Inc.

One common distributed DBMS architecture that Schuster claims is not well-suited to production applications is actually an extension of a centralized DBMS. In the centralized version, a front end that contains a high-level query facility talks to a back end that supports a low-level data-table access mechanism. So there are two processes running for every user in the system.

These systems add a third process between the front-end and back-end processes to support distributed DBMS capabilities. This process accepts SQL (structured query language) queries and decomposes them into subqueries for each of the remote back-end processes. There would always be more than one back-end process because the purpose of distributed DBMS is to talk to two or more databases simultaneously.

This means that, for each user on such a system, there would be a minimum of four processes running. Each process uses system resources and engages in interprocess communications. The process is another object to be scheduled, to open files and to send and receive messages. All this limits performance and throughput.

In a decision-support system, where only a handful of users are performing ad hoc work at any one time, these limitations are not noticeable. However, an on-line environment, which supports large numbers of users, all executing many transactions and requiring fast response times and data integrity, needs a different architecture. There, it is necessary to minimize the number of processes, as well as network traffic. It is not enough to maximize performance; throughput must also be optimized.

Sybase's fully distributed DBMS is designed for such high-volume, on-line applications. Its architecture requires one front-end process for each user but only a single back-end process for each machine. Furthermore, the next version of the system will implement the distributed DBMS functions directly in the back-end server rather than add another process. The fewer processes required by this architecture conserve resources and minimize the messages count.

Sybase can make do with so few processes because the back end of its DBMS is implemented as a multithreaded server. Therefore the back end can accept messages, such as SQL requests, from many requesters and operate on them in parallel—at least as far as the operating system is concerned. In fact, the Sybase DBMS acts like a database operating system in that it performs several operating system functions.

For example, the DBMS implements its own multitasking inside the back-end process so that the process can simultaneously talk to all the requesters. In so doing, it does its own scheduling instead of issuing operating system calls. The DBMS can perform these functions more efficiently than the operating system. That's because it uses algorithms that are designed specifically to process only SQL requests to and from the data server, rather than the general-purpose algorithms that an operating system must use.

Simple to migrate

The modular nature of a distributed DBMS makes it easy to upgrade standalone and cen-

Companies mentioned in this article

Applied Data Research Inc.
Route 206 and Orchard Road
Princeton, N.J. 085403
(201) 874-9000
Circle 355

Cincom Systems Inc.
2300 Montana Ave.
Cincinnati, Ohio 45211
(513) 662-2300
Circle 356

Computer Corp. of America
4 Cambridge Center
Cambridge, Mass. 02143
(617) 492-8860
Circle 357

Computer-X Inc.
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Schaumburg, Ill. 60173
(312) 576-8800
Circle 358

Cullinet Software Inc.
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Westwood, Mass. 02090
(617) 329-7700
Circle 359

Digital Equipment Corp.
146 Main St.
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Circle 360

IBM Corp.
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Circle 362

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Sybase Inc.
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(415) 548-4500
Circle 366

Tandem Computers Inc.
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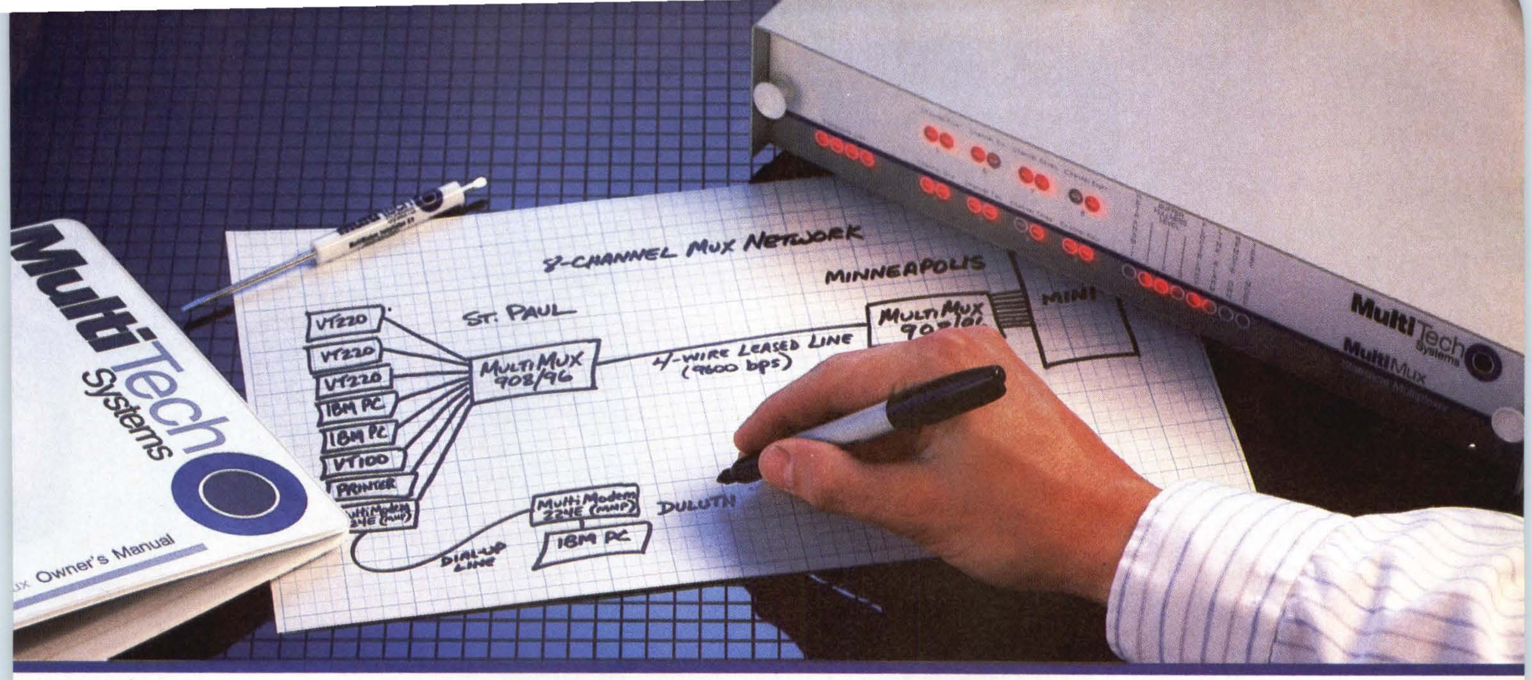

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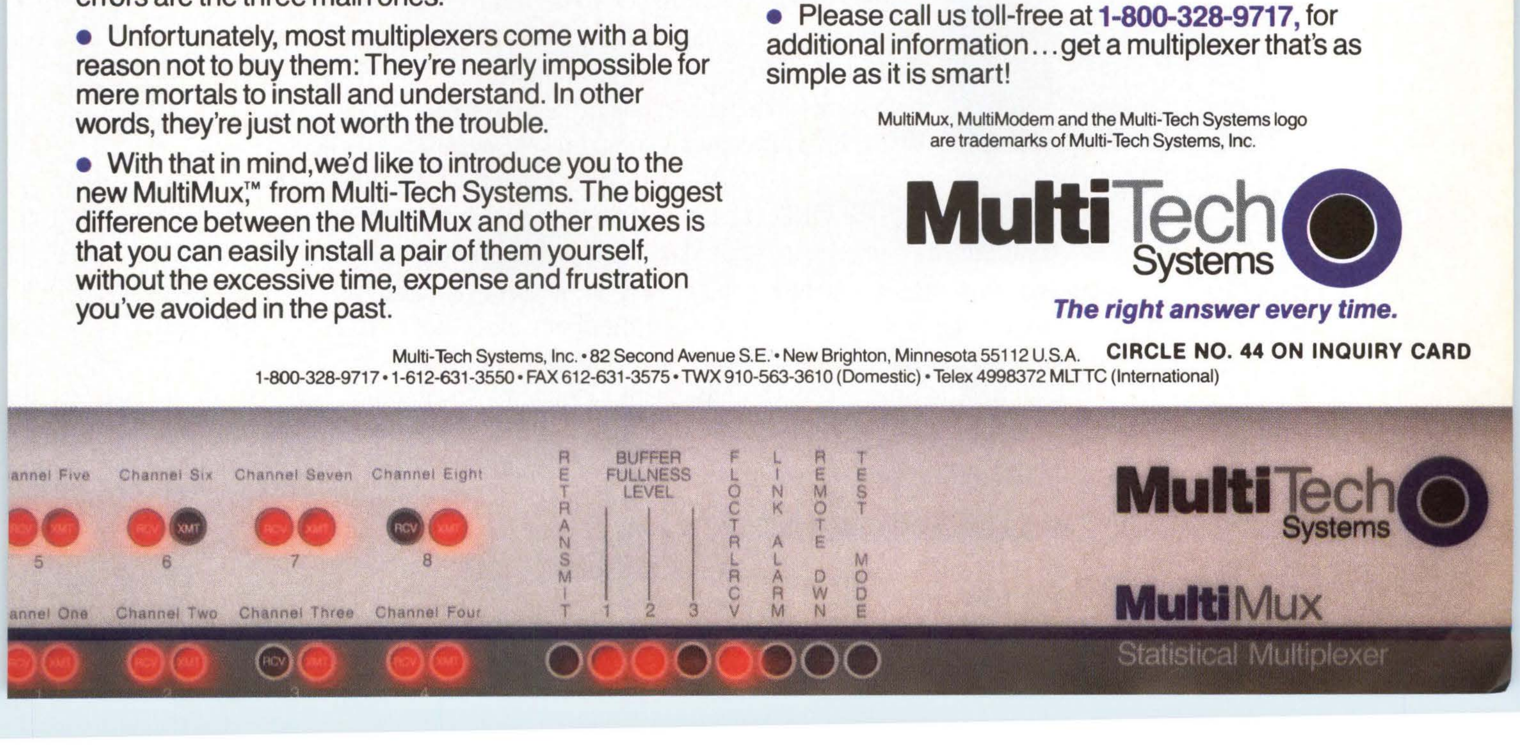

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tralized DBMSes to distributed systems without disrupting services or requiring totally new investments. In some cases, to make existing independent DBMSes, running on different computers, appear to users as a single distributed DBMS, it is only necessary to drop an additional layer of software on top of the existing database.

A decision to distribute Relational Technology Inc.'s Ingres/Star, for instance, would only require a Star process to be layered on top of existing Ingres databases on every machine that will run a distributed application (Fig. 2). The Star process provides transparent, distributed access to other Ingres databases in the network. The Star process also can run on a computer without any databases. There the process would give distributed applications running on this computer distributed access to other databases in the network.

Upgradability is only slightly more difficult for non-Ingres, SQL-based databases. In such a case, it is necessary to add a "distributed-database access module" on top of the foreign database. This module, or gateway, allows access to the non-Ingres database by Star processes on any machine in the network.

Whenever a company wants to chop up and distribute a centralized database, it must decide how to optimally distribute the data so that most of its use is local to some individual machine. This is a human-intensive, non-trivial database design problem. But there is a growing opinion that, some time in the future, database designers will have help from knowledge systems. At that time, knowledge and an inference engine will probably be built into the data-definition language of distributed databases.

Research on this subject is in its infancy. However, experts at several database companies foresee a long-term future in which geographically dispersed, interconnected heterogeneous networks, computers, applications and databases will contain terabytes of data. The way the data is used may dictate that data definitions, partitions, organization, location, etc., dynamically change over time. This all will likely outstrip a human's capacity to handle, modify and keep track of the data. Consequently, with true distributed DBMSes emerging commercially, many observers view distributed DBMS design and maintenance as a future candidate for artificial-intelligence support. ☐

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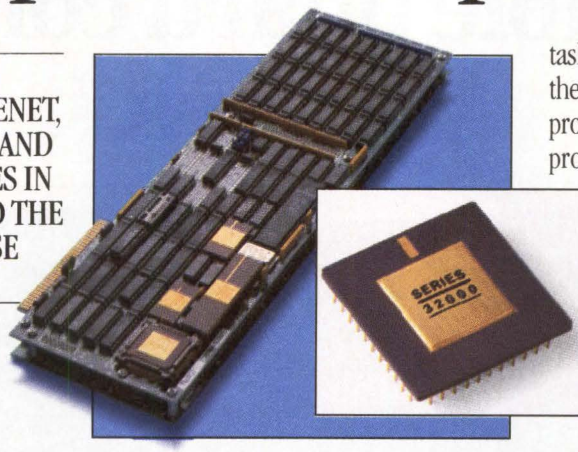

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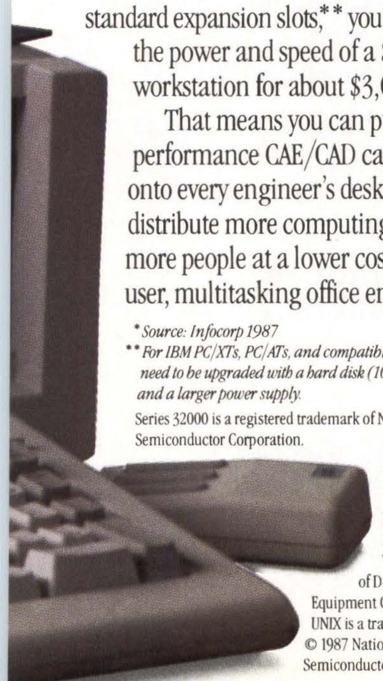

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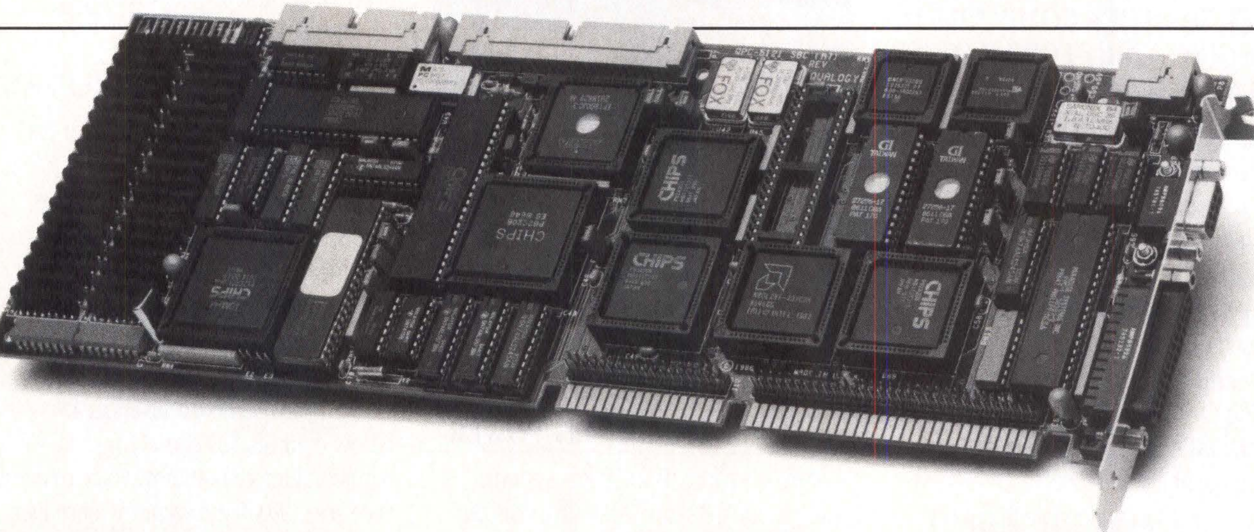

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A VANISHING BREED OF WORKHORSES

Although 16-bit machines get the job done in certain applications, they are threatened by mounting pressure from supermicrocomputers on the low end and 32-bit superminicomputers on the high end

Andrew Allison, Contributing Editor

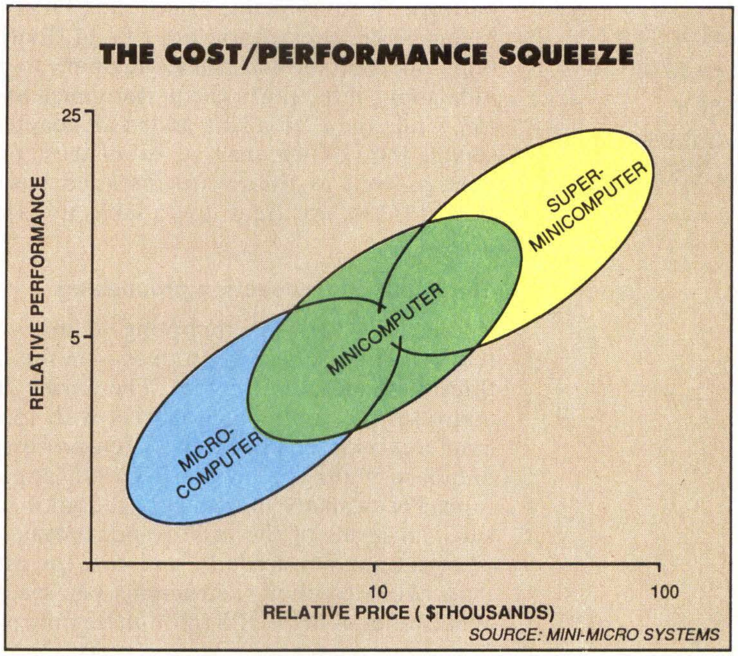
Last February the company that invented the minicomputer, Digital Equipment Corp., probably signaled its demise. While it may be premature to identify the announcement of the MicroVAX 2000 as the death knell of the traditional (proprietary, 16-bit) minicomputer, it portends the beginning of the end.

DEC has focused on its VAX product line and connectivity for the past several years, and the latest, single-board implementation of the VAX architecture aims squarely at merchant market, microprocessor-based supermicrocomputers.

Of the other well-known minicomputer suppliers, Data General Corp. is no longer manufacturing 16-bit products (although it does operate a refurbishing and resale operation), Hewlett-Packard Co. is busy integrating the 32-bit RISC (reduced instruction set computer)-based Performance Architecture into its three product lines. And Honeywell Inc. replaced its venerable 16-bit DPS 6 product line with a family of 32-bit, upwardly compatible products (DPS 6 PLUS) in June of last year.

IBM Corp., having discontinued the System/3, System/7 and System/34, continues to promote the overpriced, underpowered and mutually incompatible Series/1, System/36 and System/38. Meanwhile, the bottom end of what used to be the minicomputer market is being taken over by PC/AT-class machines and their clones (MMS, March, Page 55).

Established 16-bit minicomputer lines are still actively marketed and some are enjoying rising unit sales, but they face mounting pressure from the supermicrocomputer and superminicomputer pincer movement. With the minicomputer mantle being fought over by both low-end superminicomputers and high-end personal computers (see Graph), little room remains for traditional 16-bit minicomputer products.



SOURCE: MINI-MICRO SYSTEMS

Keeps the PDP-11 viable

Despite the recent emphasis on the VAX, the older PDP-11 line continues to represent a major business area for DEC. The installed base exceeded half a million units at the end of 1986 and, according to business manager Deane Curran, "If it were a separate entity, the PDP-11 operation would be part of the Fortune 300." DEC's strategy, here, is twofold: to provide a cost/performance ratio adequate to discourage users of 16 years' worth of the PDP-11's specific software from converting to lower cost merchant market microprocessor-based systems, and to utilize its connectivity capabilities to incorporate PDP-11 systems into the seamless networks required for today's inte-

Despite recent emphasis on the VAX, the PDP-11 line continues to represent a major business area for DEC.

grated database and shared data environment. Nevertheless, though large (contributing about 10 percent of DEC's 1986 revenues) and highly profitable, the PDP-11 business is no longer growing.

This reality is reflected in the recent development of the product line, which today makes use of one single-board, Q-bus-compatible microcomputer. Its J-11 microprocessor first appeared with the PDP-11/73 in mid-1984. Other than an increase from 15 MHz to 18 MHz in maximum clock frequency for the PDP-11/83, which was introduced in November 1985, it is has remained unchanged.

The PDP-11/73 offered about two and a half times the performance of the /23, while the /53 (June '86) provides roughly twice the /23's performance at the same price. The PDP-11/83 incorporates the proprietary FPA11 floating-point coprocessor and private memory to provide about three times the performance of the /53, while the PDP-11/84 added an adapter to service the UNIbus market. All of these products, as well as the entire installed base of PDP-11/23s, are field upgradable to MicroVAXes.

Emphasis on transaction processing

Like DEC, HP is attempting to maximize return on its established products—in this case three separate architectures. The Series 3000 addresses the commercial market with special emphasis on interactive transaction-processing, database management and COBOL applications. Performance in such applications is measured in terms of the task: response time, tps (transactions per second), and cost/tps rather than MIPS (million instructions per second), Whetstones or MFLOPS (million floating point operations per second). This increases the value of the, generally proprietary, specialized operating systems employed and, unlike the PDP-11, HP3000 sales are still growing.

HP's industrial/technical product line, the Series 1000, targets the real-time multitasking market and, like the 3000, emphasizes specific applications, especially CIM (computer integrated manufacturing). Although HP1000 shipments are also still increasing, the PC/AT and clones are beginning to penetrate the low-end (single-task) segment of the market. As with the 3000 and the UNIX-based 9000 series, the (32-bit RISC) Performance Architecture will be more or less transparently inserted at the high end of the Series 1000. (The first 32-bit system shipped, beginning last November, was the Series 9000 Model 840, and 3000 series products are promised later this year.)

IBM's relatively poor performance in the midrange was widely commented upon following the announcement of the company's 1986 financial results. Although the 9370 adequately addresses the top end of the midrange, the rest of it presents real difficulties. However, with the February announcement of enhancements to the RT PC and extension of its target market to include the administrative and commercial areas, IBM has put a high-performance fox into its low-end systems hen house.

The Series/1 upgrade announced at the same time makes the machine comparable in performance to a high-performance PC/AT clone at more than twice the cost—a 1 MIPS engine, 2M bytes of on-board RAM, a 40M-byte rigid disk and a 1.2M-byte flexible disk drive and seven I/O slots for $23,000. The System/36 and System/38 suffer similar price/performance handicaps relative to their minicomputer and emerging supermicrocomputer competition.

Niche players gather strength

This shambles, rather than in the personal computers, would be the logical place for the long-awaited 80386-based products, the PS/2 Model 80. But that strategy would make IBM vulnerable again to poaching by clone suppliers. As an alternative, the RT PC engine is a suitably proprietary hardware platform. In fact, IBM could be the first major supplier to abandon the 16-bit minicomputer.

Second-tier minicomputer suppliers have already done so, and only the three major players and a group of niche marketeers remain. Of these, Modular Computer Systems (Modcomp) and Point 4 Data Corp. are representative of the technical and commercial markets, respectively. The pressures are stronger in the technical market, and Modcomp had a tough couple of years before being taken over by West German conglomerate and major customer AEG AG in mid-1986 (AEG is part of the Daimler-Benz Group, the largest industrial group in West Germany). Modcomp is strongly focussed on high-performance industrial automation and process-control applications. The company added a fully compatible 32-bit upgrade to its product line at the end of 1983.

Point 4 introduced a proprietary, commercial operating system (IRIS) for the Data General NOVA in 1974 and an implementation of the NOVA architecture with half the cycle time of the NOVA/3 in 1979. The company has been developing ever-more powerful execution units for its proprietary, Business-BASIC-oriented, software ever since. These small business systems (typically 16-user, but covering the range from four to 64 users) are marketed exclusively through value-added resellers. With software and hardware tuned for specific applications (and for the user who wants to avoid the

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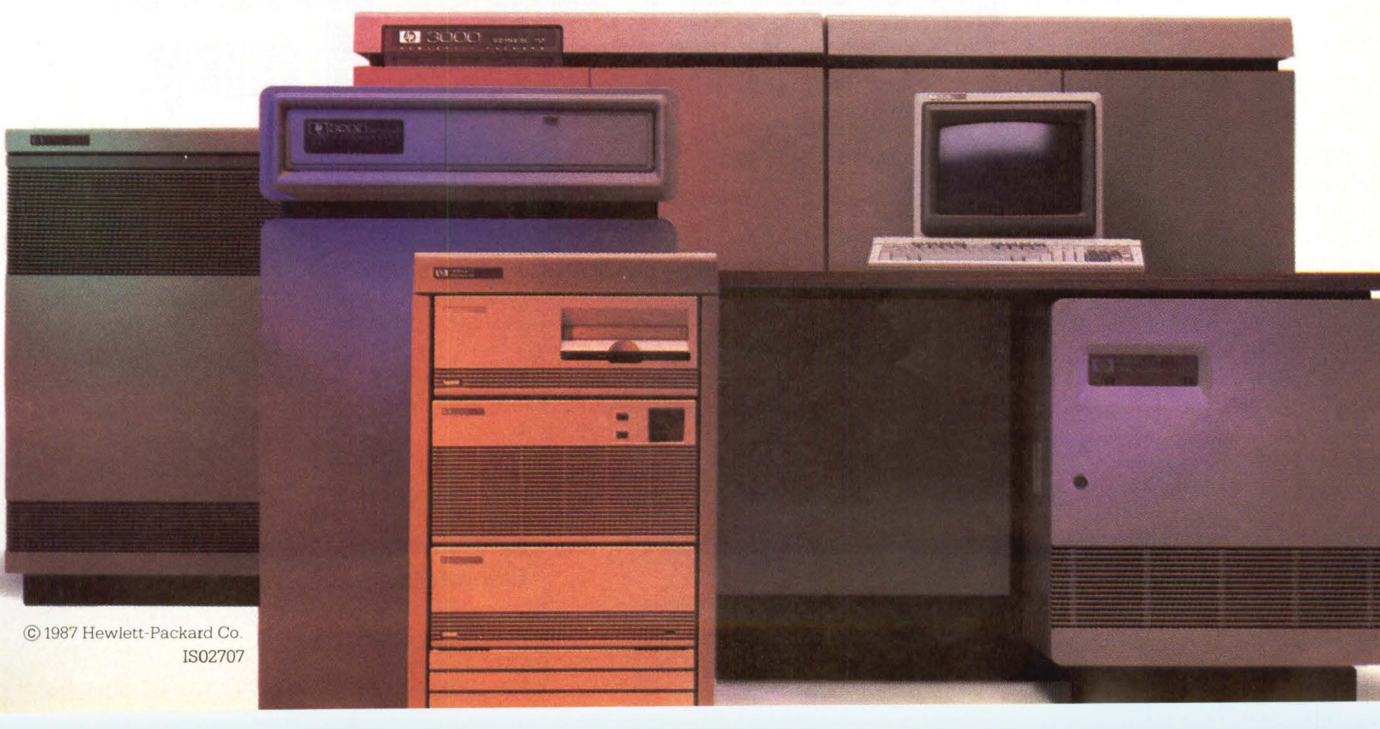

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overhead of a computer priesthood), niche suppliers like Point 4 are enjoying growth.

Minicomputers of the future

Two primary barriers prevent penetration of the minicomputer market by the PC/AT and its clones: performance and proprietary software. The PC/AT backplane imposes a fundamental limitation on performance and restricts current products to the low end of the minicomputer market. Newer implementations avoid this bottleneck, either by putting all memory, together with mass-storage and other high-throughput controllers on the motherboard, or by using additional connectors. The new Micro Channel bus introduced by IBM with the PS/2 family may also provide relief.

The commodity status of PC/AT-compatible products provides powerful incentives for low-end minicomputer users to switch from proprietary architectures and represents a serious challenge to the surviving suppliers. Release early next year of Microsoft Corp.'s long-overdue upgrade of MS-DOS, which turns out to be OS/2 Standard Edition, will take advantage of the capabilities of the 80286 and set the stage for a major assault on this market by powerful AT-compatible PCs. Offering two to 10 times the performance of the original IBM product, such machines can hardly be called clones. They are, in fact, the minicomputers of the future.

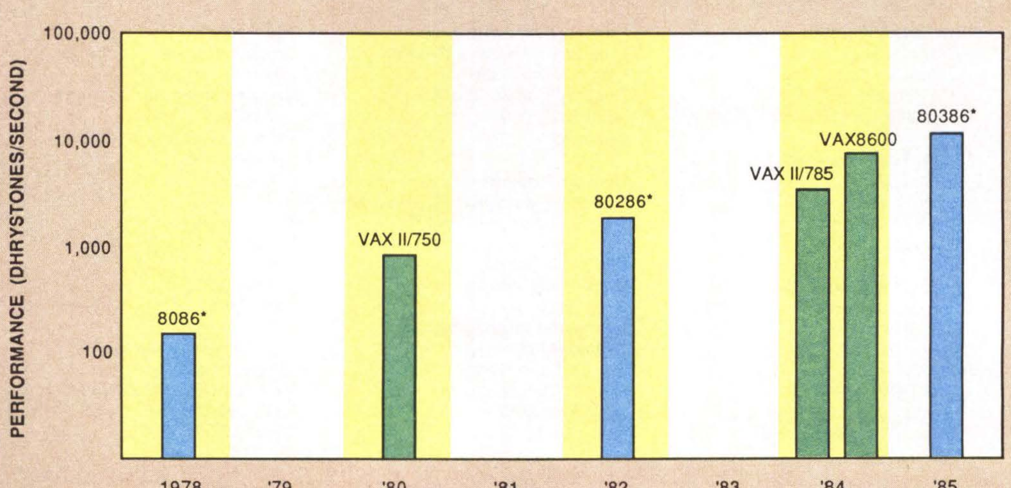
There are two other minicomputer performance categories to consider: the midrange (four- to 16-user systems, workstations, network and communications) and the high end (32- to 128-user high-performance machines used in real-time and multitasking applications). The former is vulnerable to the proliferating 32-bit merchant market microprocessor-based and low-end superminicomputer systems, while the latter is well served by multimicrocomputers and midrange superminicomputers (MMS, May, Page 77 and December 1986, Page 49).

Because the operating systems and much of the application software developed for traditional minicomputers are architecture specific, they are not readily convertible to the MS-DOS environment—which, in any event, lacks real-time or multitasking support. Last March's agreement between AT&T Information Systems and Microsoft to port UNIX System V to the 80386 microprocessor means that the multitasking requirement will be met by 80386-based systems, but there remains a tremendous opportunity for a real-time operating system in the microcomputer environment.

HP is attempting to maximize return on established products.

This need and the pervasiveness of UNIX will almost certainly result in the development of a de facto standard real-time implementation. Companies such as Masscomp have already demonstrated that UNIX is not as incompatible with real-time applications as has been commonly thought. The major change required with UNIX is in task scheduling: from the democratic approach (all tasks inherently equal) of classical timesharing to the Orwellian (some tasks more equal than others). In other words, a change is needed in the implementation of dynamic task prioritization. The rapidly declining cost of 32-bit systems, coupled with their performance benefits, make it likely that they will predominate.

MINICOMPUTER/MICROPROCESSOR EVOLUTION



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IBM could be the first major supplier to abandon the 16-bit minicomputer.

Most minicomputer real-time applications are written in assembly language or FORTRAN, although C is making headway as programmers discover the benefits of structured languages. Since support of C is a prerequisite for UNIX, and all UNIX-based system suppliers offer FORTRAN compilers, conversion of assembly language applications is the only serious impediment left to switching to the new generation of microprocessor-based minicomputers and low-end superminicomputer systems. The outcome will, however, be decided more by users' perceptions of the relative merits of the feature-rich proprietary operating systems and by the ease of use, the portability and the lower cost of the newer systems.

The mounting competition in the midrange will also profoundly affect workstation suppliers like Sun Microsystems Inc. and Apollo Computer Inc., something that the latter company has recognized by entering into joint marketing agreements with superminicomputer supplier Concurrent Computer Corp. and minisupercomputer manufacturer Alliant Computer Systems Corp. Sun responded by slashing the price of its low-end workstation 37 percent last April.

Ironically, implementation of the second phase of distributed processing, that is, the wholesale replacement of terminals with personal computers, will alleviate the pressure to replace 16-bit central processors in the multitasking environment. Finally, the impact of the acceptance of PC clones and DEC's recent success should not be underestimated: more and more computer purchasers are discovering that it's okay not to buy from IBM.

The emergence of standard operating systems and execution units (MS-DOS and the 80286 for 16-bit systems, UNIX and a handful of 32-bit microprocessors for 32-bit) is a competitive threat to VARs as well as to minicomputer manufacturers. Availability of forward integrated systems and a wide range of board-level products is reducing the amount of custom design required in industrial applications. As a result, the traditional OEM is being replaced by system integrators, software houses and distributors, and the retail distribution channel (distributors, dealers and retailers) is growing in importance.

As the basic system building blocks become standardized, compatibility, reliability, ease of use, level of support and other direct benefits begin to differentiate competing products. Resellers and end users alike are seeking utility—solutions to their problems—rather than the latest and greatest technology. Suppliers must respond by getting closer to their customers, identifying their needs, and satisfying them better than ever. □

Andrew Allison is a management consultant specializing in minicomputer and microcomputer technology, products and markets. He had been more than 12 years with Digital Equipment Corp. Rolm Corp. and Advanced Micro Devices Inc., before founding his business in 1977.

Interest Quotient (Circle One)
High 486 Medium 487 Low 488

Companies mentioned in this article

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Apollo Computer Inc.
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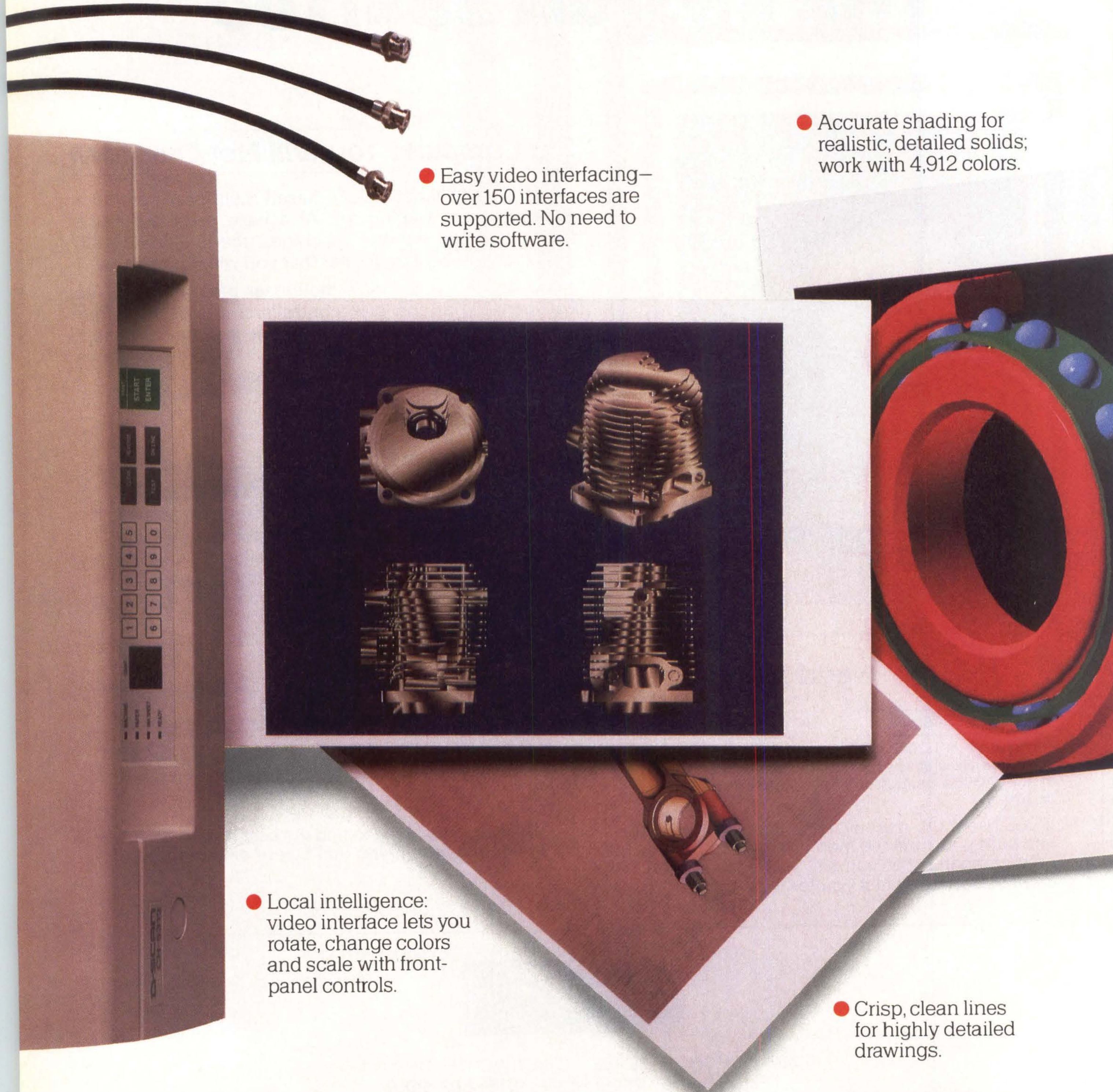

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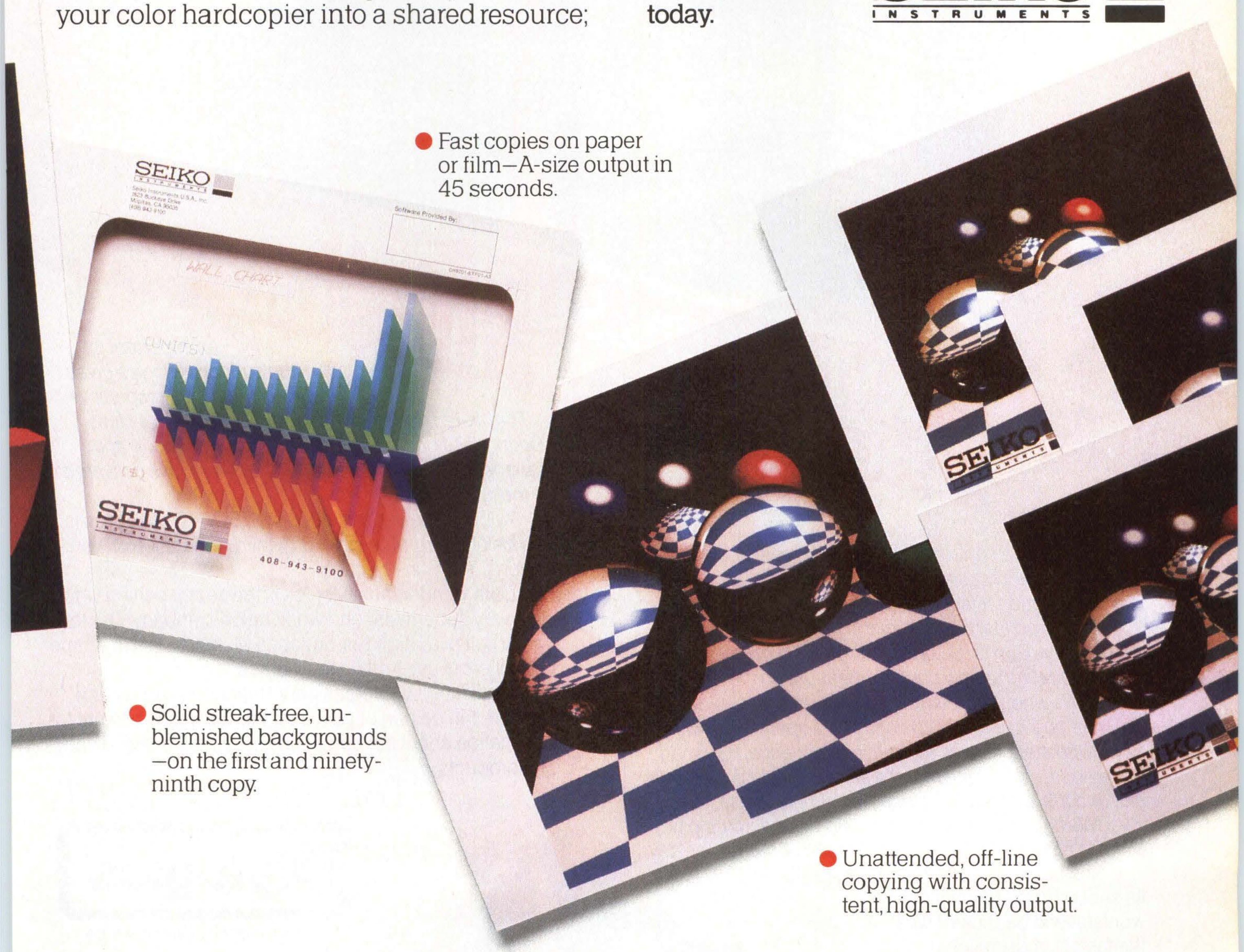

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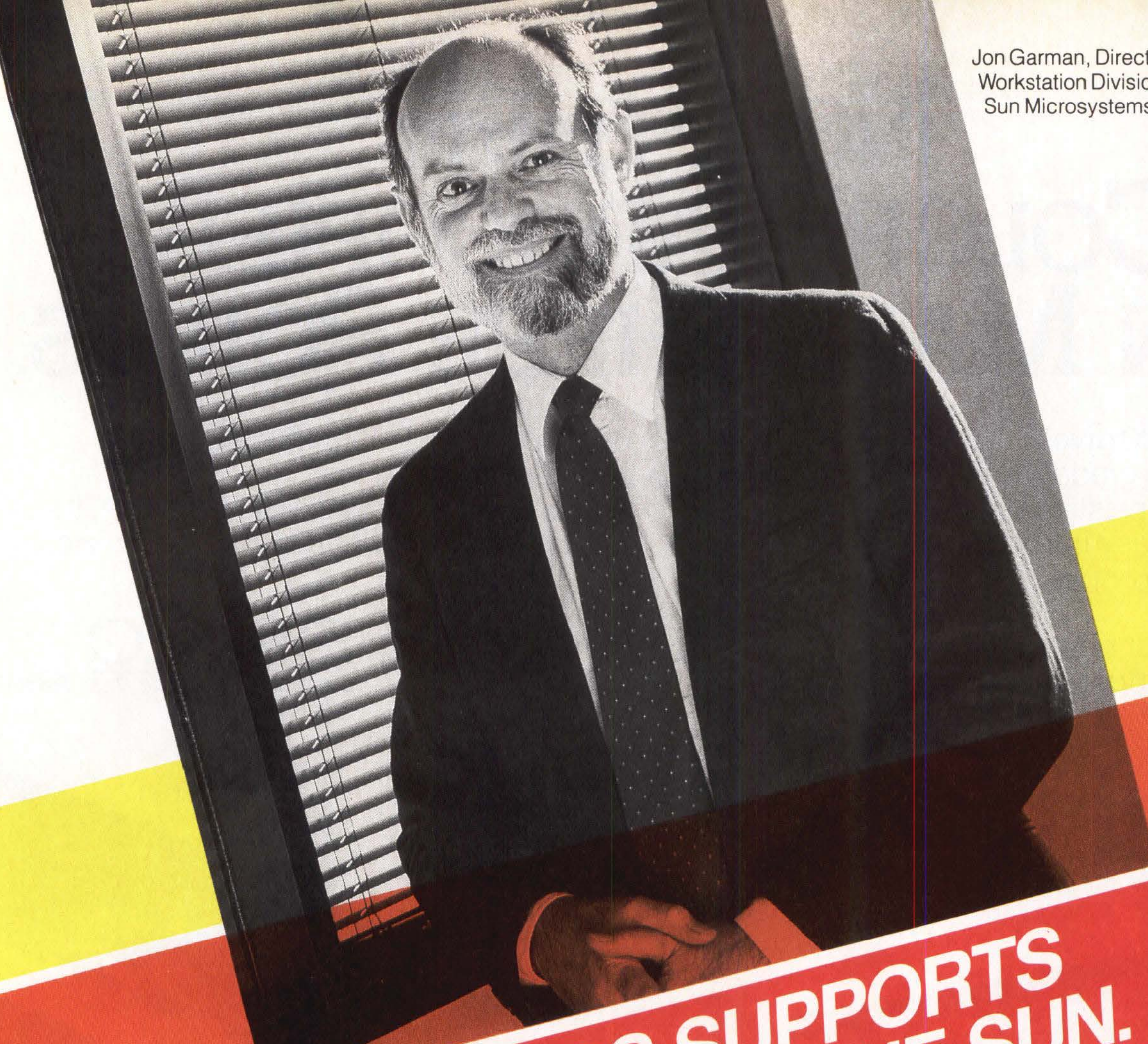


COMPUTE SERVERS CUT PROCESSING COST

Network compute servers change the cost-per-seat and price/performance equations for engineering and design workstations

Dave Folger
Culler Scientific Systems

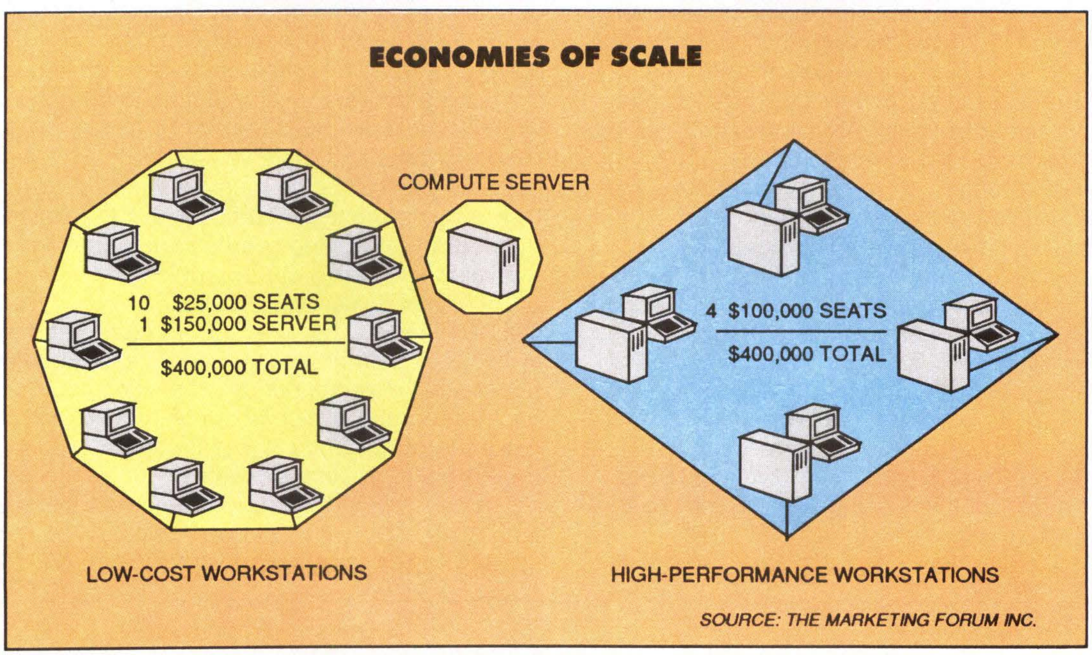
How many engineers can a company hire when each one needs a $40,000 workstation immediately? Alternatively, how productive can an engineer be without full-time, personal access to these expensive but necessary resources? More important, how good is the work done by an engineer without these tools?

The cost-per-seat for high-performance computer assistance is key in determining a company's ability to compete. For example, companies that can simulate designs instead of having to make physical models reach the market quicker. And, with shrinking market windows for technology-based products, the time of entry usually proves the difference between profit and loss.

Simulations that attempt to model real-world effects, like those of circuit designs and thermal stresses for example, are well known as compute-intensive applications, consuming large amounts of floating-point computing cycles. In addition, portions of the design process itself are compute intensive, like solids modeling, styling, package design and animation.

Both the quality and the quantity of output from today's design and engineering department directly relate to the computing power available to the individual engineer.

Keeping designers engaged in the creative



process "on a roll" is related to the workstation's response as a design tool. When an analysis or a design rendering takes too long to finish, the designer's thought process breaks down. The result: lower productivity and diminished design quality. (For a presentation of this concept by James T. Brady of IBM Corp., see "A Theory of Productivity in the Creative Process" in the May 1986 issue of *IEEE Computer Graphics & Applications.*)

In most technical-professional workstation environments, therefore, the compute server provides a clear cost-per-seat advantage, offering high-performance computing capabilities to low-cost workstations. This reduction in cost-per-seat results in a wider deployment of less expensive workstations.

Intensity should match job

Compute servers are designed for fast, sustained computing of floating-point and integer arithmetic in both scalar and vector problems. They work efficiently in networks when a number of workstations have problems of this nature and need assistance from a higher powered capability. Typically, these problems are data-intensive as well as compute-intensive.

For instance, in picture rendering, the input data might include 50,000 floating-point vector coordinates for a network data transfer of 200,000 bytes. Output from the computation is a full-color (16-bit) pixel representation for a 1M-pixel display, or 3M bytes sent back to the workstation. Simulations of electronic circuits, wind tunnels, thermal stresses and other physical phenomena can also require large numbers of points to describe their initial and/or final states.

Compute-intensive "interactive" applications, like animations or trial-and-retrial modelings, can be improved if the server time-slice and network packet size match the dominant applications so that the typical interaction finishes in a single time-slice and a single packet transmission.

The general compute server utilizes some form of pipeline and parallel architecture for better performance. However, these architectures still must match the network problem mix in order to gain performance improvements. For instance, a high-performance vector processor might be efficient in running wind tunnel simulations in an aerospace design environment but be woefully inadequate for the rendering requirements of the styling department in the same company. At the opposite

Compute server

Targeted for compute service in the typical engineering and design problem mix, the CULLER PSC is designed to offer a balanced capability for both vector and scalar computations. The architecture is an extension of the functional parallelism and Very Long Instruction Word (VLIW) concepts developed by Dr. Glen Culler in earlier array-processor designs. It eliminates the pipeline overhead usually associated with high-performance vector processing and delivers high performance on scalar mathematics.

In a single instruction, this general-purpose mathematical processor can perform a double-precision floating-point multiplication, a double-precision floating-point addition, an indexing operation, a loop limit check, two address calculations and much more. With a basic cycle time of 200 nsec, a single-processor PSC is peak rated at 5 MFLOPS and 11 MIPS (million instructions per second).

Culler's VLIW architecture and "expert" FORTRAN compiler deliver an average of 25 percent of the machines peak power in measured Livermore Loop benchmarks. Typical machines deliver on the order of 5 percent to 10 percent of peak.

In order to reduce network traffic and speed task swapping the PSC includes a local dedicated swapping disk. A complete compute server includes both the PSC and a front-end processor for network interfacing, swapping-disk management and operating system kernel execution. This parallelism allows the PSC to concentrate on the compute-intensive portion of the task while the front-end processor, typically a standard network workstation, anticipates the PSC's task-swapping needs for data and state vector information. An upcoming task is set in memory while the current task is being processed, boosting network throughput by reducing swapping overhead and concentrating on the compute portion of the problem.

The Culler system is UNIX-based and comes with FORTRAN and C compilers. Both compilers have switches in them to accommodate a large number of the popular dialects found in the scientific, engineering and design community. The idea is to make the power of the compute server readily accessible to existing problems.

The new "expert" compiler, so called because of its use of artificial-intelligence techniques to generate optimal object code, allows dusty-deck FORTRAN extreme, a high-performance scalar processor that failed to take advantage of the relatively low incremental cost of parts to boost vector performance would incur the contrary imbalance.

Tackle massive throughput

Compute-intensive problems in today's design environments are being solved with programs that run on supercomputers, high-performance mainframes or even on high-performance minicomputers. These existing solutions can't be thrown out when the network is upgraded and a compute server is added. Compute servers generally have sufficient software support to accommodate the majority of these "dusty decks," most of which are written in popular languages like FORTRAN or C. However, the efficiency of these compilers, whose object code is aimed at a parallel architecture, needs to be examined.

Producing efficient code for a parallel architecture is still difficult for compilers. This is especially true if the compilers deal with a program carefully structured for a different parallel architecture—frequently the case with dusty decks.

A key attribute that distinguishes compute servers form high-performance computers designed for a centralized terminal, processing environment is that the servers are multiprocessors optimized for network throughput of compute-intensive jobs. Thus, they are not designed to respond to every keyboard in the network within a few milliseconds nor do they favor quick computing tasks.

Compute servers should deal with large problems that require massive amounts of state switching in a multitasking environment. As utilities on the network, they typically employ multiprocessors when additional capacity is required and coexist with other compute servers when compute-intensive needs exceed the capacity of a single fully expanded server.

Popular applications that run slowly on a workstation or minicomputer can usually be simply recompiled to run on a compute server and then activated by the workstation. However, restructuring these programs into two parts —with the interactive portion on the workstation and the compute portion on the server—improves throughput and offers a useful user interface.

Server usage in a network can increase network traffic enormously. Network protocols, transmission media and bandwidth all affect

stresses throughput

programs to be readily ported to the compute server, regardless of the architecture of the original target machine. Culler also takes advantage of NFS (network file system) and remote-procedure call services in Sun Microsystems Inc. and compatible networks to make compute-server access as transparent as possible in today's networks.

The PSC has been benchmarked on the Livermore Loops, a collection of 24 different mathematical exercises written in FORTRAN, and offers an average of 15 times more power than a Sun-3, a typical example of today's high-performance workstation. This difference provides more than a sufficient performance increment for compute service and is a direct result of the PSC's single-minded focus on intensive computational needs.

Culler sells the PSC principally through resellers and value-added resellers and lists the basic PSC at just under $100,000. When the PSC is joined with a Sun-3 workstation for front-end processing the complete compute server costs under $150,000. At roughly three times the cost of a high-performance workstation and 15 times the power, the PSC can offer superworkstation performance to virtually all network users, without the need to upgrade the workstations.

Alternatively, the PSC can offer this same performance to networks with older workstations and extend the life of existing assets.

throughput. For example, 10M-bit collision detection local area networks, like Ethernet, which deliver a sustained rate far less then their 10M-bit burst rate, will give way to newer LANs like Proteon Inc.'s ProNET-80. This 80M-bit LAN features token passing efficiency at high utilization, eliminates the deadtime between packets and actually delivers a sustained and usable 80M-bit transmission rate. However, Ethernet has become a de facto standard and won't loose ground gracefully until a high-performance LAN attains the same stature.

In many cases, networks with active compute-server users will provide improved service when packet sizes are increased to accommodate the larger computational data transfers typical in distributed processing, especially in token-ring topologies. If a packet is sized to accommodate a complete pixelated display frame, animation effects would be improved at workstations using compute servers for rendering, an increasingly popular application.

Compute servers generally have sufficient software to accommodate "dusty decks."

Transparent access crucial

Compute servers are meant to augment the compute power of a workstation without interfering with the workstation's interactive nature. To workstation users and programs, they must offer the accessiblity and nearly the feel of a transparent and seamless extension to the workstation resource.

This capability requires cooperation from the compute server but, more important, it requires network-wide services that deal with file transfers, file access and program control transfers. For instance, the NFS (network file system) standard that Sun Microsystems Inc. introduced to the industry provides a solid foundation for these file-access and transfer needs. Without the ability to access files network-wide, a compute server has to receive a duplicate copy of the data file at the workstation. These duplicate copies increase network traffic and file-confusion opportunities.

Distributed operating systems have been a topic of conversation and an active research effort in many academic institutions for some time now. The increased presence of compute servers will focus a stronger light on the needs of distributed processing and may well act as the catalyst to bring these new operating systems to maturity.

The use of compute servers increases users' expectations for application performance. When the nuisance of losing the workstation to a time-consuming computation is eliminated for a few applications, the user views other applications as backward. Most popular applications in the design and engineering community go through a porting process to the various compute servers and high-performance standalone computers as they, themselves, become popular. As new applications are developed that anticipate the presence of a compute server, the computation can be split between the server and workstation, offering new interactive capabilities.

Relative power issues

How much more power must a compute server have to offer advantages to a workstation network? Ten times or more appears to be the correct factor. With that, even if a workstation shares the compute server with three or four others at the same time, meaningful performance improvement results.

Shortly, system integrators can expect a new class of superworkstation from companies like Stellar Systems and The Dana Group. These machines have been projected to cost in the $75,000 to $100,000 price range and promise considerable processing capability for engineering and design problems. Though they would seem to rule out the need for compute servers on the surface, two contrary arguments are worth noting.

First, most design and engineering tasks cannot use this dedicated power on a full-time basis and are better served with less expensive workstations and a shared compute server. Second, there will always be a need for more computing power. For instance, rendered images animated at 16 frames per minute for real-time visualization are still orders of magnitude beyond today's best supercomputers. Regardless of the capability these machines bring, a compute server shared among them can boost their interactive performance at an economic advantage.

Compute servers defined

Unlike application servers specialized for a single function, like database management or array processing, the compute server offers a general-purpose capability to a wide range of compute-intensive problems. Though compute servers may come in many forms, they exhibit five common characteristics:

- They provide a clear cost-per-seat economy alternative to higher powered workstations in a given environment and applications mix.
- They are designed for fast, sustained computing of floating point and integer arithmetic in both scalar and vector problems.
- They are multiprocessors optimized for network throughput—as opposed to user keyboard response, for instance.
- They are easily accessible to workstation users and programs and approach the feel of a

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transparent and seamless extension to the workstation resource.

• They offer on the order of ten times or more the power of the workstation on general compute-intensive problems.

Compute servers are general-purpose devices within the context of compute-intensive problem solving. For instance, in a network environment dedicated to word processing a device meeting the last four requirements does not reduce the cost-per-seat of a workstation. At the opposite extreme, a small network of five workstations dedicated to graphics design might be more cost-effective configured with $100,000 superworkstations than $25,000 workstations and a $500,000 minisupercomputer. The economics should determine whether a given device is better used as a compute server in a given environment.

How the server evolved

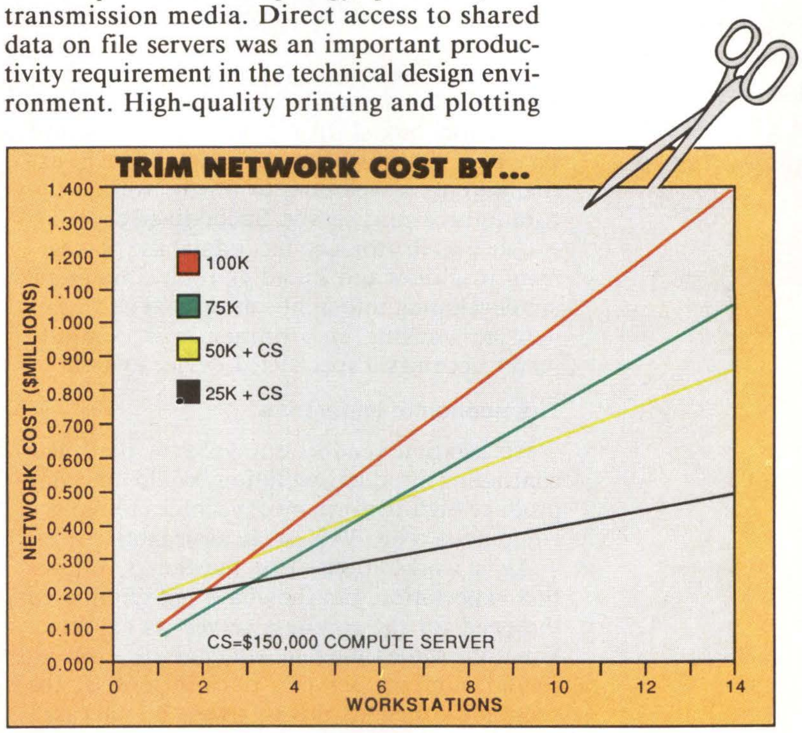
In the past, virtually any computer attached to a network and available to the workstation had been called a compute server. When workstations were based on 8-bit and 16-bit microprocessors, the term accurately described the computer's functional relationship in the network. The typical compute server of the past was a minicomputer and the Digital Equipment Corp. VAX was one of the most popular.

With DEC's strong presence in the engineering department it was natural to include the VAX in the CAD workstation network. The resulting capability allowed designers to set up design simulations from personal workstations and access the results easily. It also eliminated the cumbersome database transfers associated with batch submissions to non-networked centralized computers.

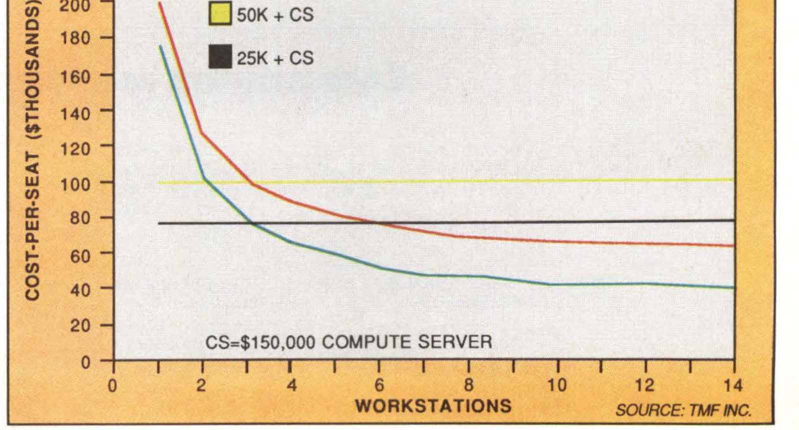
Recently, two important changes in workstation networking have made this old version of compute server obsolete: The new 32-bit workstations are as powerful as yesterday's minicomputers and today's workstation problems have become much more compute intensive than is suitable for VAX-class minicomputing. Minicomputers and mainframe computers were not designed for the compute-server environment and market; they were drafted at an early stage when they had a performance advantage to offer.

Along with these two changes, networking is maturing. Though the standards picture is far from complete, it has reached a point of acceptable stability. The real value of networking becomes apparent when collections of disparate equipment from many vendors can be put to use as a cohesive resource. The rapid acceptance of standards allows the network itself to be viewed as resource—a collection of servers and services; not just a connection topology, transport mechanism and communications protocol.

Networks actually began with a server and services motivation, before users got caught up in the questions of topology, protocol, and transmission media. Direct access to shared data on file servers was an important productivity requirement in the technical design environment. High-quality printing and plotting



If compute-intensive processing *is not a constant requirement for technical workstations, a compute server can stretch network budgets by off loading processing chores from low-cost interactive workstations. The result: performance comparable to superworkstations at a relatively low cost-per-seat.*



The typical compute server of the past was a minicomputer.

were the standards in the centralized computing environment, but they could only be provided economically to the workstation by sharing among many users. Electronic mail was a service that had held many design teams together in the VAX-terminal environment that was quickly missed by the early isolated workstation user.

Now that the fervor over physical networking is settling down to understandable alternatives, the action has shifted back to servers and services. Data PBXes (private branch exchanges) are developing to fill the role of the communications server. Specialized computers, such as Britton Lee Inc.'s database management machines and Zycad's circuit simulators, are developing into application servers. In this new networking environment the compute server becomes a specialized device as well.

The economic imperative

Workstation vendors always knew that their continuing product evolution would one day produce high-performance machines to replace compute-serving VAXes, at affordable prices. Today's workstations, like the Sun-3, ratifies that expectation, but they have not eliminated the need for the compute server, as expected. For at the same time that workstations evolved, so did compute servers. A close look at the economics suggests this to always be the case.

The economic underpinning for compute servers is the typical workstation utilization pattern. The workstation, the technical professional's personal computer, has become an indispensable tool in the daily work routine. Workstation activities include highly interactive processes like memo and report writing, spreadsheet calculation, electronic communications and, perhaps, list management, as well as the original design functions that prompted their development. Even when the workstation is being used as a design tool, the computational requirements are largely interactive and not intensive.

Workstation requirements for computational intensity do not typically occur frequently, though completing these tasks when they are required may well dominate the available time. For example, in an electronics application, this demand for computer cyles peaks when a completed circuit design must be simulated. For mechanical engineering, finite element analysis might be used to test a preliminary or completed design. In graphics design, the final step is a full reflection rendering that eats up enormous amounts of computational power. The point: These calls for power occur infrequently, but when they do, they remove the workstation from service as an interactive tool.

Adding more processing capability to the basic workstation in order to accommodate these occasional needs for power adds to the unit's cost. If this extra capability is sufficiently strong enough to reduce the computational wait time noticeably, then the interactive applications dominate usage. Thus, this added costly potency is generally unused.

Conceptually, the compute server includes this same circuitry but time-shares it with all workstations in a network. Of course, extra costs are involved in network interfacing and multiprocessing architecture, but these are easily amortized over the network's population of workstations. At the same time, the compute server's singleminded focus on power computing means that design optimizations can provide a better price/performance ratio in basic processor cost. □

Dave Folger is president of Culler Scientific Systems in Santa Barbara, Calif., and was founder and president of Ridge Computers. He holds a master of science in electrical engineering from the University of California at Berkeley.

Interest Quotient (Circle One)
High 492 Medium 493 Low 494

Companies mentioned in this article

Britton Lee Inc.
14600 Winchester Blvd.
Los Gatos, Calif. 95030
(408) 378-7000
Circle 369

The Dana Group
550 Del Rey Ave.
Sunnyvale, Calif. 94086
(408) 732-0400
Circle 371

Proteon Inc.
2 Technology Dr.
Westborough, Mass. 01581
(617) 898-2800
Circle 373

Sun Microsystems Inc.
2550 Garcia Ave.
Mountain View, Calif. 94043
(415) 960-1300
Circle 375

Culler Scientific Systems Corp.
100 Burns Place
Santa Barbara, Calif. 93117
(805) 683-5631
Circle 370

Digital Equipment Corp.
146 Main St.
Maynard, Mass. 01754
(617) 897-5111
Circle 372

Stellar Systems
3540 Bassett St.
Santa Clara, Calif. 95054
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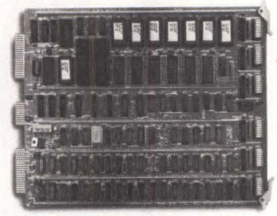

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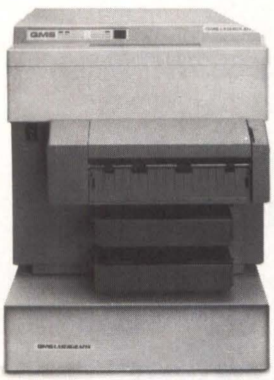

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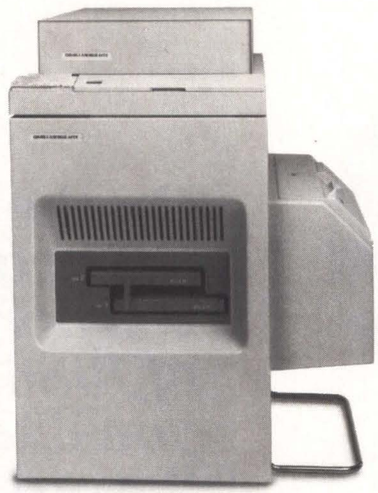

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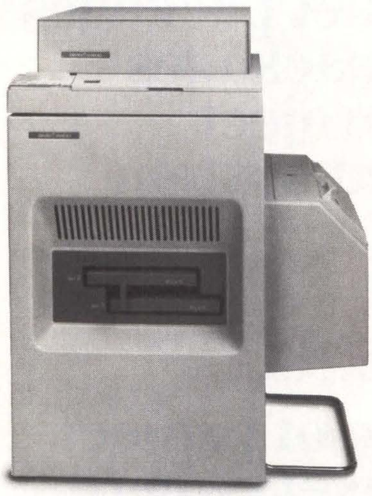

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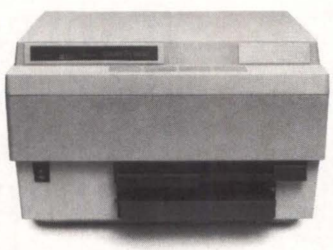

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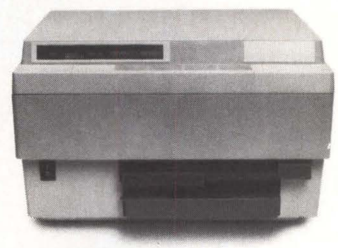

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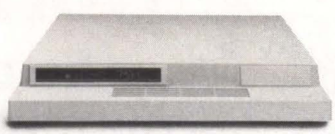

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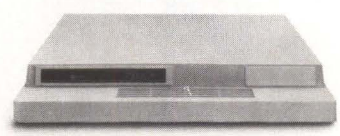

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The flexibility and compatibility of QMS products make your job of pulling together a total system solution for your clients a lot easier. VAR's and OEM's can choose from almost every product we manufacture. Our product families represent innovative combinations of print engines, controllers, fonts and accessories to help you fit almost any niche. Plus, we're always willing to make custom modifications to our products to help you close the sale.

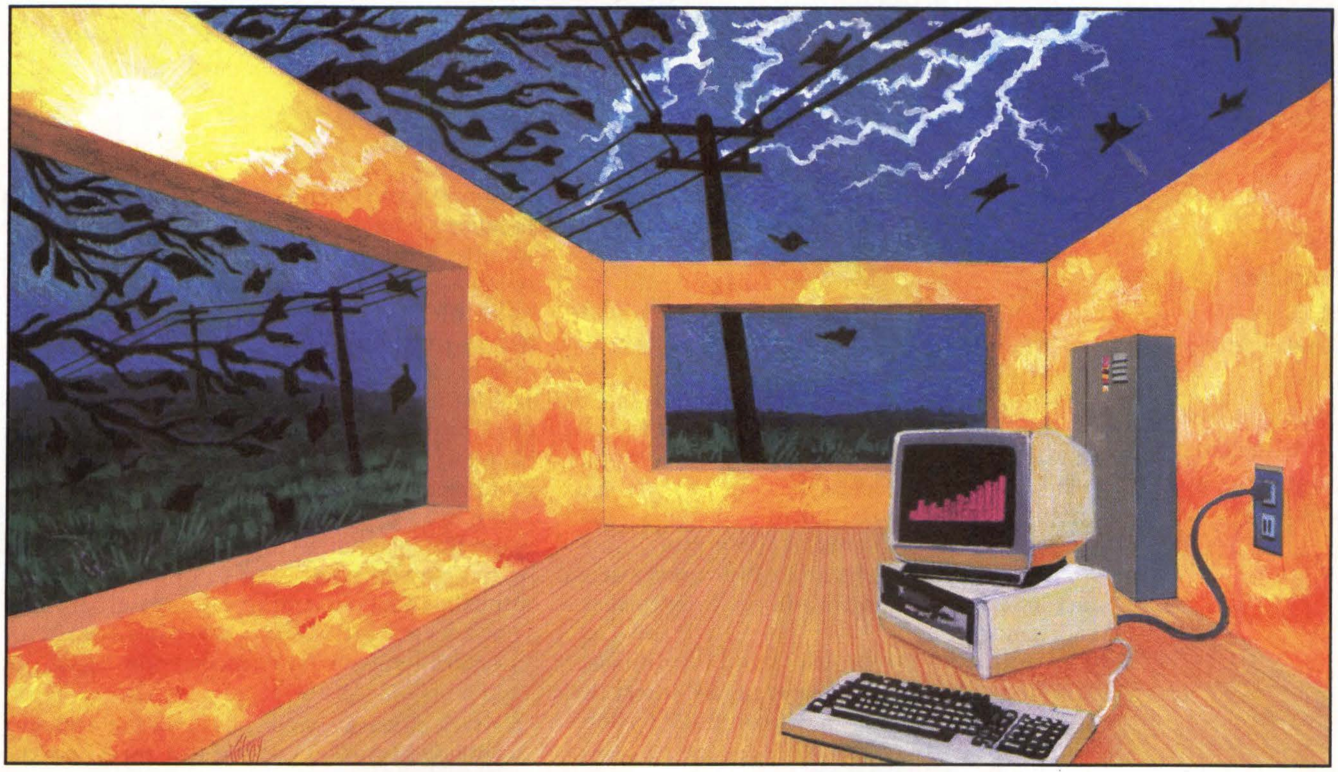


Illustration by John Kilroy.

THE SAFE WAY TO FIGURE UPS SPECS

By accurately determining your power-protection needs, you will prevent buying too little or too much UPS capacity

Jesse Victor, Associate Editor

Most experts insist that the quality of AC power available to computer systems in the United States is still deteriorating. They do not see any sign of improvement. That means computer users, system integrators and resellers of equipment must endure a rising tide of "dirty" and unreliable power: high-voltage spikes, overvoltages, undervoltages, radio-frequency interference/electromagnetic interference (RFI/EMI), brownouts and blackouts.

The solution: an uninterruptible power system (UPS). However, acccording to recent surveys, most computer users still prefer to ignore power problems rather than spend extra dollars for a UPS. But that situation is changing as the real and, more important, perceived cost of power protection dwindles relative to the real cost of power-induced problems.

As a result of this shift in perception, Frost & Sullivan Inc., a New York market research company, expects UPS sales to grow at a vigorous 19 percent annual rate through 1991. If so, annual sales will triple, rising from $450 million in 1985 to $1.3 billion in 1991.

Use the following four-step guide to power-protection selection to locate the appropriate UPS in the accompanying *Mini-Micro Systems* table.

1. Calculate the cost of obvious and hidden computer system damage from power problems.

Most personal computers should tolerate up to 5 percent overvoltage and as much as 12 percent undervoltage, depending on the duration of the disturbance (in milliseconds). Over-

Most computer users still rather ignore power problems than spend extra dollars for a UPS.

voltages or undervoltages out of that range can cause "fried" systems, lost data and scrambled rigid disk directories. They can also produce hidden stress in sensitive components that shows up later in high rates of failure in board or chip, unaccounted for in service department investigations.

Operational problems are compounded by the fact that line power may be perilously close to the undervoltage tolerance of the computer system before it reaches the computer. In such cases, strained distribution systems, load switching, excess demand for power, inadequate building wiring and other pre-existing factors can cause undervoltages to exceed design limits.

In addition, the proliferation of multiuser and networked systems and highly integrated application programs make computer systems more vulnerable than in the past to power problems. A few pages of text lost in a personal computer word-processing program is disturbing. A scrambled directory on a local area network file server's rigid disk, a bit lost in RAM holding a large spreadsheet or 30 minutes downtime in a transactional processing system are all disastrous.

2. Estimate or measure the number of power disturbances for your computer system.

The number of power disturbances usually varies erratically. However, broad geographical and time-of-occurrence generalizations can be made.

The Gulf states and rural areas are especially vulnerable to lightning strikes and subsequent undervoltages. When impulse-suppression equipment in the power distribution system momentarily shorts, the line experiences sags. Snow, ice, hurricanes and tornados cause obvious problems. Fast-growing suburbs frequently are areas of power problems. And a high concentration of new office parks can strain local distribution systems, producing unreliable power.

Studies have shown August to be the peak month for power disturbances, followed by February, April and June (although no month is immune). Forty-two percent of undervoltages occur during regular business hours, but doing batch transfers at night won't solve your daytime dilemmas: 30 percent of undervoltages occur between 1 and 9 a.m.

Oscillatory disturbances, caused by network and load switching at power sources, result in common utility problems. These oscillations menace systems at an average rate of 62 per month. Moreover, spikes crackle across lines on an average of 50 times a month. And undervoltages strain system power supplies an average 14 times per month.

If averages are not daunting enough, a U.S. Department of Commerce study warns: "Average daily fluctuations in utility line voltages range from 5 to 10 dips or surges greater than equipment design limits."

But averages do not pinpoint the problems of a specific installation. To do that, you can rent or buy power-monitoring equipment to determine the exact rate and types of disturbances in your area or have a UPS vendor do a site survey to determine your power-protection needs.

3. Pick either a standby or an on-line UPS by calculating both the organizational cost of a power disturbance and the cost of subsequent computer system recovery.

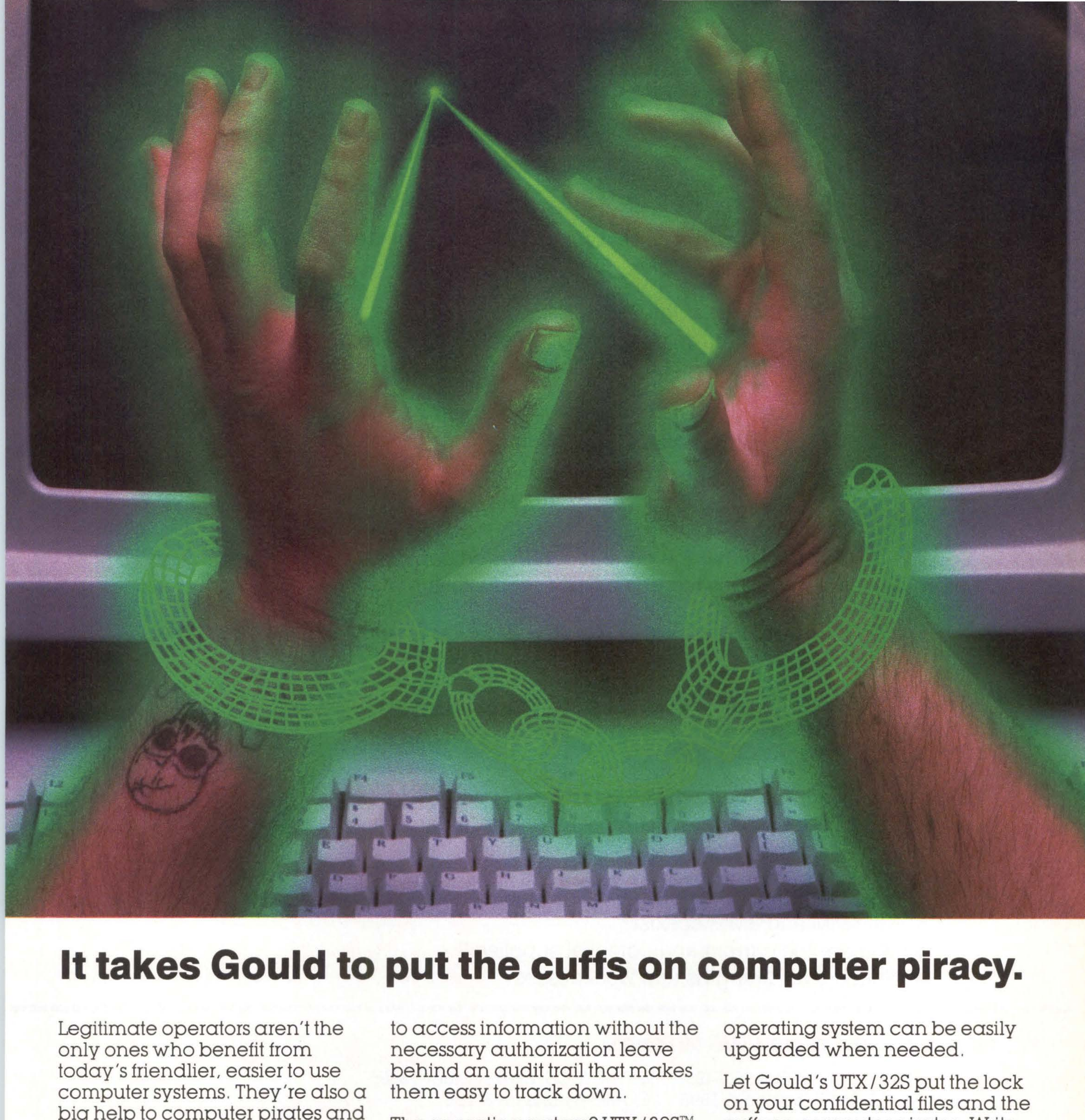
To determine power loss expenses, factor in the cost of the work-hours involved in failure recovery (lost business, throughput or productivity), estimate the time and effort required to recover or reconstruct data and add up the cost of short- and long-term equipment damage. Multiply that figure by the frequency of power disturbances in your area. If the total cost from power disturbances is more than the cost of a UPS, buying a UPS is cost-effective.

Standby UPSes, which can be half the size and cost of on-line units, require milliseconds to switch to back-up battery power when the main AC power fails. While 15 milliseconds was once the norm, 5 to 8 milliseconds is common and 2 to 3 milliseconds is becoming the new standard. Switch-over time becomes critical if your computer system won't tolerate the delay.

More units provide surge and spike protection than provide output regulation for the usual square-wave output, although many UPSes now generate sine-wave output. Good regulation on square-wave units, which can range from +5 percent of nominal down to 3 percent, can prevent feeding too much rms (root-mean-square) power to disk drives.

On-line UPS technology ranges from step-wave ouput with ferroresonant filtering through PWM (pulse-width modulation) output (closely approximating a sine wave) to true sine waves from linear power amplifiers.

PWM systems and power transistors are



It takes Gould to put the cuffs on computer piracy.

Legitimate operators aren't the only ones who benefit from today's friendlier, easier to use computer systems. They're also a big help to computer pirates and other intruders who want to plunder your confidential data.

Gould has developed a way to repel would-be pirates. A complete operating system that eliminates unauthorized access without interfering with day-to-day operations. What's more, those who attempt to access information without the necessary authorization leave behind an audit trail that makes them easy to track down.

The operating system? UTX/32S™ Based on our proven UTX/32® operating system, it's the only secure version of UNIX® that has been formally evaluated and rated at the C2 level as defined by the National Computer Security Center. And we're currently working on a B security level. Naturally, your C2 operating system can be easily upgraded when needed.

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making possible smaller on-line UPSes with less radiated RFI/EMI than those using silicon-controlled rectifiers (SCRs). For demanding applications, linear-power-amplifier units can produce better than 1 percent line and load voltage regulation. Noise levels of on-line UPSes can be as low as 40 dBa at 6 feet, enabling them to fit into office environments.

Vendors of standby UPSes claim that their units are less subject to failure than are continuously operating on-line devices. On-line UPS vendors counter that it might be risky to assume that standby units will always operate reliably at the critical instant when AC line power fails.

In any case, the mean time between failure of a UPS can reach six years or more, and redundant units are available with power transistors mounted on replaceable plug-in boards—a failure on one card will not affect the inverter's output.

UPSes with fast transient response and low output impedance can help prevent problems associated with high transient loads caused by peripherals turning on. Units with static transfer switches can also retransfer back to line power when this occurs.

4. Take into account energy efficiency, capacity and the number of receptacles.

Higher efficency units save on energy costs. A UPS operating at 85 percent efficiency can rack up annual energy costs nearly 1½ times that of one operating at 90 percent efficiency.

Determine the UPS capacity required by adding up the VA (volt-ampere) rating of devices to be protected—typically CPUs, storage peripherals and terminals. (Alternatively, divide wattage by a device's power factor to get its VA rating.) Add 25 percent to total VA rating for future expansion.

Make sure standby units have adequate receptacles for all devices to be protected. Underwriters Laboratory (UL) approval eliminates the need for municipal inspection when a UPS is installed.

Finally, the best argument for installing a UPS comes from those who know best the quality of the power they produce: Most electric utilities protect their computer systems with UPSes. □

Interest Quotient (Circle One)
High 489 Medium 490 Low 491


It may be the bigg
multi-user industry
it's busines
NEW TECHNOLOGY
ALTOS INVENTS
MULTI-USER MICRO SYSTEM.
Altos Computer Systems, a newcomer to the business systems arena, is quietly revolutionizing the market for small business micro computers. Altos' founder, Dave Jackson, is the designer of the single-board micro-computer system, which has generated $260,000 in sales after only one short year in business.
Compactness and price give Altos an edge. An Altos Production Engineering Manager said, "By putting all the micro-computer's power on a single printed circuit board we can keep the size down and its price low."
Though Altos wasn't started in a garage, Jackson didn't stray far from the Silicon Valley tradition. Instead, in 1977 he rented a small room on Stevens Creek Boulevard, where he designed the single-board microcomputer.
Jackson chose the name Altos because of his fondness for the town Los Altos. He lives in Los Altos Hills.
When the computer was completed, Jackson called everyone he could think of who might be interested in buying the system. His first sale was to a Sunnyvale software company, for $4,000.
"You've got to think big," he said and he did. His second sale was to the U.S. Navy, which used it for word processing.
With the $4,000, Jackson built four more systems and the success spiral began.
"Here's the laugh," Jackson said seriously. "Since it made money from day one, we never needed any money."
1978
Altos Breaks With
8-Bit Multi-User Micro
SAN JOSE, Calif.—Altos Computer Systems has introduced the Z8000 multi-user computer system built around an 8-bit Intel microprocessor. The base system sells for about $15,000. That price includes four workstations, basic software, an eight-inch hard disk drive and a printer.
The system can help run a variety of businesses ranging from dentists' offices to car repair shops. For example, an attorney could use the system to keep track of time spent on different clients' cases and to automate billing.
1980
Anc
Altos
16-Bit
SAN JOSE, Calif.—
duction by Altos Com
tems of the 68000, a 16
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According to Altos
David Jackson, the sy
512 KB RAM and can
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Jackson has big
Altos. Currently in de
is a second 16-bit mul
32-Bit Micro Unix V System—
Latest Breakthrough From Altos
SAN JOSE, Calif.—Altos Computer Systems has incorporated the latest in 32-bit technology, the Motorola 68020 microprocessor, as the basis for the new 30-user Altos 3068.
The 32-bit supermicrocomputer system, based on the 16MHz Motorola chip is designed to support the Unix System V.
According to International Data Corp. "the Altos 3068 is arguably the most powerful single microprocesssor machine on the market…it is far and away the most exciting multi-user microprocessor based system announced this year."
Its highly modular architecture makes it especially attractive to the OEM (Original Equipment Manufacturer) channel. The Altos 3068 comes with a full complement of software development tools and applications as well as full communications and networking capabilities.
David Jackson, Altos President and CEO said, "This system outperforms many minicomputers at a fraction of the cost."
The importance of the multi-user business system solution has become increasingly evident, and Altos has led the market in developing the most advanced and cost effective systems. The advantage of a multi-user system is that it allows a number of users to share expensive software, peripherals and high powered central processing units (CPU's) efficiently, thereby reducing per-user costs.
Altos has maintained its leadership in the multi-user microcomputer industry by incorporating the latest advances in technology in a cost-effective manner. Altos led the way in pioneering 8-bit and 16-bit multi-user micros. This year Altos once again established its technical leadership with the introduction of several new state-of-the-art multi-user systems.
In addition to the 3068, Altos used the advanced 16-bit microprocessor, the Intel 80286, as the basis for the highly modular 20-user Altos 2086. The Altos 2086 was designed to extend Altos' family of Intel-compatible products up to 20 users, providing resellers with the new market opportunities and insuring that they can protect and support their customer's growing user requirements.
The Altos 486, introduced early in 1985, is a powerful 16-bit system that can support up to 4 users. Measuring less than four inches high, and weighing only twenty pounds, the Altos 486 sets the pace for new half-height technology.
With these significant new products, Altos offers the widest selection of multi-user micros on the market.
1986
It's Altos A
First To Ship 386-Based Xenix Mu
SAN JOSE, Calif.—Altos Computer Systems has announced it will ship the first Altos 386 Series 2000 multi-user system this week. It's specifically designed for the industry standard XENIX operating system.
Based on the 32-bit Intel 80386 microprocessor, the system is designed to support up to 64-users as a cost effective solution for modern office automation and commercial applications requirements.
The new Altos 386 2000 series is equipped with a standard 80387 floating point co-processor, and 32 KB data and instruction cache. The system provides zero wait states when operating out of cache.
It's capable of handling up to 426 MB (formatted) of internal mass storage with three 5.25 inch 65 MB or 170 MB ESDI disk drives.
The Series 2000 is the first of a com-
plete family of 386-based systems. Each
member conforms to a unified set of stan
dards throughout the breadth of the line
not only in processor technologies lik
Intel's, but in operating systems (XEN
V), communications (Ethernet, SN
X.25, among others), storage (the ES
disk interface, for instance), as well as
1987

est news to hit the in 10 years, but to us s as usual.

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tem based on the Motorola 68000 chip. (The company's 8-bit and 16-bit systems are built around Intel chips.)

"I want both" (microprocessors), Jackson said, "Because I want the whole market."

Altos expects to sell $60 million in small business computer systems in the year ending next June, up from $21 million last fiscal year. The privately held company was profitable from the start. Earnings reached $2.4 million last year, or 11 percent of sales.

Because of Altos' fast growth, Jackson has been planning a move into a new 250,000-square foot manufacturing and headquarters building, which the firm will build in Fremont or San Jose.

1982

Altos Announces Xenix Network. Industry Applauds.

SAN JOSE, Calif.—Altos Computer Systems has begun shipping the industry's first implementation of Xenix 3.0 to its OEM's, more than two months ahead of other scheduled Xenix releases.

Xenix 3.0 for Altos' 16-bit microcomputers is the first commercially available implementation of the new operating systems, according to OEM/VAR marketing manager Rick Vieth.

Altos will also conduct a nationwide marketing road show next month to introduce Xenix 3.0 to its current dealers and distributors.

The operating systems will be offered as upgrades to existing customers for $50 in a run-time version and $150 for an extended version that includes several programming tools, including a C compiler."

"The performance of a multi-user system is very much dependent on your implementation of Xenix," said Vieth. It's not an overnight job to put Xenix on your system. We've had it in engineering for a long time."

The Altos implementation of Xenix 3.0 is said to provide support for shared data segments accessing a common data base; semaphores allowing multiple programs to run in synchronization; symbolic links; maximum data space extended to the available memory space by way of dynamic segment allocation; a menu-driven installation procedure; automatic reboot after a power failure; and support for the Altos III terminal.

1983

Altos Expands Xenix Software Library

SAN JOSE, Calif.—Altos Computer Systems Inc. has released three new software packages for its multiuser XENIX-based microcomputers.

The three packages include SNA 3270 and X.25, both communications packages, and the Altos Office Executive, an integrated package for business users.

SNA 3270 is said to turn Altos systems into remote 3270 information-display systems functioning in an SNA environment, a company spokesman said.

With this capability, users can communicate directly with compatible mainframes to access 3270 host-based applications and data base, word processing, and electronic mail—and integrates them into a single windowing package.

Microsoft Corp.'s Multiplan forms the spreadsheet base of this package; it is said to incorporate 63 columns by 255 rows for spreadsheet construction.

No control characters are necessary with Multiplan, and the commands are all listed at the bottom of the screen for easy reference. Up to eight separate windows can be created on the screen at once, the spokesman said.

Worksheets also can be linked so that updating one spreadsheet updates all of the spreadsheets in the link.

1984

gain.

i-User System.

e range of applications software.
th the Altos 386 systems, business
s will be able to choose from a variety
nfigurations that provide the needed
bination of price and performance.
ll the systems connect to every other
e of computer, including minis and
inframes, as well as to PC's, including
se in the MS-DOS world.
In addition, there is full compatibility,
every level, for users of current Altos
36-based systems. Upgrading to the
ewer machines is simple. Just as it will
e for even more advanced technologies
when they become available.

For a decade, Altos has been a growing force in the computer business with a series of industry firsts.

Now, that leadership continues.

Introducing the Altos 386 Series 2000, the first in our family of powerful 80386 based systems.

It's capable of handling 64 users with 3 to 5 times more power than any multi-user system we've ever offered. But power is only part of the story.

The Series 2000 is designed to provide new standards in connectivity. Expandability. Modularity. And growth potential. So it will accommodate new technology and existing software.

When it comes to service, the new Altos 386 Series 2000 offers the option of a unique remote diagnostic program that allows off-site inspection of down components. Fully modular design and construction provides greatly simplified on-site repair and replacement capability.

Best of all, the new 386 Series 2000 is based on Altos multi-user technology that has been perfected over 10 years. So it comes with the bugs worked out.

For VARs and OEMs, the new Altos 386 Series 2000 not only offers the power, price, features and connectivity your customers demand, it also gives you Altos flexibility, commitment to your marketing channel, and impressive profit margins.

Call us about the new Altos Series 2000 today. We'll give you the news on the biggest innovation to hit the computer business in years.

Even though it's an everyday thing to us.

ALTOS
COMPUTER SYSTEMS®

For more information call 1-800-ALTOS-US or write to Altos Computer Systems, 2641 Orchard Parkway, San Jose, CA 95134.

CIRCLE NO. 62 ON INQUIRY CARD

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type (Response time)	Power rating (KVA)	Input voltage (AC at 60Hz)	Input current (amps/phase)	Input/output phase	Size (H×W×D/inches)	Weight (lbs.)	Price $
ABACUS CONTROLS INC. 80 Readington Rd., Somerville, NJ 08876, (201) 526-6010								Circle 308
678	on-line solid state	7.5	208, 220, 480	26	2 wire+GND 3 wire+GND 4 wire+GND	63×22×30 (cabinet)	650	
913-4	standby (2 msec)	1.2	90, 115, 120		2 wire+GND	11.5×7.7×14.5 (cabinet)	71	1,395
942-4	standby (4 msec)	0.45	90, 115, 120		2 wire+GND	6.6×4.7×14.2 (cabinet)	25	795
AMERICAN MONARCH CORP. 2801 37th Ave. N.E., Minneapolis, MN 55421, (612) 788-9161								Circle 309
AM-0250	standby (2 msec)	0.25	120	1.7/1	3 wire+GND	5.25×8.8×12.75 (rack, cabinet)	26	595
AM-0500	standby (2 msec)	0.5	120	3.4/1	3 wire+GND	5.25×13.2×12.75 (rack, cabinet)	40	799
AM-1000	standby (2 msec)	1	120	6.8/1	3 wire+GND	5.25×17.5×15.75 (rack, cabinet)	62	1,080
ATLAS ENERGY SYSTEMS 16872 Milliken Ave., P.O. Box 19129, Irvine, CA 92713, (714) 863-0900								Circle 310
RP66010	on-line rotary motor	10	208, 220, 480		2 wire+GND 3 wire+GND 4 wire +GND	65×75×34 (cabinet)	2,300	
RP66020	on-line rotary motor	20	208, 220, 480		2 wire+GND 3 wire+GND 4 wire+GND	65×75×34 (cabinet)	2,400	
RP66030	on-line rotary motor	30	208, 220, 480		2 wire+GND 3 wire+GND 4 wire+GND	65×75×34 (cabinet)	2,700	
BEAVER ELECTRONIC LABORATORY P.O. Box 202, Kingston, MA 02364, (617) 585-5666								Circle 311
BBU-912	on-line solid state	0.1	115		2 wire+GND	5.25×19×19 (rack)	28	1,129
BEHLMAN ENGINEERING CORP. 1142 Mark Ave., Carpinteria, CA 93013, (805) 684-8311								Circle 312
H-Series	on-line solid state	0.75-5	115, 120	10.5	2 wire+GND	5.25×24×19 (rack)	80	2,995+
UPS-Series	on line solid state	0.1-20	100, 115, 120, 208, 220, 380, 460	1.7	2 wire+GND	5.25×19×19 (rack)	65	2,375+
BEST POWER TECHNOLOGY INC. P.O. Box 280, Necedah, WI 54646, (608) 565-7200								Circle 313
Ferrups 15KVA	on-line solid state	15	208, 240	116/1, 102/1	2 wire+GND	41×23×30 (cabinet)	720	14,995
Micro-Ferrups M250VA	on-line solid state	0.25	120	41/2	2 wire+GND	17×8.2×20 (cabinet)	100	1,095
Micro-Ferrups M1500VA	on-line solid state	1.5	120	20/1	2 wire+GND	19×12.4×29 (cabinet)	235	3,995
CLARY CORP. 320 W. Clary Ave., San Gabriel, CA 91776, (818) 287-6111								Circle 377
Onguard Jr.	on-line solid state	0.4-0.8	120		2 wire+GND	10.5×19×18 (rack) 15×9.5×18 (cabinet)	60 (rack) 70 (cabinet)	
Onguard Series I/II	on-line solid state	0.6-3	120, 208, 220, 240		2 wire+GND 3 wire+GND	10.5×19×28 (rack) 16.5×9.5×28.5 (cabinet)	100 (rack) 128 (cabinet)	
Onguard Series II/IV	on-line solid state	3.75-30	120, 208, 220, 230, 240		2 wire+GND 3 wire+GND 4 wire+GND	72×55×27 (cabinet)	1,530	
COMPUTER POWER INC. 124 W. Main St., High Bridge, NJ 08829, (201) 638-8000								Circle 314
Computersave Mark II	on-line solid state	0.75-5	120, 208, 220	6-51/1	2 wire+GND 3 wire+GND	12.5×12.4×21 32×32×12.75 (cabinet)		1,892-6,200
Defender	standby (2-4 msec)	0.2-1.5	120	12.5/1	2 wire+GND	13×6.5×13 7×17×20 (cabinet)		560-1,450

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type (Response time)	Power rating (KVA)	Input voltage (AC at 60Hz)	Input current (amps/phase)	Input/output phase	Size (H×W×D/inches)	Weight (lbs.)	Price $
Series 36	on-line solid state	0.5-1.5	120	8-22/1	2 wire+GND	32×32×12.75 (cabinet)		2,775-3,895
CONTROL TECHNOLOGY INC. 8200 N. Classen Blvd., Oklahoma City, OK 73114, (405) 840-3163								**Circle 315**
RBS=AC 500 ZERO SWITCH	standby (less than 3 msec)	0.5	120, 220	5/1	3 wire+GND	..375×11.4×13.75 (cabinet)	37	798
RBS=AC 750 ZERO SWITCH	standby (less than 3 msec)	0.75	120, 220	7.5/1	3 wire+GND	5.375×11.4×13.75 (cabinet)	37	948
RBS=AC 1000 ZERO SWITCH	standby (less than 3 msec)	1	120, 220	10/1	3 wire+GND	5.375×11.4×13.75 (cabinet)	45	1,148
CONTROLLED POWER CO. 1955 Stephenson Highway, Troy, MI 48083, (800) 528-3700								**Circle 316**
Series 1000 Model D	on-line solid state	1-15	120, 208, 240		2 wire+GND 3 wire+GND			2,930-14,500
Series 3000	on-line solid state	15-100	120, 208, 480		2 wire+GND 3 wire+GND 4 wire+GND			
CPS ELECTRONICS INC. 4151 112th Terrace North, Clearwater, FL 33520, (813) 578-1600								**Circle 317**
EG 250 Power Reserve	standby (less than 1 msec)		115, 120, 220	2	3 wire+GND	14×7.25×8.75 (cabinet)	30	595
EG 500 Power Reserve	standby (less than 1 msec)		115, 120, 220	4	3 wire+GND	14×7.25×8.75 (cabinet)	36	995
CUESTA SYSTEMS CORP. 3440 Roberto Court., San Luis Obispo, CA 93401, (805) 541-4160								**Circle 318**
Datasaver 90 Watt	standby (2-8 msec)	0.09	115, 120	1.5	3 wire+GND	4×6×9 (cabinet)	9	350
Datasaver 200 Watt	standby (2-8 msec)	0.2	115, 120	3	3 wire+GND	4×6×9 (cabinet)	14	495
Datasaver 400 Watt	standby (2-8 msec)	0.4	115, 120	5	3 wire+GND	2×13×13 (cabinet)	28	695
CYBEREX INC. 7171 Industrial Park Blvd., Mentor, OH 44060, (216) 946-1783								**Circle 319**
MiniUPS	on-line transistorized	5, 7.5	208, 408	6.1, 14	2 wire+GND 3 wire+GND	45×27×30 (cabinet)	550	
MiniUPS	on-line transistorized	12	208, 408	14, 32	3 wire+GND 4 wire+GND	65×27×30 (cabinet)	325	
S-III/Plus	on-line transistorized	15	208, 408	22, 49	3 wire+GND 4 wire+GND	77×38×34 (cabinet)	1,750	
DELTRON INC. Wissahickon Ave., North Wales, PA 19454, (215) 699-9261								**Circle 320**
PU-F	standby (0.4 msec)	0.6-1.5	120, 220	15/1	2 wire+GND	7×17×20 (rack, cabinet)	118	1,450
PU-N	on-line solid state	0.75-1.5	120	30/1	2 wire+GND	32×32×11.5 (cabinet)	345	3,895
PU-T	on-line solid state	0.75-5	120	20/1	2 wire+GND	12.5×12.4×21 (cabinet)	150	2,250
DISPLEX INC. 1 Alexander Place, Glen Cove, NY 11542, (516) 671-4400								**Circle 321**
PSU-511	on-line solid state	1.25	120		2 wire+GND	21.625×17.375×15 (cabinet)	220	4,304
PSU-521	on-line solid state	2.5	120		2 wire+GND		230	6,491
PSU-7561	on-line solid state	6.25	120		2 wire+GND	(cabinet)		11,865
DYNATECH COMPUTER POWER INC. 4744 Scotts Valley Dr., Scotts Valley, CA 95066, (800) 638-9098								**Circle 322**
Powerhouse/300	standby (4 msec)	0.3	115, 120	3/1	3 wire+GND	4.75×12.25×14.5 (rack)	35	
Powerhouse/500	standby (4 msec)	0.5	115, 120	3/1	2 wire+GND	4.75×12.25×14.5 (rack)	46	
ELECTRONIC SPECIALISTS INC. 171 S. Main St., Natick, MA 01760, (800) 225-4876								**Circle 323**
SU-250	on-line solid state	0.25	90, 115, 120	5/1	3 wire+GND	17×9×12 (cabinet)	65	1,095

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type (Response time)	Power rating (KVA)	Input voltage (AC at 60Hz)	Input current (amps/phase)	Input/output phase	Size (H×W×D/inches)	Weight (lbs.)	Price $
SU-500	on-line solid state	0.5	90, 115, 120	10/1	3 wire+GND	17×9×12 (cabinet)	90	1,495
EMERGENCY POWER ENGINEERING INC. 3580 Cadillac Ave., Costa Mesa, CA 92626, (714) 557-1636								**Circle 324**
UPS 50	on-line solid state	2-5	208, 240		2 wire+GND 3 wire+GND	54×22×21 (cabinet)	550	11,220-16,220
UPS 100	on-line solid state	6-20	208, 480, 600		3 wire+GND	71×27×25 (cabinet)	1,275	20,440-32,700
UPS 4200	on-line solid state	10-25	208, 220, 480, 600		3 wire+GND	71×31.5×32.5 (cabinet)	1,650	36,290-47,040
EMERSON COMPUTER POWER 3300 S. Standard St., Santa Ana, CA 92702, (714) 545-5581								**Circle 325**
AP100	on-line solid state	3-10	120	47/78/153	2 wire+GND	52×25.6×18.7 52×35×18.7 (cabinet)	485-815	6,600-15,000
AP1000	standby (4 msec)	0.2-1.5	120	1.7-12.5	2 wire+GND			
AP3000	on-line solid state	15-30	208, 480		2 wire+GND			
EXIDE ELECTRONICS INC. 3201 Spring Forest Rd., Raleigh, NC 27604, (919) 872-3020								**Circle 326**
1100	on-line solid state	1.5-5	120, 208, 220, 240		2 wire+GND	43×23×35 (cabinet)	260-464	4,300-9,700
1200	on-line solid state	6-10	208, 220, 230, 240		2 wire+GND 3 wire+GND	43×32×34 (cabinet)	1,480	12,500-16,700
6080	on-line solid state	100	208, 400, 480, 600		4 wire+GND	73.5×38×31.5 (cabinet)	2,500	45,000-60,000
GENERAL POWER SYSTEMS 1405 S. East St., P.O. Box 65008, Anaheim, CA 92805-8508, (714) 956-9321								**Circle 327**
GPS-25KVA	on-line solid state	25	208, 480		4 wire+GND	69.6×27.1×30.1 (cabinet)	1,683	34,680-35,625
GPS-37.5KVA	on-line solid state	37.5	208, 480		4 wire+GND	69.6×33.1×30.1 (cabinet)	2,246	39,200-40,275
GPS-50KVA	on-line solid state	50	208, 480		4 wire+GND	69.6×33.1×30.1 (cabinet)	2,942	43,750-44,950
HDR POWER SYSTEMS INC. 600 Oakland Park Ave., Columbus, OH 43214, (614) 262-6832								**Circle 328**
1300-10	on-line solid state	10	208, 240	32	2 wire+GND	79×29×36 (cabinet)	1,770	
2038-15	on-line solid state	15	208, 240	47	3 wire+GND 4 wire+GND	79×56×33.5 (cabinet)	2,700	26,000
3100-30	on-line solid state	30	208, 240	94	3 wire+GND 4 wire+GND	87×56×33.5 (cabinet)	4,050	30,000
HITRAN CORP. 362 Highway 31, Flemington, NJ 08822, (201) 782-5525								**Circle 329**
BAO278-00	on-line solid state	7.5	208, 480	17, 38	2 wire+GND 3 wire+GND	68×46×30 (cabinet)	1,200	16,200
BAO279-00	on-line solid state	10	208, 480	22, 51	2 wire+GND 3 wire+GND	68×46×30 (cabinet)	1,400	18,800
BAO280	on-line solid state	15	480	33	2 wire+GND 3 wire+GND	68×46×30 (cabinet)	1,700	23,500
ICS INC. (ELECTRO-PAC DIV.) 520 Interstate Rd., Addison, IL 60101, (312) 543-6200								**Circle 330**
Lifeline 930-0055	on-line solid state		120	7/1	2 wire+GND	24×20×11.5 (cabinet)	130	1,695
Lifeline II 930-0065	on-line solid state		120	9.3/1	2 wire+GND	28×10×22 (cabinet)	220	2,780
Lifeline SB	standby		120	3.33/1, 6.66/1	2 wire+GND	5.5×8×11.5 (cabinet)	23, 28	
IMUNELEC INC. 7600 Jericho Turnpike, Suite 201, Woodbury, NY 11797, (516) 364-8008								**Circle 331**
MS 300	on-line solid state	0.3	120		3 wire+GND	5.1×15.3×11.3 (cabinet)	38	1,050

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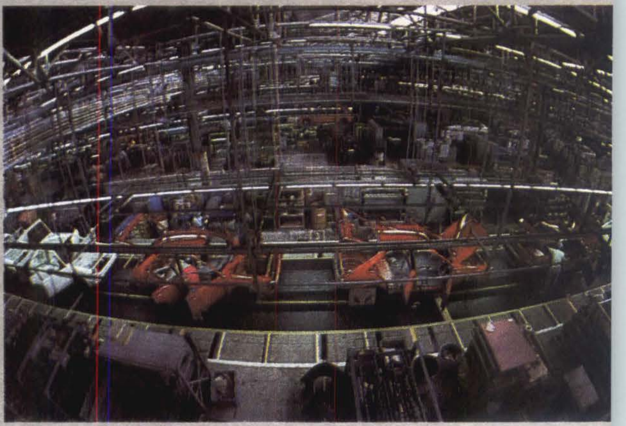

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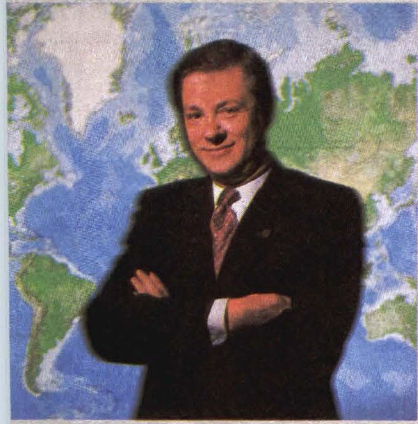

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UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type (Response time)	Power rating (KVA)	Input voltage (AC at 60Hz)	Input current (amps/phase)	Input/output phase	Size (H×W×D/inches)	Weight (lbs.)	Price $
MS 600	on-line solid state	0.6	120		3 wire+GND	15.4×7.7×18.3 (cabinet)	86	1,750
Series 11	on-line solid state	0.5-3	120		3 wire+GND	20×22×22 (cabinet)	155	3,760
INMAC (DATACOM DIV.) 2350 Zanker Rd., San Jose, CA 95131, (408) 435-1700								**Circle 332**
Turbo 550VA	on-line solid state	0.55	90, 115, 120	12/1	2 wire+GND	2×15×16 (rack)	23	885
Turbo 1000VA	on-line solid state	1	90, 115, 120	12/1	2 wire+GND	2×17×16 (rack)	26	1,395
INTERNATIONAL POWER MACHINES 11534 Pagemill Rd., Dallas, TX 75243, (214) 343-6076								**Circle 333**
DP-50	on-line solid state	50	208, 480	74, 173	3 wire+GND 4 wire+GND	78×70×35 (cabinet)	3,000	
EP 32	on-line solid state	32	208, 480, 600	46, 55, 126	3 wire+GND 4 wire+GND	76×64×32 (cabinet)	2,900	
EP 64	on-line solid state	64	208, 480, 600	92, 110, 252	3 wire+GND 4 wire+GND	76×64×32 (cabinet)	3,550	
ISOREG CORP. P.O. Box 486, Littleton, MA 01460, (617) 486-9483								**Circle 334**
UPI6-050-12-12-TS-HH	on-line solid state	1	120	23	2 wire+GND	22×23×23 (cabinet)	320	3,568
UPI6-200-12-12-TS-HH	on-line solid state	2	120	48	2 wire+GND	31×24×25 (cabinet)	400	5,390
UPI6-300-12-12-TS-HH	on-line solid state	3	120	62	2 wire+GND	45×24×25 (cabinet)	612	7,382
JEFFERSON ELECTRIC 1400 Center Circle Dr., Downers Grove, IL 60515, (312) 691-2400								**Circle 335**
ENERGYGUARD	on-line solid state	0.25-1	120	2.08-8.33/1	2 wire+GND	11.125×15×20.25 (cabinet)	110-185	1,610-2,262
KALGLO ELECTRONICS CO. INC. 6584 Ruch Rd., Bethlehem, PA 18017-9359, (215) 837-0700								**Circle 336**
LS250	standby (2 msec)	0.25	115, 120, 220	2	2 wire+GND	4.75×9.25×6.75 (cabinet)	18	549
LS500	standby (2 msec)	0.5	115, 120, 220	4	2 wire+GND	5×13.25×7 (cabinet)	28	795
LS750	standby (2 msec)	0.75	115, 120, 220	6	2 wire+GND	5×13.25×8.5 (cabinet)	39	995
K/W CONTROL SYSTEMS INC. RD #4 S. Plank Rd., Middletown, NY 10940, (914) 355-6741								**Circle 393**
T UPS-10KVA	on-line solid state	10	120, 208	36/3	3 wire+GND	60×52×25 (cabinet)	2,200	19,600
T UPS-20KVA	on-line solid state	20	120, 208	68/3	4 wire+GND	60×52×25 (cabinet)	3,100	29,500
LIEBERT CORP. 1050 Dearborn Dr., P.O. Box 29186, Columbus, OH 43229, (614) 438-5778								**Circle 337**
PC-ET	on-line solid state	1.08	115, 120	10/1	3 wire+GND	2.3×15×14.8 (cabinet)	23	
Single-Phase	on-line solid state	1-10	120, 208, 240	9-174/1	2 wire+GND 3 wire+GND	25×23×24 (cabinet)	320-1,320	
Three-Phase	on-line solid state	15-50	208, 480, 600	22-194/1	3 wire+GND 4 wire+GND	70×28×32 (cabinet)	1,100-2,900	
LORAIN PRODUCTS 1122 F St., Lorain, OH 44052, (216) 288-1122								**Circle 338**
801GAA	standby (1-4 msec)	0.8	115, 120	10/1	2 wire+GND	16.25×7.25×18.5 (cabinet)	100	
WA103B	on-line solid state	10	115, 120	130/1	2 wire+GND	72×36×21.25 (cabinet)	1,485	
WDA302B	on-line solid state	3	115, 120	40/1	2 wire×GND	71.5×21×15 (cabinet)	495	
LORTEC POWER SYSTEMS INC. 145 Keep Court, Elyria, OH 44035, (216) 327-5050								**Circle 339**
ContinuAC Single Phase	on-line solid state	2-5	120, 208, 220	21-50/1	2 wire+GND	52×22×27 35×22×27 (cabinet)	600-950	4,995-9,995

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type (Response time)	Power rating (KVA)	Input voltage (AC at 60Hz)	Input current (amps/phase)	Input/output phase	Size (H×W×D/inches)	Weight (lbs.)	Price $
ContinuAC Three Phase	on-line solid state	10-160	120, 208, 220, 480	47-183/3	4 wire+GND	78×40×29.5 80×60×30 (cabinet)	2,000-14,000	19,000-86,000
SPS	standby (2-4 msec)	0.3-1.2	120	3-12.5/1	2 wire+GND	66×4.7×14.2 11.5×7.7×14.5 (cabinet)	23-75	459-1,395
MODULAR POWER CORP. 1150 Ringwood Court, San Jose, CA 95131, (408) 432-3060								**Circle 378**
UPSTAR Model 6A	on-line solid state	up to 72	90, 115, 120, 208, 220, 480, 600		3 wire+GND 4 wire+GND	57×34×38 (cabinet)	1,100	from 30,000
UPSTAR Model 12A	on-line solid state	up to 144	90, 115, 120, 208, 220, 480, 600		3 wire+GND 4 wire+GND	66×34×38 (cabinet)	1,700	from 37,000
NORTH AMERICAN POWER DEVICES INC. 12919 Alcosta Blvd., Suite 3, San Ramon, CA 94583, (415) 866-9414								**Circle 340**
SBPS300	standby (5 msec)	0.3	120, 220		2 wire+GND	3.5×11.5×16 (cabinet)	32	445
UPS400	on-line ferroresonant	0.4	120		2 wire+GND	7.5×12×17 (cabinet)	70	1,095
UPS650	on-line ferroresonant	0.65	120, 220		2 wire+GND	9.5×16×17 (cabinet)	105	1,595
NOVA ELECTRIC INC. 263 Hillside Ave., Nutley, NJ 07110, (201) 661-3434								**Circle 341**
11-3K60	on-line solid state	3	115, 120, 208, 220	50	2 wire+GND 3 wire+GND	8.75×19×21 (rack) 30×22×22 (cabinet)	145 (rack) 270 (cabinet)	5,335
11-5K60	on-line solid state	5		80	2 wire+GND 3 wire+GND	8.75×19×21 (rack) 30×22×22 (cabinet)	195 (rack) 340 (cabinet)	7,500
11-10K-316	on-line solid state	10	120, 208, ~~221,~~ 227, 480	60	2 wire+GND 3 wire+GND 4 wire+GND 5 wire+GND	56×60×30 (cabinet)	900	19,735
PARA SYSTEMS INC. 1455 LeMay Dr., Carrollton, TX 75007, (800) 238-7272, (214) 446-7363								**Circle 342**
MM300SS	standby (1 msec)	0.3	115			5.5×9.5×15 (cabinet)	34	549
MM600/SS	standby (1 msec)	0.6	115			7×12×17 (cabinet)	65	899
MM1000SS	standby (1 msec)	1	115			15×3.5×20 (cabinet)	126	1,399
RELIABLE POWER SYSTEMS INC. 6175-W Shamrock Court, Dublin, OH 43017, (614) 766-0494								**Circle 343**
UPS 1-2.5	on-line solid state	2.5	90, 115, 120, 208, 220, 480	20	2 wire+GND 3 wire+GND 4 wire+GND	25×25×50 (cabinet)	650	5,700
UPS 1-5	on-line solid state	5	90, 115, 120, 208, 220, 480	41	2 wire+GND 3 wire+GND 4 wire+GND	25×25×50 (cabinet)	800	8,875
UPS 1-7.5	on-line solid state	7.5	90, 115, 120, 208, 220, 480	62	2 wire+GND 3 wire+GND 4 wire+GND	33×33×70 (cabinet)	1,000	11,000
SAFE POWER SYSTEMS INC. 528 W. 21st St., Tempe, AZ 85282, (602) 894-6864								**Circle 344**
400A	standby (3-5 msec)	0.4	115, 220	3.9	2 wire+GND	6×10.75×12.625 (cabinet)	40	595
500	standby (1-2 msec)	0.5	115	4.9	2 wire+GND	5.25×15.5×8.5 (cabinet)	43	795
1200A	standby (2-4 msec)	1.2	115	10.5	2 wire+GND	19×5.25×15.625 (rack) 17×5.25×15.625 (cabinet)	70 (rack) 68 (cabinet)	1,595

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type (Response time)	Power rating (KVA)	Input voltage (AC at 60Hz)	Input current (amps/phase)	Input/output phase	Size (H×W×D/inches)	Weight (lbs.)	Price $
SHAPE MAGNETRONICS INC. 901 DuPage Ave., Lombard, IL 60148, (312) 620-8394								**Circle 345**
Line Tamer UPS 250	on-line solid state	0.25	120	3/1	2 wire+GND	17×8.15×20 (cabinet)	90	1,265
Line Tamer UPS 500	on-line solid state	0.5	120	6/1	2 wire+GND	17×8.15×20 (cabinet)	100	1,455
SL WABER INC. 300 Harvard Ave., Westville, NJ 08093, (609) 456-5400								**Circle 346**
Linegard 300	on-line solid state	0.3	120	10	3 wire+GND	4.8×17×17 (cabinet)	48	950
Linegard 600	on-line solid state	0.6	120	15	3 wire+GND	4.8×19×20 (cabinet)	80	1,500
SOLA (A UNIT OF GENERAL SIGNAL) 1717 Busse Rd., Elk Grove, IL 60007, (312) 439-2800								**Circle 347**
SPS 800	standby (4-8 msec)	0.8	120	6.6	2 wire+GND	(cabinet)	65	1,024
SPS 1200	standby (4-8 msec)	1.2	120	10	2 wire+GND	(cabinet)	110	1,490
UPS 750	on-line solid state	0.75	120	6.25	2 wire+GND	(cabinet)	125	1,976
SOLIDSTATE CONTROLS INC. 875 Dearborn Dr., Columbus, OH 43085, (614) 846-7500								**Circle 348**
Powerbase 1000	on-line solid state	0.75-3	120, 208	13-39/1, 13/3	3 wire+GND	29×18×16 (cabinet)	180	4,000
Powerbase 4000	on-line solid state	5-20	208	30/1, 55/3	4 wire+GND	50×26×30 (cabinet)	750	16,500
Powerbase 5000	on-line solid state	30-150	120, 208, 277, 480	139/3	4 wire+GND	78×64×32 (cabinet)	2,535	42,600
STACO ENERGY PRODUCTS CO. 301 Gaddis Blvd., Dayton, OH 45403, (513) 253-1191								**Circle 349**
UPS-111-401-0	on-line solid state	1	120	8/1	4 NEMA 5-15 R	16×9×28 (cabinet)	136	3,470
UPS-174-610-0	on-line solid state	10	115, 230	89/1	3 wire+GND	66×56×25 (cabinet)	1,500	20,500
UPS-333-630-0	on-line solid state	30	120, 208	118/3	3 wire+GND	66×68×25 (cabinet)	2,400	37,000
THE SUPERIOR ELECTRIC CO. 383 Middle St., Bristol, CT 06010, (203) 582-9561								**Circle 379**
PSP61012	standby (4 msec)	0.2-1.2	120		3 wire+GND	14×7×18 (cabinet)	130	1,295
UPS61005V	ferroresonant hybird	0.2-0.5	120		3 wire+GND	9×19×16 (rack) 8×15×16 (cabinet)	82 (rack) 79 (cabinet)	1,000
UPSR6110	on-line solid state	3-10	120		3 wire+GND	56×56×25 (cabinet)	1,600	14,500
TERADO CORP. 1068 Raymond Ave., St. Paul, MN 55108, (612) 646-2868								**Circle 350**
50-168	standby (8 msec)	0.2	115, 120	2.5/1	3 wire+GND	8×6×12 (cabinet)	29	261
660-114	standby (10 msec)	0.4	115, 120	6/1	3 wire+GND	5×17×9 (rack)		335
TOPAZ INC. 9192 Topaz Way, San Diego, CA 92123, (619) 279-0831								**Circle 394**
Powermaker UPS	standby (1 msec)	1.8-2.5	120	15-20.8/1	2 wire+GND	18×8.5×19 23×19.5×26.6 (cabinet)	174-338	3,400-4,450
Powermaker E/S UPS	on-line solid state	5-15	120, 208, 240	25-47/3	2 wire+GND 3 wire+GND 4 wire+GND	52×27.5×30 52×40×30 (cabinet)	1,000-2,300	12,490-25,000
Powermaker Micro UPS	standby (4 msec)	0.4-1.3	120	3.3-10.8/1	2 wire+GND	15×7×18 (cabinet)	48-90	795-1,490
TRIPP LITE 500 N. Orleans, Chicago IL 60610, (312) 329-1777								**Circle 351**
BC-200	standby (5 msec)	0.2	120	18	3 wire+GND	6×7.125×16.75 (cabinet)	19	359

UNINTERRUPTIBLE POWER SYSTEMS

Company Model	Type (Response time)	Power rating (KVA)	Input voltage (AC at 60Hz)	Input current (amps/phase)	Input/output phase	Size (H×W×D/inches)	Weight (lbs.)	Price $
BC-450	standby (5 msec)	0.45	120	37	3 wire+GND	6×7.125×16.75 (cabinet)	39	599
BC-1000	standby (5 msec)	1	120	85	3 wire+GND	10.5×11×17.5 (cabinet)	80	1,179
U.P. SYSTEMS 7801 E. Compton Blvd., Paramount, CA 90723, (213) 634-0621								**Circle 352**
M500	on-line solid state	0.5	120	6.84/1	2 wire+GND	24×17×15 (cabinet)	150	1,950
M1000	on-line solid state	1.25	120	14.77/1	2 wire+GND	24×17×15 (cabinet)	220	2,985
M2000	on-line solid state	2.5	120	29.7/1	2 wire+GND	24×17×15 (cabinet)	270	3,990
UNISON TECHNOLOGIES INC. 23456 Madero, Mission Viejo, CA 92691, (714) 855-8700								**Circle 353**
UniPower 400	on-line proprietary	0.4	90, 115, 120	10/1	2 wire+GND	2.5×18×15	24	495
UniPower 600	on-line proprietary	0.6	90, 115, 120	10/1	2 wire+GND	2.5×18×15	24	695
WILMORE ELECTRONICS CO. INC. Routes 86 and 70-A East, P.O. Box 1329, Hillsborough, NC 27278, (919) 732-9351								**Circle 354**
1407	standby (10-15 msec)	0.25	115, 120, 220	2.2/1	2 wire+GND	8.75×12.75×11 (cabinet)	42	630
1408	standby (10-15 msec)	0.5	115, 120, 220	4.4/1	2 wire+GND	9×12.75×16 (cabinet)	56	875
1409	standby (10-15 msec)	1	115, 120, 220	8.7/1	2 wire+GND	9×12.75×16 (cabinet)	60	1,250

The first choice in plotting.

First in monochrome. Versatec invented the wide format electrostatic plotter in 1974. Three generations later, Versatec plotters are still the fastest, most accurate, most reliable of all monochrome electrostatics.

Only Versatec offers 200 and 400 ppi resolution in plotting widths of 22, 24, 36 and 44 inches. Get paper and film output, twin roll media supply, "plug-in anywhere" international power supply, and lowest operating costs.

And only Versatec gives you all these options – high accuracy ($\pm$ 0.01%), automated media cutter, tilt to 15 degrees, line enhancement, and hardware character generator.

First in color. Versatec invented electrostatic color plotting in 1982. We give you a choice of plotting widths (24, 36 and 44 inches), 200 and 400 ppi resolution, and color/monochrome output.

Dual axis tracking and an integral alignment pass assure unparalleled accuracy. High quality paper and film with mirror imaging enable proofing and final output on the same plotter. And a character generator creates banner pages quickly and efficiently.

Compact size, light weight, and low power requirements simplify installation. And an easy-to-use control panel simplifies operation.

First in connectivity. Versatec offers more interfaces to more computers, a larger library of integrated plotting software packages, and a bigger family of modular standalone and embedded rasterizers accepting both parallel and industry-standard serial data formats.

Discover why Versatec sells more electrostatic plotters than all competitors combined. Circle the readers' service number or call toll-free 800/538-6477.*

*In California, call toll-free 800/341-6060

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Plot data courtesy of Intergraph Corporation, Uniras, and Zeh Engineering Systems

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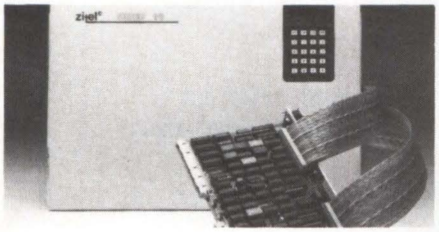
See us at SIGGRAPH

CIRCLE NO. 25 ON INQUIRY CARD

NEW PRODUCTS

DISK/TAPE

Megan Nields, Staff Editor



Storage subsystem supports VME systems

- 128M bytes of memory
- 40M bytes per second
- Real-time processing

A subsystem for VME-based systems, the VME93 sports up to 128M bytes of memory and handles signal, image and real-time processing and data acquisition. It executes error-corrected block transfers at up to 40M bytes per second. A chassis, power supply and error logger are included. Features include selectable uninterrupted block transfer and hidden refresh. The unit occupies one bus slot. $1,300 per megabyte. **Zitel Corp.,** 630 Alder Drive, Milpitas, Calif. 95035, (408) 946-9600.

Circle 401

Tape subsystems back up 125M bytes

- Quarter-inch device
- IBM compatible
- 5M bytes per minute

Quarter-inch cartridge tape systems, the QT-125 Series backs up 125M bytes of data. The IBM PC/XT- and PC/AT-compatible units work with Intel 8088-, 80286- and 80386-based computers. They provide file-by-file backup and restore capabilities at data rates of up to 5M bytes per minute. The drives conform to the QIC-120 standard and can read tapes generated on IBM's 6157 series of cartridge tape subsystems for the PC. $1,895, internal; $2,495, external. **Tecmar Inc.,** 6225 Cochran Road, Solon, Ohio 44139-3377, (216) 349-0600.

Circle 402

Flexible disk drives suit 286, 386 systems

- 1.44M bytes
- 3½-inch units
- Three configurations

The Manzana 1.44M-byte (2M bytes unformatted) flexible disk drive system works with Intel 80286- and 80386-based computers. The 3½-inch unit is available as an internal drive, a host-powered external drive and a self-powered external drive. Software is offered. $325, internal unit; $425, host-powered unit; $595, self-powered unit. **Manzana Microsystems Inc.,** Suite B, 7334 Hollister Ave., Goleta, Calif. 93117, (805) 968-1387.

Circle 403

Tape subsystem holds 125M bytes

- Quarter-inch unit
- XENIX compatible
- 5M bytes per minute

A quarter-inch streaming cartridge tape system, the SMS 4120X stores up to 125M bytes of formatted data at 5M bytes per minute. The device supports MS-DOS- and XENIX-based multiuser computers. Available in internal or external configurations, the subsystem uses the SIGEN 4002 controller. $1,995, $1,085 (OEM pricing). **Scientific Micro Systems Inc.** 339 N. Bernardo Ave., Mountain View, Calif. 94043, (415) 964-5700.

Circle 404

Tape subsystem stores 60M bytes

- IBM compatible
- 31K bytes per second
- Proprietary controller

Storing 60M bytes of data, the Smart Image 60 is an IBM PC/XT- and PC/AT-compatible streaming tape backup subsystem. The device measures 8 by 5¼ by 1¾ inches. It produces a 31K-byte-per-second data-transfer rate via a proprietary controller. Features include dual read/write heads for data verification. $895. **Sysgen Inc.,** 47853 Warm Springs Blvd., Fremont, Calif. 94539, (415) 490-6770.

Circle 405

Disk subsystems suit 386-based units

- Up to 630M bytes
- 18-msec access time
- ESDI interface

Supporting both 80286- and 80386-based systems, the Emerald Disk Subsystems are available in 120M-, 250M-, 315M-, 500M- and 630M-byte capacities. The units feature an 18-msec average access time and utilize an ESDI interface. A proprietary controller and software is available. $4,995 to $19,990. **Emerald Systems Corp.,** 4757 Morena Blvd., San Diego, Calif. 92117, (619) 270-1994.

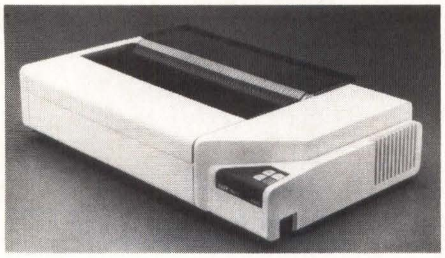
Circle 406

3½-inch disk drive holds 20M bytes

- 5M-bps transfer
- 60-msec access time
- ST412 interface

A 3½-inch rigid disk drive, the Spartan 20 stores 20M bytes. The unit provides an ST412 interface with a 5M-bps transfer rate. Average access time is 60 msec and MTBF is 28,000 hours. $250, OEM quantities. **LaPine Technology Corp.,** 182 Topaz St., Milpitas, Calif. 95035, (408) 262-7077.

Circle 407

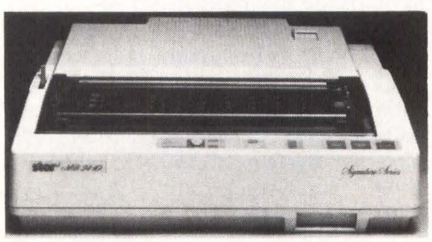


Dot-matrix printer yields 850 cps

- 19.2K baud rate
- 10 cpi
- 240 lpm

A dot-matrix printer, the 850XL produces 850 cps. The unit provides 240 lpm, 19.2K baud rate and 10 cpi while handling 80- and 136-column applications and six-part forms. It emulates Digital Equipment Corp. and Epson printers. Features include an 8K-byte data buffer and multipitch printing. Serial and parallel ports are standard. The product targets data processing, spreadsheet and financial applications. $2,395. **Output Technology Corp.,** Suite #6, E. 9922 Montgomery, Spokane, Wash. 99206, (509) 926-3855.

Circle 408



Dot-matrix printer offers draft, letter quality

- 24-wire unit
- 72 to 216 cps
- Parallel interface

A dot-matrix printer, the NB24-10 outputs from 72 cps, letter-quality mode, to 216 cps, draft mode. The 24-wire unit offers over 13 print and format functions; an 8K-byte buffer, expandable to 24K bytes; and downloadable fonts. A parallel interface is standard. $749. **Star Micronics Inc.,** Suite 3510, 200 Park Ave., New York, N.Y. 10166, (212) 986-6770.

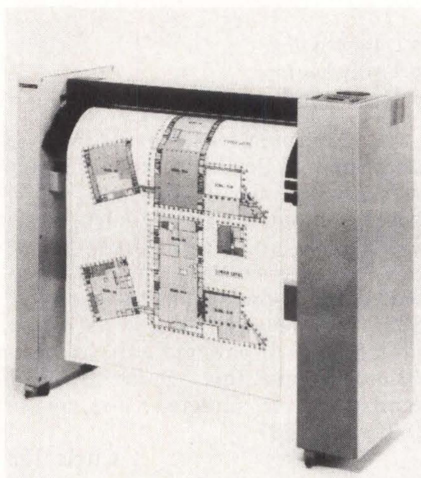
Circle 409

Dot-matrix printer runs in three speeds

- 360-by-180 dpi
- 55 dB(a)
- 6,000-hour MTBF

A monochrome dot-matrix printer, the DL2600 runs at 96 cps in letter-quality, 190 cps in report-quality and 288 cps in draft mode. It has a 360-by-180-dpi resolution. Features include a 16-character LCD front panel display, a 55-dB(a) noise level and a 6,000-hour MTBF. The device offers a built-in bidirectional tractor and automatic sheet load. $1,495. **Fujitsu America Inc.,** 3055 Orchard Drive, San Jose, Calif. 95134, (408) 946-8777.

Circle 410

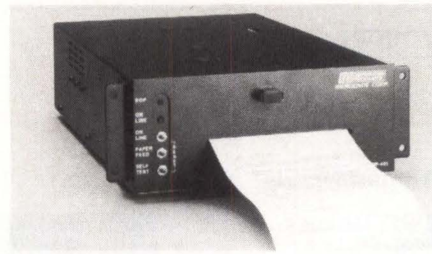


Plotters includes eight pens

- 19.2K baud rate
- MC68000 processor
- Two models

Consisting of two models, the DraftMaster family of eight-pen plotters replaces the 758X series. The units furnish a 19.2K baud rate, bidirectional plotting and a 10-MHz MC68000 microprocessor. They feature a 32-character LCD and a 24-ips speed. The DraftMaster I and II are high performance units. An RS422A interface is standard. $9,900, DraftMaster I; $11,900, DraftMaster II. **Hewlett-Packard Co.,** 1820 Embarcadero Road, Palo Alto, Calif. 94303, phone local sales office.

Circle 411

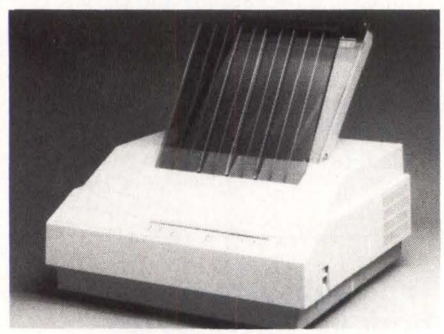


Thermal printer supplies 40 columns

- Six lps
- 1K-byte buffer
- Proprietary software

A 40-column thermal printer, the MP-401 outputs 6 lines per second. The unit provides a 1K-byte data buffer, a 1,200 baud rate and ASCII to HEX conversion. IBM PC-compatible proprietary software is included. $893, OEM pricing available. **Memodyne Corp.,** 200 Reservoir St., Needham, Mass. 02194, (617) 444-7000.

Circle 412



Thermal printer handles 300 dpi

- Thermal transfer
- Seven colors
- Four display formats

A thermal transfer printer, the G650 handles a 300-by-300-dpi resolution for A- and B-sized prints. The unit produces more than 200,000 shades of seven colors and outputs letter-quality text in monochrome mode. Features include built-in self test, four display formats and an 8-bit parallel interface. $8,995. **Mitsubishi Electronics America Inc.,** Computer Peripherals Division, 991 Knox St., Torrance, Calif. 90502, (213) 515-3993.

Circle 413

60 Megabytes is more than the other guys can swallow.

When it comes to maximum storage on a single Philips streaming cassette back-up, Teac stands alone.

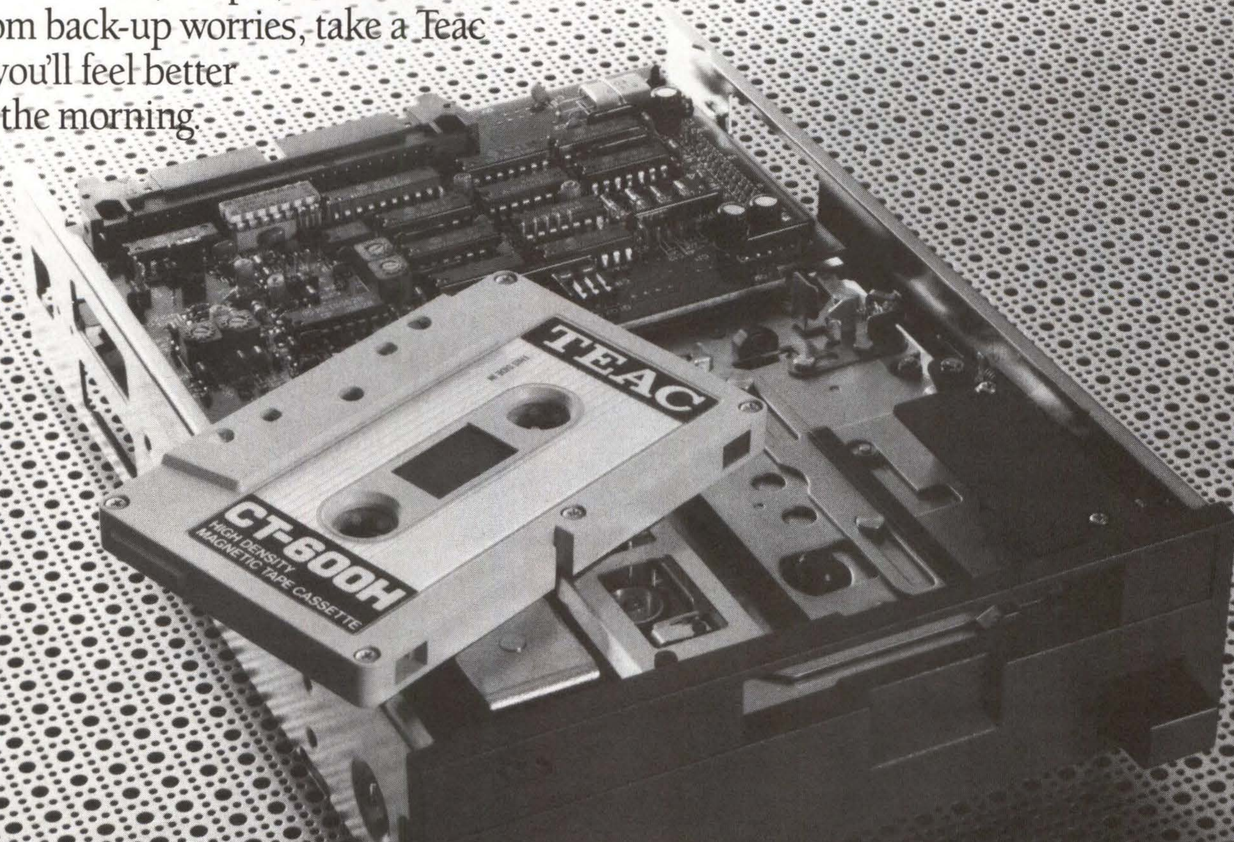
With our MT-2ST and CT-600H cassette tape we've made a giant leap over the competition. Its 90 ips performance can back-up an incredible 60 megabytes in only 12 minutes. And this is data on a medium that's totally interchangeable from drive to drive.

To make sure things are what they seem, our read-after-write system constantly checks data integrity. We've included a built-in data formatter logic board, and all three commonly used data streamer interfaces are available: D/CAS-05 (QIC-02), SCSI, or D/CAS-15 (QIC-36).

Teac's reliable servo-controlled direct reel drive is free of belts and mechanical complexities to jam-up or break-down.

All of this in a half-height unit that requires no warm-up or the need to preformat the recording medium.

For fast, simple, and reliable relief from back-up worries, take a Teac —you'll feel better in the morning.



Built To Fanatical Standards. **TEAC**®

INSTRUMENTATION AND COMPUTER PRODUCTS DIVISION, 7733 TELEGRAPH ROAD, MONTEBELLO, CA 90640

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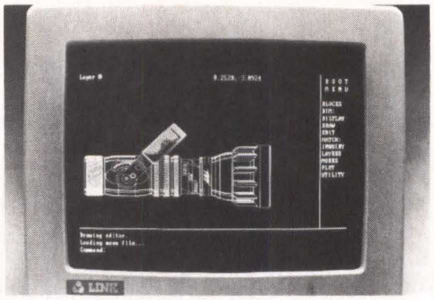
Northwest (408) 727-1427 Southern California (213) 726-0303

CIRCLE NO. 69 ON INQUIRY CARD

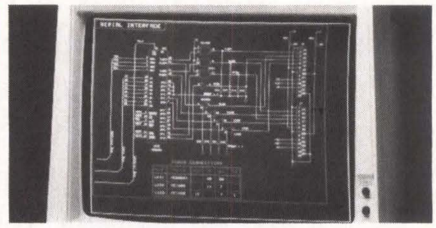
Terminal furnishes bit-mapped graphics



- 720 by 348 pixels
- IBM emulation
- 80188 processor

For personal computer multiuser system configurations, PCTerm is a bit-mapped graphics terminal. The unit shows a 720-by-348-pixel resolution on a 14-inch green or amber screen. It emulates the Hercules GB-101 graphics standard and the IBM monochrome display adapter in alphanumeric mode. An Intel 80188 processor, 38.4K baud rate, 256K bytes of memory and a Centronics interface are standard. Refresh rate is 60 Hz. $749. **Link Technologies Inc.,** 47339 Warm Springs Blvd., Fremont, Calif. 94539, (415) 651-8000.

Circle 414



Color monitor boasts high resolution

- 0.33-mm dot pitch
- IBM compatible
- 1,024 by 1,024 pixels

A color monitor, model 7250, displays 1,024 by 1,024 pixels on a 19-inch screen. The multiscanning unit is compatible with IBM MDA, CGA, EGA and PGA boards and features 0.31-mm dot pitch and a 40-MHz video bandwidth. Horizontal scan rates range from 15.75 kHz to 37 kHz. The device suits CAD/CAM, CAE and 3-D solids imaging applications. $2,995. **Conrac Display Products Group,** 600 N. Rimsdale Ave., Covina, Calif. 91722, (818) 966-3511.

Circle 415

Color terminal aims at CAD/CAM

- 16 colors
- 1,024 by 780 pixels
- 19-inch screen

The MX10000, a color graphics terminal for high-end CAD/CAM projects, utilizes a Motorola MC68020 processor and a 16K-byte cache memory. The unit furnishes 16 to 256 colors. It displays 1,024 by 780 pixels on a 19-inch screen. Processor expansion slots are available. Compatibility with Tektronix 4107/9 and 4111 devices is supplied. $12,000. **Pericom Inc.,** Suite 103, 2291 205th St., Torrance, Calif. 90501, (213) 618-9190.

Circle 416

A LOT OF VARS ARE HAPPY THAT FACIT IS BEHIND BARS

19 FACIT•1 87

There's good reason why: Facit printers are the toughest machines going.

Just consider the ordeal a bar code printer endures day in and day out. It's no wonder more and more resellers insist on Facit. For readability as much as reliability, they know their customers can depend on Facit line after line, time after time. And that means you'll spend less time trouble-shooting problems for your customers. And more time building your business.

Facit printers are engineered to withstand the most strenuous environments. Everything . . . from forms handling to fast precise output . . . is engineered to perform one way—*perfectly!* Facit makes a quality printer for every printer need—from dot matrix to laser. With a host of features and options for customized applications.

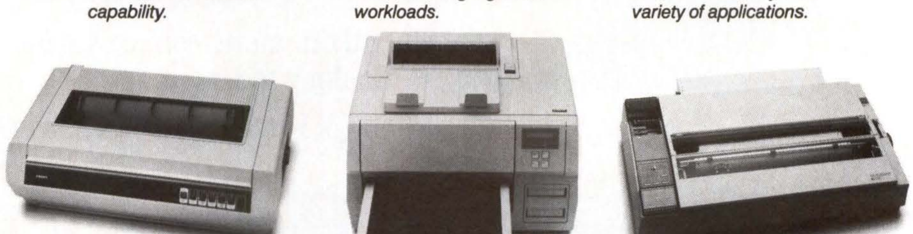
Facit also has one of the best service support programs in the business, to keep you and your customers running around the clock. We also have generous margins, to help you offer your customers trouble-free systems at competitive prices.

So put Facit to work for you . . . for a bar code job no ordinary printer can pull off. Write Facit, Inc., 9 Executive Park Drive, PO Box 334, Merrimack, New Hampshire, U.S.A., 03054. Or call (603) 424-8000. You'll be glad you did. After all, when it comes to your reputation, isn't quality always on the line?

Facit 4528 Matrix Printer—with resident bar code capability.

Facit 7080 Laser Printer—for demanding high-volume workloads.

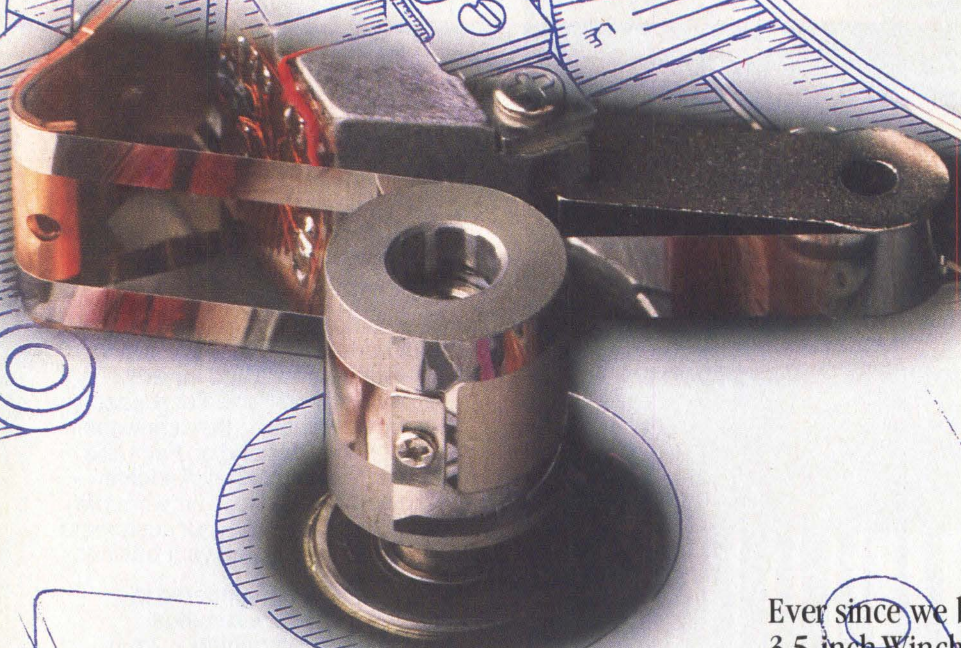
Facit B3350 Matrix Printer—versatility for a variety of applications.



FACIT

QUALITY RUNS IN THE FAMILY.

CIRCLE NO. 71 ON INQUIRY CARD



We've been going back and forth on this idea for a long time.

Ever since we began making LaPine 3.5-inch Winchester drives, we've been using advanced stepper-motor technology to move the heads across the media. Because stepper motors are proven to be fast, reliable, and economical.

But the use of stepper motors is just one facet of LaPine's advanced-engineering approach to its family of 3.5-inch Winchesters.

More for less. LaPine Spartan™ series drives are engineered to deliver high-performance with substantially fewer components. By integrating components with flex circuitry, eliminating connectors, and utilizing a two-layer PC board, LaPine has effectively simplified the drive while increasing inherent reliability.

Secure Data. Maintaining data integrity is what storage is all about. LaPine's Titan™ 20, 30 RLL, and 40 SCSI drives employ a unique head-suspension system–ideal for physically demanding applications.

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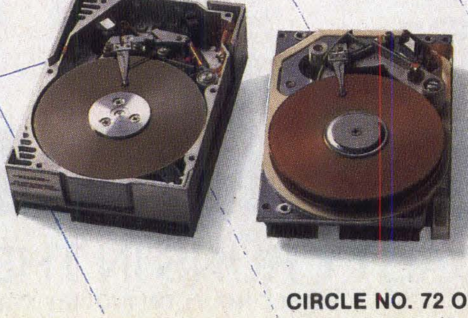
The Idea. Refined.



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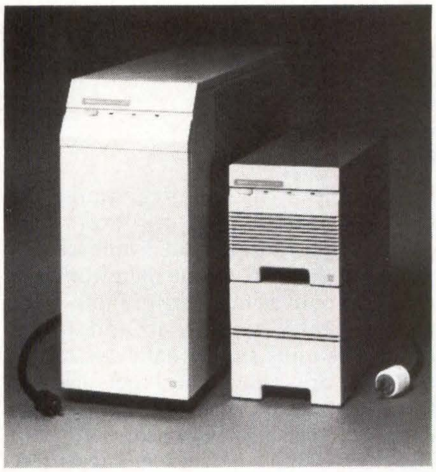
In association with
Prudential-Bache and Kyocera.

CIRCLE NO. 72 ON INQUIRY CARD



UPS satisfies ANSI, IEEE

- Off-line operation
- 70 dB(a)
- 1.8 kVA, 2.5 kVA

The Powermaker UPS furnishes power ratings of 1.8 kVa and 2.5 kVA. The unit consists of a power conditioner, battery charger, battery inverter, a static transfer switch and a surge-suppression network. It provides 100 dB(a) of common-mode noise attenuation and 70 dB(a) of normal-mode noise attenuation. The device meets ANSI and IEEE surge-withstand specifications. $2,550 and higher. **Topaz Inc.,** 9192 Topaz Way, San Diego, Calif. 92123-1165, (619) 279-0831.

Circle 417

Graphics board aids desktop publishing

- 2,880 by 1,024 dpi
- Screen drivers
- Raster processor

Shaped for desktop publishing, the ConoVision 2800 board suits the IBM PC, PC/XT and PC/AT. The device consists of a 2,880-by-1,024-dpi monochrome graphics adapter and an 8-second-per-page raster image processor. Screen drivers enable software operating under Microsoft Windows to run on the board. Hardware for scrolling, pan and zoom is provided. A Hercules-compatible mode accommodates personal computer software. Features include 512K bytes of RAM and Hewlett-Packard compatibility. $1,985. **Conographic Corp.,** 17841 Fitch, Irvine, Calif. 92714, (714) 474-1188.

Circle 418

SBC uses 80286 processor

- 1M byte of RAM
- 128K bytes of EPROM
- IBM PC/AT compatible

An IBM PC/AT-compatible single-board computer, the QPC-5121 is based on the Intel 80286 microprocessor. The unit furnishes 1M byte of RAM and up to 128K bytes of EPROM. It fits in a single slot. Winchester and flexible disk drive controllers are included. An 80287 coprocessor is optional. $1,695. **Qualogy Inc.,** 2241 Lundy Ave., San Jose, Calif. 95131, (408) 434-5200.

Circle 419

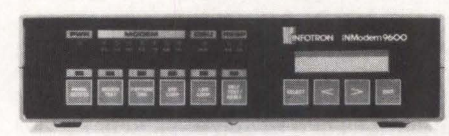
DATACOMM

Synchronous modem furnishes 9.6K bps

- Full or half duplex
- Built-in diagnostics
- CCITT compatible

A 9.6K-bps synchronous modem, the CLX96DP complies with CCITT V.29 requirements. The unit operates in half-duplex mode on dial-up lines and half- or full-duplex mode on dedicated lines. Diagnostics include local analog, digital and remote-digital tests. $1,495. **Okidata,** 523 Fellowship Road, Mount Laurel, N.J. 08054, (609) 235-2600.

Circle 420



Diagnostic modems conform to CCITT

- Up to 56K bps
- CSU/DSU functions
- Six models

Available in six configurations, the INModem series of diagnostic modems supports CCITT standards. Four of the devices are analog and transfer data at rates to 14.4K bps. The two digital units transmit data from 2.4K to 56K bps. They combine CSU/DSU functions with diagnostic control. Options include a four- or six-channel multiplexer. $1,650 to $6,100. **Infotron Systems Corp.,** 9 Cherry Hill Industrial Center, Cherry Hill, N.J. 08003-1688, (609) 424-9400.

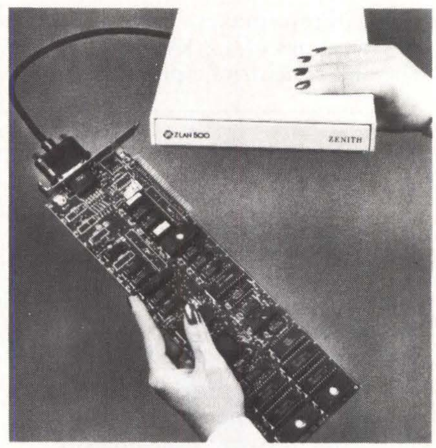
Circle 421

Multiplexers handle up to 640 channels

- Up to 19.2K bps
- Two models
- Diagnostics

Available in two configurations, the ISM 900 statistical multiplexers support asynchronous and synchronous protocols. They combine data from 640 channels onto as many as 15 links. Data automatically rerouts around failed links. The units supply data rates of up to 19.2K bps. Diagnostics include pass/fail test patterns and local and remote channel loopbacks. Remote polling of IBM 3270 BSC devices is supported. $12,850 to $24,650. **Infinet Inc.,** 40 High St., North Andover, Mass. 01845, (617) 681-0600.

Circle 422



Card fosters PC communication

- 0.5M bps
- NETBIOS interface
- CSMA/CD protocol

An intelligent bus adapter card, LANcard enables IBM PCs, XTs, ATs and compatibles to communicate at 0.5M bps over the Z-LAN broadband LAN. The device provides an Intel 8088 microprocessor, the NETBIOS interface and CMSA/CD protocols. Features include an external modem and built-in network management and diagnostic capabilities. The product conforms to the ISO reference model. $495. **Zenith Communications Products,** 699 Wheeling Road, Mt. Prospect, Ill. 60056, (312) 699-2199.

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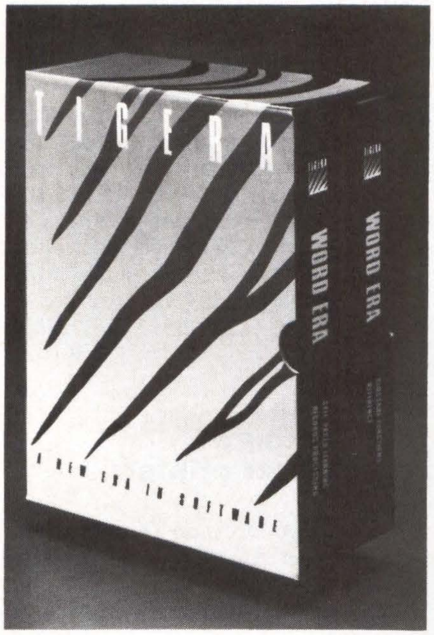


OS software targets UNIX-based systems

Word Era office-automation software targets UNIX-based systems. It furnishes integrated voice recognition, voice annotation and document conversion capabilities. The package supplies multiwindow and simultaneous editing functions. It is written in C, requires 256K bytes of RAM and furnishes a spelling checker and corrector, password protection and insert/delete modes. $895, OEM discounts available. **Tigera Corp.,** 350 Bridge Parkway, Redwood City, Calif. 94065, (415) 598-4440.

Circle 424

OS software provides UNIX compatibility

IC-DOS 3.0 is a UNIX-compatible, real-time multitasking operating system for factory automation and process-control applications. The software can run 48 concurrent tasks on one IBM PC or compatible. It includes a proprietary terminal emulator and communications package. $695. **Action Instruments Inc.,** 8601 Aero Drive, San Diego, Calif. 92123, (619) 279-5726.

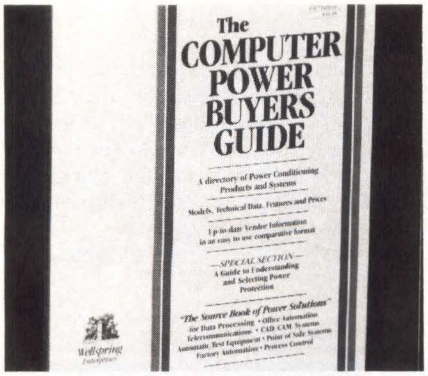
Circle 425

DBMS software runs on personal computers

Ingres for personal computers supplies DBMS capabilities when integrated into business computing systems. The package shares data transparently among IBM PCs, minicomputers and mainframes. It can be used as a 4GL application development tool. Features include a data dictionary and query and update capabilities. $1,200 to $2,000. **Relational Technology Inc.,** 1080 Marina Village Parkway, P.O. Box 4006, Alameda, Calif. 94501, (415) 769-1400.

Circle 426

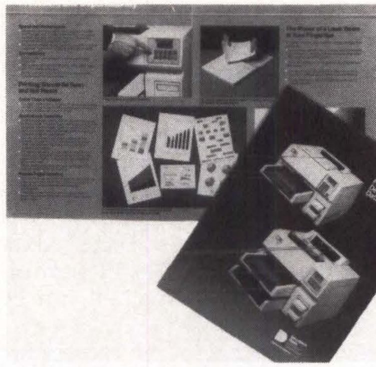
LITERATURE



Computer catalogue targets power sources

The 1987 edition of the *Computer Power Buyers Guide* lists 3,000 computer power sources and power conditioners from over 100 manufacturers. Products are grouped in six major categories and 31 sub-categories. Sections include standby power systems, uninterruptible power supplies and power conditioners. $39.95. **Wellspring Enterprises,** Suite 188, 9921 Carmel Mountain Road, San Diego, Calif. 92129, (619) 484-4479.

Circle 427



Volume assesses non-impact printing

A 372-page book, *Principles of Non Impact Printing* analyses 13 non-impact methods including thermal, ink-jet, electrographic and ion-projection printing. It features over 275 illustrations and tables, 346 equations and 192 references. Speeds and resolutions are discussed. $225. **Palatino Press Inc.,** 18792 Via Palatino, Irvine, Calif. 92715, (714) 854-3908.

Circle 428

Directory covers telecom, datacom

This supplement to the second edition of the *Telecommunications Systems and Services Directory (TSSD)* profiles more than 2,000 telephone, data communications, electronic and voice mail, networking and telex systems and services. It also covers consultants and publishers. Up to 18 categories of information are furnished for each entry. $170. **Gale Research Co.,** Book Tower, Detroit, Mich. 48226, (313) 961-2242.

Circle 429

Free brochure covers laser printers

A four-page Decision Data brochure provides specifications and operating characteristics on 8-ppm and 15-ppm laser printers. Noise levels, power requirements and capacities are detailed. Free of charge. **Decision Data Computer Corp.,** 400 Horsham Road, Horsham, Pa. 19044, (215) 956-5736.

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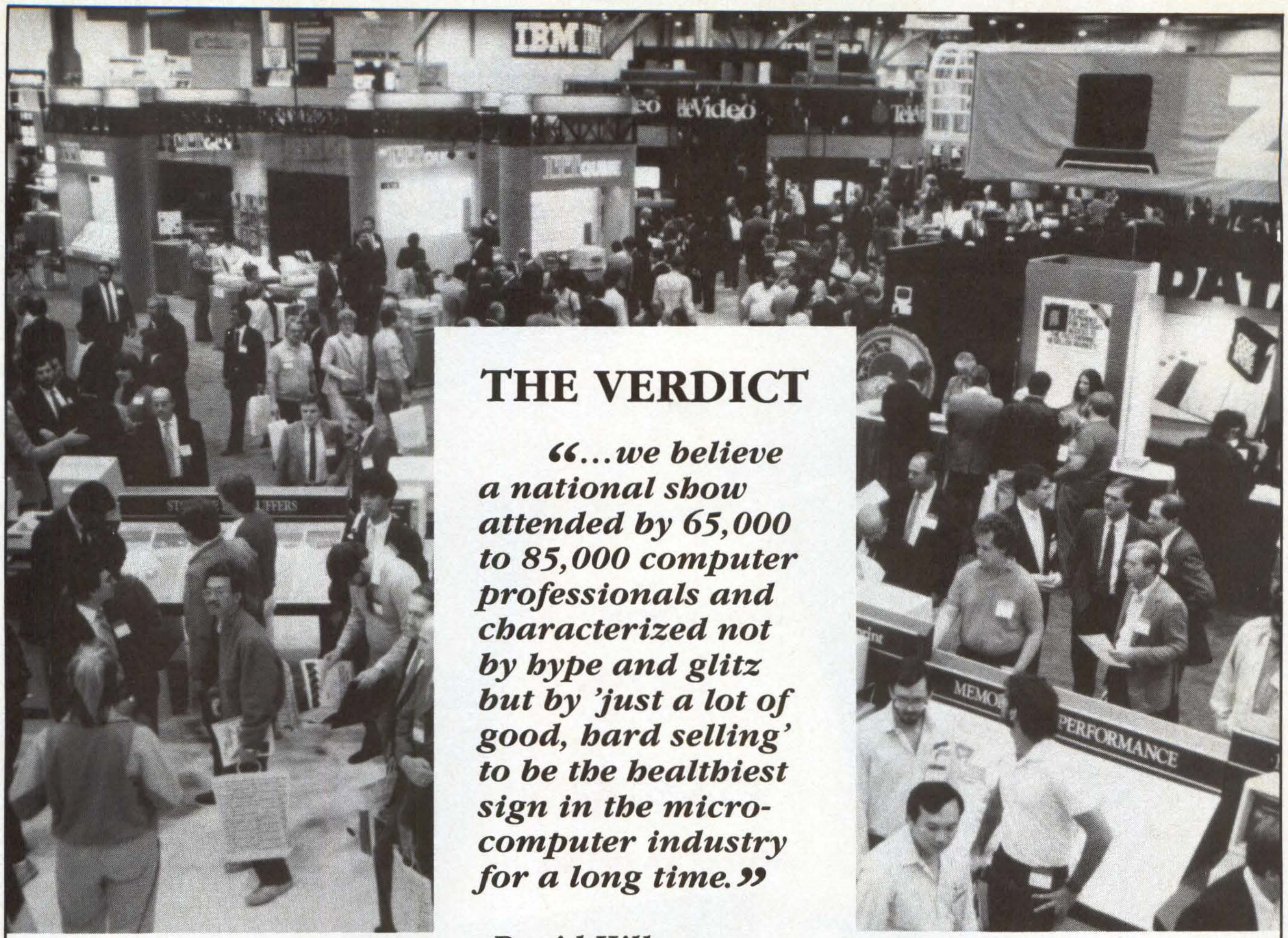

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Editor
MICRO MARKETWORLD
11/24/86

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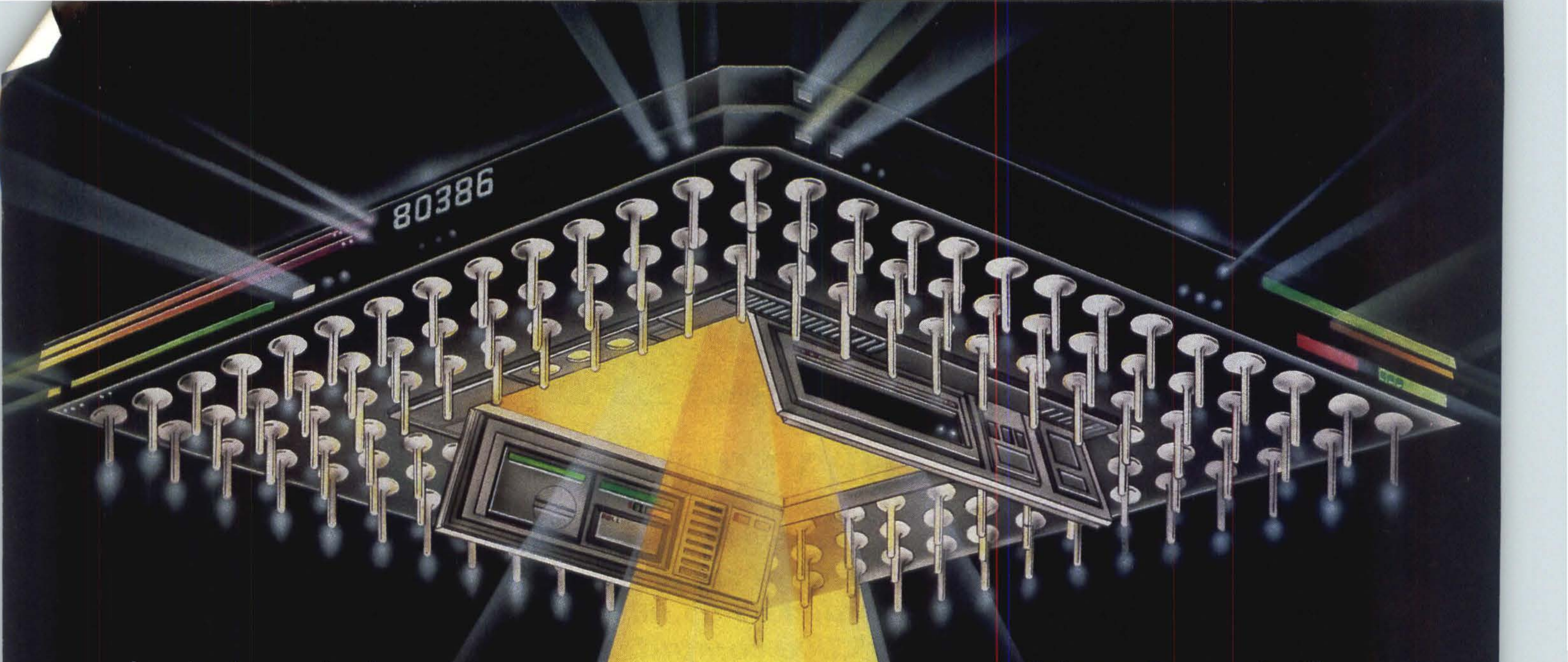

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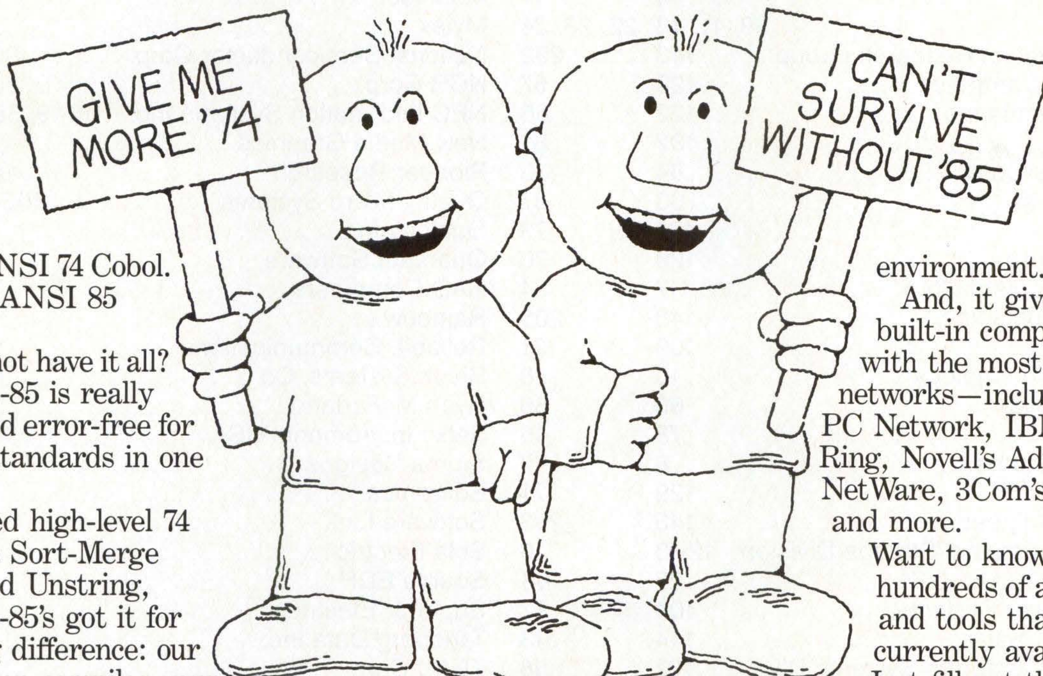

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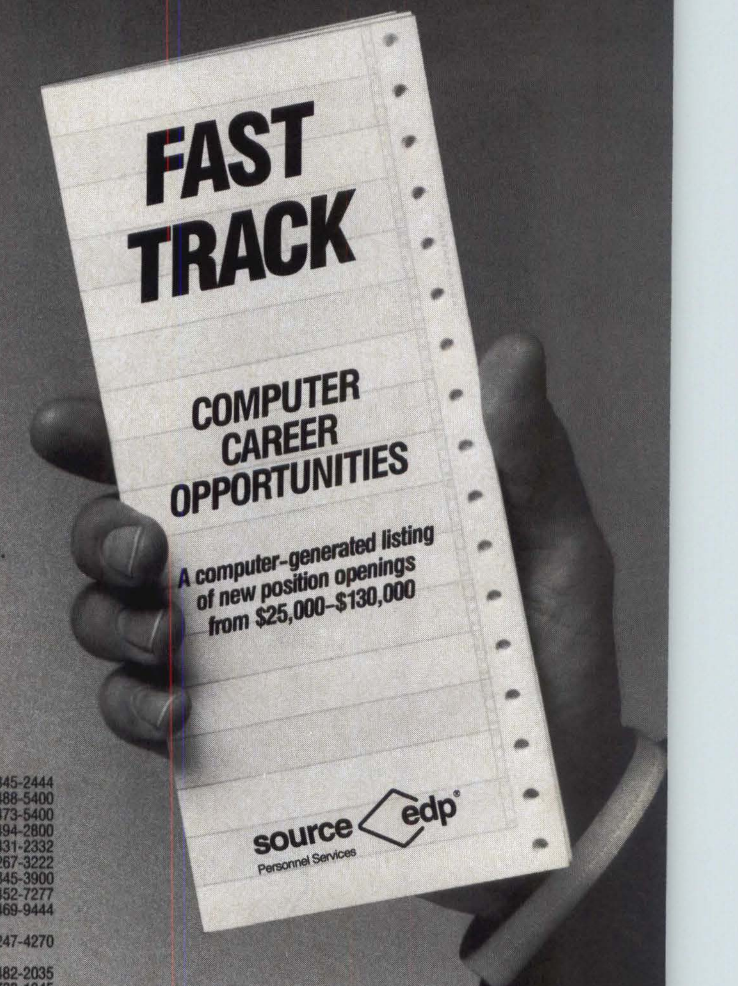

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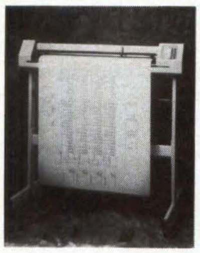

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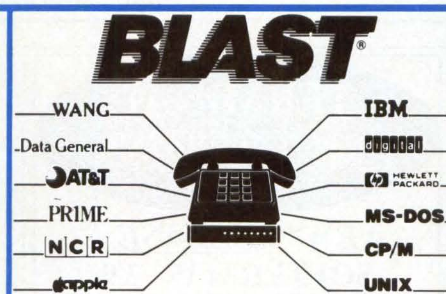

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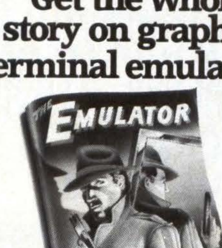

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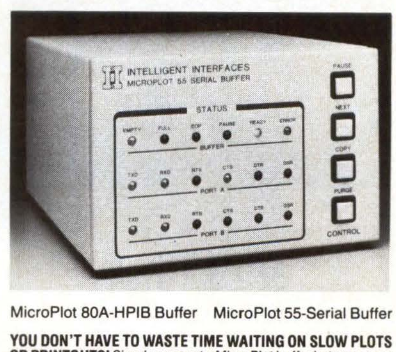

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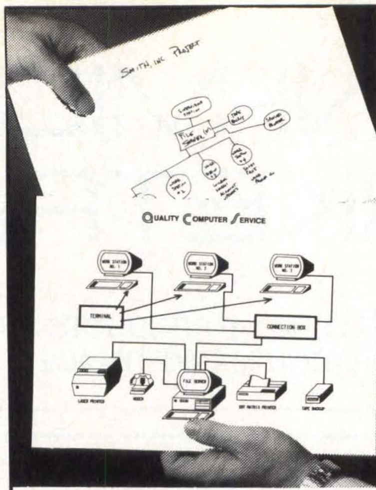

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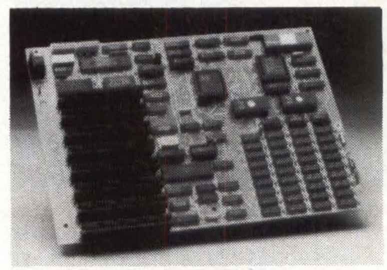

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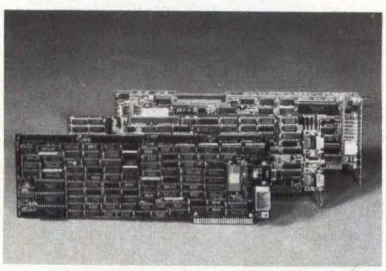

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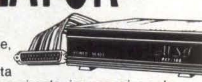

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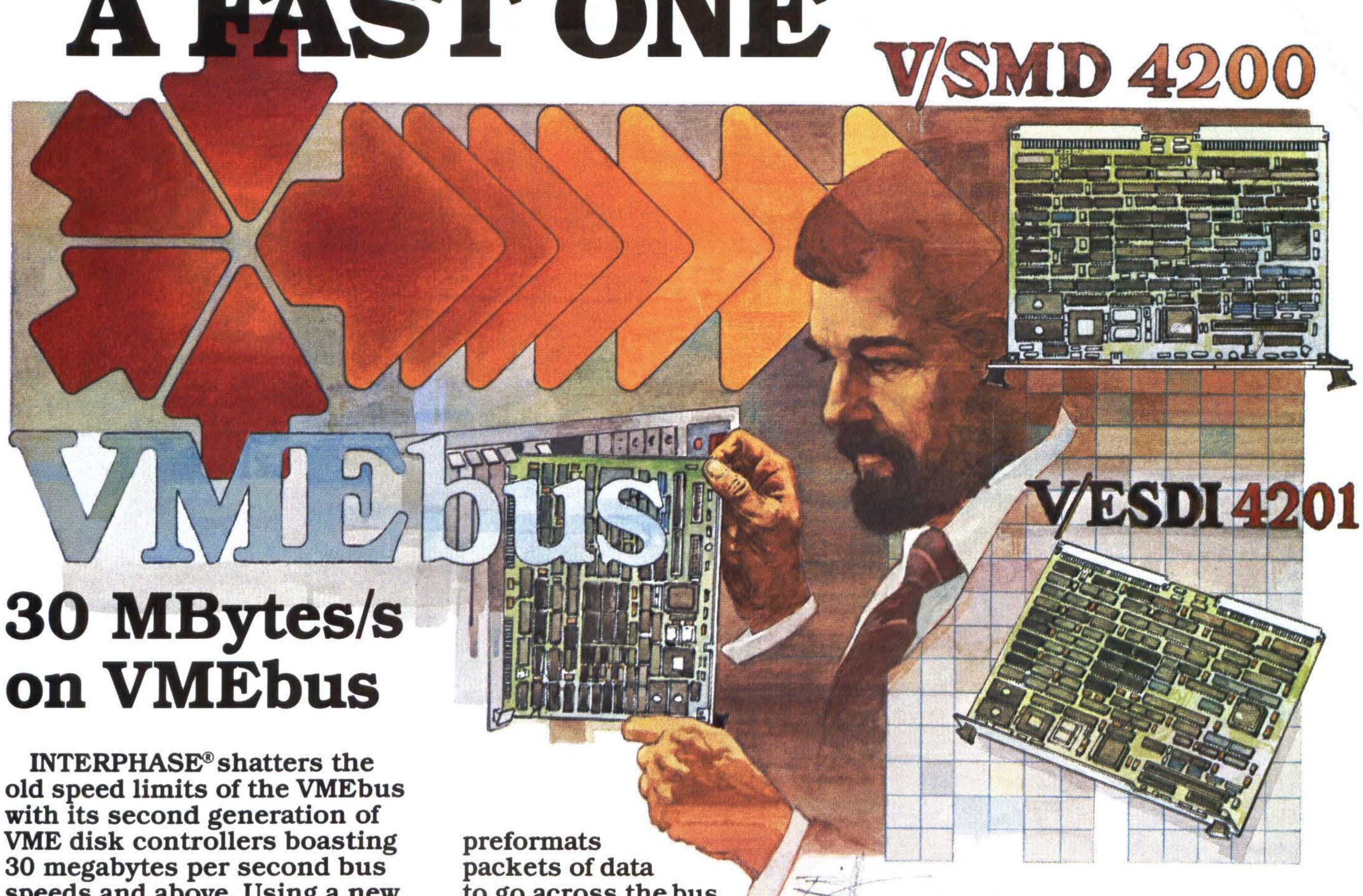

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